1973 - CID515531_VirginiaBeach_CFPF

Application Details

Funding Opportunity:	1447-Virginia Community Flood Preparedness Fund - Project Grants - CY23 Round 4
Funding Opportunity Due Date:	Nov 12, 2023 11:59 PM
Program Area:	Virginia Community Flood Preparedness Fund
Status:	Under Review
Stage:	Final Application
Initial Submit Date:	Nov 9, 2023 5:21 PM
Initially Submitted By:	Stanley Smith Jr
Last Submit Date:	
Last Submitted By:	

Contact Information

Primary Contact Information

Active User*: Yes

Type: External User

Name*: Mr. (Salutation) Stanley (First Name) Middle Name Smith Jr (Last Name)

Title: Engineer IV

Email*: PWEngsupport@vbgov.com

Address*: 484 Viking Drive

Virginia Beach (City) Virginia (State/Province) 23452 (Postal Code/Zip)

Phone*: 757-385-8459 Ext.
Phone
###-###-####

Fax: ###-###-####

Comments:

Organization Information

Status*: Approved

Name*: VIRGINIA BEACH, CITY OF

Organization Type*: Local Government

Tax ID*:

Unique Entity Identifier (UEI)*:

Organization Website: https://www.vbgov.com/Pages/default.aspx

Address*: 2875 Sabre Street

Suite 250

Virginia Beach	Virginia	23452
City	State/Province	Postal Code/Zip

Phone*: (757) 385-8746 Ext.

###-###-####

Fax: ###-###-####

Benefactor:

Vendor ID:

Comments:

VCFPF Applicant Information

Project Description

Name of Local Government*: Virginia Beach

Your locality's CID number can be found at the following link: Community Status Book Report

NFIP/DCR Community Identification Number (CID)*: 515531

If a state or federally recognized Indian tribe,

Name of Tribe:

Authorized Individual*: Stanley Smith

First Name Last Name

Mailing Address*: 484 Viking Drive

Address Line 1

Suite 200

Address Line 2

Virginia Beach	Virginia	23452
City	State	Zip Code

Telephone Number*: 757-385-8459

Cell Phone Number*: 757-385-8459

Email*: SFSmitJr@vbgov.com

Is the contact person different than the authorized individual?

Contact Person*: No

Enter a description of the project for which you are applying to this funding opportunity

Project Description*:

Marsh Restoration in Back Bay Project: The primary objective of this project is to create a sustainable coastal marsh island system in Back Bay through reclamation of historically lost marsh habitat and protection of existing marsh complexes from erosion. This restoration effort aims to provide multiple benefits of reduced flood impacts, enhanced fish and wildlife habitat, and improved water quality.

Low-income geographic area means any locality, or community within a locality, that has a median household income that is not greater than 80 percent of the local median household income, or any area in the Commonwealth designated as a qualified opportunity zone by the U.S. Secretary of the Treasury via his delegation of authority to the Internal Revenue Service. A project of any size within a low-income geographic area will be considered.

Is the proposal in this application intended to benefit a low-income geographic area as defined above?

Benefit a low-income geographic area*: No

Information regarding your census block(s) can be found at census.gov

Census Block(s) Where Project will Occur*: 518100454.121 and 518100464.001

Is Project Located in an NFIP Participating Community?*: Yes

Is Project Located in a Special Flood Hazard Area?*: Yes

Flood Zone(s) (if applicable): VE, AE, and Open Water

Flood Insurance Rate Map Number(s) (if applicable): 5155310215G and 5155310220G

Eligibility CFPF - Round 4 - Projects

Eligibility

Is the applicant a local government (including counties, cities, towns, municipal corporations, authorities, districts, commissions, or political subdivisions created by the General Assembly or pursuant to the Constitution or laws of the Commonwealth, or any combination of these)?

Local Government*: Yes

Yes - Eligible for consideration
No - Not eligible for consideration

Does the local government have an approved resilience plan and has provided a copy or link to the plan with this application?

Resilience Plan*: Yes

Yes - Eligible for consideration under all categories
No - Eligible for consideration for studies, capacity building, and planning only

If the applicant is not a town, city, or county, are letters of support from all affected local governments included in this application?

Letters of Support*: N/A

Yes - Eligible for consideration
No - Not eligible for consideration
N/A - Not applicable

Has this or any portion of this project been included in any application or program previously funded by the Department?

Previously Funded*: No

Yes - Not eligible for consideration
No - Eligible for consideration

Has the applicant provided evidence of an ability to provide the required matching funds?

Evidence of Match Funds*: Yes

Yes - Eligible for consideration
No - Not eligible for consideration
N/A - Match not required

Scoring Criteria for Flood Prevention and Protection Projects - Round 4

Scoring

Category Scoring:
Hold CTRL to select multiple options

Project Category*: Wetland restoration

Is the project area socially vulnerable? (based on ADAPT Virginia?s Social Vulnerability Index Score)
Social Vulnerability Scoring:
Very High Social Vulnerability (More than 1.5)
High Social Vulnerability (1.0 to 1.5)
Moderate Social Vulnerability (0.0 to 1.0)
Low Social Vulnerability (-1.0 to 0.0)
Very Low Social Vulnerability (Less than -1.0)

Socially Vulnerable*: Low Social Vulnerability (-1.0 to 0.0)

Is the proposed project part of an effort to join or remedy the community?s probation or suspension from the NFIP?

NFIP*: No

Is the proposed project in a low-income geographic area as defined below?
"Low-income geographic area" means any locality, or community within a locality, that has a median household income that is not greater than 80 percent of the local median household income, or any area in the Commonwealth designated as a qualified opportunity zone by the U.S. Secretary of the Treasury via his delegation of authority to the Internal Revenue Service. A project of any size within a low-income geographic area will be considered.

Low-Income Geographic Area*: No

Projects eligible for funding may also reduce nutrient and sediment pollution to local waters and the Chesapeake Bay and assist the Commonwealth in achieving local and/or Chesapeake Bay TMDLs. Does the proposed project include implementation of one or more best management practices with a nitrogen, phosphorus, or sediment reduction efficiency established by the Virginia Department of Environmental Quality or the Chesapeake Bay Program Partnership in support of the Chesapeake Bay TMDL Phase III Watershed Implementation Plan?

Reduction of Nutrient and Sediment Pollution*: No

Does this project provide ?community scale? benefits?

Community Scale Benefits*: More than one census block

Expected Lifespan of Project

Expected Lifespan of Project*: Over 20 Years

Comments:

Lifespan is 30 years

Scope of Work - Projects - Round 4

Scope of Work

Upload your Scope of Work
Please refer to Part IV, Section B. of the grant manual for guidance on how to create your scope of work

Scope of Work*: CID515531_VirginiaBeach_CFPF-Scope of Work.pdf

Comments:

Budget Narrative

Budget Narrative Attachment*: CID515531_VirginiaBeach_CFPF-Budget Narrative.pdf

Comments:

Scope of Work Supporting Information - Projects

Supporting Information - Projects

Provide population data for the local government in which the project is taking place

Population*: 459373.00

Provide information on the flood risk of the project area, including whether the project is in a mapped floodplain, what flood zone it is in, and when it was last mapped. If the property or area around it has been flooded before, share information on the dates of past flood events and the amount of damage sustained

Historic Flooding data and Hydrologic Studies*: CID515531_VirginiaBeach_CFPF.pdf

Include studies, data, reports that demonstrate the proposed project minimizes flood vulnerabilities and does not create flooding or increased flooding (adverse impact) to other properties

No Adverse Impact*: CID515531_VirginiaBeach_CFPF.pdf

Include supporting documents demonstrating the local government's ability to provide its share of the project costs. This must include an estimate of the total project cost, a description of the source of the funds being used, evidence of the local government's ability to pay for the project in full or quarterly prior to reimbursement, and a signed pledge agreement from each contributing organization

Ability to Provide Share of Cost*: CID515531_VirginiaBeach_CFPF.pdf

A benefit-cost analysis must be submitted with the project application

Benefit-Cost Analysis*: CID515531_VirginiaBeach_CFPF.pdf

Provide a list of repetitive loss and/or severe repetitive loss properties. Do not provide the addresses for the properties, but include an exact number of repetitive loss and/or severe repetitive loss structures within the project area

Repetitive Loss and/or Severe Repetitive Loss Properties*: CID515531_VirginiaBeach_CFPF.pdf

Describe the residential and commercial structures impacted by this project, including how they contribute to the community such as historic, economic, or social value. Provide an exact number of residential structures and commercial structures in the project area

Residential and/or Commercial Structures*:

There are approximately 70 commercial and 2,350 residential structures within the two census block groups surrounding the project site. Around 635 of those structures are vulnerable to flooding during a 50-year event today. With three feet of sea level rise, approximately 2,060 structures are expected to be vulnerable to flooding during a 50-year return period event, representing about 85% of the residential structures within the project vicinity. These numbers underscore the importance of implementing the proposed project alongside complimentary flood risk reduction projects.

If there are critical facilities/infrastructure within the project area, describe each facility

Critical Facilities/Infrastructure*:

In addition to Muddy Creek Road, two other critical access roads are anticipated to benefit from delayed flooding. This includes Shipps Cabin Road (intersecting with Muddy Creek Road) and Sandpiper Road, which runs parallel to the eastern bank of Back Bay and provides ingress/egress out of the Sandbridge community.

Explain the local government's financial and staff resources. How many relevant staff members does the local government have? To what relevant software does the local government have access? What are the local government's capabilities?

Financial and Staff Resources*:

City of Virginia Beach has three staff personnel and construction inspection staff dedicated to this project. City has all relevant software needed for the project.

Identify and describe the goals and objectives of the project. Include a description of the expected results of the completed project and explain the expected benefits of the project. This may include financial benefits, increased awareness, decreased risk, etc.

Goals and Objectives*:

The overarching goal of this project is to construct the City's first nature-based adaptation project in the Southern Rivers Watershed and one of the CRMP's exemplary nature-based projects. This project aims to stabilize two critically eroding marsh islands from further degradation, decrease turbidity to promote the growth of aquatic vegetation, and provide flood risk reduction benefits through increased friction and wave attenuation.

Outline a plan of action laying out the scope and detail of how the proposed work will be accomplished with a timeline identifying expected completion dates. Determine milestones for the project that will be used to track progress. Explain what deliverables can be expected at each milestone, and what the final project deliverables will be. Identify other project partners

Approach, Milestones, and Deliverables*: CID515531_VirginiaBeach_CFPF-supplemental.docx

Where applicable, briefly describe the relationship between this project and other past, current, or future resilience projects. If the applicant has received or applied for any other grants or loans, please identify those projects, and, if applicable, describe any problems that arose with meeting the obligations of the grant and how the obligations of this project will be met

Relationship to Other Projects*:

This project represents the first nature-based project in the Southern Rivers Watershed to advance to design and construction to implement the City's Wise Resilience Plan. The project is also an aspect of the Stormwater Green Infrastructure aspect of the City?s Flood Protection Plan. The City has received a $3M award from the CFPF to support another project in the Stormwater Green Infrastructure element of the Flood Protection Program ? the Elizabeth River Wetland and Floodplain Restoration Project (Round 1 CFPF Grant Awards).

The City has also received two NFWF NRCF grants from the Marsh Restoration in Back Bay project. Approximately $135,000 in NFWF NRCF funding was awarded in 2020 for the previous phase (design and permitting) for the project. The City continues to meet the obligations and period of performance of this NFWF grant. In 2022, the NFWF NRCF awarded $9,886,400 to support construction activities.

In its Resilience Plan, Virginia Beach identifies an adaptation approach for the Southern Rivers Watershed that emphasizes natural mitigation methods and integrated systems of defenses. As a natural mitigation strategy, the marsh terrace project aims to serve as a first line of defense during flood events, reducing wind-driven fetch, wave energy, and flow velocities to protect the important marsh buffer surrounding the shorelines of Back Bay. Other projects are also needed to provide multi-layered flood protection to northern Back Bay communities. Several of these projects are highlighted below. It should be noted that the projects described below are either not yet funded or will be funded in the future through the City?s Capital Improvement Program. Marsh island restoration serves as a critical first line of defense of the multi-layered protection system in the Southern Rivers Watershed. The structural adaptation projects proposed for the Southern Rivers Watershed, including the Muddy Creek Road and Sandbridge flood defense systems. The City?s numerical modeling shows that, if implemented, there is potential for small increases in flooding outside of these structural protection systems. This emphasizes the need for complimentary measures, including the marsh terrace project, land acquisition, and conservation efforts, to mitigate this residual risk.

For ongoing projects or projects that will require future maintenance, such as infrastructure, flood warning and response systems, signs, websites, or flood risk applications, a maintenance, management, and monitoring plan for the projects must be provided

Maintenance Plan*: Attachment6_Back Bay Marsh Terraces_Annual_Monitoring_Draft_07.6.23.pdf

Describe how the project meets each of the applicable scoring criteria contained in Appendix B. Documentation can be incorporated into the Scope of Work Narrative

Criteria*:

The project receives a total score of 65 Points. An explanation of how the project meets each of the applicable scoring criteria contained in Appendix D is provided below.
Eligible Project (Type)
Category/Points: Wetland/floodplain restoration, Living shorelines and vegetated buffers (25 Points)
Explanation: Marsh terraces are considered a type of wetland restoration or a component of a living shoreline project:
? Wetland Restoration: Wetland restoration aims to reestablish or enhance natural wetland ecosystems. Marsh terraces can be constructed in areas where wetlands have been degraded or lost, and they help to recreation or support wetland functions. They provide habitat for various species, improve water quality, and can contribute to the overall health and resilience of a wetland ecosystem.
? Living Shoreline Project: Living shorelines are designed to protect shorelines from erosion while also promoting ecological and environmental benefits. Marsh terraces are often used as a component of living shoreline projects. They can serve as a buffer against wave action, stabilize shorelines, and create suitable habitat for marsh and aquatic species.
Social Vulnerability Index Score
Category/Points: Low Social Vulnerability (0 Points)
Explanation: Based on the Virginia Flood Risk Information System (VFRIS) Social Vulnerability Index Layer, the Social Vulnerability Index scores of the communities located in the two census block groups adjacent to Back Bay near the project site are -1.07 and -0.43 (an average of -0.75), which falls into the Low Social Vulnerability category.
Community Scale Benefits
Category/Points: More than one census block group (30 Points)
Explanation: As documented in the Supporting Documentation - Project Information ? Population section of this document, the project is anticipated to benefit two census block groups (518100454.121 and 518100464.001).
Expected Lifespan of Project
Category/Points: Over 20 Years (10 Points)
Explanation: As documented in the Supporting Documentation ? Approach, Milestones, and Deliverables ? Activity 3 (Marsh Terrace Construction) section, the marsh terraces have a 30-year design life.

Budget

Budget Summary

Grant Matching Requirement*: Projects that will result in nature-based solutions - Fund 70%/Match 30%

Total Project Amount*: $53,378,490.00

REQUIRED Match Percentage Amount: $16,013,547.00

BUDGET TOTALS

Before submitting your application be sure that you meet the match requirements for your project type.

Match Percentage: 90.63%
Verify that your match percentage matches your required match percentage amount above.

Total Requested Fund Amount: $5,000,000.00

Total Match Amount: $48,378,490.00

TOTAL: $53,378,490.00

Personnel

Description	Requested Fund Amount	Match Amount	Match Source

No Data for Table

Fringe Benefits

Description	Requested Fund Amount	Match Amount	Match Source

No Data for Table

Travel

Description	Requested Fund Amount	Match Amount	Match Source

No Data for Table

Equipment

Description	Requested Fund Amount	Match Amount	Match Source

No Data for Table

Supplies

Description	Requested Fund Amount	Match Amount	Match Source

No Data for Table

Construction

Description	Requested Fund Amount	Match Amount	Match Source

No Data for Table

Contracts

Description	Requested Fund Amount	Match Amount	Match Source

No Data for Table

Maintenance Costs

Description	Requested Fund Amount	Match Amount	Match Source

No Data for Table

Pre-Award and Startup Costs

Description	Requested Fund Amount	Match Amount	Match Source

No Data for Table

Other Direct Costs

Description	Requested Fund Amount	Match Amount	Match Source
NFWF Grants (shown as Federal Share on Budget Form)	$0.00	$10,021,524.00	NFWF Grants for Design and Construction
Local Share	$0.00	$37,330,166.00	City of Virginia Beach
State Share	$5,000,000.00	$0.00	Requested CFPF grant amount
Site Investigation	$0.00	$276,800.00	City of Virginia Beach
Post Construction Monitoring	$0.00	$750,000.00	City of Virginia Beach
	$5,000,000.00	**$48,378,490.00**	

Long and Short Term Loan Budget - Projects - VCFPF

Budget Summary

Are you applying for a short term, long term, or no loan as part of your application?

If you are not applying for a loan, select "not applying for loan" and leave all other fields on this screen blank

Long or Short Term*: Not Applying for Loan

Total Project Amount: $0.00

Total Requested Fund Amount: $0.00

TOTAL: $0.00

Salaries

Description	Requested Fund Amount

No Data for Table

Fringe Benefits

Description	Requested Fund Amount

No Data for Table

Travel

Description	Requested Fund Amount

No Data for Table

Equipment

Description	Requested Fund Amount

No Data for Table

Supplies

Description	Requested Fund Amount

No Data for Table

Construction

Description	Requested Fund Amount

No Data for Table

Contracts

Description	Requested Fund Amount

No Data for Table

Other Direct Costs

Description	Requested Fund Amount

No Data for Table

Supporting Documentation

Supporting Documentation

Named Attachment	Required	Description	File Name	Type	Size	Upload Date
Detailed map of the project area(s) (Projects/Studies)		See Figure 2 on page 4.	CID515531_VirginiaBeach_CFPF.pdf	pdf	9 MB	11/09/2023 04:59 PM
FIRMette of the project area(s) (Projects/Studies)		See figures 15 and 16 on pages 30 and 31	CID515531_VirginiaBeach_CFPF.pdf	pdf	9 MB	11/09/2023 05:00 PM
Historic flood damage data and/or images (Projects/Studies)		See pages 29 through 36	CID515531_VirginiaBeach_CFPF.pdf	pdf	9 MB	11/09/2023 05:09 PM
A link to or a copy of the current floodplain ordinance		Floodplain Ordinance	Attachment5_Floodplain Ordinance.pdf	pdf	151 KB	11/09/2023 04:50 PM
Maintenance and management plan for project		Monitoring plan	Attachment6_Back Bay Marsh Terraces_Annual_Monitoring_Draft_07.6.23.pdf	pdf	2 MB	11/09/2023 05:03 PM
A link to or a copy of the current hazard mitigation plan		Hampton Roads Hazard Mitigation Plan	Hampton Roads Hazard Mitigation Plan 2022 FINAL.pdf	pdf	28 MB	11/09/2023 04:55 PM
A link to or a copy of the current comprehensive plan		City of Virginia Beach Comp Plan	City of Virginia Beach Comp Plan.pdf	pdf	16 MB	11/09/2023 04:55 PM
Social vulnerability index score(s) for the project area		See page 64	CID515531_VirginiaBeach_CFPF.pdf	pdf	9 MB	11/09/2023 05:04 PM
Authorization to request funding from the Fund from governing body or chief executive of the local government		Authorization from City Manager	City Manager.pdf	pdf	71 KB	11/09/2023 04:47 PM
Signed pledge agreement from each contributing organization		Signed Pledge	City Manager.pdf	pdf	71 KB	11/09/2023 05:09 PM
Maintenance Plan		Monitoring Plan	Attachment6_Back Bay Marsh Terraces_Annual_Monitoring_Draft_07.6.23.pdf	pdf	2 MB	11/09/2023 04:48 PM
Benefit-cost analysis must be submitted with project applications over $2,000,000. in lieu of using the FEMA benefit-cost analysis tool, applicants may submit a narrative to describe in detail the cost benefits and value. The narrative must explicitly indicate the risk reduction benefits of a flood mitigation project and compares those benefits to its cost-effectiveness.						
Benefit Cost Analysis		See page 37 through 39	CID515531_VirginiaBeach_CFPF.pdf	pdf	9 MB	11/09/2023 05:10 PM
Other Relevant Attachments						

Letters of Support

Description	File Name	Type	Size	Upload Date
APNEP	VA_Beach_CFPF_APNEP_26Oct2023.pdf	pdf	213 KB	11/09/2023 04:44 PM
Back Bay National Wildlife Refuge	Signed_BKB_MarshTerraceProject_Oct2023.pdf	pdf	47 KB	11/09/2023 04:46 PM
Back Bay Restoration Foundation	BBRF LOS.pdf	pdf	233 KB	11/09/2023 04:44 PM

Resilience Plan

Resilience Plan

Description	File Name	Type	Size	Upload Date
Virginia Beach Resilience Plan DCR Approval	Attachment1_VADCR Response VA Beach Resilience Plan Second Submission 07202021.pdf	pdf	232 KB	11/09/2023 05:13 PM

Matthew J. Strickler
Secretary of Natural Resources

Clyde E. Cristman
Director

Rochelle Altholz
Deputy Director of Administration and Finance

Russell W. Baxter
Deputy Director of Dam Safety & Floodplain Management and Soil & Water Conservation

Nathan Burrell
Deputy Director of Government and Community Relations

Thomas L. Smith
Deputy Director of Operations

COMMONWEALTH of VIRGINIA
DEPARTMENT OF CONSERVATION AND RECREATION

July 20, 2021

Toni Utterback, P.E.
Department of Public Works
2875 Sabre Street, Suite 250
Virginia Beach, VA 23452

RE: Virginia Beach Resilience Plan Second Submission - CFPF

Dear Ms. Utterback:

Thank you for the resubmission of the Sea Level Wise Adaptation Plan for City of Virginia Beach. After careful review and consideration, the Virginia Department of Conservation and Recreation has deemed the Plan complete and meets all the criteria outlined in the June 2021 Community Flood Preparedness Grant Manual. This approval will remain in effect for a period of three years, ending on July 31, 2024.

The following elements were evaluated as part of this review:

1. **Element 1: It is project-based with projects focused on flood control and resilience. DCR RESPONSE**

    a. Project-based: Four watersheds—each with a defined geographic area, analysis of community social and environmental characteristics, types of flooding, and a tailored flood resilience strategy with discrete projects identified.

Projects focused on flood control and resilience include:

Neighborhood	Flood Control Project
Elizabeth River	City-wide alignment, living shoreline, marsh restoration, land conservation
Lynnhaven	Chesapeake Bay alignment, Lesner Bridge Neighborhood alignment (East & West), beach & dune nourishment, ecological revetments, shellfish reef restoration, seagrass restoration
Oceanfront	Atlantic Oceanfront alignment, Rudee Heights alignment
Southern Rivers	West Neck Creek city-wide alignment, Muddy Creek Road city-wide alignment, Sandbridge city-wide alignment

**additional projects listed within the Sea Level Wise Adaptation Strategy.*

2. **Element 2: It incorporates nature-based infrastructure to the maximum extent possible. DCR RESPONSE**

   a. Nature-based infrastructure: Flood mitigation projects throughout the city incorporate nature-based solutions and were identified for maximum use within specific watersheds.

3. **Element 3: It includes considerations of all parts of a locality regardless of socioeconomics or race. DCR RESPONSE**
   a. All parts of a locality: Locality divided into four watersheds, covering the entirety of the jurisdictional boundary.
   b. Social vulnerability: Social implications of flood hazards and analysis of populations at-risk documented.
   c. Demographic Analysis: Demographic and Population Vulnerability Analysis conducted by Dewberry and incorporated into the Plan.

4. **Element 4: It includes coordination with other local and inter-jurisdictional projects, plans, and activities and has a clearly articulated timeline or phasing for plan implementation. DCR RESPONSE**
   a. Coordination with other projects, plans, and activities: Contains the planning processes and frameworks which outline local and regional plans used by the City and address resilience; and how they have been integrated for flood adaptation planning.
   b. Clearly articulated timeline or phasing for plan implementation: Program phases clearly articulated and described in detail—Impact assessment, Adaptation research, Strategy development, and Long-term implementation.

5. **Element 5: Is based on the best available science, and incorporates climate change, sea level rise, storm surge (where appropriate), and current flood maps.**
   a. Technically backed water-resources analysis, sea level rise projections, storm surge, and climate change incorporated into strategic approach.

VA DCR looks forward to working with you as you work to make Virginia Beach a more resilient community. If you have questions or need additional assistance, please contact us at cfpf@dcr.virginia.gov. Again, thank you for your interest in the Community Flood Preparedness Fund.

Sincerely,

Wendy Howard Cooper, Director
Dam Safety and Floodplain Management

cc: Darryl Glover, DCR

Back Bay Restoration Foundation

PO Box 57041 • Virginia Beach, Virginia • 23457• 757-818-4829

November 6, 2023

Department of Conservation and Recreation
Dam Safety and Floodplain Management
600 E. Main St., 24th Floor
Richmond, VA 23219

Re: Virginia Community Flood Preparedness Fund Grant

Grantors:

The Back Bay Restoration Foundation (BBRF), is a 35 year-old non-profit watershed organization, founded in 1986 by a group of local citizens concerned about deterioration of the Back Bay watershed visible then through decreases in Submerged Aquatic Vegetation (SAV), fish, and waterfowl. BBRF is the only voice solely dedicated to conserving and improving Virginia Beach's two Southern Watersheds; namely, the Back Bay and North Landing River watersheds. Our efforts focus on education, stewardship and outreach to conserve the largest watersheds in Virginia Beach. We team with other non-profits, and city, state and federal agencies to work toward best solutions for the future of the Back Bay and North Landing River watersheds. BBRF strives to raise awareness, addressing issues that negatively affect these watersheds such as sea level rise, land subsidence and land use changes.

Back Bay is a historical, nationally significant, watershed. With the Back Bay National Wildlife Refuge (NWR) and significant State conservation lands at its core, the watershed was recognized as an Aquatic Resource of National Importance (ARNI) in 2008 by both the US Fish and Wildlife Service and the US Army Corps of Engineers. Back Bay is a wind-tidal oligohaline estuary and is located at the northern tip of the Albemarle/Pamlico estuarine system, the second largest estuarine complex in the United States. The Albemarle/Pamlico estuarine system was designated as an Estuary of National Significance in 1987 and selected to be studied as part of the Environmental Protection Agency's National Estuary Program. Back Bay is a shallow-water aquatic ecosystem with an average depth of four feet. Winds can influence the water depth by as much as three feet.

BBRF supports the City of Virginia Beach's application for Round 4 of VADCR's Community Flood Preparedness Fund. We were strong advocates of the City's successful applications to the National Fish and Wildlife Foundation (NFWF), and have seen what they accomplished with the initial NFWF funding they received. With the combined funding of NFWF, the City of Virginia Beach, and this application for DCR funding, their project of creating a Marsh Terrace Network to Achieve Restoration and Flood Resilience has overachieved by any measure. From community engagement and the NEPA process to conceptual and preliminary designs as described in the recent Army Corps Public Notice, the City has been productive and completely transparent.

As noted above, the City's community engagement and partnerships with organizations like ours has been transparent and resulted in broad support. Although the current project is localized in its first application, we expect the results will significantly mitigate SLR, land subsidence and wind tides in Back Bay. Similarly, this restoration will provide the biotic building blocks to maintain the watershed's national importance for wildlife. The innovative designs proposed will inform future projects at the landscape level. Although innovative, we believe the project is technically sound based on BBRF's 35 years of experience in habitat restoration.

Please feel free to contact us for further information.

Jared Brandwein

Jared Brandwein

Executive Director
Back Bay Restoration Foundation

Albemarle - Pamlico
National Estuary Partnership

Our mission is to identify, protect, and restore
the significant resources of the Albemarle-Pamlico estuarine system.

October 26, 2023

Wendy Howard Cooper
Virginia Dept. of Conservation and Recreation
Division of Dam Safety and Floodplain Management
600 E. Main St., 24th Floor
Richmond, VA 23219

Dear Wendy,

The Albemarle-Pamlico National Estuary Partnership (APNEP) strongly endorses the City of Virginia Beach and partners' application to Round 4 of The Virginia Community Flood Preparedness Fund (CFPF). The proposal is to support construction of the Back Bay Marsh Terrace Restoration Project.

APNEP relies on regional partnerships and collaboration to implement our 2012-2022 Comprehensive Conservation & Management Plan (CCMP) within the waterways of our congressionally designated "estuary of national significance." The proposed partnership between the City of Virginia Beach and the U.S. Fish and Wildlife Service will also advance our 2020 Memorandum of Understanding between Virginia and North Carolina to protect the ecosystem resources in the shared waterways between our two states. The project also addresses a "high priority" area for restoring and enhancing vulnerable marshes with high flood risk reduction benefits and habitat value, as identified by Audubon's Currituck Sound Coalition Marsh Conservation Plan released in 2021.

The marsh terrace project employs the use of natural features to build resilience to flooding in the Back Bay watershed. The project offers coastal resilience and habitat protection and conservation co-benefits including preserving marsh islands, restoring Submerged Aquatic Vegetation, migratory bird and fish habitat, reducing flow that could exacerbate wind tide flooding in local communities, and filling a gap in prior applied research on predominantly fresh water coastal lagoons. These features support the following CCMP actions:

- A2.3: Support research on adapting to impacts associated with climate change and sea level rise.
- C3.2: Develop and implement a coordinated wetland restoration strategy.
- C3.3: Develop and implement a submerged aquatic vegetation (SAV) restoration strategy.
- D3.3: Provide assistance to state, regional, and local governments to incorporate climate change and sea level rise considerations into their planning processes.

In closing, we strongly support the full funding of the City of Virginia Beach's proposal to Round 4 of The Virginia Community Flood Preparedness Fund (CFPF). Please contact Steve Anderson, Partnership Coordinator, at (919) 707-8743 with questions.

Sincerely,

W. Crowell

William L. Crowell, Jr., Ph.D., AICP, CEE
Director

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Back Bay National Wildlife Refuge
1324 Sandpiper Road
Virginia Beach, VA 23456

October 30, 2023

Wendy Howard Cooper
Division of Dam Safety and Floodplain Management
600 East Main Street, 24th Floor
Richmond, Virginia 23219

Dear Ms. Cooper,

The City of Virginia Beach is proposing to install marsh terraces in the waters of Back Bay adjacent to Back Bay National Wildlife Refuge. This project is expected to reduce wave energy and thus decrease the speed of erosion of remaining islands in the project area, many of which are managed by the U.S. Fish and Wildlife Service and provide habitat for migratory birds and other species. Additionally, the addition of multiple vegetative structures added to the bay will supplement habitat and provide nesting grounds for multiple species.

The mission of the U.S. Fish and Wildlife Service is *working with others to conserve, protect, and enhance fish, wildlife, plants, and their habitats for the continuing benefit of the American people*. Although much work is conducted on federal property to achieve this mission, the Service equally coordinates with external partners to further mutual goals. The proposed marsh terrace project is an excellent example of local and federal government coordination, and we support the City of Virginia Beach's proposed project.

Megan Reed

Megan Reed
Refuge Manager

City of Virginia Beach

DEPARTMENT OF BUDGET AND MANAGEMENT SERVICES
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BUILDING 1, 3RD FLOOR
2401 COURTHOUSE DRIVE
VIRGINIA BEACH, VA 23456-9001

INTER-OFFICE MEMORANDUM

DATE: November 1, 2023

TO: Patrick A. Duhaney, City Manager

FROM: Stuart McCrery, Budget and Policy Analyst KJ for SM

SUBJECT: Application for Virginia Community Flood Preparedness Fund Grant

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The Department of Public Works is requesting permission to apply for the Virginia Community Flood Preparedness Fund Grant from the Virginia Department of Conservation and Recreation. The Virginia Community Flood Preparedness Fund was established in the 2020 session of the General Assembly. Money in this fund comes from the auction of carbon allowances through the Regional Greenhouse Gas Initiative. It was established to provide support to localities across Virginia to reduce the impacts of flooding, including flooding driven by climate change.

Public Works is requesting a total of $5,000,000 to construct marsh terraces in Back Bay to promote wetland restoration and mitigate frequent flooding. The City has already made significant investments into this project through CIP project 100551 "Stormwater Green Infrastructure."

This grant also requires a local match of 30% for projects that implement nature-based solutions; however, the City has more than met this requirement through its current appropriations to CIP project 1000551 "Stormwater Green Infrastructure" which currently total over $49 million from the Referendum and other grant awards.

Budget & Management Services recommends this grant application for approval. Please indicate approval or disapproval below. Applications are due by November 12, 2023.

11/1/2023

Approve (Date) Disapprove (Date)

[DRAFT] Annual Monitoring Plan and Post-Construction Monitoring Report

Marsh Restoration in Back Bay, Virginia Beach, VA

Prepared by: Dewberry Engineers, Inc.

[July 6, 2023]

[REPORT VERSION [DRAFT]]

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INTRODUCTION

This project is intended to implement one of the nature-based projects proposed in Virginia Beach's "Sea Level Wise" (SLW) Adaptation Strategy[1] adopted by the Virginia Beach City Council in June 2020. The SLW Adaptation Strategy presents a holistic framework for addressing flood risks across the City, consisting of four general strategies – natural mitigations, engineered defenses, adapted structures, and prepared communities. These strategies were applied to each major watershed in the City and tailored to their unique characteristics and risk profiles. The adaptation vision for the Lower Southern Rivers Drainage Basin, where the proposed project is located, focuses on employing natural mitigation methodologies to strategically reduce flow into and within Back Bay, along with an integrated system of defense structures and complementary adaptation measures, such as land-use strategies, to improve flood storage and overall coastal resiliency. The Bonney Cove area of Back Bay, where the project site is proposed, is particularly suitable for the use of nature-based strategies given the low elevations of marshlands and documented historic degradation of habitat. Participants at the 'near-neighbor' public engagement meetings held during the SLW Adaptation Strategy development were supportive of these types of strategies.

The City has several dedicated Capital Improvement Program (CIP) initiatives for the Lower Southern Rivers Drainage Basin for implementation of these strategies. The City's Stormwater Green Infrastructure CIP has obligated approximately $421,700 in contracts to support field investigations, environmental assessments, and engineering designs of the project – a true indication of the City's commitment to nature-based approaches and the critical first step in a broader effort. During the General Election on November 2, 2021, Virginia Beach residents voted to authorize $567.5 million dollars in debt to fund the design and construction of 21 Phase 1 projects in the citywide Flood Protection Program. [2] The Back Bay Marsh Terrace project is included under the Stormwater Green Infrastructure Master Project.[3] Other Southern Watershed projects that received funding under the Flood Protection Program include the West Neck Creek Bridge City-Wide Sea Level Rise Strategy, the Pungo Ferry Road Improvements, and the Sandbridge/New Bridge Intersection Improvements projects.

Outside of this project, the Virginia Beach City Council has recently funded a $5.2 million dollar voluntary acquisition program to encourage flood-prone properties to apply for a buyout to enable the City to convert parcels to open space to serve as flood storage and a marsh migration buffer. The City's

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[1] City of Virginia Beach Sea Level Wise Adaptation Strategy webpage: https://www.vbgov.com/government/departments/public-works/comp-sea-level-rise/Pages/default.aspx

[2] City of Virginia Beach Flood Protection Program webpage: https://www.vbgov.com/government/departments/public-works/flood-protection-program/Pages/Flood-Protection-Program.aspx.

[3] Stormwater Green Infrastructure Page: https://www.vbgov.com/government/departments/public-works/flood-protection-program/Pages/Stormwater-Green-Infrastructure-.aspx

Stormwater Green Infrastructure CIP is also supporting the implementation of other natural and nature-based projects across the City, including a wetland and floodplain restoration project along the Eastern Branch of the Elizabeth River.

An assessment of restoration opportunities in the City's Lower Southern Rivers Drainage Basin with dual flood reduction and habitat restoration benefits identified the Bonney Cove area as a potential project site for several reasons. The Bonney Cove site has experienced significant historical ecological degradation. Historical shoreline data from 1869 indicates approximately 50% of present-day open water in Bonney Cove (260 acres) was previously marsh (Figure 1). Loss of the marsh island habitat within Bonney Cove has resulted in the opening of a secondary channel allowing increased flow exchange between the upper and lower bays. In comparison to shore-adjacent restoration, off-shore marsh restoration leveraging hydraulic modeling identified Bonney Cove as a location where marsh restoration has the potential to reduce the propagation of floodwaters through key pathways within Back Bay. The United States Fish and Wildlife Service (USFWS) and the Virginia Department of Wildlife Resources (VDWR) also identified Bonney Cove as a restoration priority as this area serves as an ideal location for Submerged Aquatic Vegetation (SAV) reestablishment and vital habitat for migratory birds and fish.

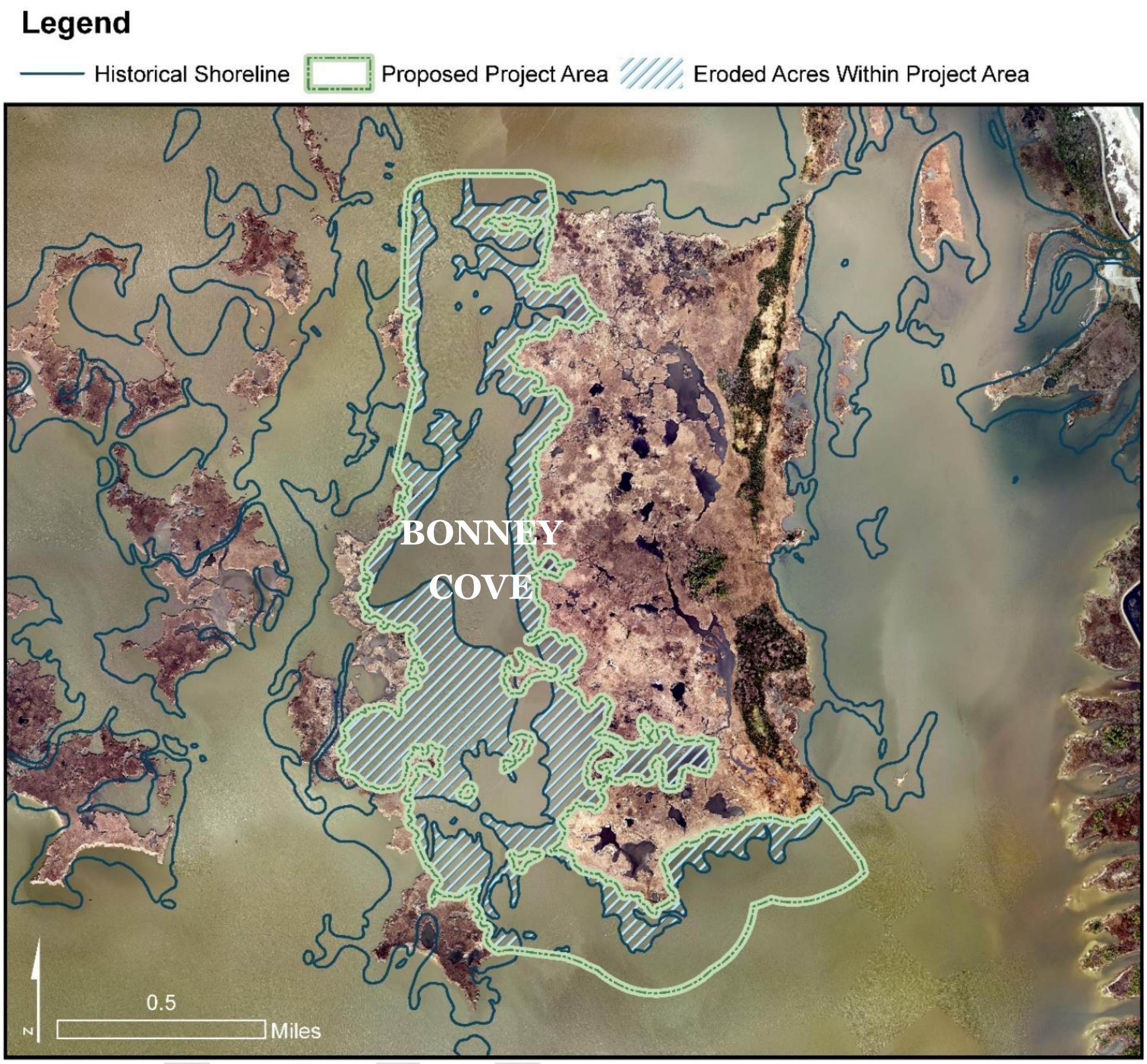

Figure 1: Historical marsh erosion within the project area.

The project is situated within the Bonney Cove area of Back Bay, spanning the western and southern lengths of Long Island, as shown in Figure 1.

Project Background

Marsh island restoration through terracing was identified as a particularly viable solution given Back Bay's shallow bottom and the historical loss of habitat. The marsh terraces are narrow man-made islands that will be arranged across areas that were historically marsh but are now shallow open water. A series of these islands, or terraces, are typically arranged in a chevron pattern. The overall field of terraces dissipates waves and slows down water moving through the area. In turn, the calmer water allows more sunlight to penetrate to the shallow bottom, promoting establishment and growth of marsh

and SAV habitats. Further, as opposed to one continuous marsh platform, marsh terraces maximize habitat for a variety of fish and wildlife species.

The Preferred Alternative includes the creation of 41 individual marsh terraces totaling approximately 25,000 linear feet (or an approximately 47-acre footprint) across Bonney Cove. These 47 acres of terraces are comprised of approximately 13 acres of emergent (low and high marsh) vegetated habitat, 14 acres of upland vegetated habitat, and 16 acres of submerged terrace habitat. Approximately 310 acres of suitable SAV habitat will remain in between the terraces.

Terrace Construction and Orientation

Terrace construction will begin in the northern extent of the project site, and the contractor will work towards the southern extent of the site. The contractor will complete each terrace, including installing plants, before moving to the next. Marsh terrace construction will occur over two years (2025 to 2026) and will pause annually between October 31st and March 1st to limit disturbance to wintering waterfowl and migration, in accommodation of BBNWR's requirement. Approximately 20 terraces will be constructed in 2025 ("Phase 1"), and 21 terraces will be constructed in 2026 ("Phase 2"). The following sections summarize the proposed design and construction approach.

Terraces will be generally oriented perpendicular to the predominant wind direction (south-southwest) to maximize wave energy reduction. The terraces will be segmented in a chevron (duck-wing) pattern to create the most favorable fish and swimming crustacean (termed "nekton") habitat, facilitate adequate circulation, and maintain navigability throughout the project area. The terraces will not be connected to the adjacent marsh to maintain a physical open water barrier to deter the invasion of Common Reed (*Phragmites australis*) stands.

The terraces will be spaced at approximately 300-foot intervals in the northern and southern quarters and span 15 feet in width, and at least 600-foot intervals in the center and span 30 feet in width. This arrangement will lessen the amount of open water and subsequent wave action at the northern and southern ends of the site and provide space for marine-based construction equipment. The design team reviewed the final spacing layout of the terraces to ensure navigability of a watercraft through the project site which will be required for post-construction monitoring, any needed maintenance, as well as community recreational access.

The terraces would consist of a sand filled core encapsulated by a high-strength blend of woven and non-woven geotextile fabrics ("geobags"). The sand for this material would need to come from offsite sources. Back Bay is too shallow to accommodate conventional barges for material placement. To avoid extensive impacts to the bottom of the bay, the slurry basin will pump sand for the project from the proposed Shipps Cabin Road staging area to Bonney Cove. The slurry pipeline will consist of approximately 10,424 linear feet of 12" diameter HDPE fused/welded pipeline that will be assembled on land and floated into its proposed alignment within Back Bay. The pipe would be marked by floats

every 5 feet and temporary signage as reasonable. It is anticipated the pipeline will be submerged to the bottom of the bay at channel crossings and adjacent to a duck hunting cabin adjacent to the alignment. By establishing a floating pipeline, it will limit disturbances to the subaqueous bottomlands along the alignment and allow for the retraction of the pipeline during the winter inactive periods and inclement weather events. Booster stations would be placed approximately every mile. These booster stations would consist of a pontoon mounted diesel engine pump capable of moving the sand slurry from the laydown area to the site. Given the distance to the site, four or five of these booster stations are anticipated to be necessary to create the sand cores of the terrace. It is estimated that 450 Gallons Per Minute (GPM) of sand slurry would be pumped through the pipe.

Once the cores are in place, long reach excavators would travel along the tops of the terraces and begin to shape the cross slopes. Appropriate materials for establishing vegetation atop the terraces will be primarily sourced from materials dredged during the Sandbridge Road Nimmo Parkway Phase VII-A project located immediately north of Back Bay (VMRC 15-1564, USACE IP NAO-2015-00151). Materials will be tested and screened to remove organics prior to application to the terraces. As needed, dredging sites adjacent to the proposed terrace locations that are confirmed to be devoid of SAV will be utilized to provide supplemental soil materials to top the proposed terraces[4]. It was determined that the in-situ bay sediment would be suitable for vegetation growth. The marsh terraces would be covered with 1 to 3 feet of suitable fill, depending on crest widths. Jute netting will cover the topsoil to control erosion and promote vegetation establishment. Coir logs will be places along the terrace slope controls to further promote vegetation establishment along the slope.

SAV Plantings

The City has partnered with Virginia Polytechnic Institute and State University ("Virginia Tech") to evaluate opportunities for restoring populations of native Wild Celery (*Vallisneria americana*) in Back Bay. The Virginia Tech research team has developed an innovative technique to grow Wild Celery in an aquaculture center that results in larger, mature plants that can better withstand Back Bay's turbidity. Once transplanted, plants are surrounded by cages to prevent predation. These founder colonies can be used for propagation throughout Back Bay. After terrace construction, the City will transplant Wild Celery in an area adjacent to the site. This founder colony will be used to strategically transplant Wild Celery in between the terraces for 5 years after construction (2026 – 2029) with the ultimate goal of establishing 10 acres of SAV vegetation in between the marsh terraces.

[4] The 60% preliminary design showed preliminary siting of these dredge areas based on avoidance of existing SAV habitat; however, pre-construction surveys of SAV would be required to re-delineate these dredging areas.

Terrace Plantings – Upland and Marsh Vegetation

The terraces' intertidal perimeter will be planted with appropriate emergent estuarine plant species (e.g., Saltmarsh Cordgrass [*Spartina alterniflora*] and Salt Meadow Hay [*Spartina patens*]) and brackish plant species (e.g., Big Cordgrass [*Spartina cynosuroides*]). These plants will be installed as soon as possible after construction to stabilize planting areas and protect the terrace from erosion. In addition to emergent grass, woody growth (i.e., shrubs and trees) within the terrace crest will be incorporated to protect the terraces' surfaces from rain and wind erosion and hold the landform together through substantial root systems.

Appropriate native species were identified based on the review of the reference marshes surrounding the project site and a review of water levels in Back Bay. Since the Bay's water levels are not affected by lunar tides and instead by wind-driven fluctuations, the project team evaluated average water elevations at the U.S. Geological Survey (USGS) Beggars Bridge Creek Gauge (Gauge ID 0204300267) from 2016 – 2021 to determine ranges of inundation to achieve functional marsh elevations throughout the project life, defined as:

- *Mean Low Water (MLW)*: the average low water at the site (10th Percentile: -0.62 ft NAVD88)
- *Mean High Water (MHW)*: the average high water at the site (95th Percentile: 1.22 ft NAVD88)
- *Mean Tide Level (MTL)*: halfway between MLW and MHW (0.3 ft NAVD88)
- *Upper Limit of Wetlands (ULW)*: approximately 1.5 times the mean tide range at the site (2.76 ft NAVD88)

These elevations were correlated to suitability for low marsh, high marsh, and upland species, as shown in Table 1.

Table 1: Proposed planting elevation zones.

Planting Zone	Definition	Elevation Range	Elevation (feet NAVD88)	Percentage of record where water reaches these elevations
Low Marsh	Marsh that is flooded frequently but exposed sometimes	MTL - MHW	0.3 – 1.2 ft	48%
High Marsh	Marsh that is generally only flooded during higher-than average water conditions	MHW – ULW	1.2 to 2.8 ft	7%
Upland Habitat	Habitat that is rarely flooded, only during extreme conditions	> ULW	> 2.8 ft	0%

Five planting schemas were identified to provide the highest possible environmental benefit in terms of erosion control, habitat diversity, and fetch reduction. The wider (30-foot) terraces will be planted with Bald Cypress (*Taxodium districhum*) trees capable of withstanding rising water levels. The full list of species and quantities is provided in the 95% design plan set.

The final engineered design component is the strategic placement of rock on the exposed perimeter terraces on the project site's north, west, and southern extents. The need for the rock armor was determined through analysis of wind data both from NOAA and ASCE-7-10 50-year return period anticipated 3-second gust values. These values were used to calculate fetch-generated waves at the project site. The calculations performed confirmed that armored protection would be required to protect the proposed terraces from the forces created by wave action. The stone sizes required for these features (Class II rip rap) were calculated following the procedures laid out in the USACE Coastal Engineering Manual (CEM) and Virginia Institute of Marine Science (VIMS) Living Shoreline Design Guidelines for Shore Protection in Virginia's Estuarine Environments. Two calculation methods, Hudson (1974) and Van Der Meer (1988), from the CEM were utilized to evaluate the range of acceptable rock armor for the exposed perimeter. These two methods calculate the armor stone size based on several design inputs including initial wave height, allowable damage level, revetment slope, and breaking versus non-breaking waves. The two methods often result in corresponding values that are used by the engineer to make an experienced determination on the final rock armor sizing. The rock armor will serve as a nature-based design element by acting as a substrate for the Wild Celery grass that has proven to be successful for SAV establishment in Back Bay (see Figure 2).

Figure 2: Example Back Bay SAV experiment; photo courtesy of Virginia Tech.

Monitoring Goals and Objectives

Annual post-construction monitoring of the site is required by the Virginia Marine Resource Commission (VMRC) (TBD) Permit (VMRC #XXXX-XXXX) and the U.S. Army Corps of Engineers (USACE) Individual Permit (NOA-20XX-XXXXX). [Insert details of the relevant permits and permit conditions]. The following goals, objectives, and metrics were established to enable consistent tracking of the primary living shoreline project components across each monitoring year.

1. **Monitoring Goal 1**: Establishment of a Sustainable Coastal Marsh Island System
    a. Objective 1a: Establish Emergent Marsh Habitat
        - Metric: For each monitoring year, the project area should maintain or increase the overall coverage of emergent marsh vegetation. There should be no significant signs of herbivory or invasive species establishment.

    b. Objective 1b: Establish Upland Habitat
        - Metric: For each monitoring year, the project area should maintain or increase the overall coverage of upland vegetation. There should be no significant signs of herbivory or invasive species establishment.
2. **Monitoring Goal 2**: Stability of Marsh Terraces
    a. Objective 2: Marsh Terrace Structures
        - Metric: For each monitoring year, the terrace structures should show no significant signs of damage, deterioration or extreme settlement.
3. **Monitoring Goal 3**: Establishment of a Sustainable SAV Community
    a. Objective 3: Establish SAV Communities

- Metric: For each monitoring year, the SAV planting areas should maintain or increase the overall coverage of SAV vegetation. There should be no significant signs of herbivory or invasive species establishment.

MONITORING PLAN

The monitoring plan includes stakeholders, a schedule for the annual monitoring inspections, the monitoring strategy/sampling plan, and approach for addressing any needs for maintenance.

Monitoring Stakeholders

An Environmental Scientist from Dewberry Engineers Inc. will perform the annual monitoring inspections and provide a copy of the monitoring report to the City of Virginia Beach, USACE, VDEQ, VMRC, and the City of Virginia Beach Wetlands Board as necessary. As owners of the project, the City of Virginia Beach will review monitoring recommendations and perform corrective actions as necessary.

Annual Inspection Schedule

Monitoring inspections should be conducted annually, during the peak growing season, which is defined by VMRC as between June and August. To enable consistent tracking of project performance from year to year, annual monitoring inspections will be conducted prior to the end of the growing season in September of each year, with annual reports to be submitted to regulatory stakeholders prior to November 30th [or an annual date defined in the permit conditions] of each year. The following outlines the monitoring inspection schedule and deliverables.

Phase 1 Post-Construction As-Built Report (Date: Prior to December 31st, 2025)

To serve as a baseline for the post-construction annual monitoring, an as-built report for the Phase 1 terraces will be completed following the construction of each phase of terraces and submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following.

- Coordinates and diagrams of established transects, as well as site photographs from photo stations 1-40 as defined in the Methods section.
- Final location of all planted vegetation (upland plantings, high marsh plantings and low marsh plantings).
- Final grade topographic surveys (plan, profile, and cross sections).
- Discussion of the project design versus as-built conditions.

Phase 2 Post-Construction As-Built Report (Date: Prior to December 31st, 2026)

To serve as a baseline for the post-construction annual monitoring, an as-built report for the Phase 2 terraces will be completed following the construction of each phase of terraces and submitted to the

City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following.

- Coordinates and diagrams of established transects, as well as site photographs from photo stations 41-80 as defined in the Methods section.
- Final location of all planted vegetation (upland plantings, high marsh plantings and low marsh plantings).
- Final location and extent of SAV plantings.
- Final grade topographic surveys (plan, profile, and cross sections).
- Discussion of the project design versus as-built conditions.

Year 1a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2026)

At the end of the first full growing season following planting of the Phase 1 terraces, a Year 1a monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 40 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 1 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion; it is anticipated that the wetland planting contractor will provide a one-year post construction maintenance and guarantee period for the wetland plantings.

Year 1b/2a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2027)

At the end of the first full growing season following planting of the Phase 2 terraces following planting, and the second full growing season of the Phase 1 terraces, a Year 1b/2a monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 1 conditions (for Phase 2 terraces) and to Year 2 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).

- Estimated percent cover and change in coverage from planted conditions to Year 1 conditions for SAV planting quadrants
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion; it is anticipated that the wetland planting contractor will provide a one-year post construction maintenance and guarantee period for the wetland plantings.

Year 2b/3a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2028)

At the end of the second full growing season of the Phase 2 terraces following planting, and the third full growing season of the Phase 1 terraces, a Year 2b/3a monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 2 conditions (for Phase 2 terraces) and to Year 3 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- Estimated percent cover and change in coverage from planted conditions to Year 2 conditions for SAV planting quadrants
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

Year 3b/4a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2029)

At the end of the third full growing season of the Phase 2 terraces following planting, and the fourth full growing season of the Phase 1 terraces, a Year 3b/4a monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 3 conditions (for Phase 2 terraces) and to Year 4 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).

- Estimated percent cover and change in coverage from planted conditions to Year 3 conditions for SAV planting quadrants
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

Year 4b/5a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2030)

At the end of the fourth full growing season of the Phase 2 terraces following planting, and the fifth full growing season of the Phase 1 terraces, a Year 4b/Final (Year 5a) monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 4 conditions (for Phase 2 terraces) and to Year 5 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- Estimated percent cover and change in coverage from planted conditions to Year 4 conditions for SAV planting quadrants
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

Year 5b Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2031)

At the end of the fifth full growing season of the Phase 2 terraces following planting, a Final (Year 5b) monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 41 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 5 conditions (for Phase 2 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- Estimated percent cover and change in coverage from planted conditions to Year 5 conditions for SAV planting quadrants

- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

Monitoring Strategy

The monitoring strategy consists of established transects with photo stations and quadrants that cover the area between transects. This approach enables monitoring of the four primary features of the living shoreline: uplands, low-marsh plantings, high-marsh plantings, and SAV*.

*Note: The planting scheme for SAV has not yet been established but it is anticipated that some SAV will be planted along the submerged portions of the marsh terraces. If more suitable planting locations are determined to be between terraces, separate transects will be established and sampled to track SAV survival apart from the proposed terrace transects.

Transects/Photo Points

A total of eighty (80) transects will be established across the project site, with 10 transects located along each of 8 terraces. Transects will span perpendicular to the length of each terrace from the ridge to the edge of the planted/vegetated area. See Figures 3 and 4 for graphic depictions of the proposed transect locations and layouts. Terraces were selected using a random stratified method to ensure representative terraces in each location within the project area (North Interior, North Exterior, South Interior, South Exterior), and of each planting scheme, were represented in the proposed monitoring plan. The selected terraces are as follows:

- North Interior: T-110, T-113
- North Exterior: T-100, T-106
- South Interior: T-124, T-131
- South Exterior: T-123, T-140

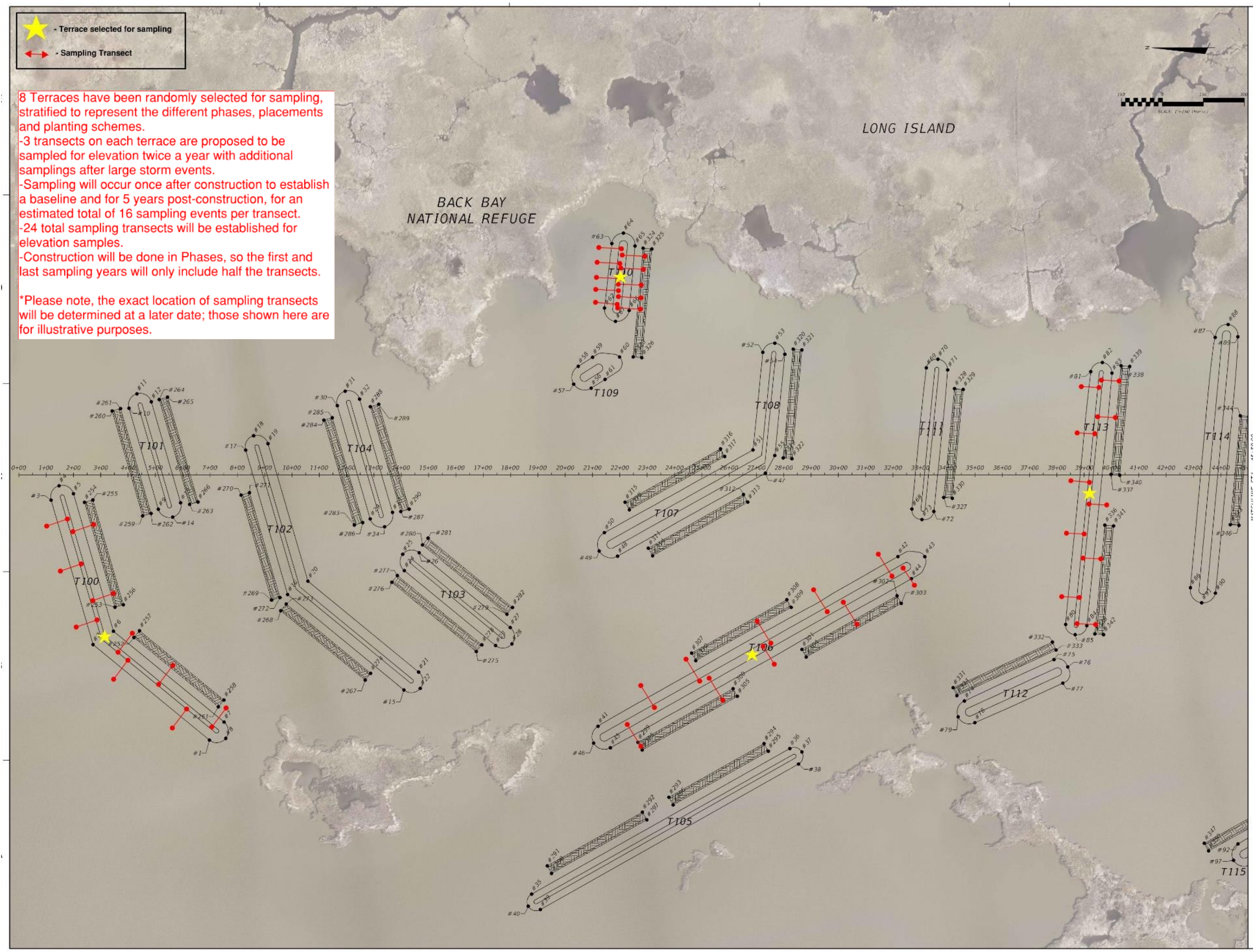

Figure 3: Monitoring design site plan – North Terraces

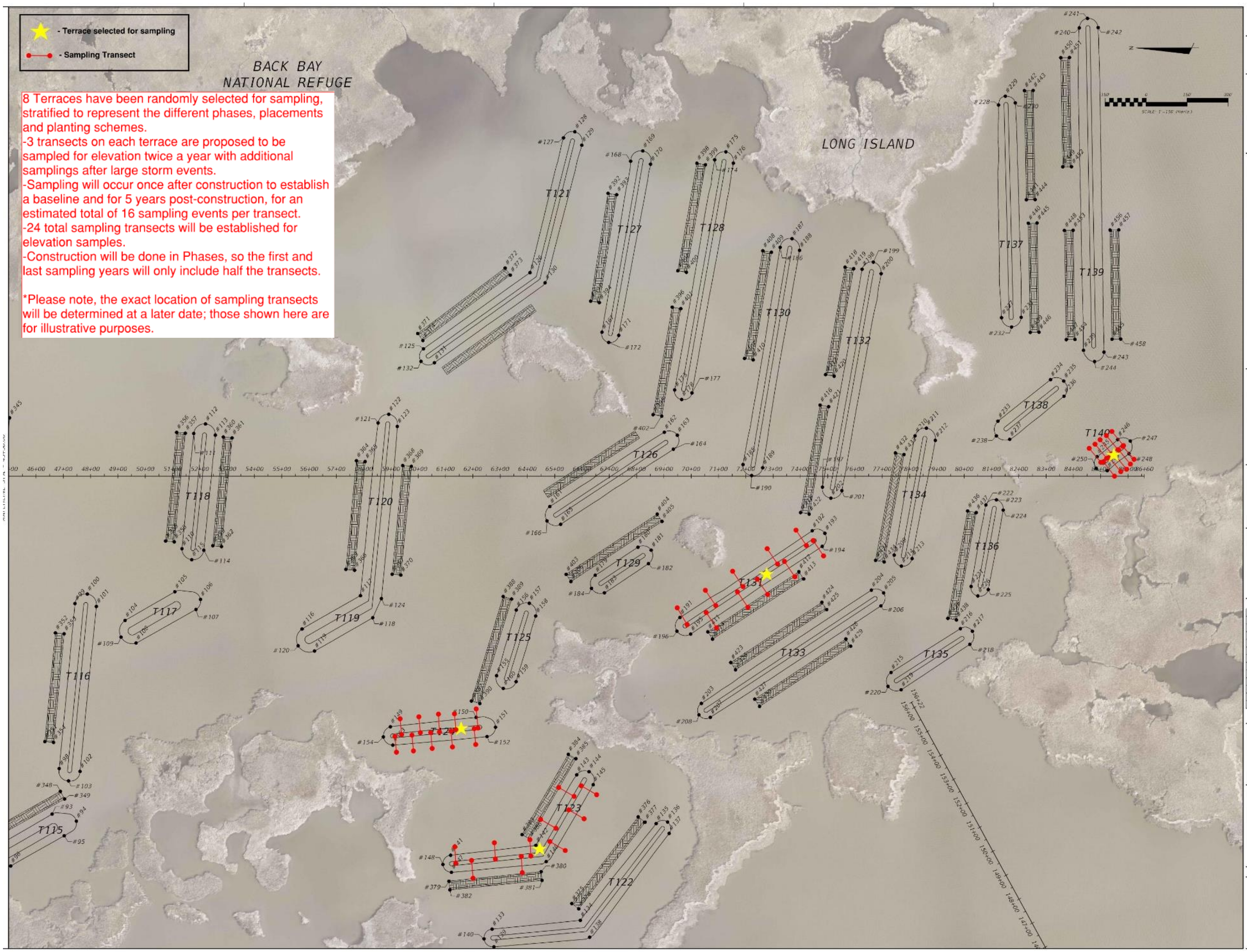

Figure 4: Monitoring design site plan – South Terraces

Permanent photo stations will be established at each quadrant along each transect to capture the design features/established habitats and vegetation. Figure 5 shows the general proposed locations (indicated by the red arrows/labels) for each quadrant and photograph station along each transect. Photos were shot from each photo location on [DATE]. These photos will be collected annually and compiled in Appendix B.

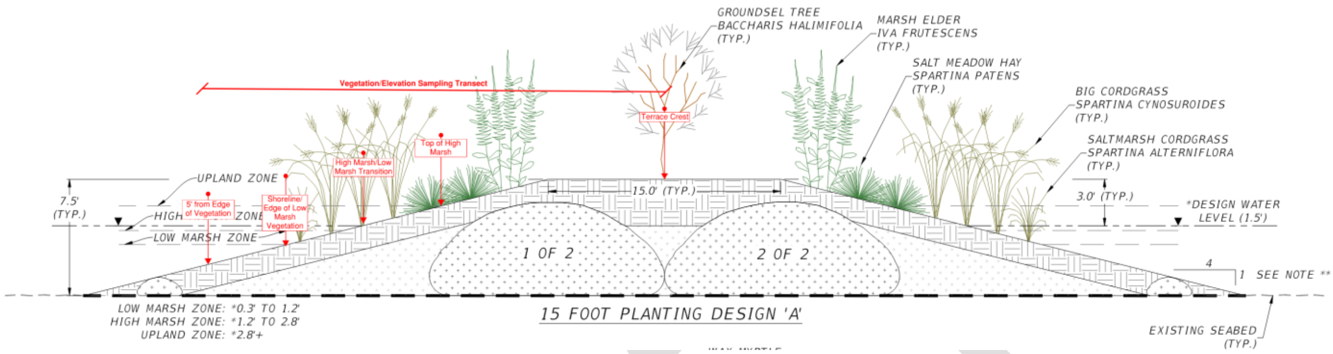

Figure 5: Photo station layout example

Quadrants

To estimate percent cover of vegetation, four (4) quadrants along each of ten (10) transects will be established on the eight selected terraces to allow for estimates of habitat coverage and planting survival. Estimates of coverage and survival were compared to post-construction conditions to evaluate changes.

Further, the following guiding questions were established to monitor overall project performance, presence of invasive species, and identify any needs for maintenance:

1. Are there specific problem areas where plants are dying or appear unhealthy?
2. Were any signs of herbivory observed?
3. Are there any undesirable plant species present?
4. Condition of the terrace structures: Is there any observed settlement, dislodged stone, significant debris etc.?
5. If an updated survey was conducted, are there any significant changes in the profile of the marsh terraces?
6. Does the upland portion of each terrace show any significant signs of erosion or loss of vegetation?

MONITORING RESULTS

Table 2: Low Marsh Vegetation Percent Cover Monitoring Results (Example Table – Terrace 1).

		Estimated Percent Coverage						Percent Change in Coverage (from Baseline)				
Terrace/ Transect	Photo Station Reference	Baseline (2024)	Year 1 (2025)	Year 2 (2026)	Year 3 (2027)	Year 4 (2028)	Year 5 (2029)	Baseline to Year 1	Baseline to Year 2	Baseline to Year 3	Baseline to Year 4	Baseline to Year 5
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1 - 2	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 3	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 4	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 5	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 6	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 7	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 8	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 9	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 10	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
Overall		**Choose an item.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**

Table 3: High Marsh Vegetation Percent Cover Monitoring Results (Example Table – Terrace 1).

		Estimated Percent Coverage						Percent Change in Coverage (from Baseline)				
Terrace/ Transect	Photo Station Reference	Baseline (2024)	Year 1 (2025)	Year 2 (2026)	Year 3 (2027)	Year 4 (2028)	Year 5 (2029)	Baseline to Year 1	Baseline to Year 2	Baseline to Year 3	Baseline to Year 4	Baseline to Year 5
1 - 1	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 2	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 3	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 4	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 5	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 6	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 7	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 8	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 9	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 10	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
Overall		**Choose an item.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**

Table 4: General Observations for Wetland Planting Areas on the Marsh Terraces (Example Table – Terrace 1)

Monitoring Questions	Terrace/Transect									
	1 - 1	1 - 2	1 - 3	1 - 4	1 - 5	1 - 6	1 - 7	1 - 8	1 - 9	1 - 10
Are there specific problem areas where plants are dying or appear unhealthy?	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.
Were any herbivory issues observed?	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.
Are there any undesirable plant species present?	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.
If updated survey was conducted, are there any significant changes in the profile of the living shoreline system?	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.

Table 5: General Observations for the Unplanted Structural Components of the Marsh Terraces (Example Table – Terrace 1)

	Terrace/Transect									
Monitoring Questions	1 - 1	1 - 2	1 - 3	1 - 4	1 - 5	1 - 6	1 - 7	1 - 8	1 - 9	1 - 10
Are there any structural issues with the planted terrace structures (e.g. observed settlement, loss of topsoil, etc.)?	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.
Is there any observed growth in SAV on or adjacent to the marsh terraces?	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.

Are there any structural issues with the rock armoring on the terraces (e.g. observed settlement, dislodged stone, significant debris, etc.)?	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.

MAINTENANCE RECOMMENDATIONS

The following table outlines the recommendations for maintenance, including estimated quantities and specific guidance, based on the results of the [YEAR] monitoring results.

Table 6: Maintenance Recommendations Checklist

Design Feature/ Monitoring Objective	Maintenance Elements	Location & Estimated Quantity	Specific Guidance
Terrace Upland and Wetland Habitats and Wetland Soils – Monitoring Objectives 1a/1b	☐ Replace plants	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Add new plants	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Remove debris	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Remove invasive vegetation	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Add sand to eroding areas	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Replace waterfowl barrier	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.

Design Feature/ Monitoring Objective	Maintenance Elements	Location & Estimated Quantity	Specific Guidance
Terrace Structures & Stone Armoring, Monitoring Objective 2a/2b	☐ Re-place dislodged stones	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Add additional stone to address settlement	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Remove debris	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Repair sand cores or other structural elements	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
SAV Establishment, Monitoring Objective 3	☐ Replace plants	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Add new plants	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.

APPENDIX A: AS-BUILT PLANS

[Page left intentionally blank; as-built plans will be included in the Year 1 monitoring report]

APPENDIX B: MONITORING PHOTOGRAPHS

Table 7: Terrace 1 Transect 1 Photographs

Photograph from Photo Location 1A	Photograph from Photo Location 1B
Photograph from Photo Location 1C	Additional photos of any problem areas.

Table 8: Terrace 1 Transect 2 Photographs

Photograph from Photo Location 2A	Photograph from Photo Location 2B
Photograph from Photo Location 2C	Additional photos of any problem areas.

Table 9: Terrace 1 Transect 3 Photographs

Photograph from Photo Location 3A	Photograph from Photo Location 3B
Photograph from Photo Location 3C	Additional photos of any problem areas.

Table 10: Terrace 1 Transect 4 Photographs

Photograph from Photo Location 4A	Photograph from Photo Location 4B
Photograph from Photo Location 4C	Additional photos of any problem areas.

Table 11: Terrace 1 Transect 5 Photographs

Photograph from Photo Location 5A	Photograph from Photo Location 5B
Photograph from Photo Location 5C	Additional photos of any problem areas.

Table 12: Terrace 1 Transect 6 Photographs

Photograph from Photo Location 6A	Photograph from Photo Location 6B
Photograph from Photo Location 6C	Additional photos of any problem areas.

Table 13: Terrace 1 Transect 7 Photographs

Photograph from Photo Location 7A	Photograph from Photo Location 7B
Photograph from Photo Location 7C	Additional photos of any problem areas.

Table 14: Terrace 1 Transect 7 Photographs

Photograph from Photo Location 7A	Photograph from Photo Location 7B
Photograph from Photo Location 7C	Additional photos of any problem areas.

Table 15: Terrace 1 Transect 8 Photographs

Photograph from Photo Location 8A	Photograph from Photo Location 8B
Photograph from Photo Location 8C	Additional photos of any problem areas.

Table 16: Terrace 1 Transect 9 Photographs

Photograph from Photo Location 9A	Photograph from Photo Location 9B
Photograph from Photo Location 9C	Additional photos of any problem areas.

Table 17: Terrace 1 Transect 10 Photographs

Photograph from Photo Location 9A	Photograph from Photo Location 9B
Photograph from Photo Location 9C	Additional photos of any problem areas.

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ORD-3685

AN ORDINANCE TO AMEND SECTIONS 1.1, 1.2, 1.3, 1.8, 2.1, 2.2, 2.3, 2.4, 2.8, 2.11, 3.1, 4.1, 4.2, 4.3, 4.4, 4.6, 4.8, 4.9, 4.10, 5.1, 6.1, AND 6.3 OF APPENDIX K, FLOODPLAIN ORDINANCE OF THE CITY CODE PERTAINING TO HOUSEKEEPING THE DELETION OF PUBLIC WORKS REQUIREMENTS AND THE ADDITION OF A COASTAL A ZONE AND A COASTAL HIGH HAZARD ZONE

Sections Amended: 1.1, 1.2, 1.3, 1.8, 2.1, 2.2, 2.3, 2.4, 2.8, 2.11, 3.1, 4.1, 4.2, 4.3, 4.4, 4.6, 4.8, 4.9, 4.10, 5.1, 6.1, and 6.3 of Appendix K, Floodplain Ordinance

WHEREAS, the public necessity, convenience, general welfare and good zoning practice so require;

BE IT ORDAINED BY THE CITY COUNCIL OF THE CITY OF VIRGINIA BEACH, VIRGINIA:

That Sections 1.1, 1.2, 1.3, 1.8, 2.1, 2.2, 2.3, 2.4, 2.8, 2.11, 3.1, 4.1, 4.2, 4.3, 4.4, 4.6, 4.8, 4.9, 4.10, 5.1, 6.1, and 6.3 of Appendix K, Floodplain Ordinance is hereby amended and reordained to read as follows:

APPENDIX K FLOODPLAIN ORDINANCE

ARTICLE I. GENERAL PROVISIONS

Sec. 1.1. Statutory authorization and purpose.

A. This ordinance is adopted pursuant to the authority granted to localities by Code of Virginia § ~~10.1-600 et seq~~ 15.2-984.

B. The city council finds the purpose of these provisions is to prevent the loss of life and property, the creation of health and safety hazards, the disruption of commerce and governmental services, the extraordinary and unnecessary expenditure of public funds for flood protection and relief, and the impairment of the tax base by:

1. Regulating uses, activities, and development that, alone or in combination with other existing or future uses, activities, and development, will cause unacceptable increases in flood heights, velocities, and frequencies;

2. Restricting or prohibiting certain uses, activities, and development from locating within districts subject to flooding;
3. Requiring all uses, activities, and developments that do occur in flood-prone districts be protected or flood-proofed against flooding and flood damage;

4. Protecting individuals from buying land and structures that are unsuited for intended purposes because of flood hazards; and

5. Acknowledging that the tide data over the last one hundred (100) years shows that Virginia Beach is facing an increased danger of flooding caused by both sea level rise and subsidence and has adopted the Sea Level Wise Adaptation Report as part of the Comprehensive Plan.

Sec. 1.2. Applicability.

These provisions shall apply to all privately and publicly owned lands within the jurisdiction of the City of Virginia Beach and identified as areas ~~of special flood hazard~~ at risk of flooding by the City of Virginia Beach or shown ~~according to~~ on the Flood Insurance Rate Map (FIRM) or included on the flood insurance study (FIS) that ~~is~~ are provided to the City of Virginia Beach by the Federal Emergency Management Agency (FEMA) and dated January 16, 2015 ~~or identified as floodplains subject to special restrictions in section 4.10 of this ordinance~~.

Sec. 1.3. Definitions.

. . . .

City manager. The City Manager of the City of Virginia Beach, or his designees.

Design Flood Elevation (regulatory flood protection elevation). The base flood elevation plus the freeboard required by this ordinance.

. . . .

Recreational vehicle. A vehicle that is:

1. Built on a single chassis;
2. Four hundred (400) square feet or less when measured at the largest horizontal projection;
3. Designed to be self-propelled or permanently towable by a light duty truck; and
4. Designed primarily not for use as a permanent dwelling but as temporary living quarters for recreational camping, travel, or seasonal use.

~~*Regulatory flood protection elevation (design flood elevation)*. The base flood elevation plus the freeboard required by this ordinance.~~

. . . .

Sec. 1.8. Penalty for violations.

Any person who fails to comply with any of the requirements or provisions of this ordinance or directions of the ~~d~~Directors of ~~p~~Planning ~~or public works~~ or any authorized employee of the City of Virginia Beach shall be guilty of the appropriate violation and subject to the penalties therefore. Any violation of the provision of this ordinance shall be punishable by a fine of not more than one hundred dollars ($100.00). Each person shall be deemed guilty of a separate offense for each and every day or portion thereof during which any violation of any of the provisions of this ordinance is committed.

The Virginia Uniform Statewide Building Code (VA USBC) addresses building code violations and the associated penalties in ~~section 104 and section 115~~ VA USBC § 104 and § 115. Violations and associated penalties of the Zoning Ordinance for the City of Virginia Beach are addressed in § 104 of the Zoning Ordinance.

In addition to the above penalties, all other actions are hereby reserved, including an action in equity for the proper enforcement of this ordinance. The imposition of a fine or penalty for any violation of, or noncompliance with, this ordinance shall not excuse the violation or noncompliance or permit it to continue, and all such persons shall be required to correct or remedy such violations within a reasonable time. Any structure constructed, reconstructed, enlarged, altered, or relocated in noncompliance with this ordinance may be declared by the City of Virginia Beach to be a public nuisance and abatable as such. Flood insurance may be withheld from structures constructed in violation of this ordinance.

ARTICLE II. ADMINISTRATION

Sec. 2.1. Designation of the floodplain administrator.

The City Manager of the City of Virginia Beach is hereby appointed the floodplain administrator to administer and implement this ordinance. The floodplain administrator has delegated the duties and responsibilities set forth in this ordinance to the ~~departments of public works and planning, as specified below~~ Department of Planning and Community Development.

Sec. 2.2. Duties and responsibilities of the ~~department of public works~~ floodplain administrator or his designee.

The duties and responsibilities of the ~~department of public works~~ floodplain administrator of his designee shall include but are not limited to:

A. Interpreting floodplain boundaries and providing available base flood elevation and flood hazard information;

B. Verifying that applicants proposing an alteration of a watercourse have notified adjacent communities, the department of conservation and recreation (division of dam safety and floodplain management), and other appropriate agencies (Virginia Department of Environmental Quality (VADEQ), United States Army Corps of Engineers (USACE), etc.) and have submitted copies of such notifications to FEMA;

C. Advising applicants for new construction or substantial improvement of structures that are located within an area of the coastal barrier resources system established by the Coastal Barrier Resources Act that Federal flood insurance is not available on such structures; areas subject to this limitation are shown on FIRMs as coastal barrier resource system areas or otherwise protected areas;

D. Submitting to FEMA, or requiring applicants to submit to FEMA, data and information necessary to maintain FIRMs, including hydrologic and hydraulic engineering analyses prepared by or for the city, within six (6) months after such data and information becomes available if the analyses indicate changes in base flood elevations;

E. Maintaining and permanently keeping records that are necessary for the administration of these regulations, including:

1. ~~flood~~ Flood insurance studies, FIRMs (including historic studies and maps and current effective studies and maps) and letters of map change; and

2. Documentation supporting issuance and denial of permits, Elevation Certificates, documentation of the elevation (in relation to the datum on the FIRM) to which structures have been floodproofed, inspection records, other required design certifications, variances, and records of enforcement actions taken to correct violations of these regulations.

F. Notifying FEMA when the corporate boundaries of the City of Virginia Beach have been modified and:

1. Providing a map that clearly delineates the new corporate boundaries or the new area for which the authority to regulate pursuant to this ordinance has either been assumed or relinquished through annexation; and

2. If the FIRM for any annexed area includes SFHAs that have flood zones with regulatory requirements that are not set forth in this

ordinance, prepare amendments to this ordinance to adopt the FIRM and appropriate requirements, and submit the amendments to the city council for adoption; such adoption shall take place at the same time as or prior to the date of annexation and a copy of the amended ordinance shall be provided to the department of conservation and recreation (division of dam safety and floodplain management) and FEMA.

G. Upon the request of FEMA, completing and submitting a report concerning participation in the NFIP, which may request information regarding the number of buildings in the SFHA, the number of permits issued for development in the SFHA, and the number of variances issued for development in the SFHA.

H. Reviewing applications for permits to determine whether proposed activities will be located in the SFHA;

I. Reviewing applications to determine whether proposed activities will be reasonably safe from flooding and requiring new construction and substantial improvements to meet the requirements of this ordinance;

J. Reviewing applications to determine whether all necessary permits have been obtained from the federal, state, or local agencies from which prior or concurrent approval is required; in particular, permits from state agencies for any construction, reconstruction, repair, or alteration of a dam, reservoir, or waterway obstruction (including bridges, culverts, structures), any alteration of a watercourse, or any change of the course, current, or cross section of a stream or body of water, including any change to the SFHAs of free-flowing non-tidal waters of the state;

K. Approving applications and issuing permits to develop in flood hazard areas if the provisions of this ordinance have been met, or disapproving applications if the provisions of this ordinance have not been met;

L. Granting administrative variances pursuant to section 6.1 of this ordinance;

M. Inspecting, or causing to be inspected, buildings, structures, and other development for which permits have been issued to determine compliance with this ordinance or to determine if non-compliance has occurred or violations have been committed;

N. Reviewing elevation certificates and requiring incomplete or deficient certificates to be corrected;

O. Maintaining and permanently keeping documentation supporting the issuance and denial of permits, elevation certificates, documentation of the elevation (in relation to the datum on the FIRM) to which structures have been flood proofed, and other required design certifications, variances, and records of enforcement actions taken to correct violations of this ordinance;

P. Enforcing the provisions of this ordinance, investigating violations, issuing notices of violations or stop work orders, and requiring permit holders to take corrective action;

Q. Advising the city council regarding the intent of this ordinance and, for each application for a variance, preparing a staff report and recommendation; and

R. Administering the requirements related to proposed work on existing buildings:

1. Making determinations as to whether buildings and structures that are located in flood hazard areas and that are damaged by any cause have been substantially damaged; and

2. Making reasonable efforts to notify owners of substantially damaged structures of the need to obtain a permit to repair, rehabilitate, or reconstruct, and prohibit the non-compliant repair of substantially damaged buildings except for temporary emergency protective measures necessary to secure a property or stabilize a building or structure to prevent additional damage.

S. Undertaking, as determined appropriate by the floodplain administrator due to the circumstances, other actions that may include but are not limited to: issuing press releases, public service announcements, and other public information materials related to permit requests and repair of damaged structures; coordinating with other federal, state, and local agencies to assist with substantial damage determinations; providing owners of damaged structures information related to the proper repair of damaged structures in SFHAs; and assisting property owners with documentation necessary to file claims for increased cost of compliance coverage under National Flood Insurance Program (NFIP) flood insurance policies; and

T. It is the duty of the city floodplain administrator to take into account flood, mudslide, and flood-related erosion hazards, to the extent that they are known, in all official actions relating to land management and use throughout the entire jurisdictional area of the city, whether or not those

hazards have been specifically delineated geographically (e.g., via mapping or surveying).

~~Sec. 2.3. Duties and responsibilities of the department of planning.~~ Reserved.

~~The duties and responsibilities of the department of planning shall include but are not limited to:~~

~~A.~~ ~~Reviewing applications for permits to determine whether proposed activities will be located in the SFHA;~~

~~B.~~ ~~Reviewing applications to determine whether proposed activities will be reasonably safe from flooding and requiring new construction and substantial improvements to meet the requirements of this ordinance;~~

~~C.~~ ~~Reviewing applications to determine whether all necessary permits have been obtained from the federal, state, or local agencies from which prior or concurrent approval is required; in particular, permits from state agencies for any construction, reconstruction, repair, or alteration of a dam, reservoir, or waterway obstruction (including bridges, culverts, structures), any alteration of a watercourse, or any change of the course, current, or cross section of a stream or body of water, including any change to the SFHAs of free-flowing non-tidal waters of the state;~~

~~D.~~ ~~Approving applications and issuing permits to develop in flood hazard areas if the provisions of this ordinance have been met, or disapproving applications if the provisions of this ordinance have not been met;~~

~~E.~~ ~~Granting administrative variances pursuant to section 6.1 of this ordinance;~~

~~F.~~ ~~Inspecting, or causing to be inspected, buildings, structures, and other development for which permits have been issued to determine compliance with this ordinance or to determine if non-compliance has occurred or violations have been committed;~~

~~G.~~ ~~Reviewing elevation certificates and requiring incomplete or deficient certificates to be corrected;~~

~~H.~~ ~~Maintaining and permanently keeping documentation supporting the issuance and denial of permits, elevation certificates, documentation of the elevation (in relation to the datum on the FIRM) to which structures have been flood proofed, and other required design certifications, variances, and records of enforcement actions taken to correct violations of this ordinance;~~

~~I.~~ ~~Enforcing the provisions of this ordinance, investigating violations, issuing notices of violations or stop work orders, and requiring permit holders to take corrective action;~~

~~J.~~ ~~Advising the city council regarding the intent of this ordinance and, for each application for a variance, preparing a staff report and recommendation; and~~

~~K.~~ ~~Administering the requirements related to proposed work on existing buildings:~~

~~1.~~ ~~Making determinations as to whether buildings and structures that are located in flood hazard areas and that are damaged by any cause have been substantially damaged; and~~

~~2.~~ ~~Making reasonable efforts to notify owners of substantially damaged structures of the need to obtain a permit to repair, rehabilitate, or reconstruct, and prohibit the non-compliant repair of substantially damaged buildings except for temporary emergency protective measures necessary to secure a property or stabilize a building or structure to prevent additional damage.~~

~~Sec. 2.4. Shared duties and responsibilities.~~ Reserved.

~~The duties and responsibilities shared by the departments of public works and Planning shall include but are not limited to:~~

~~A.~~ ~~Undertaking, as determined appropriate by the floodplain administrator due to the circumstances, other actions that may include but are not limited to: issuing press releases, public service announcements, and other public information materials related to permit requests and repair of damaged structures; coordinating with other federal, state, and local agencies to assist with substantial damage determinations; providing owners of damaged structures information related to the proper repair of damaged structures in SFHAs; and assisting property owners with documentation necessary to file claims for increased cost of compliance coverage under National Flood Insurance Program (NFIP) flood insurance policies; and~~

~~B.~~ ~~It is the duty of the city floodplain administrator to take into account flood, mudslide, and flood-related erosion hazards, to the extent that they are known, in all official actions relating to land management and use throughout the entire jurisdictional area of the city, whether or not those hazards have been specifically delineated geographically (e.g., via mapping or surveying).~~

. . . .

Sec. 2.8. Interpretation of district boundaries.

Initial interpretations of the boundaries of the floodplain districts shall be made by the floodplain administrator. Should a dispute arise concerning the boundaries of any of the districts~~, the city council shall make the necessary determination. The person questioning or contesting the location of the district boundary shall be given a reasonable opportunity to present his case to the city council and to submit his own technical evidence if he so desires~~ a surveyor shall provide either an elevation certificate or recent survey showing topographic elevations and delineating the Special Flood Hazard Area.

. . . .

Sec. 2.11. Appeals to decisions made by the floodplain administrator.

It is further provided that any decision of the floodplain administrator or his designee may be modified, reversed, or affirmed by the city council upon appeal by any aggrieved party to such decision, if such appeal is filed with the floodplain administrator within thirty (30) days of such decision through the application for a Floodplain Variance outlined in Section VI of this ordinance.

ARTICLE III. ESTABLISHMENT OF FLOODPLAIN DISTRICTS

Sec. 3.1. Description of floodplain districts.

A. Special flood hazard areas (SFHA). The SFHAs shall include land in the floodplain subject to a one (1) percent or greater chance of being flooded in any given year. The basis for the delineation of these districts shall be the FIS and the FIRM for the City of Virginia Beach prepared by FEMA, Federal Insurance Administration, dated January 16, 2015, and any subsequent revisions or amendments thereto.

The boundaries of the SFHAs are established as shown on the FIRM, which is declared to be a part of this ordinance and shall be kept on file at the City of Virginia Beach Department of ~~Public Works~~ Planning and Community Development, and include the following districts:

1. The Floodway District is in an AE Zone and is delineated, for the purposes of this ordinance, using the criterion that certain areas within the floodplain must be capable of carrying the waters of the one (1) percent annual chance flood without increasing the water surface elevation of that flood more than one (1) foot at any point. The areas included in this district are specifically defined in Table 7 of the above-referenced FIS and shown on the accompanying FIRM.

2. The AE or AH Zones on the FIRM accompanying the FIS shall be those areas for which one (1) percent annual chance flood elevations have been provided and the floodway has not been delineated.

3. The A Zone on the FIRM accompanying the FIS shall be those areas for which no detailed flood profiles or elevations are provided, but the one (1) percent annual chance floodplain boundary has been approximated.

4. The AO Zone on the FIRM accompanying the FIS shall be those areas of shallow flooding identified as AO on the FIRM.

5. ~~Reserved.~~ The Coastal A Zone on the FIRM accompanying the FIS shall be those areas labeled as AE and are located seaward of the limit of moderate wave action (LiMWA) line.

6. The VE or V Zones on FIRMs accompanying the FIS shall be those areas that are known as coastal high hazard areas, extending from offshore to the inland limit of a primary frontal dune along an open coast and any other area subject to high velocity wave action from storm or seismic sources.

B. ~~Floodplain subject to special restrictions~~ *Local Flood Hazard Areas*. The City of Virginia Beach may identify and regulate local flood hazard or ponding areas that are not delineated on the FIRM. These areas are ~~identified in section 4.10 and may be delineated on a map using best available topographic data and locally derived information such as flood of record, historic high water marks, or approximate study methodologies~~ identified as follows:~~.~~

a. *Other areas of flood risk*. The X and the X(Shaded) Zone on the FIRM where the City of Virginia Beach Stormwater Master Plan has identified areas, outside SFHAs delineated on the FIRM, that area susceptible to flooding. The most recent updated version of the modeling shall be used to identify areas that are likely to experience flooding.

b. *Floodplain Subject to Special Restrictions*. The Floodplain Subject to Special Restrictions is identified in section 4.10 and includes areas in the southern part of the city which are characterized by wind tides, low topography, and poorly draining soils.

ARTICLE IV. FLOODPLAIN DISTRICT PROVISIONS

Sec. 4.1. Permit and application requirements.

. . . .

B. Site plans and permit applications. All applications for development within any floodplain district and all building permits issued within ~~the~~ any floodplain district shall incorporate the following information:

1. For any addition, conversion of any non-habitable space to habitable space, or the construction or installation of a new accessory structure that requires a building permit.

   a. A physical survey, performed after the effective date of the FIRM that:

      i. accurately depicts current improvements on the property;
      ii. provides a flood zone determination and BFE or flood depth at the stie; and
      iii. delineates the location of the flood zones on the property.

   b. For structures located in the SFHA delineated on the FIRM, a current elevation certificate sealed by a licensed design professional.

2. For new construction and any substantial improvement of the principal structure:

   a. a proposed site plan sealed by a registered design professional that provides:

      ~~1~~i. The elevation of the base flood at the site;

      ~~2~~ii. The elevation of the lowest floor (including basement) or, in V Zones, the lowest horizontal structural member;

      ~~3~~iii. For structures to be flood-proofed (non-residential only), the elevation to which the structure will be flood-proofed; and

      4iv. Topographic information showing existing and proposed ground elevations.

Sec. 4.2. General standards.

. . . .

5. Electrical, heating, ventilation, plumbing, air conditioning equipment, and other service facilities, including duct work, shall be designed and/or ~~located so as to prevent water from entering or accumulating within the components during conditions of flooding~~ or above the design flood elevation.

6. New and replacement water supply systems shall be designed to minimize or eliminate infiltration of flood waters into the system.

7. New and replacement sanitary sewage systems shall be designed to minimize or eliminate infiltration of flood waters into the systems and discharges from the systems into flood waters.

8. On-site waste disposal systems shall be located and constructed to avoid impairment to them or contamination from them during flooding.

9. No use shall be permitted if such use will increase the amounts of potentially damaging materials, including those likely to be injurious to health, that might be transported in floods.

10. For properties located in SFHAs delineated on the FIRM, an elevation certificate and, if applicable, a flood-proofing certificate shall be provided to the Floodplain Administrator prior to any foundation inspection, final inspections, and the issuance of any certificates of occupancy, in order to assure compliance with these floodplain regulations.

11. Prior to any proposed alteration or relocation of any channels or of any watercourse or stream within the city, a permit shall be obtained from the USACE, VADEQ, the Virginia Marine Resources Commission, and the Wetlands Board through the joint permit application process. Furthermore, notification of the proposal shall be given by the applicant to all affected adjacent jurisdictions, the department of conservation and recreation (division of dam safety and floodplain management), other required agencies, and FEMA.

12. The flood carrying capacity within an altered or relocated portion of any watercourse shall be maintained.

~~B. In all SFHAs, the following additional provisions shall apply:~~

~~1. Prior to any proposed alteration or relocation of any channels or of any watercourse or stream, within the city a permit shall be obtained from the USACE, VADEQ, the Virginia Marine Resources Commission, and the Wetlands Board through the joint permit application process. Furthermore, notification of the proposal shall be given by the applicant to all affected adjacent jurisdictions, the department of conservation and recreation (division of dam safety and floodplain management), other required agencies, and FEMA.~~

~~2. The flood carrying capacity within an altered or relocated portion of any watercourse shall be maintained.~~

~~3. Sand dunes, barrier beaches, and other natural protective barriers shall remain intact to provide protection against wind, waves, and erosion drainage. Any person who desires to use or alter any coastal primary sand dune, other than for the purpose of conducting the activities specified in section 1602 of the Zoning Ordinance of the City of Virginia Beach, shall first obtain a permit from the USACE, VADEQ, the Virginia Marine Resources Commission, and the Wetlands Board through the joint permit application process.~~

Sec. 4.3. Elevation and construction requirements.

In all ~~SFHAs where base flood elevations have been provided in the FIS or generated by a licensed professional in accordance with section 4.6 of this ordinance~~ floodplain districts, with the exception of Coastal A and Coastal High Hazard (VE) zones, the following provisions shall apply:

A. Residential construction requirements. ~~New construction or substantial improvement of any residential structure or manufactured home in Zones AE, AH, and A with detailed base flood elevations shall have the lowest floor, including basement, elevated to a minimum of two (2) feet above the base flood level.~~ The lowest flood, including basement, shall be set to the higher of the following:

i. A minimum of two (2) feet above the base flood elevation established on the most recent FIRM or by the most recent FIS or,

ii. A minimum of one (1) foot above the 100-year HGL elevation measured at the nearest existing or proposed public drainage structure or BMP, in the City Stormwater Master Plan.

B. Non-residential construction requirements. New construction or substantial improvement of any commercial, industrial, or non-residential building or manufactured home shall have the lowest floor, including basement, elevated as ~~minimum of two (2) feet above the base flood level~~ established in Section 4.3 A of this ordinance. Buildings ~~located in AE or AH Zones~~ may be flood-proofed in lieu of being elevated provided that all areas of the building components below the ~~elevation corresponding to the base flood elevation plus a minimum of two (2) feet freeboard~~ design flood elevation are watertight with walls substantially impermeable to the passage of water, and use structural components having the capability of resisting hydrostatic and hydrodynamic loads and the effect of buoyancy. A professional engineer or architect licensed by the Commonwealth of Virginia shall certify that the standards of this subsection are satisfied. Such certification, including the specific elevation (in relation to NAVD88) to which such structures are flood proofed, shall be maintained by the building official.

C. ~~Space below the lowest floor requirements. In Zones A, AE, AH, and AO, f~~Fully enclosed areas of new construction or substantially improved existing structures that are below the ~~regulatory~~ design flood protection elevation shall:

1. Not be designed or used for human habitation, but shall only be used for parking of vehicles, building access, or limited storage of maintenance equipment used in connection with the premises. Access to the enclosed area shall be the minimum necessary to allow for parking of vehicles (garage door), limited storage of maintenance equipment (standard exterior door), or entry to the living area (stairway or elevator).

2. Be constructed entirely of flood resistant materials below the ~~regulatory~~ design flood ~~protection~~ elevation.

3. Space below the lowest floor of SFHAs delineated on the FIRM shall ~~I~~include measures to automatically equalize hydrostatic flood forces on walls by allowing for the entry and exit of floodwaters. To meet this requirement, the openings shall either be certified by a professional engineer or architect licensed by the Commonwealth of Virginia or meet or exceed the following minimum design criteria:

. . . .

Sec. 4.4. Floodway requirements.

. . . .

B. The placement of new or replacement manufactured homes (mobile homes) is prohibited.

~~C.~~ ~~The following uses and structures may be permitted in the floodway district, subject to the requirements of articles III, IV, V, and VI of this ordinance:~~

~~1.~~ ~~Public and private outdoor recreational facilities;~~

~~2.~~ ~~Agricultural uses, including farming, grazing, and the raising of poultry or livestock; provided, that poultry or livestock shall not be housed within five hundred (500) feet of any residential, apartment, or hotel district;~~

~~3.~~ ~~Open uses, such as public and private roadways, off street parking, or loading and unloading areas related to uses in adjoining districts;~~

~~4.~~ ~~Commercial mining, soil removal, and sand pits subject to regulations applicable to extractive industries as set forth in the conditional use provisions of the Zoning Ordinance of the City of Virginia Beach;~~

~~5.~~ ~~Public improvements, such as dams, levees and channel improvements, and utilities installations and substations, including temporary storage of materials, except flammable, toxic or noxious materials, and temporary location of maintenance installations; and~~

~~6.~~ ~~Uses and structures customarily accessory and clearly incidental and subordinate to uses listed above, including in connection with agricultural uses; roadside stands for the sale of agricultural products produced on the premises; provided that:~~

~~a.~~ ~~Only one (1) such stand shall be permitted per lot;~~

~~b.~~ ~~No such stand shall exceed five hundred (500) square feet in floor area; and~~

~~c.~~ ~~No such stand on the street frontage shall be erected within twenty (20) feet of the property line.~~

. . . .

Sec. 4.6. A Zone requirements.

. . . .

B. The floodplain administrator reserves the right to require a hydrologic and hydraulic analysis for any development and to determine the base flood elevation. When such base flood elevation data is utilized, the lowest floor shall be elevated to minimum of two (2) feet above the base flood level. During the permitting process, the floodplain administrator shall obtain:

1. The elevation of the lowest floor (including the basement) of all new and substantially improved structures; and

2. If the structure has been flood-proofed in accordance with the requirements of this ordinance, the elevation (in relation to NAVD88) to which the structure has been flood-proofed.

~~C.~~ ~~When the data is not available from any source, the lowest floor of the structure shall be elevated to not less than two (2) feet above the highest adjacent grade.~~

Sec. 4.8. ~~Reserved~~ X and X(Shaded) Zone requirements. (Other Areas of Flood Risk).

A. *Residential construction requirements*. The lowest floor, including basements, shall be set to a minimum of one (1) foot above the 100-year HGL elevation measured at the nearest existing or proposed public drainage structure or BMP, in the City Stormwater Master Plan.

B. *Non-residential construction requirements*. New construction or substantial improvement of any commercial, industrial, or non-residential building or manufactured home shall have the lowest floor, including basement, elevated as established in Section 4.8 A of this ordinance above. Buildings may be flood-proofed in lieu of being elevated provided that all areas of the building components below the design flood elevation are watertight with walls substantially impermeable to the passage of water, and use structural components having the capability of resisting hydrostatic and hydrodynamic loads and the effect of buoyancy. A professional engineer or architect licensed by the Commonwealth of Virginia shall certify that the standards of this subsection area satisfied. Such certification, including the specific elevation (in relation to NAVD88) to which such structures are flood proofed, shall be maintained by the building official.

Sec. 4.9. – Coastal High Hazard (~~V and~~ VE Zone) requirements.

The following provisions shall apply within ~~V and VE Zones~~ Coastal A Zones and Coastal High Hazard Areas:

A. All new construction and substantial improvements, including to manufactured homes, shall be elevated on pilings or columns so that:

1. The bottom of the lowest horizontal structural member of the lowest floor (excluding the pilings or columns) is elevated to a minimum of ~~two~~ three (~~2~~3) feet above the base flood ~~level~~ elevation; and

2. The pile or column foundation and structure attached thereto is anchored to resist flotation, collapse, and lateral movement due to the effects of wind and water loads acting simultaneously on all building components. Wind and water loading values shall each have a one (1) percent chance of being equaled or exceeded in any given year.

B. A professional engineer or architect licensed by the Commonwealth of Virginia shall develop or review the structural design, specifications, and plans for the construction and shall certify that the design and methods of construction to be used are in accordance with accepted standards of practice for meeting the provisions of article IV, section 4.6 A. A V Zone

Design Certificate shall be submitted to Permits and Inspections with plans for a building permit.

. . . .

I. ~~The man-made alteration of sand dunes, which would increase potential flood damage, is prohibited.~~ Sand dunes, barrier beaches, and other natural protective barriers shall remain intact to provide protection against wind, waves, and erosion drainage. Any person who desires to use or alter any coastal primary sand dune or beaches, other than for the purpose of conducting the activities specified in Article 1600, Section 1602 of the Zoning Ordinance of the City of Virginia Beach, shall first obtain a permit, or authorization, from the USACE, VADEQ, the Virginia Marine Resources Commission, and the Wetlands Board through the joint permit application process.

J. Manufactured homes are prohibited.

Sec. 4.10. Floodplain subject to special restrictions.

A. All ~~FIRM delineated~~ SFHAs that ultimately drain to Back Bay or the Currituck Sound ~~located in the following areas~~ shall be identified as a floodplain subject to special restrictions~~:~~.

~~1. North Landing River and its tributaries south of Lynnhaven Parkway;~~

~~2. West Neck Creek and its tributaries south of Shipps Corner Road, London Bridge Road, and the portion of Dam Neck Road east of its intersection with London Bridge Road; and~~

~~3. Bays, creeks, lakes, guts, coves, wetlands, marshes and swamps and their tributaries comprising the Back Bay and Small Coastal South watersheds south of South Birdneck Road and east of Princess Anne Road and General Booth Boulevard.~~

B. The following provisions shall apply within the floodplain subject to special restrictions:

1. Notwithstanding any provision of this ordinance to the contrary, no filling shall be permitted, including filling with material excavated from the same floodplain except for:

a. The purpose of public roadway or other similar public works construction undertaken by the Department of Public Works or Virginia Department of Transportation, or their agent for

construction. This construction includes flood protection and flood mitigation projects;

b. The maintenance, alteration, or relocation of bona fide agricultural ditches, swales, or agricultural pathways or those ditches required for proper lot drainage;

c. For shoreline stabilization or maintenance projects, such as riprap revetment, bulkheads, or other treatment used to stabilize and protect the banks of waterways, the city manager or his designee may approve the placement of fill provided the following criteria are met:

i. A joint permit application is submitted;

ii. The alignment of the stabilization structure is along the escarpment or in line with adjacent stabilization structures; ~~and~~

iii. If there is an existing shoreline stabilization structure, any proposed replacement structure shall be no more than six (6) inches higher than the existing structure; and

~~iii~~iv. Fill must be the minimum necessary to support the stabilization project.

2. The city manager, or his designee, may approve the placement of fill provided that the following criteria are met:

a. Proposed fill within the floodplain:

i. Shall be mitigated to result in no decrease in flood storage volume on the site;

ii. Shall be mitigated entirely on the same site that will incur the fill;

iii. Shall be contiguous to the existing floodplain that is being filled; and

iv. Shall be limited to the smallest amount of area and volume possible to correct irregularities within the boundary of the project.

b. The combined areas of fill and mitigation shall not exceed five (5) percent of the total area within the floodplain located on the site that will incur the fill.

3. Residential dwelling structures shall not be located within the floodplains subject to special restrictions on lots created after October 23, 2001. Residential dwelling structures located in ~~local flood hazard areas as of~~ a SFHA and constructed prior to October 23, 2001 may be expanded with attached additions to a total footprint of less than one thousand (1,000) square feet; such additions shall also comply with the requirements set forth in article V of this ordinance.

. . . .

ARTICLE V. EXISTING STRUCTURES IN FLOODPLAIN AREAS

Sec. 5.1. Existing structures.

A structure or use of a structure or premises that lawfully existed prior to the adoption of this ordinance, but which is not in conformity with this ordinance, may be continued subject to the following conditions:

A. Any existing structures in the floodway area shall not be expanded or enlarged unless it has been demonstrated through hydrologic and hydraulic analyses performed in accordance with standard engineering practices that the proposed expansion or enlargement would not result in any increase in the base flood elevation.

B. Any modification, alteration, repair, reconstruction, or improvement of any kind to a structure and/or use located in any floodplain ~~areas~~ district to an extent or amount of less than fifty (50) percent of its market value shall conform to the VA USBC and meet the freeboard height in effect at the start of construction for the original structure.

C. Any modification, alteration, repair, reconstruction, or improvement of any kind to a structure and/or use, in any floodplain ~~area~~ district to an extent or amount of fifty (50) percent or more of its market value shall be undertaken only in full compliance with this ordinance and shall require the entire structure to conform to the VA USBC.

ARTICLE VI. VARIANCES AND APPEALS

Sec. 6.1. Administrative variances.

The floodplain administrator shall approve or deny an application requesting an administrative variance after receipt of a complete application. Administrative variances may only be granted for the following uses, development, or redevelopment:

A. As defined in section 4.10, floodplains subject to special restrictions, for filling only.

B. Any structure or use sustaining damage not caused by flood to an extent or amount of fifty (50) percent or more of its market value to allow the structure to be rebuilt to the freeboard height in effect at the start of construction for the original structure. If the structure is a pre-FIRM structure, full compliance with the current VAUSBC freeboard above the base flood elevation is required. Structures that are utilizing an approved land management plan for their on-site waste disposal may be allowed to continue the use of the land management plan as long as it is approved by the city and the health department, even for damage or destruction resulting from flood.

C. As defined in section 4.8 B, X and X(Shaded) Zone requirements. (Other Areas of Flood Risk), and 4.3 A(ii) when the required finished floor is higher than the BFE plus two feet of freeboard, where the floodplain administrator, in consultation with the Development Services Center, has determined that the proposed stormwater engineering design will approximately mitigate any impacts to the finished floor of the nonresidential development.

Sec. 6.3. Application process.

A. Applications for variances from the requirements of this ordinance shall be made to the city council and filed with the director of planning. The fee for such applications shall be ~~six hundred fifty dollars~~ seven hundred eighty ($~~650~~780.00). Such fee shall include all costs of notifications and advertising. Except in cases in which such fee is waived, the director shall not accept any application not accompanied by payment of the required fee. The procedure for the advertising, hearing and determination of applications for floodplain variances shall be in accordance with the requirements pertaining to applications for subdivision variances, as set forth in section 9.4 of the subdivision ordinance. In cases in which a variance application is filed by reason of a natural disaster that is the subject of a federal declaration of emergency, application and associated advertising fees shall be waived and such application shall be given expedited processing to the maximum practical extent.

B. All applications shall be accompanied by the following:

1. A separate map, on a 1″ = 100′ or greater scale, identifying all proposed land disturbance, including fill and mitigation areas, and the limits of the existing and proposed SFHAs, tidal and non-tidal wetlands, Southern Rivers Watershed Management Area Buffer, and CBPA Resource Protection Area Buffer; and

2. A preliminary floodplain study addressing the physical and environmental characteristics of the floodplain located on adjoining properties and in the general area. Such study shall be sufficient to show that the variance, if granted, will meet the standards defined in section 6.~~3~~4 and in addition thereto, shall:

    a. Contain supporting data and calculations required for a Preliminary Stormwater Engineering Analysis as appropriate~~, given the preliminary nature of the floodplain study~~;

    b. Comply with the Public Works Design Standards Manual; and

    c. Be certified by a professional engineer, architect, surveyor, landscape architect or practitioner of a related field having a valid license issued by the Commonwealth of Virginia or who is exempt from licensure pursuant to applicable provisions of the Virginia Code.

Adopted by the Council of the City of Virginia Beach, Virginia, on the 1st day of February, 2022.

June 2022 Final

Hampton Roads Hazard Mitigation Plan

City of Hampton
City of Newport News
City of Poquoson
City of Williamsburg
James City County
York County
City of Norfolk
City of Portsmouth
City of Suffolk
City of Virginia Beach
City of Chesapeake
Isle of Wight County
Town of Smithfield
Town of Windsor
City of Franklin
Southampton County
Surry County
Town of Claremont
Town of Dendron

AECOM

REPORT DOCUMENTATION

	TITLE	REPORT DATE
	Hampton Roads Hazard Mitigation Plan	June 2022 Final

ABSTRACT

The *Hampton Roads Hazard Mitigation Plan* has been updated for 2022. The region is vulnerable to a wide range of hazards that threaten the safety of residents and have the potential to damage or destroy both public and private property and disrupt the local economy and overall quality of life. While the threat from hazards may never be fully eliminated, the *Hampton Roads Hazard Mitigation Plan* recommends specific actions designed to protect residents, business owners and the built environment.

GRANT/SPONSORING AGENCY	ACKNOWLEDGEMENTS
This report was funded by the Federal Emergency Management Agency through the Virginia Department of Emergency Management, via grant Agreement number PDMC-PL-03-VA-2019-003 for $150,000.	The HMPC would like to acknowledge the contributions of AECOM and Salter's Creek Consulting, Inc., Hampton, Virginia, throughout the planning process, as well as the contributions of the members of Steering Committee and the extended planning committee that made the planning process work.

INTRODUCTION

Contents

2022 UPDATE

As part of the 2022 update process, participating communities and stakeholders were engaged in a facilitated process to review all plan components in light of new circumstances. Accordingly, each section of this plan has been updated. At the beginning of each section, there is a synopsis of the changes made to that section as part of the update. The biggest changes for 2022 are in Section 5 and include new information regarding social vulnerability and climate change impacts for each of the hazards assessed in detail in this plan. Pandemic Flu or Communicable Disease and Radon Exposure were added as hazards of interest in the region.

Section 1 was updated to modify the scope to include Surry County, the Town of Dendron and the Town of Claremont, which participated in this Hampton Roads planning process for the first time.

BACKGROUND

The Hampton Roads region of southeastern Virginia is vulnerable to a wide range of natural hazards that threaten the safety of residents and have the potential to damage or destroy both public and private property and disrupt the local economy and overall quality of life.

While the threat from hazards may never be fully eliminated, much can be done to lessen their potential impact. The concept and practice of reducing risks associated with known hazards is referred to as *hazard mitigation*. As discussed in the National Mitigation Framework, mitigation includes the capabilities necessary to reduce loss of life and property by lessening the impact of disasters.

FEMA Definition of Hazard Mitigation

"Any sustained action taken to reduce or eliminate the long-term risk to human life and property from hazards."

Hazard mitigation techniques include both structural measures, such as strengthening or protecting buildings and infrastructure, and non-structural measures, such as the adoption of sound land use or floodplain management policies and the creation of public awareness programs. Effective mitigation measures are often implemented at the county or municipal level, where decisions that regulate and control development are made. A comprehensive mitigation approach addresses hazard vulnerabilities that exist today and in the foreseeable future. Therefore, projected patterns of future development must be evaluated and considered in terms of how that growth will increase or decrease a community's hazard vulnerability over time.

As a community formulates a comprehensive approach to reduce the impacts of hazards, a key means to accomplish this task is through the development, adoption, and regular update of a local hazard mitigation plan. A hazard mitigation plan establishes the community vision, guiding principles, and the specific actions designed to reduce current and future hazard vulnerabilities.

The Hampton Roads Hazard Mitigation Plan (hereinafter referred to as “Hazard Mitigation Plan”, “Plan”, or “HMP”) is a logical part of incorporating hazard mitigation principles and practices into routine government activities and functions. The Plan recommends specific actions designed to protect residents, business owners, and the developed environment from those hazards that pose the greatest risk. Mitigation actions should go beyond recommending structural solutions to reduce existing vulnerability, such as elevation of structures, retrofitting, and acquisition projects. Local policies that guide community growth and development, incentives tied to natural resource protection, and public awareness and outreach activities should be considered to reduce the region’s future vulnerability to identified hazards.

In keeping with federal requirements and to present a review of Hampton Road’s risk and vulnerability, state and regional capabilities, and current local capabilities, the Hampton Roads Planning District Commission (HRPDC) prepared this updated Hazard Mitigation Plan over the course of 2021. The planning committee worked throughout the planning period to update mitigation goals, objectives, and recommended actions, as outlined in detail in Section 2. As part of the ongoing mitigation planning process, this Plan is the result of the 2021/2022 mitigation evaluation.

DISASTER MITIGATION ACT OF 2000

In an effort to reduce the Nation's mounting natural disaster losses, Congress passed the Disaster Mitigation Act of 2000 (DMA 2000). Section 322 of DMA 2000 requires that state and local governments develop a hazard mitigation plan in order to remain eligible for pre- and post-disaster mitigation funding. These funds include the Hazard Mitigation Grant Program (HMGP), Hazard Mitigation Assistance (HMA) and the Pre-Disaster Mitigation (PDM) program, which are administered by the Federal Emergency Management Agency (FEMA). Communities with an adopted and federally-approved hazard mitigation plan are eligible for available mitigation funds before and after the next disaster strikes.

This Plan was prepared and updated in coordination with FEMA and the Virginia Department of Emergency Management (VDEM) to make certain it meets all applicable state and federal mitigation planning requirements. In addition, guidance from the March 2013 FEMA manual, *Local Mitigation Planning Handbook* was used by the committee and professional consultants to guide the plan update process. The *Local Mitigation Plan Review Tool*, found in Appendix A, provides a summary of FEMA’s current minimum standards of acceptability, and notes the location within the Plan where each planning requirement is met.

NATIONAL MITIGATION FRAMEWORK

The National Mitigation Framework establishes a common platform and forum for coordinating and addressing how the Nation manages risk through mitigation capabilities. Mitigation reduces the impact of disasters by supporting protection and prevention activities, easing response, and speeding recovery to create better prepared and more resilient communities. This Framework describes mitigation roles across a whole community. The Framework addresses how the Nation will develop, employ, and coordinate core mitigation capabilities to reduce loss of life and property by lessening the impact of disasters. Building on a wealth of objective and evidence-based knowledge and community experience, the Framework seeks to increase risk awareness and leverage mitigation products, services, and assets across a whole community or, in this case, across a region.

National Mitigation Framework, Second Edition, June 2016, was published by the Department of Homeland Security to further discuss seven core capabilities required for entities involved in mitigation:

threats and hazards identification, risk and disaster resilience assessment, planning, community resilience, public information and warning, long-term vulnerability reduction, and operational coordination. The document focuses on the need for the whole community (or region) to be engaged in examining and implementing the doctrine contained in the Framework and to create a culture that embeds risk management and mitigation in all planning, decision making and development.

The operational work plan for this Hazard Mitigation Plan Update considered the objectives of the National Mitigation Framework in many aspects of its implementation: building the committee and choosing committee leaders; providing risk and vulnerability data early in the planning process; requesting capability update information from communities to foster understanding of capability gaps early in the planning process; and creating regional mitigation actions that help create a culture of mitigation at the local and regional levels that brings together a larger group of stakeholders.

PURPOSE

The general purposes of this Hazard Mitigation Plan are to:

- protect life and property by reducing the potential for future damages and economic losses that result from natural hazards;
- qualify for additional grant funding, in both the pre-disaster and post-disaster environment;
- speed recovery and redevelopment following future disasters;
- integrate existing mitigation documents;
- demonstrate a firm local commitment to hazard mitigation principles; and
- comply with state and federal legislative requirements tied to local hazard mitigation planning.

SCOPE

This Hazard Mitigation Plan shall be updated and maintained to continually address those natural hazards determined to be of high and moderate risk as defined by the results of the risk assessment (see “Conclusions on Hazard Risk” in Section 5: *Vulnerability Assessment*). This enables Hampton Road’s planning committees to prioritize mitigation actions based on those hazards which present the greatest risk to lives and property.

The planning area includes the following communities in Hampton Roads, which were further broken down into 3 categories based on geography:

The Peninsula:

City of Hampton
City of Newport News
City of Poquoson
City of Williamsburg
James City County
York County

The Southside:
- City of Norfolk
- City of Portsmouth
- City of Suffolk
- City of Virginia Beach
- City of Chesapeake

Western Tidewater:
- Isle of Wight County
- Town of Smithfield
- Town of Windsor
- City of Franklin
- Southampton County
- Surry County
- Town of Claremont
- Town of Dendron

AUTHORITY

This updated Hazard Mitigation Plan was adopted by each of the participating communities in 2022. A copy of each resolution adopting the Plan is included in Appendix B.

This Plan was developed and updated in accordance with current state and federal rules and regulations governing local hazard mitigation plans. The Plan shall be monitored and updated on a routine basis to maintain compliance with the following legislation:

- Section 322, Mitigation Planning, of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, as enacted by Section 104 of the Disaster Mitigation Act of 2000 (P.L. 106-390); and
- Title 44 Code of Federal Regulations, Part 201, used as the basis for the October 1, 2011, update to FEMA's *Local Mitigation Plan Review Guide*.

APPENDICES

Several appendices are used to provide additional background information and references for information included in this plan. The appendices are referenced within the text, but are included her as an additional tool for navigating the document:

Appendix A - Local Hazard Mitigation Plan Review Crosswalk
Appendix B – Resolutions of Adoption
Appendix C - Hazard Mitigation Planning Committee and Public Meeting Advertisements and Minutes
Appendix D – Public Participation Survey Responses
Appendix E – Review Comments
Appendix F – Mitigation Action Status
Appendix G - Acronyms
Appendix H – Dam Safety Data Sheets for High Hazard Potential Dams
Appendix I – Hazardous Materials Incidents
Appendix J – Archived Mitigation Actions

PLANNING PROCESS

Contents

2022 UPDATE

Summaries of each meeting and the procedures followed during the update process were updated for each subsection. Summaries of previous planning processes were removed for brevity and because they are available in previous plans.

OVERVIEW OF MITIGATION PLANNING

Local hazard mitigation planning involves the process of organizing community resources, identifying and assessing hazard risks, and determining how to minimize or manage those risks. This process results in a hazard mitigation plan that identifies specific actions designed to meet the goals established by those that participate in the planning process. To ensure the functionality of each mitigation action, responsibility is assigned to a specific individual, department or agency along with a schedule for its implementation. Plan maintenance procedures are established to help ensure that the plan is implemented, as well as evaluated and enhanced as necessary. Developing clear plan maintenance procedures helps ensure that the Hazard Mitigation Plan remains a current, dynamic, and effective planning document over time.

Participating in a hazard mitigation planning process can help local officials and citizens achieve the following results:

- save lives and property;
- save money;
- speed recovery following disasters;
- reduce future vulnerability and increase future resiliency through wise development and post-disaster recovery and reconstruction;
- enhance coordination within and across neighboring jurisdictions;
- expedite the receipt of pre-disaster and post-disaster grant funding; and
- demonstrate a firm commitment to improving community health and safety.

Mitigation planning is an important tool to produce long-term recurring benefits by breaking the repetitive cycle of disaster loss. A core assumption of hazard mitigation is that pre-disaster investments will significantly reduce the demand for post-disaster assistance by lessening the need for emergency response, repair, recovery, and reconstruction. Furthermore, mitigation practices will enable local residents, businesses, and industries to re-establish themselves in the wake of a disaster, getting the community economy back on track sooner and with less interruption.

The benefits of mitigation planning go beyond reducing hazard vulnerability. Measures such as the acquisition or regulation of land in known hazard areas can help achieve multiple community goals, such as preserving open space, improving water quality, maintaining environmental health, and enhancing recreational opportunities. It is the intent of this document to help identify overlapping community objectives and facilitate the sharing of resources to achieve multiple aims, and to include information wherever possible to demonstrate when the plan is or has been implemented through other planning mechanisms.

PREPARING THE PLAN

44 CFR Requirement

44 CFR Part 201.6(c)(1): The plan shall include documentation of the planning process used to develop the plan, including how it was prepared, who was involved in the process and how the public was involved.

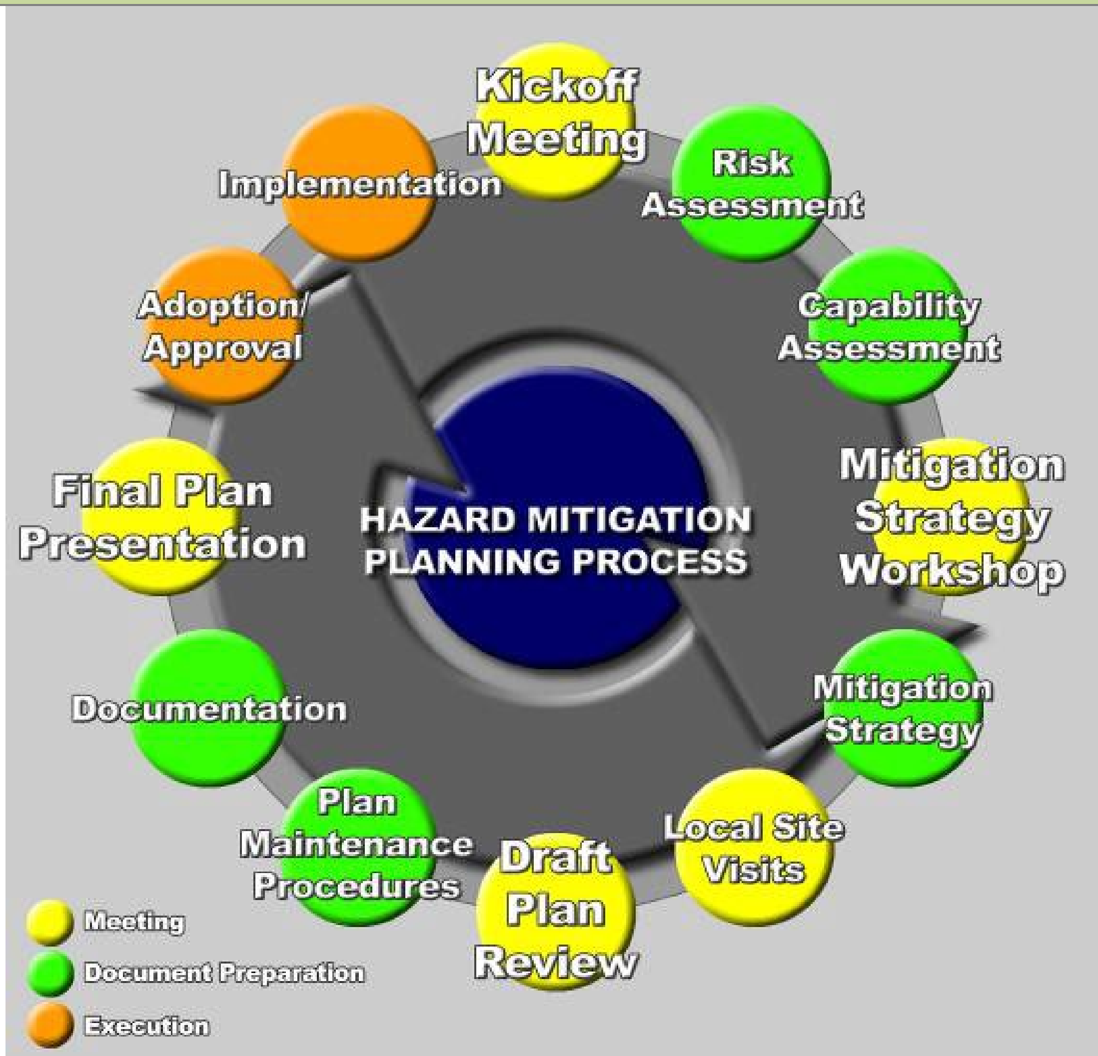
The HRPDC used FEMA guidance (FEMA Publication Series 386) to develop and update this Hazard Mitigation Plan. A Local Mitigation Plan Review Tool, found in Appendix A, provides a detailed summary of FEMA's current minimum standards of acceptability for compliance with DMA 2000 and notes the location where each requirement is met within the Plan. These standards are based upon FEMA's Interim Final Rule as published in the Federal Register on February 26, 2002, and October 31, 2007, in Part 201 of the Code of Federal Regulations (CFR).

The planning process included eight major steps that were completed during 2021 through 2022; they are shown in green and yellow in **Figure 2.1**. Each of the planning steps illustrated in Figure 2.1 resulted in work products and outcomes that collectively make up the Hazard Mitigation Plan.

Table 2.1 provides a summary of the National Flood Insurance Program's Community Rating System (CRS) User's Manual 10-step guidance for plan preparation and how that guidance fits within the 10-step, 4-phase process advocated by FEMA. This plan strives to accomplish the steps in each of these processes.

TABLE 2.1: FEMA GUIDANCE AND CRS HAZARD MITIGATION PLANNING GUIDANCE	
FEMA Guidance	**CRS Guidance**
Phase I: Organize Resources Step 1. Get Organized Step 2. Plan for Public Involvement Step 3. Coordinate with Other Departments & Agencies	 Step 1. Organize Step 2. Involve the Public Step 3. Coordinate
Phase II: Assess Risk Step 4. Identify the Hazards Step 5. Assess the Risks	 Step 4. Assess the hazard Step 5. Assess the Problem
Phase III: Develop Mitigation Plan Step 6: Review Mitigation Alternatives Step 7: Draft an Action Plan Step 8: Set Planning Goals	 Step 6. Set Goals Step 7. Review Possible Activities Step 8. Draft an Action Plan
Phase IV: Adopt & Implement Step 9: Adopt the Plan Step 10: Implement the Plan	 Step 9. Adopt the Plan Step 10. Implement, Evaluate, Revise

FIGURE 2.1: HAMPTON ROADS HAZARD MITIGATION PLANNING PROCESS



THE PLANNING COMMITTEE

A community-based planning team made up of local government officials and key stakeholders has continually helped guide the development of this Plan. The committee organized local meetings and planning workshops to discuss and complete tasks associated with preparing the Plan, including reviewing plan drafts and providing timely comments. Additional participation and input from residents and other identified stakeholders were sought through public meetings that described the planning process, the findings of the risk assessment, and the proposed mitigation actions. The committee convened in 2021.

HAMPTON ROADS MITIGATION PLANNING COMMITTEE

Due to the large geographic area covered and the number of communities participating, the project leaders felt that a Steering Committee was necessary to help more efficiently guide the planning process and facilitate the numerous Working Group members. Thus, the representatives for the communities and stakeholders were divided into a primary Steering Committee and a Working Group. The division was based on discussions with potential committee members from each community and stakeholders and a determination as to which members were most willing to commit themselves to the entire process, to do the majority of the work, to debate goals and objectives and discuss alternatives, and to report back to their constituencies and Working Group members. The participants listed in **Table 2.2a** are the Steering Committee and **Table 2.2b** shows the Working Group members for the 2022 Hampton Roads Hazard Mitigation Plan Update. Names marked with an asterisk indicate the lead person responsible for that community in the planning, update and maintenance process. Specifically, the tasks assigned to the Steering Committee members included:

- participate in mitigation planning meetings and workshops;
- provide best available data as required for the risk assessment portion of the Plan;
- provide copies of any mitigation or hazard-related documents for review and incorporation into the Plan;
- support the development of the Mitigation Strategy, including the design and adoption of community goals and objectives;
- help design and propose appropriate mitigation actions for incorporation into the Mitigation Action Plan;
- review and provide timely comments on all study findings and draft components of the plan; and
- support the adoption of the Hazard Mitigation Plan by community leaders.

The Working Group includes the Steering Committee members. Working Group members were provided the opportunity and invitation to participate in workshops and public meetings, asked for best available data, asked to review and comment on plan elements, and relied upon to ensure successful adoption of the plan in their community. In many cases, the Working Groups for individual communities also met with additional local staff outside of the more official planning process in additional meetings facilitated by Steering Committee members. Additional participation and input from other identified community staff and stakeholders was sought by the Steering Committee during the planning process primarily through e-mails and phone calls. Stakeholder involvement is discussed in more detail later in this section.

TABLE 2.2a: HAZARD MITIGATION PLANNING STEERING COMMITTEE MEMBERS

NAME AND POSITION	COMMUNITY AND AGENCY	EXPERTISE
Tracy Hanger, Emergency Planner	City of Hampton, Emergency Management	Fire Department/Emergency Management
*Hui-Shan Walker, Deputy Coordinator	City of Hampton, Emergency Management	Emergency Management, Public Information
*George Glazner, Deputy Coordinator	City of Newport News, Emergency Management	Emergency Management/Public Information
Heather Brown, Emergency Operations Planner	City of Newport News, Emergency Management	Emergency Management/Public Information
*Michael Bryant, Emergency Management Coordinator	City of Poquoson, Emergency Management	Emergency Management, Public Information
Ken Somerset, Building Official	City of Poquoson, Community Development	Preventive Measures, Property Protection
Michael Teener, Emergency Management Planner	James City County, Emergency Management	Emergency Management, Public Information
*Sara Ruch, Deputy Coordinator	James City County, Emergency Management	Emergency Management/Public Information

TABLE 2.2a: HAZARD MITIGATION PLANNING STEERING COMMITTEE MEMBERS

NAME AND POSITION	COMMUNITY AND AGENCY	EXPERTISE
*Sean Segerblom, District Captain	York County, Fire and Life Safety	Fire Department/Emergency Management, Public Information
Kent Henkel, Environmental Specialist	York County, Public Works	Property Protection, Natural Resource Protection
*Matthew Simons, Coastal Resiliency Manager	City of Norfolk, Office of Resilience	Planning/Preventive Measures, Property Protection, Resiliency
Tristian Barnes, Floodplain Administrator and Principal Planner	City of Norfolk, Planning	Planning/Preventive Measures, Property Protection, Resiliency
*Joseph Rubino, Response & Recovery Specialist	City of Portsmouth, Fire Rescue & Emergency Services	Fire Department/Emergency Management, Public Information
John Millspaugh, Senior Engineer	City of Portsmouth/Arcadis (consultant)	Preventive Measures, Property Protection
Whitney McNamara, Environmental Planner	City of Virginia Beach, Wetlands & Shoreline Construction Team, Planning Administration	Planning/Preventive Measures, Property Protection, Resiliency
*Danielle Spach, Emergency Management Planner	City of Virginia Beach, Emergency Management	Emergency Management, Public Information
Lucy Stoll, Principal Planner	City of Chesapeake, Planning Department	Planning/Preventive Measures, Property Protection, Resiliency
*Robert Gelormine, Senior Planner	City of Chesapeake, Office of Emergency Management	Emergency Management, Public Information
*Will Drewery, Emergency Management Coordinator	Isle of Wight County, Emergency Services	Emergency Management, Public Information
*Vernie Francis, Deputy Chief	City of Franklin, Emergency Services	Emergency Management, Public Information
Carlee Smith, Environmental Specialist	City of Franklin, Community Development Department	Planning/Preventive Measures, Property Protection, Resiliency
Markiella Moore, Citizen member	Stakeholder: Chesapeake National Event Mitigation Advisory Committee (NEMAC)	Public Information, Property Protection
Noelle Slater, Senior Water Resources Engineer	Stakeholder: AECOM	Planning/Preventive Measures, Property Protection, Resiliency, Natural Resource Protection
Bill Egerton, Disaster Program Manager	Stakeholder: American Red Cross, Coastal Chapter	Emergency Services, Public Information
Ed Barnette, Government Liaison	Stakeholder: American Red Cross, Coastal Chapter	Emergency Services, Public Information
Judy Hinch, Citizen	Stakeholder: Old Dominion University Ph.D. student and climate researcher; also Citizen member of Chesapeake NEMAC	Property Protection, Resiliency, Natural Resource Protection
Alex Gurchinoff Schlebach, Emergency Management Specialist	Stakeholder: U.S. Army Corps of Engineers	Structural Flood Control Projects, Property Protection
Robert Angrisoni, Emergency Management Specialist	Stakeholder: U.S. Army Corps of Engineers	Structural Flood Control Projects, Property Protection
Judy Shuck, Regional Coalition Coordinator	Stakeholder: Eastern Virginia Healthcare Coalition	Emergency Services, Public Information
Harrison Bresée, Chief Regional Coordinator, Region 5	Stakeholder: Virginia Department of Emergency Management	Emergency Services
Elaina Dariah, Outreach Manager	Stakeholder: Virginia 211	Emergency Services
Mari Radford/Renee Hupp, Community Planning Lead	Stakeholder: FEMA, Region III	Emergency Services

TABLE 2.2a: HAZARD MITIGATION PLANNING STEERING COMMITTEE MEMBERS		
NAME AND POSITION	**COMMUNITY AND AGENCY**	**EXPERTISE**
Mark Heckler, Representative	Stakeholder: Hampton Roads Association, Chiefs of Police (also Chief of Police in Chesapeake)	Emergency Services
John Sadler, Emergency Management Administrator	Stakeholder: Hampton Roads Planning District Commission	Planning/Preventive Measures, Property Protection, Resiliency
Ben McFarlane, Senior Regional Planner	Stakeholder: Hampton Roads Planning District Commission	Planning/Preventive Measures, Property Protection, Resiliency
Anas Malkawi, Chief of Asset Management	Stakeholder: Hampton Roads Sanitation District	Structural Flood Control Projects, Property Protection
Leigh Ann Erdman, Emergency Management Specialist	Stakeholder: U.S. Department of Veterans Affairs	Emergency Services
Mark Killgore, Dam Safety Engineer	Stakeholder: Virginia DCR, Dam Safety	Structural Flood Control Projects
David Luke, Safety & Health Program Manager	Stakeholder: Jefferson Labs	Planning/Preventive Measures, Property Protection
Kaleen Lawsure, Senior Project Scientist	Stakeholder: Old Dominion University, Virginia Modeling and Simulation Center	Emergency Management, Public Information
Michael Player, Executive Director	Stakeholder: Peninsulas EMS Council	Emergency Management, Public Information
Steve Pincus, EMS Planner & Emergency Mgmt Coordinator	Stakeholder: Peninsulas EMS Council	Emergency Management, Public Information
Leigh Chapman, Senior Planner & Hampton property owner	Stakeholder: Salter's Creek Consulting	Planning/Preventive Measures, Property Protection, Resiliency
David Long, Executive Director	Stakeholder: Tidewater EMS Council	Emergency Management, Public Information
Ross Weaver, Program Assistant Director	Stakeholder: Wetlands Watch	Property Protection, Resiliency, Natural Resource Protection
Kenton Towner, Emergency Management Coordinator	Stakeholder: William & Mary	Emergency Management, Public Information, Property Protection
Jim Kaste, Professor of Geology	Stakeholder: William & Mary	Property Protection

* Lead person responsible for that community in the planning, update and maintenance processes outlined in Section 8.

TABLE 2.2b: HAZARD MITIGATION PLANNING WORKING GROUP MEMBERS		
NAME AND POSITION	**COMMUNITY AND AGENCY**	**EXPERTISE**
* Larry Snyder, Deputy Fire Chief	City of Williamsburg, Fire Department	Emergency Management, Public Information, Property Protection
* Richard Stephens, Deputy Coordinator	City of Suffolk, Fire & Rescue	Emergency Management, Public Information, Property Protection
* Michael Stallings, Town Manager	Town of Smithfield	Public Information
* William Saunders, Town Manager	Town of Windsor	Public Information
* Beth Lewis, Community Development Director	Southampton County, Community Development	Planning/Preventive Measures, Public Information, Property Protection
* Ray Phelps, Chief	Surry County, Emergency Management	Emergency Management, Public Information, Property Protection
Angela King, Asst City	City of Hampton, City Attorney's Office	Public Information

TABLE 2.2b: HAZARD MITIGATION PLANNING WORKING GROUP MEMBERS		
NAME AND POSITION	**COMMUNITY AND AGENCY**	**EXPERTISE**
Attorney		
Mohammed Shar, Senior Civil Engineer	City of Hampton, Public Works	Property Protection
Scott Smith, Senior Civil Engineer	City of Hampton, Public Works	Property Protection
Tamara Bullock, Business Services Administration	City of Hampton, Parks & Rec	Natural Resource Protection
Carolyn Heaps, Resiliency Officer	City of Hampton, Community Development	Planning/Preventive Measures, Property Protection, Resiliency
Hanna Sabo, Zoning Administrator	City of Hampton, Community Development	Planning/Preventive Measures, Property Protection
Cashayla Rodgers, Neighborhood Development Associate	City of Hampton, Housing & Neighborhood Services	Planning/Preventive Measures, Property Protection
Sara Snowden, Planner	City of Hampton, Emergency Management	Emergency Management
Brian Lewis, Water Resource Engineer	City of Hampton, Public Works	Property Protection
Jonathan McBride, Divisional Manager	City of Hampton, Housing & Neighborhood Services Division	Planning/Preventive Measures, Property Protection
Bruce Sturk, Director	City of Hampton, Federal Facilities	Public Information
Anna Hammond, Neighborhood Development Associate	City of Hampton, Community Development	Planning/Preventive Measures, Property Protection
Phil Prisco, Building Official	City of Hampton, Community Development	Planning/Preventive Measures, Property Protection
Mike Hayes, Planning & Zoning Administration Manager	City of Hampton, Community Development	Planning/Preventive Measures, Property Protection, Natural Resource Protection
Tim Drewry, Deputy City Attorney	City of Hampton, City Attorney's Office	Public Information
Robin McCormick, Communications Strategist	City of Hampton, Marketing	Public Information
Gwen Pointer, Emergency Mgmt Planner	City of Hampton, Emergency Management	Emergency Management
Nicole DelValle, Emergency Operations Planner	City of Newport News, Emergency Management	Emergency Management
Kathie Angle, Civil Design Engineer	City of Newport News, Public Works	Property Protection
Louis Bott	City of Newport News	Emergency Management
John Anderson, Director	City of Poquoson, Public Works	Property Protection
Thomas Cannella, Planner	City of Poquoson, Planning	Planning/Preventive Measures, Property Protection, Natural Resource Protection
Tonya O'Connell, Asst City Manager	City of Poquoson, City Manager's Office	Public Information
Jessica Davis, Finance Specialist	City of Poquoson, Finance	Public Information
Caroline Dunlap, Emergency Management Planner	James City County, Emergency Management	Emergency Management , Public Information
Mike Woolson, Section Chief, Resource Protection	James City County, General Services	Planning/Preventive Measures, Property Protection
Steve Kopczynski, Fire Chief, Director	York County, Fire & Life Safety	Emergency Management , Planning/Preventive Measures, Property Protection

TABLE 2.2b: HAZARD MITIGATION PLANNING WORKING GROUP MEMBERS		
NAME AND POSITION	**COMMUNITY AND AGENCY**	**EXPERTISE**
Susan Kassel, Director	York County, Planning & Development Services	Planning/Preventive Measures
Amy Parker, Senior Planner	York County, Planning Division	Planning/Preventive Measures
Gail Whittaker, Public Information Officer	York County, Public Affairs	Public Information
Daniel Hudson, Deputy Emergency Mgmt Coordinator	City of Norfolk, Emergency Management	Emergency Management
Jalesha Smith, Management Analyst	City of Norfolk, City Manager's Office of Diversity, Equity & Inclusion	Public Information
Jim Redick, Director	City of Norfolk, Emergency Preparedness & Response	Emergency Management
Scott Mahone, Deputy Emergency Mgmt Coordinator	City of Norfolk, , Emergency Preparedness & Response	Emergency Management
Kyle Spencer, Chief Resilience Officer	City of Norfolk, Office of Resilience	Planning/Preventive Measures, Property Protection, Resilience, Natural Resource Protection
David Topczynski, Deputy Emergency Management Coordinator	City of Portsmouth, Office of Emergency Management	Emergency Management
Stephen Davis, Deputy Emergency Management Coordinator	City of Portsmouth, Office of Emergency Management	Emergency Management
Danielle Progen, Director	City of Virginia Beach, Office of Emergency Mgmt	Emergency Management
Marissa Jones, Office Asst	City of Virginia Beach, Emergency Mgmt	Emergency Management
PJ Scully, Landscape Architect	City of Virginia Beach, Office of Planning	Planning/Preventive Measures, Natural Resource Protection
Brian Spicer, Emergency Mgmt Coordinator	City of Suffolk, Suffolk Fire & Rescue	Emergency Management
Michael Barber, Director	City of Chesapeake, Parks, Recreation & Tourism	Planning/Preventive Measures, Property Protection, Resilience, Natural Resource Protection
David Jurgens, Director	City of Chesapeake, Public Utilities	Property Protection
Ana Elezovic, Planner	City of Chesapeake, Planning	Resilience, Natural Resource Protection
Patrick Hughes, Citizen member	City of Chesapeake, NEMAC	Planning/Preventive Measures
James Haluska, Citizen member	City of Chesapeake, NEMAC	Planning/Preventive Measures
Heather Stanton, Public Utilities Representative	City of Chesapeake, Public Utilities & NEMAC	Property Protection, Planning/Preventive Measures
Michael Johnson, County Administrator	Southampton County	Public Information
Regan Prince, Environmental Specialist	Southampton County, Environmental Services Division	Property Protection
Natalie Rountree, Director	City of Franklin, Community Development	Planning/Preventive Measures, Property Protection, Resilience, Natural Resource Protection

* Lead person responsible for that community in the planning, update and maintenance process outlined in Section 8.

2021/2022 COMMITTEE MEETINGS AND WORKSHOPS

Below is a summary of the key meetings and committee workshops during the 2021/2022 update process. Routine discussions and additional meetings were held by local officials to accomplish planning tasks specific to their department or agency. A consultant team (AECOM, partnered with Salter's Creek Consulting, Inc., of Hampton, Virginia) was hired with grant funds to update the hazard identification and vulnerability analysis, to guide the committee through the planning process based on the revised information and to assist each community with adoption of the final plan. All meeting summary information is included in Appendix C, which includes committee and public meeting minutes, attendance sheets, and correspondence with committee members and stakeholders.

FEBRUARY 25, 2021: PROJECT KICKOFF MEETING

Participants in the Kickoff Meeting discussed the overall approach to updating the Hazard Mitigation Plan, including strategies for outreach and public participation, as well as the steps necessary to meet the requirements of the DMA 2000, and the Community Rating System (CRS) of the National Flood Insurance Program (NFIP). The consultant initiated data collection efforts at the meeting and reviewed the existing list of hazards with the representatives present.

The group discussed project schedule and potential stakeholders and how they would be asked to participate, including tasks such as: reviewing drafts, participating on the committee, and/or attending public meetings. Due to the ongoing COVID-19 safety protocols in place at the time , the group and the consultant decided that each of the main three meetings would be held virtually through online meeting software. Committee meetings would be held virtually, as well.

JULY 27, 2021: FIRST PLANNING COMMITTEE MEETING

The consultant provided an overview of the proposed update approach to committee members. The Committee reviewed the Hazard Identification and Vulnerability Assessment information presented. Committee members discussed the hazards of most critical concern to the region, and concurred to adjust the names of several hazards, removed several hazards and added hazards.

The committee members present voted on their mitigation priorities and ranked hazards using the methodology described in Section 5. The committee considered a list of hazards that included flooding, sea level rise and land subsidence, coastal and tropical storms, severe thunderstorm/hail/lightning, winter storm, drought, high hazard dam failure, tornado, extreme heat, earthquake, wildfire, coastal erosion and landslides, hazardous materials incidents and pandemic flu.

The first part of the meeting focused on the flood analysis, including the hybrid analysis conducted using HAZUS. Participants discussed their frustration with obtaining NFIP repetitive flood loss data and the inability to know flood insurance coverage happening in private flood insurance market. The group discussed nomenclature for Infectious Disease/Pandemic Flu. Surry County requested that landslides not be deleted as it is a significant hazard in their region, and several participants indicated Extreme Heat and Winter Storm should be moved up in the risk assessment.

SEPTEMBER 28, 2021: SECOND PLANNING COMMITTEE MEETING

The second Planning Committee meeting was the beginning of the "Mitigation Strategy Workshops." The meeting began with a presentation on how a complete capability assessment contributes to identification of effective mitigation strategies. The discussion focused on local capabilities and the capability matrix each community was asked to complete.

The consultant helped Committee members review several documents in preparation for the goal setting exercise which was the focus of the workshop. This background helped Committee members maintain continuity and to develop linkages between various local, regional, and state planning efforts.

Data, documents, plans and procedures reviewed as part of the goal setting portion of the planning process included, but were not limited to the following:

- *2018 Commonwealth of Virginia Hazard Mitigation Plan* goals and objectives –
  - These items were reviewed by committee members prior to the work on updating the goals and objectives to help ensure that the regional plan supports and does not contradict the State's goals and objectives;
- Goals, objectives and recommendations from Virginia Beach, Hampton and Norfolk Resiliency planning efforts;
- Goals and objectives from the Virginia Coastal Resilience Master Planning Framework, 2020;
- *Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards*, FEMA January 2013;
- Hampton Roads Planning District Commission three-part study entitled *"Climate Change in Hampton Roads"*;
  - Impacts and Stakeholder Involvement (Phase I, released in February 2010);
  - Storm Surge Vulnerability and Public Outreach (Phase II, released June 2011);
  - Sea Level Rise in Hampton Roads, Virginia (Phase III, released July 2012);
- Each of the existing plan's three primary goals and related objectives; and
- Dam Safety Data Sheets for the region's High Hazard Potential Dams, as well as the list of all State-regulated dams in the region (included in **Appendix H**).

The group was provided a list of potential, broad community goal key phrases extracted from the existing plans in order to encourage brainstorming about revising the goal statements. The members also reviewed existing goal statements from the current plan and other plans pertinent to the region. The group then went to work carefully reviewing the existing mitigation plan goal statements. Participants were encouraged to critique each word in light of the goal key words identified earlier and any changes that had taken place in their communities in the previous five years. The facilitator reworked, grouped together, and presented the revised goals and objectives in real time during the meeting so that the group could arrive at a consensus on the broader mitigation goals and objectives associated with the updated mitigation plan. Detailed notes on the reasoning behind why the mitigation goals and objectives were modified is included in Section 7, which shows the changes and the revised goals and objectives.

The group discussed the current status of COVID-19 protocol and the ability to meet in person for the third workshop. Those present preferred a hybrid approach for Workshop #3 and the development of new and revised mitigation actions for 2022. The consultant proposed a virtual group workshop that would discuss the types of mitigation actions and provide examples and some suggested reading materials, followed by a series of in-person working group meetings, termed "office hours" at three locations in the study area to facilitate review, revision and development of each community's existing mitigation actions.

NOVEMBER 9, 2021: THIRD MITIGATION PLANNING COMMITTEE MEETING

The group reviewed a general list of potential mitigation actions categorized by type and the consultant provided examples, both local and national, of various successful mitigation actions. A brief discussion of the various categories followed. The consultant discussed a variety of mitigation categories for considering and evaluating possible mitigation action alternatives appropriate to each community. Suggested reading materials for the group included:

Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards, FEMA 2013;
Mitigation Best Practices – FEMA web site;
Mitigation Success Stories, Association of State Floodplain Managers, 2002;
Mitigation Matters: Policy Solutions to Reduce Local Flood Risk, Pew Charitable Trusts web site;
Zoning for Coastal Flood Resiliency, New York City Planning;

Mitigation Action Portfolio, FEMA web site;
*Buoyant City: Historic District Resiliency & Adaptation Guideline*s, Miami Beach, 2020; and
Coastal Flood Resilience Design Guidelines, Boston Planning & Development Agency, 2019.

The consultant then facilitated a discussion on regional mitigation actions from the 2017 plan and made real-time edits to those actions. Action 1 was modified to remove sidescan Light Detection and Ranging (LIDAR) and replaced with the group's desire to collect lowest floor elevations by collecting existing or creating new Elevation Certificates. Action 2 was edited to reflect desire to use existing mechanisms of the HRPDC to develop additional regional mitigation strategies and host annual workshop on funding. Action 3 was edited to refocus on Hazards U.S. Multi-Hazard (Hazus) input and output data. The group decided to remove Action 4 because a Commodity Flow Study has been identified as a capability gap in regional planning and has been referred to the Local Emergency Planning Committee (LEPC) for completion. The group discussed the addition of several new regional mitigation actions regarding: NFIP repetitive flood loss data analysis at the state or regional level and preparation of repetitive flood loss area analyses; use of radon test kits to test structures; verifying status of significant hazard dams region-wide; and, strengthening/creating transportation networks for evacuation; and partnering with private companies on critical lifeline continuity.

In addition to the facilitated discussion, the consultant cross referenced the final list of proposed mitigation actions and worked with community staff to ensure that each High Hazard Potential Dam listed in Table 4.4 with a "poor" or "unsatisfactory" condition assessment is addressed in the final Mitigation Action Plan. Regional mitigation actions in Section 7 were also added to help clarify the role of the region in addressing dam safety management.

COMMUNITY-SPECIFIC WORKING GROUP MEETINGS

All communities were invited by email to schedule a one-on-one meeting with the consultant toward the end of the planning process. Most of the communities involved in the plan took advantage of these consultant-facilitated brief, in-person meetings at the community level to discuss their final Mitigation Action Plan. Participants worked carefully through a review of the list of existing mitigation actions from their existing plan, deciding which actions to modify or delete based on their progress toward completion. The group then selected and discussed priorities for several new proposed actions suggested by the consultant.

The consultant shared additional review notes on several items that varied by community, and that typically included:

comprehensive plan, resilience plan and strategic plan review notes;
floodplain management regulation review notes;
capabilities or capability gaps noted over the course of the planning process;
repetitive loss area maps (hard copies provided during the meeting);
community-specific critical facility vulnerabilities as shown in the HIRA, and as discussed in the First Planning Committee Meeting; and
other pertinent materials such as news clippings.

While previous plans have benefitted from the synergies of having all communities attend a large workshop to address the MAP revisions and share mitigation ideas, COVID 19 protocols in 2021 required a revised methodology to allow some one-on-one discussion of mitigation actions, but to limit the number of people convened at any one time. The meetings were held over the course of several days in November 2021. York County and the City of Hampton met November 16, 2021 at the City of Hampton Emergency Operations Center. The consultant met with Poquoson representatives on November 16, 2021, as well, in their City Hall Meeting Room. November 19, 2021, in the Isle of Wight Board of Supervisors Board Room, the consultant met with Southampton County, City of Franklin, City of Suffolk, and Isle of Wight County. A virtual meeting was held that same day with James City County staff.

November 22, 2021, the consultant met with City of Williamsburg officials in their Fire Department Headquarters. Finally, on November 30, 2021, the cities of Virginia Beach, Portsmouth, Newport News, Chesapeake and Norfolk sent staff for individual one-hour sessions with the consultant in the HRPDC headquarters in Chesapeake. Attendance for each community was as follows:

City of Hampton	Hui-shan Walker
	Angela King
	Tracy Hanger
	Scott Smith
	Carolyn Heaps
	Sara Snowden
	Brian Lewis
	Jonathan McBride
	Bruce Sturk
	Anna Hammond
	Phil Prisco
	Mike Hayes
	Tim Drewry
	Robin McCormick
City Newport News	George Glazner
	Heather Brown
	Kathy Angle
City of Poquoson	Michael Bryant
	Ken Somerset
	John Anderson
	Thomas Cannella
	Tonya O'Connell
	Jessica Davis
James City County	Michael Teener
	Sara Ruch
City of Williamsburg	David Eagle
	Larry Snyder, Williamsburg
	Erin Burke, Planning Department
	Kenton Towner, William & Mary
	Joanne Chapman, Colonial Williamsburg Foundation
	Sela Gordon
York County	Sean Segerblom, York County
	Kent Henkel
City of Norfolk	Daniel Hudson
	Matthew Simons
	Tristian Barnes

City of Portsmouth	Joseph Rubino
	John Millspaugh (Arcadis)
City of Virginia Beach	Whitney McNamara, Virginia Beach
	Danielle Spach
City of Suffolk	Richard Stephens, Suffolk
City of Chesapeake	Robert Gelormine
	Markiella Moore
Isle of Wight County	Will Drewery
Southampton County	Beth Lewis
City of Franklin	Vernie Francis, Franklin
	Carlee Smith
	Natalie Rountree

Participation in the planning process by the towns of Boykins, Branchville, Capron, Courtland, Ivor, and Newsoms was negligible, despite multiple attempts at communication. PDC staff specifically reached out again to many of these communities in mid-February 2022 to inform them verbally about the final Public Meeting in March, and to encourage their attendance. The PDC called and emailed Boykins on February 22 and 23; they called Branchville and Capron on February 24 and left voicemails; they called Courtland and spoke with the Town Clerk on February 24. The PDC also called and emailed the Mayors of Ivor and Newsoms between February 22 and February 24, 2021. Despite these efforts, the towns did not send representatives to the meetings and, therefore, are not considered participants at the time of initial approval. Their mitigation actions from previous plans have been placed in Appendix J, Archived Mitigation Actions, should they need to reference or edit them in the future.

INVOLVING THE PUBLIC

44 CFR Requirement

Part 201.6(b)(1): The planning process shall include an opportunity for the public to comment on the plan during the drafting stage and prior to plan approval.

Individual citizen involvement provides the planning committee with a greater understanding of local concerns and increases mitigation success by developing community "buy-in" from those directly affected by public policy and planning decisions. As citizens become more involved in decisions that affect their life and safety, they are more likely to gain appreciation of the natural hazards present in their community and take personal steps to reduce hazard impacts. Public awareness is a key component of an overall mitigation strategy aimed at making a home, neighborhood, school, business or locality safer from the effects of natural hazards.

Public input was initially sought using three primary methods: (1) open public meetings advertised locally; (2) broadly-distributed public survey; and, (3) the posting of the draft Hazard Mitigation Plan on the HRPDC web site. Public meetings were held at three stages of the planning process; early in the process to introduce the plan update process, again in the middle stage to share results of the Hazard Identification and Risk Assessment; and again, after the planning committee workshops, but prior to adoption by governing bodies.

2021/2022 Public Meetings

Three open public meetings were held virtually via Zoom to present the planning process and to review mitigation actions to be included in the Hazard Mitigation Plan.

The first public meeting was held April 20, 2021. The goal was to introduce the public to the planning process and invite their involvement. The group discussed the hazards in the 2017 plan and provided comments on hazards proposed to be included in the update. The facilitator polled the group about their concerns regarding various hazards and provided a Q&A session at the end.

Upon completion of the Hazard Identification and Risk Assessment, the Committee held another open, virtual public meeting on July 29, 2021. This meeting included review of the results of the hazard study for the region, including detailed information regarding exposure, risk assessment and social vulnerability.

Upon completion of a draft Plan, the Committee held another public meeting on the draft Hazard Mitigation Plan on March 2, 2022. The meeting provided further opportunity for the public and identified stakeholders to review and comment on the draft plan. The plan was posted on the HRPDC web site on February 7, 2022, and contact information for the HRPDC Emergency Management Division was provided if the public needed instructions for submitting comments by March 9. The meeting and review period after the March 2 meeting, provided citizens with an opportunity to review the content of the Plan's sections.

All public meetings were advertised broadly by the communities on social media, on physical bulletin boards, and via email to help ensure that local officials, residents, businesses, and other public and private interests in the region, including neighboring communities, were notified on how to be involved in the local mitigation planning process. Additionally, HRPDC and the communities advertised the meetings on their web sites. The public meeting advertisements are included in Appendix C, which also includes all committee and public meeting minutes, attendance sheets, and invitation correspondence.

The public meeting on March 2, 2022 was termed the "Feedback Forum" in an effort to solicit public comment and feedback on the draft plan. Once again, the committee relied on the efforts of multiple community Public Information Officers, web masters, and other communication specialists, including HRPDC's Administrator of the Office of Community Affairs and Civil Rights, to use a variety of sources to spread the word about the planning effort. Records of advertisements and solicitations for involvement are included in Appendix C (meeting minutes), Appendix D (public survey response summaries), and Appendix E (responses to public comments).

Additionally, the plan was reviewed and presented to each community's elected officials at a public hearing prior to adoption. Though the plan was in its final format for these meetings, this did provide additional opportunity to answer questions and present findings to the public and elected officials. The resolution of adoption by each community is included in Appendix B. Adoption dates are shown in **Table 2.3**.

TABLE 2.3: DATE OF PLAN ADOPTION BY ELECTED OFFICIALS		
SUBREGION	COMMUNITY	DATE OF PLAN ADOPTION
Peninsula	City of Hampton	August 10, 2022
	City of Newport News	September 27, 2022
	City of Poquoson	June 13, 2022
	City of Williamsburg	July 14, 2022
	James City County	June 28, 2022
	York County	August 2, 2022
Southside	City of Norfolk	July 12, 2022
	City of Portsmouth	September 27, 2022
	City of Suffolk	June 15, 2022
	City of Virginia Beach	June 7, 2022
	City of Chesapeake	July 12, 2022
Western Tidewater	Isle of Wight County	June 16, 2022
	Town of Smithfield	July 5, 2022
	Town of Windsor	July 12, 2022
	City of Franklin	June 27, 2022
	Southampton County	June 28, 2022
	Surry County	July 7, 2022
	Town of Claremont	October 5, 2022
	Town of Dendron	November 7, 2022

Public Survey

A public survey was distributed early in the planning process to solicit additional feedback from attendees. As indicated above, the public survey was also distributed online in spring 2021 as part of the committee's effort to improve and use public feedback. The results of a total 130 responses collected are summarized in Appendix D. Unfortunately, the response period for the survey was somewhat limited due to another public survey ongoing in the region with similar questions and content.

The majority of respondents to the survey were in Norfolk, Portsmouth, Virginia Beach and Chesapeake. Eighty-seven percent of respondents indicated that, beyond COVID-19, they had experienced or been impacted by a natural or manmade disaster. The highest threats were perceived as hurricanes/tropical storms, floods, pandemic flu/disease, and sea level rise. The majority of participants (72%) did not live in the floodplain, while 44% did have a home in the floodplain. Interestingly, 53% of respondents had flood insurance indicating that many with homes out of the floodplain still had flood insurance. Many (84%) had measures and structural projects were seen as the most effective mitigation actions that local governments could administer.

The information in the survey was distributed to all committee members via the HRPDC's SharePoint data sharing site set up early in the planning process. Committee members were invited via email to review the data, particularly as it related to their community, as soon as the survey closed. The contractor reviewed the responses and used them to inform the development of the Mitigation Action Plan and other components of the plan.

HRPDC Web Site

Throughout the planning process, HRPDC maintained a web site at https://www.hrpdcva.gov/departments/emergency-management/2022-hampton-roads-hazard-mitigation-plan that provided a description of the planning process and posted meeting information. The page included a copy of the draft plan prior to the final Public Meeting to provide the public an opportunity to comment. Those comments are addressed through the standard comment/response format documented in Appendix E.

Brochure

In addition to the public meetings, web site and survey, the Committee issued a brochure template that was distributed by many of the jurisdictions, primarily via social media and web postings on their respective web sites. The brochure template is shown in **Figure 2.2** below and provides background information on the planning process, the Community Rating System, and how citizens can become involved. The blank lines are intended for individual jurisdictions to input contact information for their staff point of contact.

FIGURE 2.1: HAMPTON ROADS HAZARD MITIGATION PLANNING BROCHURE

2022 Hampton Roads Hazard Mitigation Plan Update Process

Hazard Mitigation Planning

A Hazard Mitigation Plan is the result of a planning process to identify hazards and develop strategies to reduce loss of life and property. This planning process is structured around the four phases of the Disaster Mitigation Act of 2000, which the region's planning consultant has aligned with the ten steps of the Community Rating System (CRS). Having an adopted Hazard Mitigation Plan that is updated every five years helps ensure each community in the region is eligible for federal disaster funding following a disaster event.

The Community Rating System (CRS)

The CRS is a national program developed by the Federal Emergency Management Agency (FEMA) to encourage communities to reduce their risk to flood-related hazards. The CRS rewards the efforts communities take that go above and beyond the minimum requirements of the National Flood Insurance Program (NFIP) by providing discounts on flood insurance premiums.

Phase 1
1. Organize Planning Team
2. Plan for Public Involvement
3. Coordinate with Other Agencies

Phase 2

4. Identify the Hazards
5. Estimate Losses

Phase 3

6. Identify Goals & Objectives
7. Develop Potential Mitigation Actions
8. Draft the Mitigation Plan

Phase 4

9. Adopt the Plan
10. Implement and Maintain the Plan

Hazards Addressed by the Hampton Roads Hazard Mitigation Plan

The planning committee has initially identified the following hazards for inclusion in the Hampton Roads Hazard Mitigation Plan:

- Flooding
- Sea Level Rise
- Tropical Storm
- Shoreline Erosion
- Dam Failure
- Tornado
- Winter Storm
- Earthquake
- Wildfire
- Drought
- Extreme Heat
- Hazardous Materials Incident
- Communicable Disease

Citizen Involvement

Citizen participation is an important component of mitigation planning. The planning team needs your input on the types of hazards that are your priority concern, and your opinion on ways to lessen their impact.

▶ Visit the web site. Get more information and follow the planning process at https://www.hrpdcva.gov. The website contains announcements for upcoming meetings, minutes and presentations from past planning meetings, information on the identified hazards, draft planning documents for review, a public survey, and more.

▶ Take the survey. A public outreach survey is available online here. Please complete the survey as soon as possible to ensure that your opinion is captured! If you would like a hard copy, please use the email below.

▶ Send us information or comments. If you have information to share for inclusion in the plan, please contact __________ at ____________. The draft plan will be made available for public review on the web site prior to being submitted to FEMA.

INVOLVING STAKEHOLDERS

44 CFR Requirement

Part 201.6(b)(2): The planning process shall include an opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have authority to regulate development, as well as businesses, academia and other private and non-profit interests to be involved in the planning process.

A range of stakeholders, including neighboring communities, agencies, businesses, academia, nonprofits, hospitals, and other interested parties were invited and encouraged to participate in the development of the Hazard Mitigation Plan. Stakeholder involvement was encouraged through notifications and invitations to agencies or individuals to participate in Planning Committee meetings, the Mitigation Strategy Workshops and document review.

In addition to the Planning Committee meetings, the committee encouraged open and widespread participation in the mitigation planning process through the design and publication of advertisements that promoted the open public meetings. These media and social media advertisements and the HRPDC web page postings provided opportunities for local officials, residents, and businesses to offer input.

During the 2021/2022 update process, additional stakeholders were contacted and invited to participate in one of three ways: 1) attend and participate in Committee meetings; 2) attend and participate in the Public Meetings; and/or 3) review draft documents and provide comments and critique.

Additional stakeholders who were invited *and did participate* at some point in the planning process but who were not included on the Steering or Working Committees in Table 2.2 include:

Neighboring communities:
- Brett Major, Gloucester County
- John Hutcheson, Fort Monroe Authority

Local and regional agencies involved in hazard mitigation activities:
- Christina Johnson, Jefferson Labs
- Lewis Bush, Sentara Leigh Hospital

Stakeholder-type organizations that are not represented on the planning committee:
- Perla Santillan, Office of the Chief Medical Examiner for Virginia
- John Cooke, Virginia Department of Health, Office of Emergency Preparedness
- Mike Monteith, Peninsula Community Foundation
- Carolyn Malloy, Virginia EMS
- Gary Lupton, Sr., Virginia 1st

Regional and metropolitan planning agencies:
- Riana Rich, HRPDC
- Danielle Spach, HRPDC (later on the Steering Committee for Virginia Beach);
- Jay Ruffa, Crater Planning District Commission (also representing neighboring communities)
- Katie Moody, PlanRVA (PDC for Richmond region, also representing neighboring communities)

Higher Education Facilities:
- Paul Long, Thomas Nelson Community College
- Jessica Whitehead, ODU ICAR
- Barry Ezell, ODU VMASC
- Pamela Mason, Virginia Institute of Marine Science, College of William & Mary
- William Berquist, College of William & Mary

Other State agencies:
- Allen Evans, Virginia Department of Military Affairs
- John Highsman, Virginia Department of Forestry

State geological agency:
- Anne Witt, Virginia Department of Energy

State emergency management agency;
- Bruce Sterling, VDEM
- Chris Bruce, VDEM

National Weather Service:
- Eric Seymour, NWS Wakefield Office

U.S. Army Corps of Engineers;
- Greg Williams
- Paul Moye

American Red Cross:
- Aubrie McClendon
- Lisa Mike

Representatives from military bases in the region:
- Rob Starr, Joint Base Langley-Eustis
- Steve Harrison, U.S. Coast Guard
- Don Clayton, U.S. Coast Guard.

Additional stakeholders who were invited *but chose not to participate* as stakeholders include:

State agency representatives:
- Virginia Department of Health

Representatives from colleges and universities in the region:
- Christopher Newport University

Representatives from utilities servicing the region:
- Dominion Energy

Social service providers in the region:
- The Planning Council

Representatives from the medical community:
- Riverside Health System.

COMMUNITY PROFILE

Contents

2022 UPDATE

Section 3 was updated to align the format and content of the existing plans and incorporate the most recent data available for each community. Tables and figures were updated, when necessary, to incorporate data from the 2020 U.S. Census, the 2019 American Community Survey (ACS), the HRPDC and other sources. Surry County data were appended. Figure 3.1, and Figures 3.3 through 3.7 were reviewed and determined to remain relevant; thus, they remain in the plan. Towns in Southampton and Surry County that did not participate in the planning process remain represented in this and subsequent sections with the expectation that they may participate at a later date via plan amendment.

GEOGRAPHY AND THE ENVIRONMENT

Located in the southeastern quadrant of Virginia, the portion of Hampton Roads included in this study is bordered to the north by Gloucester County, to the south by Currituck and Camden Counties in North Carolina, to the east by the Atlantic Ocean and Chesapeake Bay, and to the west by the counties of Sussex and Greenville **(Figure 3.1)**. Although Gloucester County is generally considered part of the Hampton Roads region for planning purposes, the county is participating in hazard mitigation planning processes in conjunction with another, adjacent planning district.

Table 3.1 provides a summary of the geographic characteristics of each of the participating communities.

FIGURE 3.1: THE HAMPTON ROADS REGION OF VIRGINIA

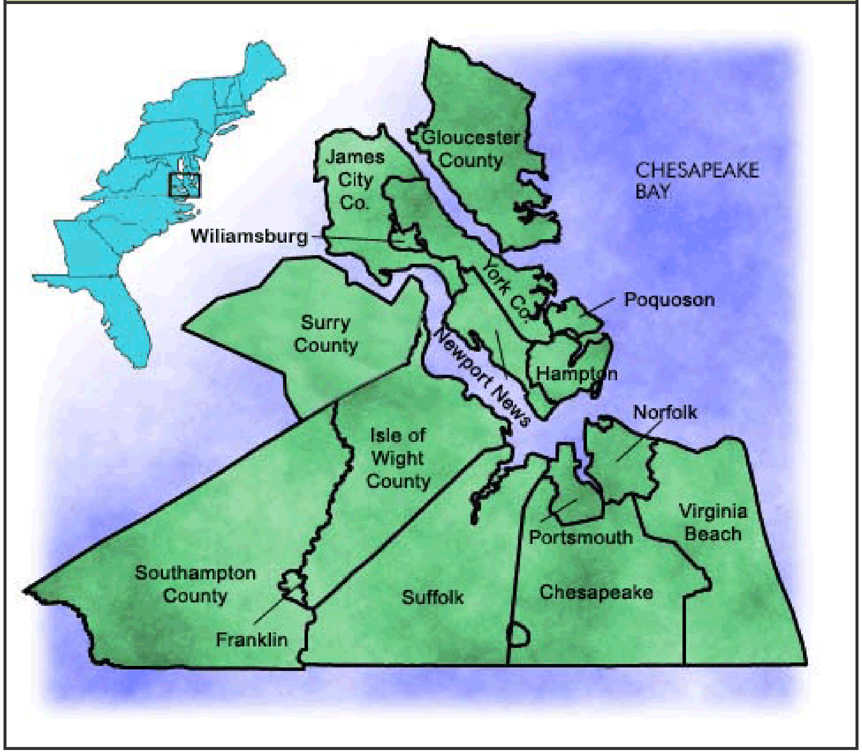


TABLE 3.1: SUMMARY OF GEOGRAPHIC CHARACTERISTICS

SUBREGION	COMMUNITY	2018 LAND AREA IN SQUARE MILES	2018 POPULATION DENSITY PER SQUARE MILE	HOUSING UNITS PER SQUARE MILE
Peninsula	Hampton	52	2,608.3	1,156
	Newport News	70	2,587.4	1,106
	Poquoson	16	770.0	298
	Williamsburg	9	1,687.0	570
	James City County	153	495.7	211
	York County	106	648.3	259
Southside	Norfolk	54	4,570.8	1,791
	Portsmouth	33	2,877.4	1,239
	Suffolk	400	231.8	89
	Virginia Beach	259	1,828.3	706
	Chesapeake	340	717.3	261
Western Tidewater	Isle of Wight County	316	118.6	49
	Smithfield	10	844.1	346
	Windsor	4	675.0	271
	Franklin	8	1,038.5	460
	Southampton	600	29.8	13

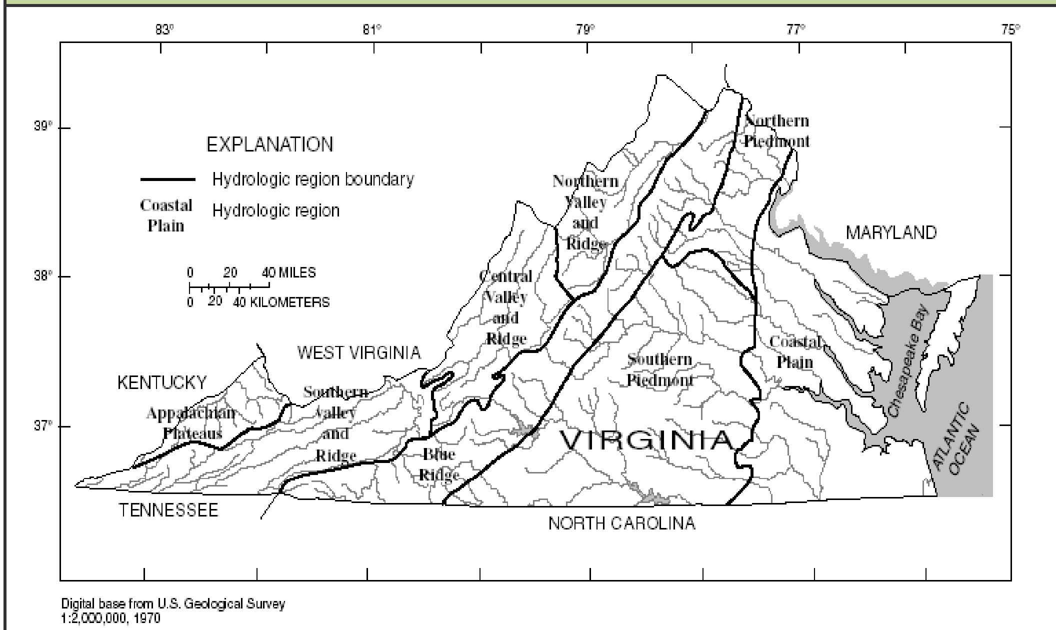
TABLE 3.1: SUMMARY OF GEOGRAPHIC CHARACTERISTICS				
SUBREGION	COMMUNITY	2018 LAND AREA IN SQUARE MILES	2018 POPULATION DENSITY PER SQUARE MILE	HOUSING UNITS PER SQUARE MILE
	County			
	Boykins	<1	854	269
	Branchville	<1	112	57
	Capron	<1	139	69
	Courtland	<1	1,958	523
	Ivor	1	495	152
	Surry County	279	23.6	13
	Claremont	3	107.7	67
	Dendron	4	85.0	32

Source: Weldon Cooper Center (land area and density) and U.S. Census Bureau 2013-2017 American Community Survey Estimates (housing unit data)

Hampton Roads is located within the Atlantic Coastal Plain Physiographic Province, which is characterized by its low, flat relief **(Figure 3.2)**. Much of the region's elevation is nearly level, with the highest elevation point in the study area being just 177 feet above sea level. For example, the overall elevation for the City of Chesapeake averages 12.2 feet above sea level.

The Atlantic Coastal Plain is the easternmost of Virginia's physiographic zones. The zone extends from New Jersey to Florida and includes all of Virginia east of the Fall Line, which is the point at which east-flowing rivers cross from the hard, igneous, and metamorphic rocks of the Southern Piedmont to the relatively soft, unconsolidated strata of the Coastal Plain (U.S. Geological Survey (USGS) 2001).

FIGURE 3.2: PHYSIOGRAPHIC REGIONS OF VIRGINIA

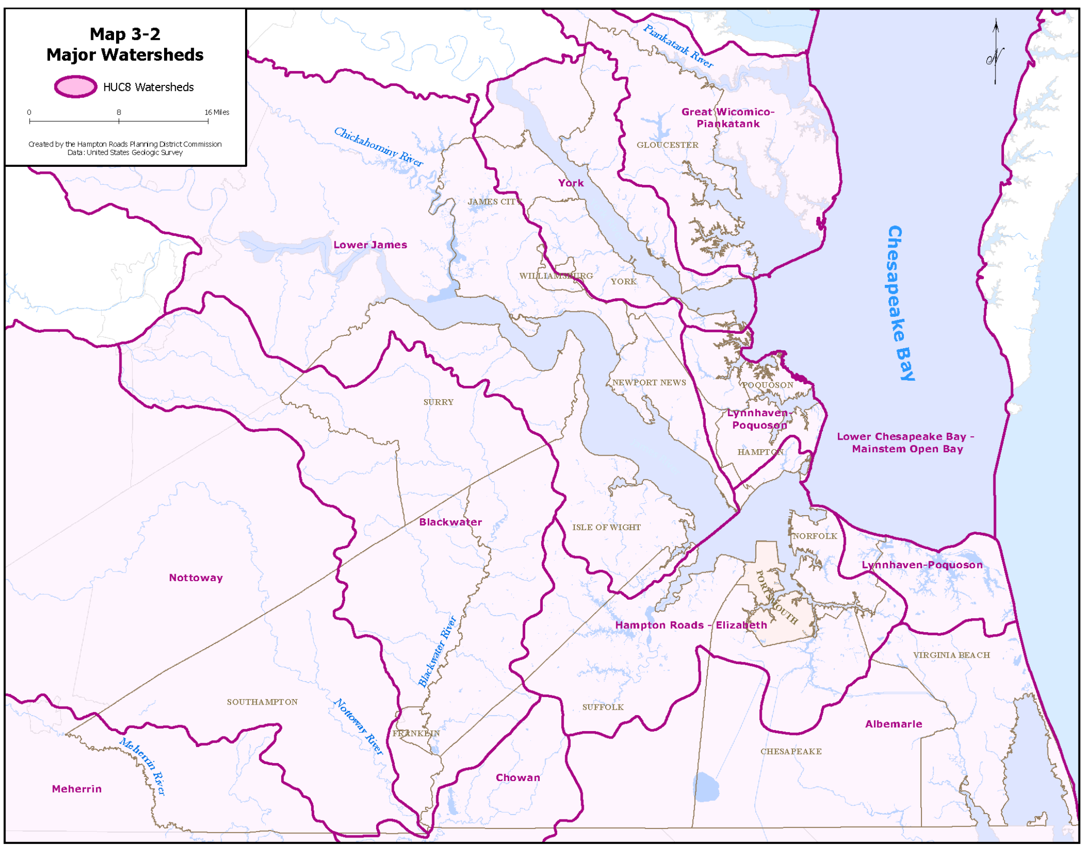


1970

Hampton Roads contains portions of four major river basins: the James River Basin, the York River Basin, Lower Chesapeake Bay, and the Albemarle-Chowan Basin. **Figure 3.3** provides a graphical illustration of the watersheds designated by their USGS Hydrologic Unit Code. The James River Watershed encompasses approximately 10,200 square miles, and its headwaters are located in Bath and Highland Counties. The James River, which is a part of the larger Chesapeake Bay Basin, empties into the Chesapeake Bay at Hampton Roads. The Lower James subbasin, as shown in **Figure 3.3**, has an area of 1,440 square miles, and the Hampton Roads – Elizabeth subbasin has an area of 425 square miles. The York River Basin encompasses 2,626 square miles with headwaters in Orange County, Virginia. The Lower York River subbasin shown in **Figure 3.3** has an area of just 275 square miles. Several tributaries in the study area flow directly into the Chesapeake Bay, including Poquoson River, Back River, and Lynnhaven River, but the basin also includes the small bays, river inlets, islands and shoreline of the Bay. While the entire basin includes just over 3,000 square miles of land area, just 53% of that land area is within the study area.

Land in both North Carolina and Virginia contribute runoff to the Albemarle-Chowan River Basin. The drainage basin within Virginia is 4,061 square miles, and the basin begins as far west as Charlotte County. Major tributaries include the Meherrin, Nottaway and Blackwater Rivers. In Virginia, there are four distinct sub-watersheds — the Great Dismal Swamp, North Landing River, Northwest River, and Back Bay. These waters flow into the Albemarle and Pamlico Sounds in southeastern North Carolina.

FIGURE 3.3: HYDROGRAPHIC REGIONS OF HAMPTON ROADS



2011

Source: Hampton Roads Regional Water Supply Plan, HRPDC, 2011

According to the Virginia Department of Conservation and Recreation (DCR) natural heritage inventory, there are at least seven important ecological community groups in Hampton Roads that are interrelated with the water resources of the region:

- Pine/Scrub Oak Sandhills – includes slightly elevated sand deposits along the Blackwater and Nottoway Rivers in Southampton and Isle of Wight counties and the City of Suffolk.
- Fluvial Terrace Woodlands – Nottoway River and Chickahominy River
- Bald Cypress – Tupelo Swamps – swamps dominated by old-growth bald cypress along the Blackwater River in Isle of Wight County and the Nottoway River in Southampton County.
- Coastal Plain/Piedmont Swamp Forests;
- Coastal Plain/Piedmont Floodplain Forests;
- Tidal Bald Cypress Forests and Woodlands; and,
- Tidal Freshwater and Oligohaline Aquatic Beds

The Virginia Scenic Rivers program, administered by DCR, identifies, recognizes and provides limited protection to rivers whose scenic beauty, historic importance, recreation value, and natural characteristics make them resources of particular importance. Reaches of the Blackwater, lower James, North Landing and Nottoway Rivers are all designated scenic rivers through the program. Similarly, the Nationwide Rivers Inventory is a register of river segments that possess unique, rare or exemplary features that are significant at a comparative regional or national scale. Segments of the Blackwater, Chickahominy, James, Northwest, Nottoway, Ware, Yarmouth, and York Rivers are designated on the National Rivers Inventory for various reasons. Additional information on the significance of each designated reach can be found at: https://www.nps.gov/subjects/rivers/virginia.htm.

The summer, fall, spring, and winter temperatures in the Hampton Roads region are typically mild. **Table 3.2** provides the annual meteorological averages for maximum, minimum, and mean temperatures, as well as total precipitation from three airports in the coastal part of the region. The region usually receives small amounts of snowfall annually. Additional discussion of weather extremes, including winter storms, is included in Section 4.

TABLE 3.2: ANNUAL METEOROLOGICAL AVERAGES

WEATHER STATION	TEMPERATURE (DEGREES FAHRENHEIT)			TOTAL PRECIPITATION (INCHES)
	MAXIMUM	MINIMUM	MEAN	
Joint Base Langley-Eustis (Hampton) 1918-2007	67.5	51.3	59.4	43.6
Holland (Suffolk) 1933-2008	70.2	47.4	58.8	48.4
Norfolk International Airport 1946-2008	68.5	51.4	59.9	45.3

Source: Hampton Roads Regional Water Supply Plan, HRPDC, 2011

The following information provides a brief overview of the history, geography and unique characteristics of the jurisdictions in the study area.

City of Hampton

Hampton is the oldest continuously settled English-speaking community in the United States. The area now occupied by Hampton was first noted by English colonists before they sailed up the James River to settle in Jamestown, where they visited an Indian village called Kecoughtan.

In 1610, the construction of Fort Henry and Fort Charles at the mouth of Hampton Creek marked the beginnings of Hampton. In 1619, the settlers chose an English name for the community, Elizabeth City. The settlement was known as Hampton as early as 1680, and in 1705 Hampton was recognized as a town. The City of Hampton was first incorporated in 1849. In 1952, Hampton, the independent town of Phoebus, and Elizabeth City County, encompassing Buckroe and Fox Hill, were consolidated under one municipal government.

Benjamin Syms and Thomas Eaton founded the first free public schools in the United States in Hampton. Hampton is the site of Hampton University, established in 1868 to educate freed slaves. St. John's Episcopal parish was founded in 1610, making it the oldest in the country.

Fort Monroe was the only active moat-encircled fort in the country from 1819 until it was decommissioned in 2011. For a long period during the Civil War, the fort was the only Union outpost in the Confederacy. The famous battle between the first ironclad battleships, the Monitor and the Merrimac, was fought just offshore in Hampton Roads, near the Hampton-Newport News municipal boundary.

During the Civil War, rather than surrender to the Federal army, Hampton was burned down by its own troops. Before the fire, Hampton had 30 businesses and over 100 homes. Fewer than six buildings remained intact after the fire. In 1884, fire again besieged Hampton and almost completely destroyed the downtown business district.

Hampton is now a thriving city with numerous industries including high-tech firms, seafood processing, NASA, military, and tourism. Fort Monroe was the headquarters for the U.S. Army Training and Doctrine Command until base decommission in 2011. It has since been redeveloped as a result of the 2005 Base Realignment Closure Commission. The *Fort Monroe Reuse Plan* was signed into effect August 2008, and the city, the Fort Monroe Authority and the Federal government have worked together on implementation of the Plan. Today, Fort Monroe is a National Park with housing units, offices, and public access to the waterfront and the entire fort. The Fort Monroe Authority works to preserve the history of the Fort and maintain the buildings and grounds for continued use. Langley Air Force Base, where historic Langley field was constructed in 1917, is home of the United States' Air Force First Fighter Wing. NASA Langley Research Center, where America's first astronauts were trained, is now a major center for aviation research.

City of Newport News

Established as a town in 1880, Newport News was incorporated as a city in 1896. In the 1960s, the City of Newport News merged with Warwick County to create today's incorporated area.

The most widely accepted version of how Newport News was named relates to Captain Christopher Newport's return to the area from England in 1610. Newport met the Jamestown colonists on Mulberry Island, (located offshore on the James River) as they were preparing to return to England. The news of his arrival with three vessels, a plentiful supply of provisions, and 150 men gave heart to the dispirited colonists who agreed to go back to Jamestown. In gratitude, they named the point of landing "Newport's News." Over the years, the "s" was dropped, thus the name Newport News.

The City of Newport News played a major role in the Peninsula Campaign during the Civil War. Numerous earthen fortifications and attractions that relate to the Civil War are still visible. Additionally, the famous Battle of the Ironclads took place off the shores of Newport News in 1862. Collis P. Huntington, a Northern railroad tycoon from Connecticut, established two major industries in Newport News: the C&O Railroad and Newport News Shipbuilding. Newport News Shipbuilding and Dry Dock Company, established in 1886, built many of the United States' aircraft carriers, including the Enterprise, Kennedy, Washington, Vinson, and Roosevelt. On November 7, 2001, Newport News Shipbuilding signed a merger agreement with Northrop Grumman, and officially became Northrop Grumman Newport News.

The U.S. Army designated the City of Newport News as a Port of Embarkation immediately after America's entry into World War I. The final major military base during WWI was Camp Eustis, which later became known as Fort Eustis. Named after the founder of Fort Monroe's Artillery School of Practice and a War of 1812 veteran, Brigadier General Abraham Eustis, the camp was created in 1918 to meet the need for an artillery firing range. Today, Fort Eustis is the home of the U.S. Army Transportation Corps, and the Transportation Corps Regiment. The U.S. Army Transportation Museum is also located at Fort Eustis.

City of Poquoson

The name "Poquoson" comes from a Native American term that has been translated as either "flat land" or "great marsh." Plum Tree Island National Wildlife Refuge covers approximately 5.5 square miles and dominates the eastern portion of the City. Together with privately owned salt marsh lands, the area makes up the largest saline marsh in the lower Chesapeake Bay.

Poquoson was part of York County for over three centuries and incorporated as a town in 1952. It was later chartered as a city in 1975. It is the oldest continuously named city in Virginia. General agriculture and seafood related businesses remained the predominant activities of the City until the construction of Langley Field in 1917 prior to the United States' entry into World War I. The Field offered residents many employment opportunities either working directly for Langley Field, its many military contractors, or ancillary businesses. Since World War II, Poquoson has been a residential community for people working all over the peninsula.

City of Williamsburg

In 1699, the General Assembly of Virginia established the City of Williamsburg as the colony's capital. The new city, formerly known as Middle Plantation, was named in honor of King William III. In 1722, King George I granted a royal charter incorporating the City of Williamsburg after the fashion of the English municipal borough.

During the 1700's, Williamsburg developed into a bustling capital city and played a singularly historic role in events leading to American Independence. In 1780, the capital of Virginia moved to Richmond, and the Williamsburg area reverted to a quiet college town and rural county seat. In retrospect, Williamsburg's loss of capital city status was its salvation. Many eighteenth century buildings survived into the early twentieth century, when John D. Rockefeller Jr. supported a massive restoration effort. Now a center of tourism and history, the area is preserved and managed by the Colonial Williamsburg Foundation, a non-profit organization.

The College of William and Mary, located in Williamsburg, currently enrolls 5,800 undergraduate and almost 2,000 graduate students. Originally founded on February 8, 1693, William and Mary is the second-oldest institution of higher learning in the United States and the fourth oldest in North America. The school was one of the original Colonial colleges; the College's Wren Building is one of the oldest academic buildings in continuous use in the United States. The College educated several American leaders, including three U.S. Presidents. George Washington served as one of the College's first Chancellors. Robert M. Gates '65, L.H.D. '98, was named twenty-fourth Chancellor of William & Mary by the Board of Visitors at his investiture on February 3, 2012. He succeeded Sandra Day O'Connor, former Associate Justice of the United States Supreme Court, who was appointed in 2005. He was re-invested for a second term on February 8, 2019.

William and Mary was occupied during the Civil War and closed from 1882-1888 due to financial strains (the College had invested in Confederate bonds). In 1888, William and Mary reopened its doors and began to expand. Today, William and Mary is one of Virginia's most-cherished universities and was one of the first universities to become coeducational in 1918. William and Mary is consistently ranked among the premier public universities in America.

James City County

On May 13, 1607, 144 English explorers arrived and soon established James Towne as the administrative center or capitol. In 1634, by order of the King of England, Charles I, eight shires or counties with a total population of approximately 5,000 inhabitants were established in the colony of Virginia. James City Shire, as well as the James River and Jamestown, took their name from King James I, the father of King Charles I. During 1642 or 1643, the name of the James City Shire was changed to James City County. The original county included what is now Surry County across the James River, part of Charles City County, and some of New Kent County.

Williamsburg became an independent city from James City County in 1884; however, the city is still the county seat of James City County, and they share a school system, courts, and some constitutional officers.

James City County encompasses land important in the early history of our nation. Three jurisdictions, James City County, York County, and the City of Williamsburg, work collaboratively on policies, programs, infrastructure, and land use to preserve this historic area.

York County

York County was formed in 1634 as Charles River Shire, named for King Charles I. It was one of the eight original shires in the Colony of Virginia. The county was renamed in 1642-43 as York County. The river, county, and town are believed to have been named for York, a city in Northern England. The first courthouse and jail were located near what is now Yorktown, although the port used for shipping tobacco to Europe was variously called Port of York, Borough of York, York, or Town of York, until Yorktown was established in 1691. Never incorporated as a town, Yorktown is the county seat of York County. The only town ever incorporated within the county's boundaries was Poquoson, which was incorporated in 1952 and became an independent city in 1975.

York County is most famous as the site of the surrender of General Cornwallis to General George Washington in 1781, ending the American Revolutionary War. Yorktown also figured prominently in the Civil War, serving as a major port to supply both Union and Confederate towns, depending upon who held Yorktown at the time.

Yorktown is part of an important national resource known as the Historic Triangle of Yorktown, Jamestown, and Williamsburg, and is the eastern terminus of the Colonial Parkway.

City of Norfolk

The City of Norfolk, located on the Elizabeth River, was founded in 1682 but was not incorporated as a city until 1845. Initially comprised of only 50 acres, the city has grown to a total of 96 square miles today.

Norfolk has seven miles of Chesapeake Bay waterfront and a total of 144 miles of shoreline, including lakefront, rivers and the Bay. Naval Station Norfolk, which was established on the old Jamestown Exposition grounds in 1917, is the world’s largest naval base. The city is also home to the North American Headquarters for the North American Treaty Organization (NATO) and Old Dominion University (ODU). Norfolk is the most densely developed jurisdiction in the Southside Hampton Roads region at 4,486 people per square mile.

City of Portsmouth

The City of Portsmouth was founded as a town in 1752 on the shores of the Elizabeth River by Colonel William Crawford. In 1858, the town was separated from the county government and given status as an independent city.

Portsmouth's location as an East Coast deep-water port, and available business sites in proximity to the nation's largest shipyard, have provided a significant impetus for economic growth in the area. Today Portsmouth is in the middle of the dynamic Norfolk-Virginia Beach metropolitan area and home to almost 100,000 people. In addition to the many medical, cultural and recreational facilities within the immediate community, Portsmouth's downtown is bustling with retail, restaurant and service-related businesses. The historic waterfront neighborhood of Olde Towne lines the Elizabeth River and is easily traversed by the famous downtown seawall, and the City of Norfolk is easily accessible by a 5-minute ferry ride across the river.

City of Suffolk

In 1742, the Town of Suffolk, which was originally part of the County of Nansemond, was established. The town was burned by the British in 1779 and damaged by other fires throughout the next century but survived to eventually become incorporated as a city in 1910. In 1974, the City of Suffolk consolidated with the towns of Holland and Whaleyville, and the County of Nansemond. At that point it became the largest city (geographically) in Virginia and the 11th largest in the country, encompassing a total of nearly 430 square miles. This large area is made up of land with woods, lakes, rivers, and rolling terrain.

The City of Suffolk is located along the Nansemond River and is still largely recognized as the "Peanut Capital" of the world and as the home of "Mr. Peanut." In 1912, an Italian immigrant named Amedeo Obici moved from Pennsylvania to Suffolk and opened Planters Nut and Chocolate Company. Today, Suffolk remains a major peanut processing center and transportation hub.

City of Virginia Beach

The first settlement inside the city limits of Virginia Beach was made on Lynnhaven Bay in 1621, and the area first became incorporated as a town in 1908. In 1963, the Town of Virginia Beach merged with Princess Anne County to form the independent City of Virginia Beach.

The city consists of 51.3 square miles of inland water and 258.7 square miles of land. The topography is relatively flat with an average elevation of twelve feet above sea level. The area contains extensive brackish tidal areas, such as the Lynnhaven and Elizabeth River systems, and expansive freshwater tidal areas, such as the North Landing River and Back Bay systems.

Due to a combination of the city's geographic position on the mid-Atlantic coastline and the straddling of two ecologically significant estuaries, Chesapeake Bay and Pamlico Sound, the area serves as the southern limit of many northern plant and animal species. The Back Bay National Wildlife Refuge, established in 1938 and managed by the U.S. Fish and Wildlife Service, is an 8,000-acre freshwater refuge that borders the Atlantic Ocean on the east and Back Bay on the west. The barrier islands feature large sand dunes, maritime forests, freshwater marshes, ponds, ocean beach, and large impoundments for wintering wildfowl.

Virginia Beach is best known as a major resort destination, with miles of beaches and dozens of hotels, motels, and restaurants. The city is also home to several state parks, several protected beach areas, four military bases, a number of large corporations, and two universities. Much of the land remained undeveloped until World War II when the U.S. Navy built Oceana Naval Air Station, followed by three more military bases, including Little Creek, Fort Story, and Dam Neck. Since the end of the war, Virginia Beach has experienced continued rapid growth and is the region's most populous jurisdiction at almost 450,000 people.

City of Chesapeake

Chesapeake's history dates back much further than 1963 when Norfolk County and the City of South Norfolk merged to create Chesapeake. The first English settlement of the area began around 1620 along the banks of the Elizabeth River. Norfolk County's founding dates back to 1636.

In the early months of the Revolutionary War, in December 1775, British Royal Governor Lord Dunmore moved his forces from Norfolk to Great Bridge where his army entrenched itself to await the arrival of American forces. The two armies clashed on December 9, 1775, in the historic Battle of Great Bridge, just a few hundred yards from where the Chesapeake Municipal Center complex stands today. In a brief but decisive battle, the Americans routed Lord Dunmore's forces which fled to Norfolk and later abandoned that city.

In 1793, work began on the Dismal Swamp Canal, an idea first envisioned by George Washington in 1763, when he visited the swamp. Because the canal was dug completely by hand, progress was slow, and expenses were high. The canal opened in 1805. Now on the National Register of Historic Places, the Dismal Swamp Canal is the oldest operating artificial waterway in the country. Both the Dismal Swamp Canal and the Albemarle and Chesapeake Canal are operated by the Army Corps of Engineers and form part of the Atlantic Intracoastal Waterway. According to the City of Chesapeake 2003 Legislative Program Document, the City has more miles of deep-water canals than any other city in the country.

The first local encounter of the Civil War occurred at Sewell's Point in May 1861. Although no battles were fought in the Chesapeake area, Union troops occupied and laid waste to much of the land. When the war ended, Norfolk County took advantage of its abundant natural resources. Its coastal location, miles of riverfront and deep-water harbors and the fertile, level farmland allowed county residents to recover quickly from the wartime destruction, moving without hesitation into the 20th century.

While most of the area retained its rural atmosphere through the early 1900s, the northern section near the growing City of Norfolk began to develop as the suburb of South Norfolk. By 1900, South Norfolk had its own waterworks, public schools and a post office. Two rail lines spurred rapid growth, allowing South Norfolk to incorporate as an independent town in 1919 and a city of the first class, independent of Norfolk County, in 1950.

The area that now comprises Chesapeake grew with residential and commercial development of "community crossroads." These areas are still commonly referred to today with community names such as Pleasant Grove, Great Bridge, Oak Grove, Fentress, South Norfolk, Portlock, Deep Creek, Western Branch, Indian River and Hickory.

During the 1950s, both Norfolk County and South Norfolk fell victim to annexation suits filed by neighboring cities. Between 1950 and 1960, the county lost nearly 50,000 residents and 30 square miles of land area. Under these circumstances, both Norfolk County and South Norfolk officials found it difficult to plan for the future.

In the fall of 1961, city and county officials met to discuss the feasibility of a merger. After several weeks of negotiations, both governing bodies approved a merger agreement on December 22, 1961. On February 13, 1962, citizens of both communities turned out in near-record numbers for a special election and approved the merger. Later that year, in June, the citizens voted again and selected the name "Chesapeake" for the new city. On January 2, 1963, the Chesapeake City Council, with five members from South Norfolk and five from Norfolk County, met for the first time.

Isle of Wight County

Isle of Wight County was established as Worrosquoyacke County in 1634, one of eight counties divided from the Virginia colony. The original boundaries of the county included Lawne's Creek to the north, the James River to the east, the head of Colonel Pitt's Creek to the south and undeveloped wooded area to the west. In 1656, Ragged Island and Nansemond County were incorporated into Isle of Wight County. A long dispute between the counties of Isle of Wight and Nansemond continued until 1674, when the General Assembly established the boundaries that exist today.

Isle of Wight County is thirty-seven miles in length and maintains an average breadth of eleven miles. The county is comprised of approximately 363 square miles, of which 80 percent is land area. The area contains relatively flat but rolling terrain with average elevation of approximately 80 feet above sea level.

The land generally dips to the northeast from a plateau west of Bethel Church, and from that same plateau, the land dips to the northwest and west. Several swamps, ravines and creeks drain to the James River, the Blackwater River and the Nansemond River.

Today, Isle of Wight's residents enjoy the rural nature of the County coupled with the quaint atmosphere of the two incorporated towns, Smithfield and Windsor. While the local economy remains agriculturally-based, the area's scenic beauty, history and proximity to other attractions in the Hampton Roads area greatly contribute to the tourist draw. In addition, the County is close enough to the transportation hubs and employment centers of the Norfolk-Virginia Beach area to attract year round residents and businesses alike.

Town of Smithfield

The Town of Smithfield was incorporated in 1752 by Arthur Smith, IV, who parceled out his family farm into 72 lots and 4 streets in order to house British merchants and ship captains. The town is located on the banks of the Pagan River, which flows into the James River. Smithfield was a river town from its very beginning, and the livelihood of its residents and continued growth over the years has been influenced by the river. The town measures approximately ten square miles.

Nurtured by trade and commerce, Smithfield soon became a town of industry with four plants devoted to the art of curing the world famous "Smithfield Ham." Located within the town is Smithfield Foods, Inc., the area's largest meat-processing industry as well as a major employer for the region.

Smithfield has many of the charms associated with Hampton Roads communities, including many historic homes representing 18th and 19th century architecture, a revitalized historic downtown, and the character of a former colonial seaport. To preserve the historical charm, the Town of Smithfield and individual property owners enacted a Historic Preservation District Ordinance in 1979. Smithfield offers residents a small-town atmosphere, a high quality school system, affordable housing, a historic downtown, and a state-of-the-art community/conference center.

Town of Windsor

The Town of Windsor is located in the heart of Isle of Wight County. The town's original name was Corrowaugh, and it was established as a post office in 1852. Five years later, the Norfolk and Petersburg Railroad obtained the post office and built a depot called Windsor Station. In 1902, a town charter was granted by the General Assembly and the town became known simply as Windsor.

In 1950, the Windsor Ruritan Club and the Town of Windsor built a "Community House" which has been a valuable asset to the community over the years. Over the next three decades, town services improved and expanded. The streets were upgraded and paved, sidewalks extended, additional streetlights installed, drainage improved, and ditches piped. The privately owned water systems in the town limits were purchased by the town, upgraded, extended and an above ground water storage tower was erected. In 1971, the Windsor Volunteer Rescue Squad was founded and continues to provide service to the town and surrounding community.

In July 2001, the Town of Windsor annexed 2.82 square miles of Isle of Wight County. As a result, the total area increased from one square mile to 3.82 square miles and population increased from approximately 900 to 2,347. Also in 2001, Isle of Wight County helped install a central sewer system in the town which opened up many areas for new homes and businesses. The Town of Windsor remains a small rural town amidst the region's larger, more populated cities which are easily accessible through two main roads bisecting the town, Route 460 and Route 258.

City of Franklin

Franklin was incorporated as a Town within Southampton County in March of 1876. The first official census of 1880 indicated that there were 447 inhabitants within its limits. By 1970, nearly 7,000 people lived in Franklin.

Franklin developed considerable steamboat commerce along the Blackwater River southward to North Carolina ports from the late 1800s and early 1900s through the 1920s. The combination of rail and water transportation led to more rapid growth in Franklin than in the other towns. The steady growth of the Camp family's lumber business after the Civil War accelerated this growth. Franklin also became a major collection point for peanuts in that period. Franklin is now the major center of commerce and industry for Southampton County.

The Blackwater River is a relatively slow moving, dark river that traverses the City and serves as a valuable resource. Residents rely on the river for recreation, using it heavily for boating and freshwater fishing.

Southampton County and towns

The earliest explorations of the area began a few years after the settlement of Jamestown. The inhabitants were then members of several small Indian tribes, mainly the Nottoways and Meherrins, with settlements along the rivers that now bear their names. In 1634, the western limit of English colonization was established at the "Blackwater Line," which extended southeast from Fort Henry (now Petersburg) through the Blackwater Swamp. Increasing pressure from colonists resulted in lifting of the line in 1705, and in following years the County lay in the path of the general southwesterly migration from the James River settlements. The soils were good for farming and there were forests for timber. More settlers were attracted, and later their slaves, as the Indians were gradually collected in reservations before they finally dispersed. There was a remnant of the Nottoway reservation still in existence in 1856 and probably for some years thereafter.

Water commerce to the south on the Blackwater and Nottoway Rivers was prominent in the early history of the County during both the Revolutionary and Civil Wars. Efforts to maintain or interrupt these routes for military supplies resulted in skirmishes on several occasions, but no major battles. South Quay on the Blackwater River was an established port from the early years of the 18th century. A most dramatic event of the County's history between the Revolutionary and Civil Wars was the slave rebellion led by Nat Turner in 1831. This bloody revolt and its aftermath resulted in the deaths of approximately 100 blacks and whites and drew national and international attention from both pro- and anti-slavery factions.

In order to establish a more convenient administrative center, the present County was split off from Isle of Wight County in 1749. The County seat was Jerusalem, renamed and incorporated as Courtland in 1888. The new County is believed to have been named for Henry Wriothesley, third Earl of Southampton, who was active in promoting colonization of Virginia under the English King James I.

The isolation of Southampton County diminished with the coming of the first railroad in 1834, as the first leg of the Portsmouth and Roanoke Railroad (now CSX) extended to the Nottoway River on its way to western Virginia and made connection with water travel to the south on the river. The Petersburg Railroad (now also CSX) had gone into operation west of the Meherrin only a year before. With the coming of the Portsmouth and Roanoke line, Southampton farmers now had access to both the Petersburg and Norfolk markets. In 1858, the Petersburg and Norfolk Railroad was completed, crossing the northeastern section of the County. Courtland eventually gained rail service with the coming of the Atlantic and Danville Railroad in 1888, about the same time the Surry, Sussex and Southampton Railway (now abandoned) provided service from the north central County to Scotland Wharf on the James River in Surry County. The Virginian Railroad (also abandoned) was built through Sebrell and Sedley in 1906. Over the years, the economic life of the County became centered on the railroad depots that were established at road crossings. Towns and villages gradually formed at these points: Newsoms, Boykins, and Branchville; Courtland, Capron, and Drewryville; and Sedley and Sebrell. Ivor to the northeast, perhaps somewhat more associated with the other towns along its railroad (Waverly, Wakefield and Zuni) also formed.

In more recent times the County's highways have assumed an increasing share of the responsibility for transporting farm products, timber, and manufactured products. In addition, improved roads and widespread automobile ownership have enabled the same kind of widely dispersed residential pattern once maintained by farming, but now maintained by community centers of trade, services, and manufacturing employment.

Surry County and Towns

When the first English settlers sailed up the James River in 1607, they first landed on the south side of the river near the present Town of Claremont in Surry County. Here they visited the Quioughcohancock Indians, allies of the Powhatan Confederacy. The English reported that they were graciously entertained during this first visit with the Native American inhabitants. These settlers went on to establish the first English settlement in the New World on Jamestown Island. The Virginia Company listed sixteen settlers on the south side of the James in May of 1625; this is the area which would later become Surry County. Surry County was formed in 1652 from a portion of James City County and was named for the English County of Surrey.

Following the American Revolutionary War, Surry County became part of the new Commonwealth of Virginia. In over 350 years of existence, the County of Surry has taken care to guard its history and its rural nature. The county is home to several picturesque small towns, historic homes and churches, and Chippokes State Park. Surry County is connected to Virginia's Historic Triangle (Jamestown, Williamsburg and Yorktown) by the Jamestown/Scotland Ferry.

Surry County is a rural county characterized by a rolling topography that gradually becomes more level in the eastern portions of the county. Seventy-five percent of the county is forested. Traditionally, forestry and agricultural land uses have supported the majority of employment but have experienced recent decline. Surry County is the location of the Surry Power Station, a nuclear power plant built in 1972 which is the County's main employer.

POPULATION AND DEMOGRAPHICS

According to the *U.S. Census Bureau 2020 Census*, the study area portion of Hampton Roads has a population of 1,693,394 people. **Table 3.3** shows total population breakdowns, including percent of children under the age of 18, percent of elderly population (age 65 and over), and percent of population living below the poverty level. Data in Table 3.3 are based on 2020 Census data and the most recent American Community Survey.

TABLE 3.3: DEMOGRAPHIC CHARACTERISTICS						
SUBREGION	COMMUNITY	TOTAL POPULATION	% UNDER 18 YEARS OLD	% 65 YEARS AND OVER	MEDIAN AGE	% PERSONS IN POVERTY
Peninsula	Hampton	134,510	21	15	35.7	15.2
	Newport News	179,225	23.1	13.3	33.4	15.1
	Poquoson	12,271	22.4	19.6	42.4	5.3
	Williamsburg	14,954	10.4	15.7	24.9	20.7
	James City County	76,523	19.7	25.8	47.0	5.8
	York County	68,280	23.5	16.6	41.3	5.1
Southside	Norfolk	242,742	19.7	10.9	31.1	18.7
	Portsmouth	94,398	23.4	14.5	36.7	16.8
	Suffolk	92,108	24.3	14.2	37.9	10.4
	Virginia Beach	449,974	22.3	13.7	36.6	7.3
	Chesapeake	244,835	24.2	13.0	37.8	8.6
Western Tidewater	Isle of Wight County	37,109	20.8	19.8	44.3	9.1
	Smithfield	8,475	23.1	18.0	40.2	17.0
	Windsor	2,746	23.6	21.5	43.6	11.0
	Franklin	7,967	25.2	19.3	39.4	14.7
	Southampton County	17,631	18.6	20.8	46.9	13.3
	Boykins	516	18.6	12.7	46.3	5.0
	Branchville	118	16.7	10.5	39.5	7.1
	Capron	141	15.8	40.5	59.7	3.8
	Courtland	1,295	23.9	19.7	43.5	17.8
	Newsoms	286	17.1	14.2	47.4	8.4
	Ivor	312	27.4	16.1	40.5	11.9
	Surry County	6,422	16.6	23.9	49.8	11.9
	Claremont	305	10.2	31.9	57.2	20.9
	Dendron	251	20.4	12.5	45.3	12.7

Source: U.S. Census Bureau, 2019 American Community Survey

Table 3.4 provides the population change experienced by communities in the region between 1980 and 2020, as well as the HRPDC population projection through 2045. Much of the projected population increase between 2020 and 2045 is fueled by population growth in rural or suburban areas, not in the more urbanized cities like Hampton, Norfolk, Newport News and Portsmouth.

TABLE 3.4: REGIONAL POPULATION CHANGE AND PROJECTED CHANGE, 1980 - 2045

SUBREGION	COMMUNITY	1980	1990	2000	2010	2020	2045
Peninsula	Hampton	122,617	133,811	138,437	137,436	134,510	139,207
	Newport News	144,903	171,439	180,150	180,719	179,225	189,962
	Poquoson	8,726	11,005	11,566	12,150	12,271	12,637
	Williamsburg	10,294	11,530	11,998	14,068	14,954	18,341
	James City County	22,339	34,859	48,102	67,009	76,523	120,741
	York County	35,463	42,422	56,297	65,464	68,280	85,930
Southside	Norfolk	266,979	261,250	234,403	242,803	242,742	263,837
	Portsmouth	104,577	103,910	100,565	95,535	94,398	97,752
	Suffolk	47,621	52,143	63,677	84,585	92,108	129,682
	Virginia Beach	262,199	393,089	425,257	437,994	449,974	518,777
	Chesapeake	114,486	151,982	199,184	222,209	244,835	317,206
Western Tidewater	Isle of Wight County	21,603	25,053	29,728	35,270	37,109	52,417
	Franklin	7,308	7,864	8,346	8,582	7,967	8,751
	Southampton County	18,731	17,550	17,482	18,570	17,631	20,218
	Surry County	6,046	6,145	6,829	7,058	6,422	7,374
REGION TOTAL		**1,193,892**	**1,424,052**	**1,532,021**	**1,629,452**	**1,678,949**	**1,982,832**

Source: Hampton Roads 2045 Socioeconomic Forecast, HRPDC, July 2020

HOUSING, INFRASTRUCTURE AND LAND USE

According to the U.S. Census Bureau, *2019 American Community Survey 5-Year Estimates*, there are 650,877 housing units in the study area portion of Hampton Roads, with more than 90-percent of the units classified as occupied. The majority of structures were built after 1970 (68%). According to the 2009-2013 American Community Survey Estimates (the most recent period available for all communities in the study area), 56% of all housing units are owner-occupied and slightly more than 40% of the housing units are mortgaged. **Table 3.5** summarizes recent data on housing characteristics. More specific information regarding the vulnerability of residential units to various hazards is provided in Section 5, *Vulnerability Assessment*.

TABLE 3.5: HOUSING CHARACTERISTICS

SUBREGION	COMMUNITY	TOTAL HOUSING UNITS	OCCUPIED UNITS	MEDIAN VALUE	AVERAGE HOUSEHOLD SIZE	% HOUSING STRUCTURES BUILT BEFORE 1970
Peninsula	Hampton	62,444	92%	$193,500	2.42	45%
	Newport News	81,901	92%	$186,600	2.45	35%
	Poquoson	4,926	94%	$307,800	2.67	28%
	Williamsburg	5,753	89%	$320,600	2.17	33%
	James City County	33,993	93%	$334,700	2.45	9%
	York County	27,827	93%	$346,200	2.7	18%
Southside	Norfolk	101,386	92%	$218,000	2.43	59%
	Portsmouth	43,164	92%	$169,600	2.47	56%
	Suffolk	38,364	93%	$263,500	2.70	26%
	Virginia Beach	190,059	94%	$296,200	2.60	21%
	Chesapeake	94,829	96%	$290,900	2.75	20%
Western Tidewater	Isle of Wight County	16,441	93%	$243,000	2.55	23%
	Franklin	3,886	88%	$178,700	2.39	48%
	Southampton County	7,724	88%	$159,700	2.53	37%
	Surry County	3,402	82%	$169,000	2.50	31%
REGION TOTAL		**650,877**	**91%**			**32%**

Source: U.S. Census Bureau, 2020 Census, 2010 Census, and 2019 American Community Survey 5-Year Estimates

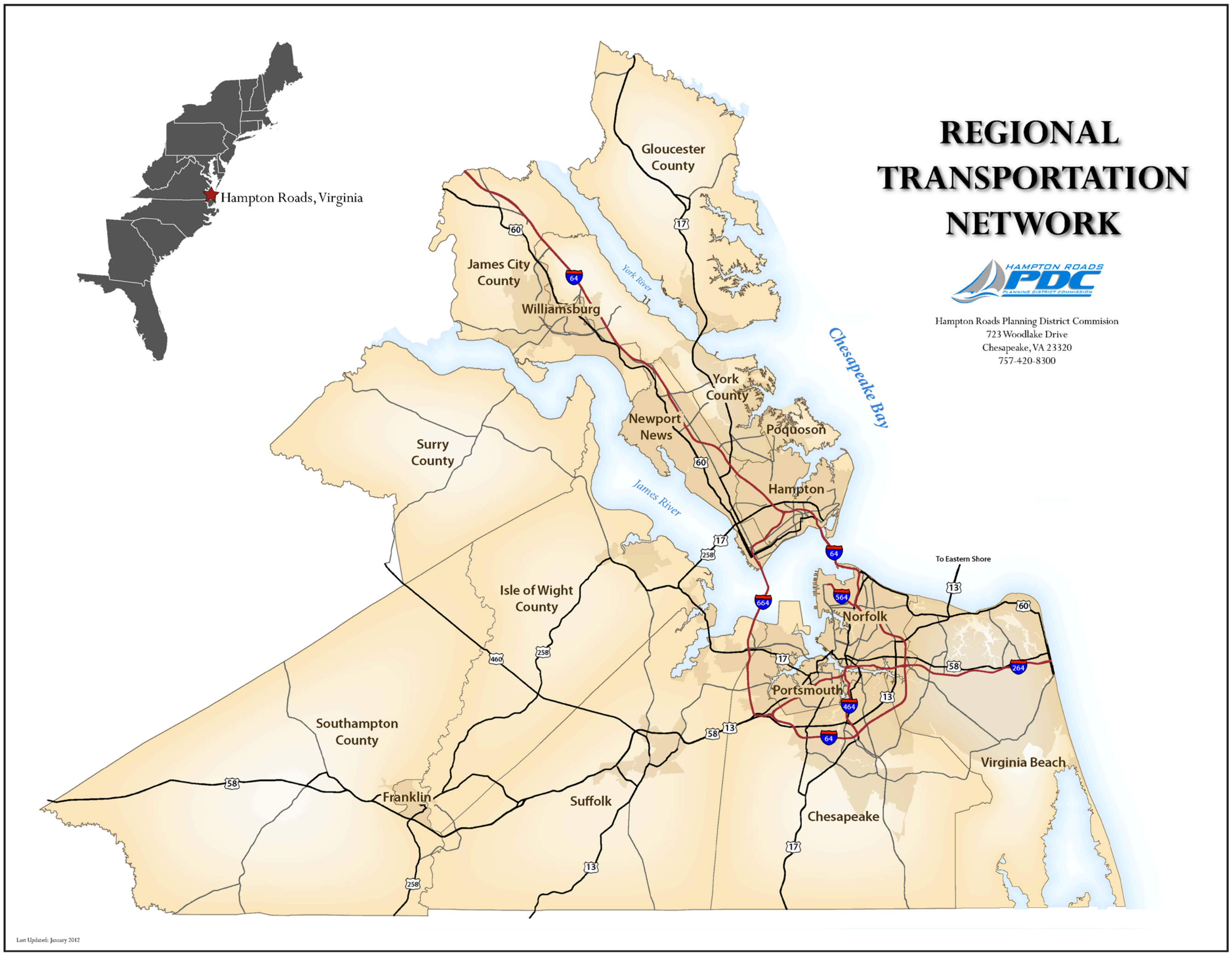
The Hampton Roads region provides an integrated network of transportation facilities and infrastructure that includes many interstates (I-64, I-264, I-464, I-564, I-664) and highways (U.S. 13, 17, 58, 60, 258, 460 and State Route 164), along with hundreds of secondary roadways and bridges throughout the area. Route 168 is a four-lane highway that links I-64 to North Carolina and the Outer Banks region, a major tourist destination throughout the year. US Route 58 and Interstate 64 link Hampton Roads with I-95 and I-85, which are the primary north-south interstate highways in Virginia. The Chesapeake Bay Bridge-Tunnel, which opened in 1964, connects Virginia's Eastern Shore with Virginia Beach and remains one of the world's modern engineering wonders. **Figure 3.4** illustrates the transportation network in the region. Freight rail service is provided by CSX Transportation and Norfolk Southern, Commonwealth Railroad, the Chesapeake and Albemarle Railroad, and the Norfolk/ Portsmouth Beltline. The nearest passenger rail is available through Amtrak at the Newport News station on the Peninsula and a station in downtown Norfolk.

Convenient commercial air service is available through two major airports: Southside's Norfolk International Airport which boasted over 75,000 flight operations in 2019, and the Peninsula's Newport News/Williamsburg International Airport, which services over 430,000 customers each year. The military maintains a long list of airfields in the region with national significance, including Oceana Naval Air Station in Virginia Beach, Naval Station Norfolk, the airfield at Joint Base Langley-Eustis in Hampton, and Fentress Naval Auxiliary Landing Field in Chesapeake. Several other small airports across the region service private aviation.

Water-related infrastructure is prevalent throughout the region's waterways for commercial, industrial, and recreational uses. On the Peninsula, Newport News Shipbuilding, a Division of Huntington Ingalls Industries, is located near the mouth of the James River in Newport News. Massive coal loading piers and facilities were established in the late 19th and early 20th century by the Chesapeake & Ohio (C&O), Norfolk & Western, and Virginian Railways at the end of the Peninsula in Newport News. CSX Transportation now serves the former C&O facility at Newport News. On Southside, over 95 percent of the world's shipping lines call on the Port of Virginia, linking the Commonwealth and the U.S. to more than 250 ports in over 100 countries around the world. With its six terminals across over 1800 acres, 19,885 linear feet of berth and 30 miles of on-dock rail, the Port of Virginia is determined to become the East Coast's leading gateway for global trade. Between 2015 and 2025, the port will have invested $1.5 billion in infrastructure, creating a network to handle any type of cargo, with the deepest channels on the East Coast. Two Class I railroads, CSX and Norfolk Southern, serve the Port via on-dock intermodal container transfer facilities at Virginia International Gateway and Norfolk International Terminals. The service offered by the Class I's is augmented by vital short line rail partners including the Norfolk & Portsmouth Belt Line and the Commonwealth Railway.

Also intersecting the southern part of the study area is a portion of the Atlantic Intracoastal Waterway, a series of federally-maintained inland navigation channels that extend from Norfolk, Virginia to Miami, Florida. The Intracoastal Waterway was authorized by the Rivers and Harbors Act of 1938 and was developed and is still maintained by the U.S. Army Corps of Engineers.

FIGURE 3.4: REGIONAL TRANSPORTATION NETWORK



2012

Source: Hampton Roads Planning District Commission

According to the HRPDC, *Hampton Roads Benchmarking Study,* 2015, the transportation network in Hampton Roads has garnered considerable attention as aging infrastructure and traffic congestion are closely tied to the economy and quality of life within the region. The recent downturn in the economy has affected many aspects of the region's transportation system, with growth in roadway travel coming to a halt and a decrease in air travel from Hampton Roads airports. In spite of relatively lower amounts of travel per capita in Hampton Roads than in competitor regions, congestion is a significant issue, particularly at the bridges and tunnels. Only Washington, DC, Baltimore, and Atlanta had a higher indexed measurement of the extra amount of time trips take during congested peak travel periods in 2011.

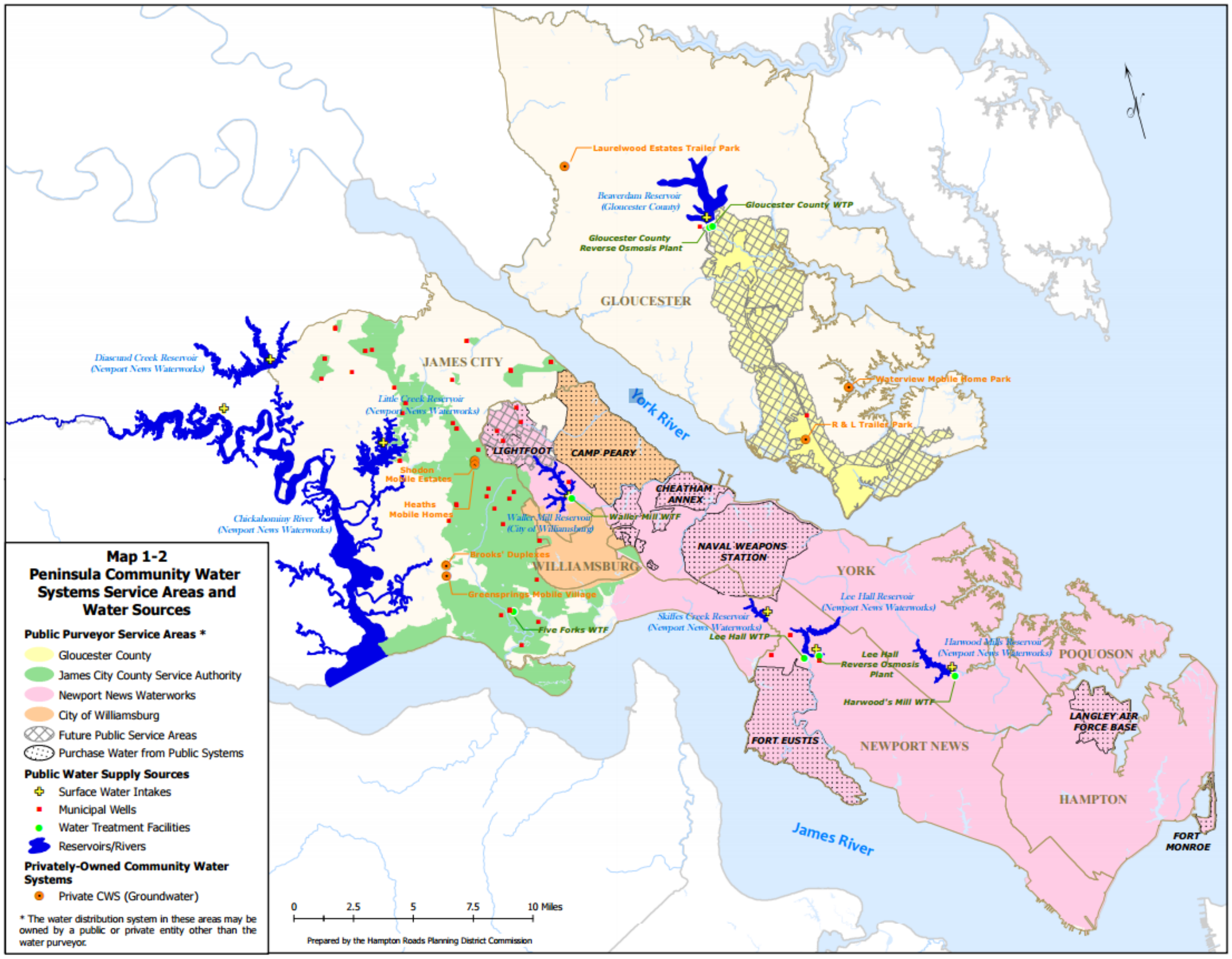
As a result of the congestion occurring at the Hampton Roads Bridge Tunnel, an expansion project is underway to increase capacity, ease major congestion and enhance travel time reliability. The Hampton Roads Bridge-Tunnel Expansion is the largest highway construction project in Virginia's history. This transformative undertaking, scheduled for completion in November 2025, will widen the current four-lane segments along nearly ten miles of the I-64 corridor in Norfolk and Hampton, with new twin tunnels across the harbor. Including the construction contract and owner's costs, the project's total budget is over $3.8 billion, making it one of the largest infrastructure projects in the country.

Public transportation continues to play a small role in the region when compared to some other areas of similar size due in part to low population density and the geography of interspersed water bodies. Norfolk has completed building the region's first light rail line, running 7.4 miles from Eastern Virginia Medical Center to Newtown Road. Light rail has the capability to impact future land use decisions and encourage increased density in development.

The communities of Hampton Roads maintain a significant number of critical facilities and infrastructure that include hospitals, schools, police stations, fire stations, energy facilities, water and wastewater facilities and hazardous material facilities (further discussed in Section 5: *Vulnerability Assessment*). The large military presence provides its own significant facilities and infrastructure base, though these are located on federal land and outside the planning area. Electrical service is supplied throughout the region by Dominion Virginia Power and Franklin Municipal Power & Light (City of Franklin and surrounding areas), and natural gas is provided by Columbia Gas and Virginia Natural Gas. Verizon, Verizon Wireless, FIOS and Cox Communications are primary service provider for cable television, phone and internet service. Surry Power Station is a nuclear power plan located in Surry County, on the south bank of the James River, across from historic Jamestown. The facility provides 14-percent of Virginia's electricity.

In order to examine the existing sources of water in Hampton Roads, the region is divided into three sub-regions. The first sub-region is the Peninsula sub-region, and it is composed of the cities of Hampton, Newport News, Poquoson, and Williamsburg and the counties of Gloucester, James City, and York. There are 26 community water systems that provide water to this sub-region as seen in **Figure 3.5**. According to the Hampton Roads District Planning Commission, these community water systems serviced about 512,000 people in 2011. The water used in the Peninsula sub-region comes from groundwater, reservoirs and the Chickahominy River and serves both urban and rural areas. The majority of the water used comes from surface water in five reservoirs located throughout the sub-region.

FIGURE 3.5: PENINSULA SUB-REGION WATER SOURCES

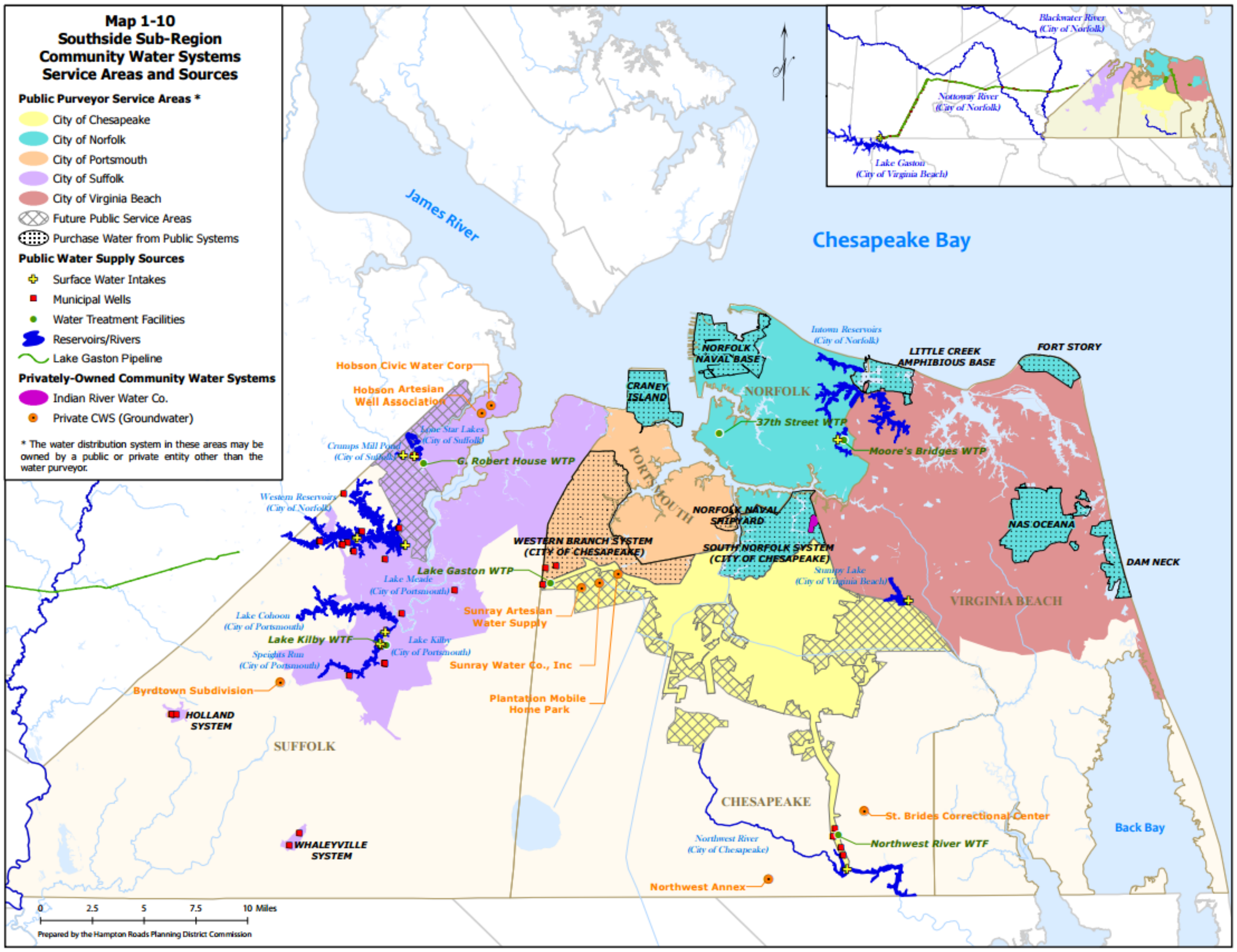


2011

Source: Hampton Roads Regional Water Supply Plan, HRPDC, 2011

The Southside sub-region includes the cities of Chesapeake, Norfolk, Portsmouth, Suffolk, and Virginia Beach. Approximately 975,000 people were served by 15 publicly-owned community water systems in 2011. Water sources for the Southside sub-region include aquifers, reservoirs, Lake Gaston, and the Northwest, Blackwater, and Nottoway Rivers and can be seen in **Figure 3.6**. Both urban and rural areas are serviced by the community water systems in the Southside sub-region.

FIGURE 3.6: SOUTHSIDE SUB-REGION WATER SOURCES

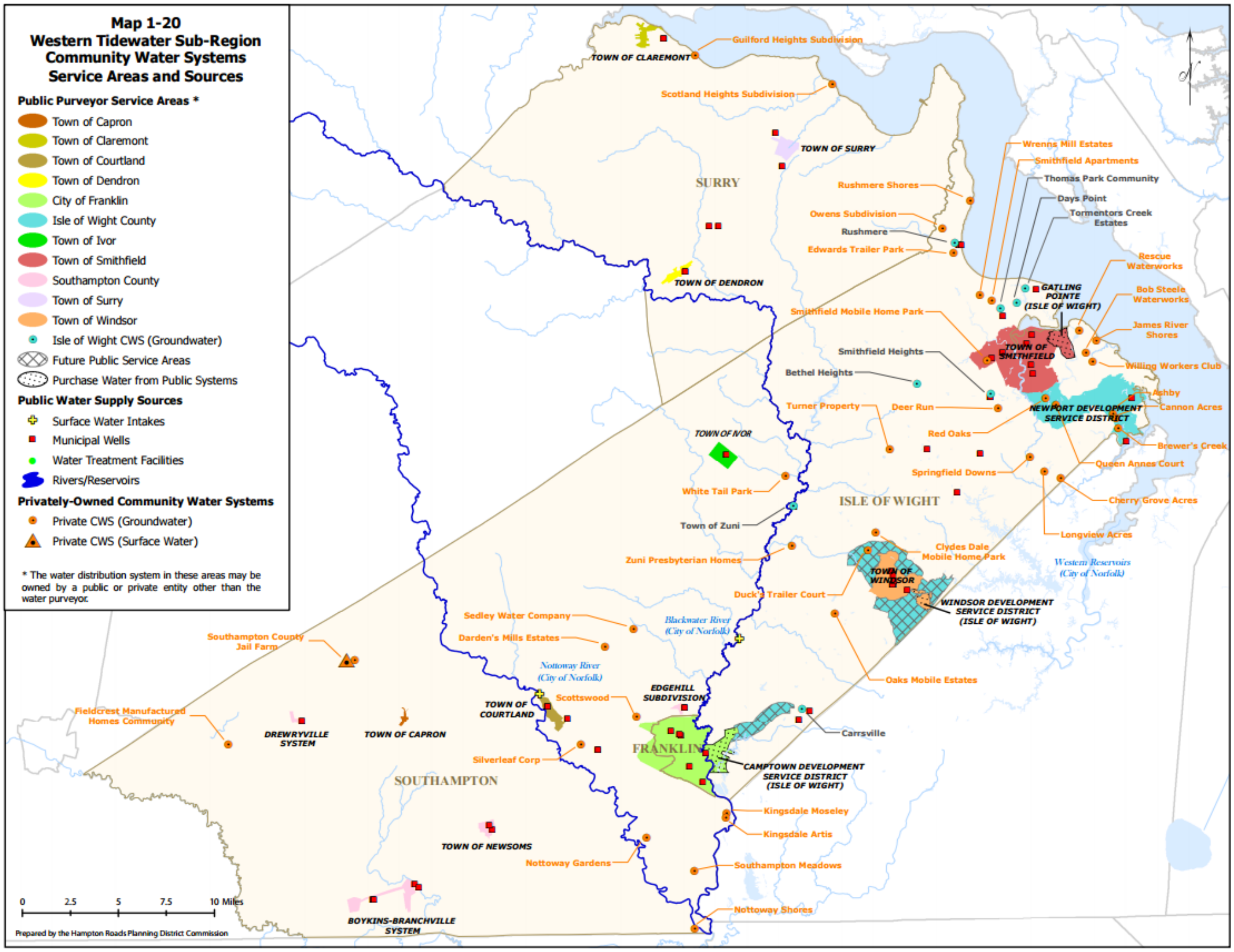


2011

Source: Hampton Roads Regional Water Supply Plan, HRPDC, 2011

The third sub-region in Hampton Roads is the Western Tidewater sub-region. It includes the city of Franklin and the Counties of Isle of Wight, Southampton, and Surry. Since it is a mostly rural sub-region, all but one of the 24 community water systems use groundwater to service 28,000 people. The water sources for the Western Tidewater sub-region can be seen in **Figure 3.7**.

FIGURE 3.7: WESTERN TIDEWATER SUB-REGION WATER SOURCES



2011

Source: Hampton Roads Regional Water Supply Plan, HRPDC, 2011

EMPLOYMENT AND INDUSTRY

Nearly two million people live in or within an hour's drive of the Hampton Roads region, and because of the presence of several military bases, a large proportion of the total population is employed in military- and service-related industries. The military bases not only contribute billions of dollars annually to the regional economy, but also supply a skilled labor force. Over 15,000 trained and disciplined personnel leave the military installations each year, and many of these skilled professionals decide to stay in the area and look for local private sector employment. In addition, there are approximately 40,000 military spouses available to work. The region's tourism industry creates over 10,000 seasonal jobs during summer months. This group provides an additional source of workers to companies with personnel needs that peak at other times of the year. Lastly, over 86,000 students attend eight universities and four community colleges in the area. Most of these students are permanent residents available for part-time or full-time employment while in school and upon graduation.

Table 3.6 shows basic employment data for the study area.

TABLE 3.6: REGIONAL EMPLOYMENT

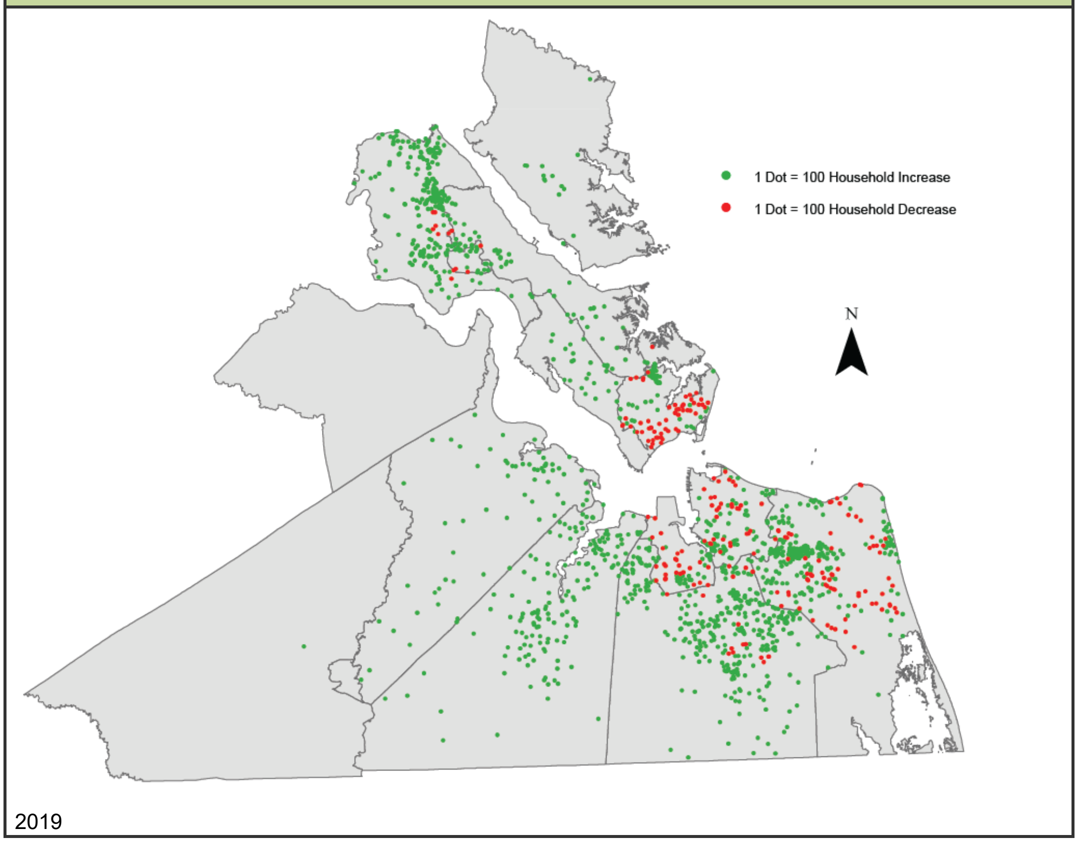
SUB-REGION	COMMUNITY	LABOR FORCE (2020 annual average)	UNEMPLOYMENT RATE (2020 annual average)
Peninsula	Hampton	64,604	8.5
	Newport News	89,715	8.7
	Poquoson	6,249	4.2
	Williamsburg	6,705	8.2
	James City County	36,558	6.1
	York County	32,390	5.6
Southside	Norfolk	111,825	8.7
	Portsmouth	44,701	9.6
	Suffolk	44,546	6.5
	Virginia Beach	230,322	6.2
	Chesapeake	122,036	6.1
Western Tidewater	Isle of Wight County	19,092	5.1
	Franklin	3,640	8.5
	Southampton County	9,063	5.0
	Surry County	3,603	5.7
	VIRGINIA	**4,244,200(September 2021)**	**3.8% (September 2021)**

Source: U.S. Bureau of Labor Statistics, April 16, 2021, except as noted

DEVELOPMENT TRENDS

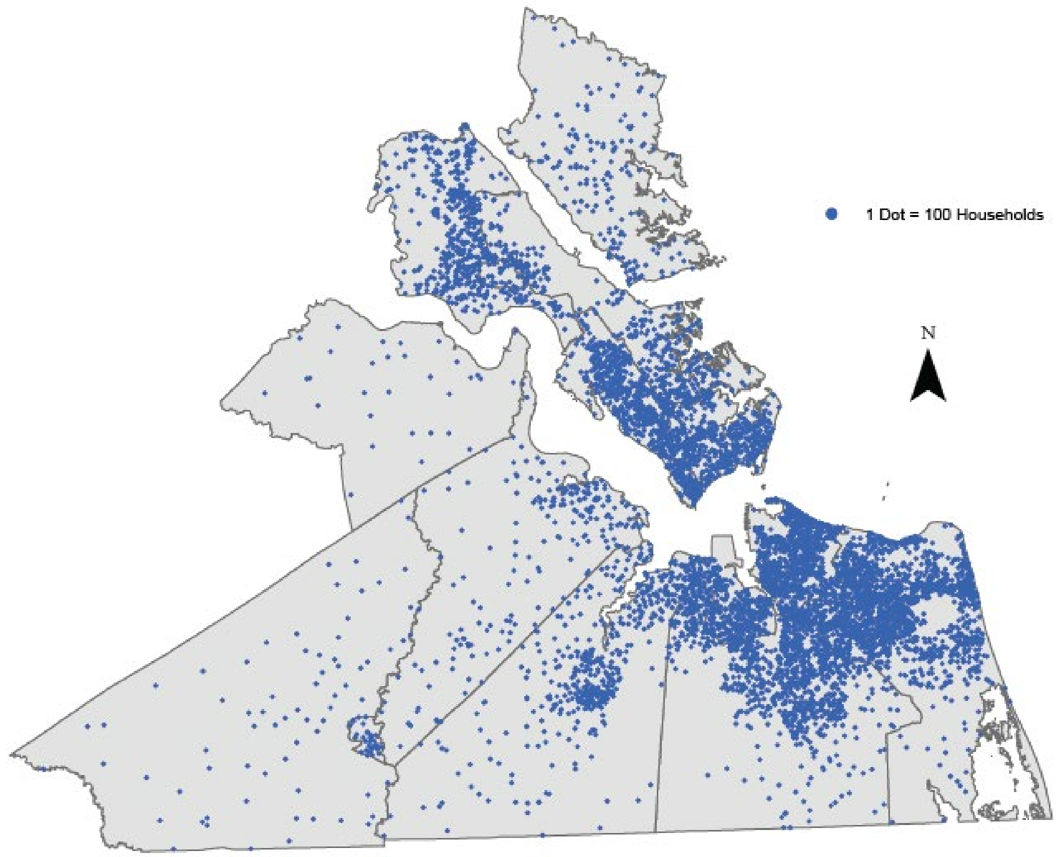
The Hampton Roads 2045 Socioeconomic Forecast prepared by the Hampton Roads Transportation Planning Organization in February 2019 provides the maps shown in **Figures 3.8 and 3.9** to help visualize where demand for employment will impact the number of households in the region. These growth patterns show expected change from 2015 through 2045 and provide a regional summary intended for the purpose of transportation planning; however, the data points shown are also relevant to hazard mitigation planning in that they provide a relative indicator of future housing needs in the region. Where and how those houses will be built influences the region's vulnerability to a range of hazards.

FIGURE 3.8: CHANGE IN HOUSEHOLDS, 2015 TO 2045



Source: Hampton Roads Transportation Planning Organization, Hampton Roads 2045 Socioeconomic Forecast and Transportation Analysis Zones (TAZ) Allocation, February 2019.

FIGURE 3.9: 2045 FORECASTED HOUSEHOLDS



2019

Source: Hampton Roads Transportation Planning Organization, Hampton Roads 2045 Socioeconomic Forecast and TAZ Allocation, February 2019.

The Hampton Roads area expects to add 124,356 net new jobs by 2033. These net new jobs would increase employment by 16.4% with jobs being added to professional and business services, health services, construction and administrative, and waste service sectors. In order to attract workers to these jobs and remain a competitive region that people want to live in, it is imperative that there is adequate housing and transportation and a skilled workforce to do the jobs.

The number of houses needed will vary by jurisdiction. It is estimated that 86,098 net new housing units must be built by 2033. In order to be able to house all of the workers of Hampton Roads, 4,305 net new units must be built each year. Assuming people live near where their jobs are and do not commute, Virginia Beach and Chesapeake will see the most job growth in the region, resulting in more housing units being built. **Table 3.7** illustrates where the housing units need to be built based on how many net new jobs will be in the jurisdiction and whether workers will commute to work or live close to their jobs. The "Remainder of Region" includes Suffolk, Franklin, Gloucester, Isle of Wight, Southampton, Surry, and York County. Gloucester County figures could not be separated out of these published data.

TABLE 3.7: PROJECTED HOUSING DEMAND FOR NEW NET WORKERS 2013-2033

SUBREGION	COMMUNITY	NET NEW JOBS	BY WORK LOCATION	BY CURRENT COMMUTING PATTERNS		
				NON-COMMUTERS	COMMUTERS	TOTAL BY COMMUTING PATTERN
Peninsula	Hampton	2,698	1,800	838	2,693	2,556
	Newport News	5,930	3,911	1,897	3,418	5,316
	James City County and Williamsburg	23,707	17,222	6,860	645	7,506
Southside	Norfolk	13,061	8,947	3,719	3,418	5,316
	Portsmouth	1,675	1,196	414	2,142	2,556
	Virginia Beach	24,661	16,659	11,987	7,974	19,962
	Chesapeake	20,868	13,578	6,634	5,864	12,498
Remainder of Region*		31,756	22,785	12,312	7,976	20,285

** Includes Gloucester County.*
Source: Sturtevant, Lisa. Housing the Future Workforce in the Hampton Roads Region, May 2014. Prepared for Housing Virginia and shared on Hampton Roads Planning District Commission web site.

Due to changes in the demographic of the average net new worker, the type of housing that will need to be built will be different than it has been in the past. The new workers who will move to Hampton Roads will be young people working for lower wages. They will require more single family houses and rental units with moderately priced rent. According to a survey done by the American Community Survey, the percentage of multi-family housing units will increase by 5.2% to 39.7% in the coming years. The percentage of rental units will also increase to 46.5%, compared to 36.4% in previous years. **Table 3.8** illustrates how many housing units will need to be built in each community and the number of units that will be owned compared to those that will be rented. The "Remainder of Region" data include the City of Franklin, and the counties of Gloucester, Isle of Wight, Southampton, Surry, and York.

TABLE 3.8: ADDITIONAL HOUSING UNITS NEEDED BY 2033

SUBREGION	COMMUNITY	TOTAL UNITS NEEDED	SINGLE FAMILY		TOWNHOUSE/MULTI-FAMILY	
			OWNER	RENTER	OWNER	RENTER
Peninsula	Hampton	1,800	1,019	118	240	423
	Newport News	3,911	1,311	495	323	1,782
	James City County and Williamsburg	17,222	8,420	2,938	1,002	4,863
Southside	Norfolk	8,947	3,400	927	930	3,690
	Portsmouth	1,196	401	233	31	531
	Virginia Beach	16,659	6,124	1,920	1,618	6,997
	Chesapeake	13,578	7,684	1,961	916	3,017
	Suffolk	13,730	6,743	2,286	881	3,820
Remainder of Region*		9,055	4,445	1,513	549	2,545
Hampton Roads Region		86,098	39,547	12,391	6,491	27,668

* Includes Gloucester County.
Source: Sturtevant, Lisa. Housing the Future Workforce in the Hampton Roads Region, May 2014. Prepared for Housing Virginia and shared on Hampton Roads Planning District Commission web site.

Virginia law requires that all communities have a comprehensive land use plan and that it be updated every five years. Each county or city government in the study area has adopted a comprehensive plan that provides additional detail on the development trends for that community. Additionally, zoning maps and ordinances within each community further dictate allowable uses and show where future development is guided, or where higher density housing is allowable. Additional information and figures in the Section 5 *Vulnerability Assessment* show recent community development patterns in more detail.

HAZARD IDENTIFICATION AND ANALYSIS

Contents

2022 UPDATE

The hazards significantly affecting the region, as determined by the planning group during the process outlined in Section 2, were updated with current hazard history information from several sources, including the National Centers for Environmental Information (NCEI), National Oceanic and Atmospheric Administration (NOAA) Hurricane Tracks, National Weather Service (NWS), and the *2018 Commonwealth of Virginia Hazard Mitigation Plan*. Flooding Due to Impountment Failure/High Hazard Dam, Pandemic Flu or Communicable Disease, and Radon Exposure were added and described.

INTRODUCTION

This section of the Plan describes the hazards that threaten the Hampton Roads region and provides general background information, local data (e.g., the location and spatial extent), and historical occurrences for each hazard. This section also presents best available data regarding notable historical damages within the region. The hazards discussed in this section are as follows:

- FLOODING
- FLOODING DUE TO IMPOUNDMENT FAILURE/HIGH HAZARD DAM
- SEA LEVEL RISE AND LAND SUBSIDENCE
- TROPICAL/COASTAL STORM

- LANDSLIDE/COASTAL EROSION
- TORNADO
- WINTER STORM
- EARTHQUAKE
- WILDFIRE
- DROUGHT
- EXTREME HEAT
- HAZARDOUS MATERIALS INCIDENT
- PANDEMIC FLU OR COMMUNICABLE DISEASE
- RADON EXPOSURE

44 CFR Requirement

Part 201.6(c)(2)(i): The risk assessment shall include a description of the type, location, and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.

Some of these hazards are interrelated (e.g., tropical/coastal storm events can cause flooding and tornado activity, and flooding can be associated with winter storms and erosion); thus, hazard discussions overlap where necessary throughout the risk assessment.

To a large extent, historical records are used to identify the level of risk within the planning area—with the assumption that the data sources cited are reliable and accurate. Maps are provided to illustrate the location and spatial extent for those hazards within the region that have a recognizable geographic boundary (i.e., hazards that are known to occur in particular areas of the region such as the 100-year floodplain). For those hazards with potential risk not confined to a particular geographic area (such as winter storms and tornadoes), historical event locations and/or general information on the applicable intensity of these events across the entire planning area is provided.

For most hazards analyzed in this section, some level of property damage was associated with any or all of the hazard events cataloged. However, for some historic events reports of property damage were not available. Therefore, totals of past property damages derived from historical records are best estimates and should not be used as a stand-alone indicator of hazard risk.

The terms “likely”, “highly likely” and “unlikely” are used to describe the probability of future occurrence for each hazard. Hazards termed “likely” to occur again in the future are expected to occur but may not have occurred with such high frequency in the past that future events are a certainty. Hazards termed “highly likely” have a history of occurrence or have characteristics that make a future event almost guaranteed. “Unlikely to occur” indicates that committee members, based on review of past events, have the impression that any future occurrence will be a rare and unique event.

The *Vulnerability Assessment*, Section 5 of this plan, expands upon the foundation provided here and assesses the vulnerability of the region to these natural hazards.

SUMMARY OF PRESIDENTIAL DISASTER DECLARATIONS

A presidential disaster declaration is issued when a disaster event is determined to be beyond the response capabilities of state and local governments. Since 1953, the first year presidential disaster declarations were issued in the United States, the region has been named in sixteen such declarations (**Table 4.1**). Under a presidential disaster declaration, the state and affected local governments are eligible to apply for federal funding to pay 75% of the approved costs for debris removal, emergency services related to the storm, and the repair or replacement of damaged public facilities. The types of natural hazards that led to these disaster declarations in Hampton Roads include ice storms, winter storms, hurricanes and tropical storms, the Hurricane Katrina evacuation in 2005 and pandemic. The most recent declarations were for Hurricanes Matthew (2016) and Florence (2018), Tropical Storm Michael (2018), and the Covid-19 Pandemic in 2020.

TABLE 4.1: PRESIDENTIAL DISASTER DECLARATIONS ISSUED FOR HAMPTON ROADS

YEAR	DATE OF DECLARATION	DISASTER NUMBER	DISASTER TYPE	DESIGNATED AREAS
1972	September 8	339	Tropical Storm Agnes	Chesapeake, Hampton, Isle of Wight Co, James City Co, Newport News, Norfolk, Portsmouth, Suffolk, Virginia Beach, Williamsburg, York Co
1996	February 16	1086	Blizzard of 1996	All study area communities
1996	October 23	1135	Hurricane Fran	Hampton, Isle of Wight Co, James City Co, Newport News, Poquoson, Suffolk, Williamsburg, York Co
1998	October 9	1242	Hurricane Bonnie	Chesapeake, Norfolk, Portsmouth, Suffolk, Virginia Beach
1999	September 6	1290	Tropical Storm Dennis and Tornadoes	Hampton
1999	September 24	1293	Hurricane Floyd	All study area communities
2000	February 28	1318	Severe Winter Storms	Franklin, Isle of Wight Co, James City Co, Newport News, Southampton Co, Suffolk, Williamsburg, York Co
2003	September 18	1491	Hurricane Isabel	All study area communities
2005	September 12	3240	Hurricane Katrina Evacuation	All study area communities
2006	September 22	1661	Tropical Depression Ernesto	Isle of Wight Co, James City Co, Newport News, Poquoson, York Co
2009	December 9	1862	Tropical Depression Ida and a Nor'easter	Chesapeake, Hampton, Isle of Wight Co, Newport News, Norfolk, Poquoson, Portsmouth, Virginia Beach
2011	August 26	4024	Hurricane Irene	All study area communities
2016	November 2	4291	Hurricane Matthew	Chesapeake, Franklin, Isle of Wight County, Norfolk, Portsmouth, Southampton County, Suffolk, Virginia Beach
2018	December 18	4411	Tropical Storm Michael	James City County
2018	October 15	4401	Hurricane Florence	Newport News, Hampton, Williamsburg, Isle of Wight County
2020	April 2	4512	Covid-19 Pandemic	All study area communities

Source: FEMA, 2021

NATIONAL CENTER FOR ENVIRONMENTAL INFORMATION STORM EVENT DATABASE

Much of the data in the remaining tables of this section were taken from the NOAA NCEI database. NCEI receives storm data from the NWS which, in turn, receives their information from a variety of sources, including: city, county, state, and federal emergency management officials, local law enforcement officials, skywarn spotters, NWS damage surveys, newspaper clippings, the insurance industry, and the general public. Information on hazard events not recorded in this database is provided in narrative format for each hazard subsection to supplement the NCEI data and to provide a more accurate depiction of historic hazard events in the region. While far from perfect, the NCEI data represents the best weather history data available that covers the entire region, and provides damages.

FLOODING

BACKGROUND

Photo courtesy of the City of Chesapeake.

Nationwide, the primary types of flooding include riverine, coastal, and urban flooding. Riverine flooding is a function of excessive precipitation levels and water runoff volumes within a stream or river. Coastal flooding is typically a result of storm surge, wind-driven waves, and heavy rainfall produced by hurricanes, tropical storms, nor'easters, and other large coastal storms. Urban flooding occurs when manmade development obstructs the natural flow of water or when impervious surfaces significantly decrease the ability of natural groundcover to absorb and retain surface water runoff.

Hampton Roads is subject to a variety of flood sources. The three major sources are: coastal flooding and storm surge associated with large amounts of tidally-influenced water being pushed inland from Hampton Roads and nontidal, riverine flooding as a result of excess precipitation in the watershed. Precipitation flooding occurs when rain intensity exceeds capacity of storm drain systems due to blockages or naturally low-lying areas. Tidal floods are influenced by tidal variations and are directly related to land elevation and proximity to the coastline. This type of flooding occurs in the study area with increasing regularity and is exacerbated by wind speed and direction, sea level rise and occurrence in conjunction with other types of flooding.

Similar to hurricanes, nor'easters are ocean storms capable of causing substantial damage to coastal areas in the Eastern United States due to their strong winds and heavy surf. Nor'easters are named for the winds that blow in from the northeast and drive storms up the East Coast along the Gulf Stream, a band of warm water that lies off the Atlantic coast. They are caused by the interaction of the jet stream with horizontal temperature gradients and generally occur during the fall and winter months when moisture and cold air are plentiful.

Nor'easters are known for dumping heavy amounts of rain and snow, producing hurricane-force winds, and creating high surf that causes severe beach erosion and coastal flooding. There are two main components to a nor'easter: (1) a Gulf Stream low-pressure system (counter-clockwise winds) generated off the southeastern U.S. coast, gathering warm air and moisture from the Atlantic, and pulled up the East Coast by strong northeasterly winds at the leading edge of the storm; and (2) an Arctic high-pressure system (clockwise winds) which meets the low-pressure system with cold, arctic air blowing down from Canada. When the two systems collide, the moisture and cold air produce a mix of precipitation and have the potential for creating dangerously high winds and heavy seas. As the low-pressure system deepens, the intensity of the winds and waves increase and can cause serious damage to coastal areas as the storm moves northeast.

The presence of the Gulf Stream off the eastern seaboard in the winter season acts to dramatically enhance the surface horizontal temperature gradients within the coastal zone. This is particularly true off the Virginia coastline where, on average, the Gulf Stream is closest to land north of 32 degrees latitude. During winter offshore cold periods, these horizontal temperature gradients can result in rapid and intense destabilization of the atmosphere directly above and shoreward of the Gulf Stream. This air mass modification or conditioning period often precedes wintertime coastal extra-tropical cyclone development. The temperature structure of the continental air mass and the position of the temperature gradient along the Gulf Stream drive this cyclone development. As a low pressure deepens, winds and waves can increase and cause serious damage to coastal areas as the storm generally moves to the northeast.

The coastal communities of Virginia are most vulnerable to the impacts of nor'easters. Since the storms typically make landfall with less warning than hurricanes (due to their rapid formation along the coast), residents and business owners may be caught unprepared for the impacts. Fortunately, nor'easters typically occur during the tourist off-season when fewer non-residents are visiting the coast. As with hurricanes, structural vulnerability to nor'easters is proportional to the strength of the structure, with mobile homes being particularly vulnerable.

Additional causes of flooding, especially in the western Tidewater portion of the study area, may include features, such as roadways and pipelines, that act as choke points in the river, blocking debris and restricting the flow of water during heavy flooding events; development of the watershed resulting in the loss of riparian zone and vegetation coverage; land management, including forestry and farming practices; and deficiencies in manmade drainage systems.

The periodic inundation of floodplains adjacent to rivers, streams, and shorelines is a natural and inevitable occurrence that can be expected to take place based upon established recurrence intervals. FEMA has studied and mapped both the 100-year floodplain (with a 1% chance of being equaled or exceeded in any given year), and the 500-year floodplain (with a 0.2% chance of being equaled or exceeded in any given year) for the study area.

LOCATION AND SPATIAL EXTENT

Flooding can occur along all waterways in the region. Localized riverine flooding can occur in areas of Hampton Roads not adjacent to a major body of water. Large sections of the region are low and subject to tidal flooding during hurricanes and severe nor'easters. Flood duration is typically shorter for hurricanes and tropical storms than for nor'easters because the storms tend to move faster and affect only 1 to 2 tidal cycles. The main impacts from flooding include:

- Inundation of low-lying residential neighborhoods and subsequent damage to structures, contents, garages, and landscaping; over time, mold and mildew from flooding can damage building components and mold spores can cause adverse health effects, including allergic reactions;
- Impassable road crossings and consequential risk for people and cars attempting to traverse flooded crossings;
- Damage to public and private infrastructure, possibly including but not limited to water and sewer lines, bridge embankments, and both small and large drainageways;
- Wave action responsible for shoreline damage, and damage to boats and facilities, including ships, ports and shipyards;
- Inundation of critical facilities, possibly including some fire stations, police facilities, public shelters, emergency operations centers (EOC), and several publicly-owned buildings. Public shelter availability is limited by the expected severity of flooding. (See **Table 5.2** for number of critical facilities in flood hazard areas.)
- Recovery time needed to bring critical infrastructure, schools and employers back online. Of particular concern in the region are transportation routes, including school buses, housing for displaced residents and debris management.

Communities in the study area have outlined detailed plans for activating their EOC, protecting critical facilities and taking specific drainage system actions when faced with an impending flood. Since power outages and threats to the water supply can result from both the wind and flood hazard (which often occur simultaneously in the region), residents are advised of appropriate precautions and specific low-lying areas are evacuated to protect the safety of residents, tourists and responders, and to minimize loss of life.

When severe floods occur, the regional economy is severely impacted by the inability of flooded homeowners to get back to work quickly, the slow rebound of closed or debris-strewn transportation routes, the closing of schools and businesses, and the general state of emergency. Power outages and boil-water advisories are common and can affect many thousands of residents and businesses in the region for several days or even weeks if the damage is severe. Severely flooded homes and even whole neighborhoods result in displaced residents, including schoolchildren. Loss of life due to people traversing flooded roads, remaining in or becoming trapped in flooded structures, and curiosity-seekers watching storm surge is possible. Flooded businesses that decide to close, move or cease operations in the region have an impact on land values and the labor force, as does flood damage to the facilities of large port-related employers in the region such as shipyards and marinas. Time spent repairing flood damage versus productive value-added labor is costly to employers.

Over time, the pressure on communities and elected officials to fix flooding problems has increased in the region. Longer-term impacts to the real estate market from flooding and flood insurance costs are impacting property sales, especially for older homes in the densely-populated floodplains of Hampton, Newport News, Poquoson, Norfolk, Portsmouth and Virginia Beach. The large number of structures vulnerable to flood damage (see Section 5 for more details) and the cost of measures needed to mitigate such a large-scale problem is daunting for emergency managers, floodplain managers, planners and building professionals throughout the region.

Areas identified as vulnerable to flooding are depicted on FEMA's Flood Insurance Rate Maps (FIRMs), which were developed through the National Flood Insurance Program (NFIP), show the existing potential flood hazard areas throughout the region based on the estimated 100-year floodplain (**Figure 4.1**)**.** The 100-year floodplain represents the area susceptible to the 1% annual flood. The 100-year flood, or base flood, has at least a 26% chance of occurring over the life of a typical 30-year mortgage. FIRM data is available through several sources for more detailed viewing at the parcel level:

- Paper FIRMs are available for viewing in each jurisdiction in the study area that participates in the NFIP;
- The FEMA Map Service Center at https://msc.fema.gov/portal/ is the official public source for flood hazard information produced in support of the NFIP;
- The Virginia Flood Risk Information System (VFRIS) is a collaboration between the Virginia Department of Conservation and Recreation (DCR) and the Virginia Institute of Marine Science (VIMS). The tool has flood depths, changes since the last FIRM, limit of moderate wave action (LiMWA), parcel boundaries, and the ability to download flood insurance studies and flood risk reports - http://cmap2.vims.edu/VaFloodRisk/vfris2.html
- Most localities in the study area have property information viewer tools with flood data layers, and several have included additional sea level rise inundation viewers. The following may be helpful:

  Hampton - https://webgis2.hampton.gov/sites/ParcelViewer/Account/LogOn
  Newport News - http://gis2.nngov.com/gis/
  Poquoson - https://parcelviewer.geodecisions.com/Poquoson/Account/Logon
  Williamsburg - https://williamsburg.maps.arcgis.com/apps/webappviewer/index.html?id=a5996d069d934d58bbcf1918129858f8 (does not have flood layer)
  James City County - http://property.jamescitycountyva.gov/JamesCity/Account/Logon
  York County - http://maps.yorkcounty.gov/York/Account/Logon
  Norfolk STORM Map – real-time event mapping - https://orf.maps.arcgis.com/apps/webappviewer/index.html?id=eb7164021ada45fea397d66fa84f4441
  Interactive Norfolk – various GIS layers, including flood zones - https://orf.maps.arcgis.com/apps/webappviewer/index.html?id=eb7164021ada45fea397d66fa84f4441
  TITAN (Tidal inundation Tracking Application for Norfolk) – https://orf.maps.arcgis.com/apps/dashboards/1fd204f3515e40428e77eea7c659a0e1
  Portsmouth - https://www.portsmouthva.gov/328/Flood-Maps
  Suffolk - http://apps.suffolkva.us/realest/
  Virginia Beach - https://gisapps.vbgov.com/map/

Chesapeake - https://www.cityofchesapeake.net/government/city-departments/departments/Real-Estate-Assessor/app.htm
Isle of Wight County, Smithfield, Windsor - http://iowgis.maps.arcgis.com/apps/webappviewer/index.html?id=4889333b70534c018c2c723b4d953f51
Southampton County, Franklin, towns - http://www.southampton.interactivegis.com/index.php#
Surry County - https://parcelviewer.geodecisions.com/surry/Account/Logon

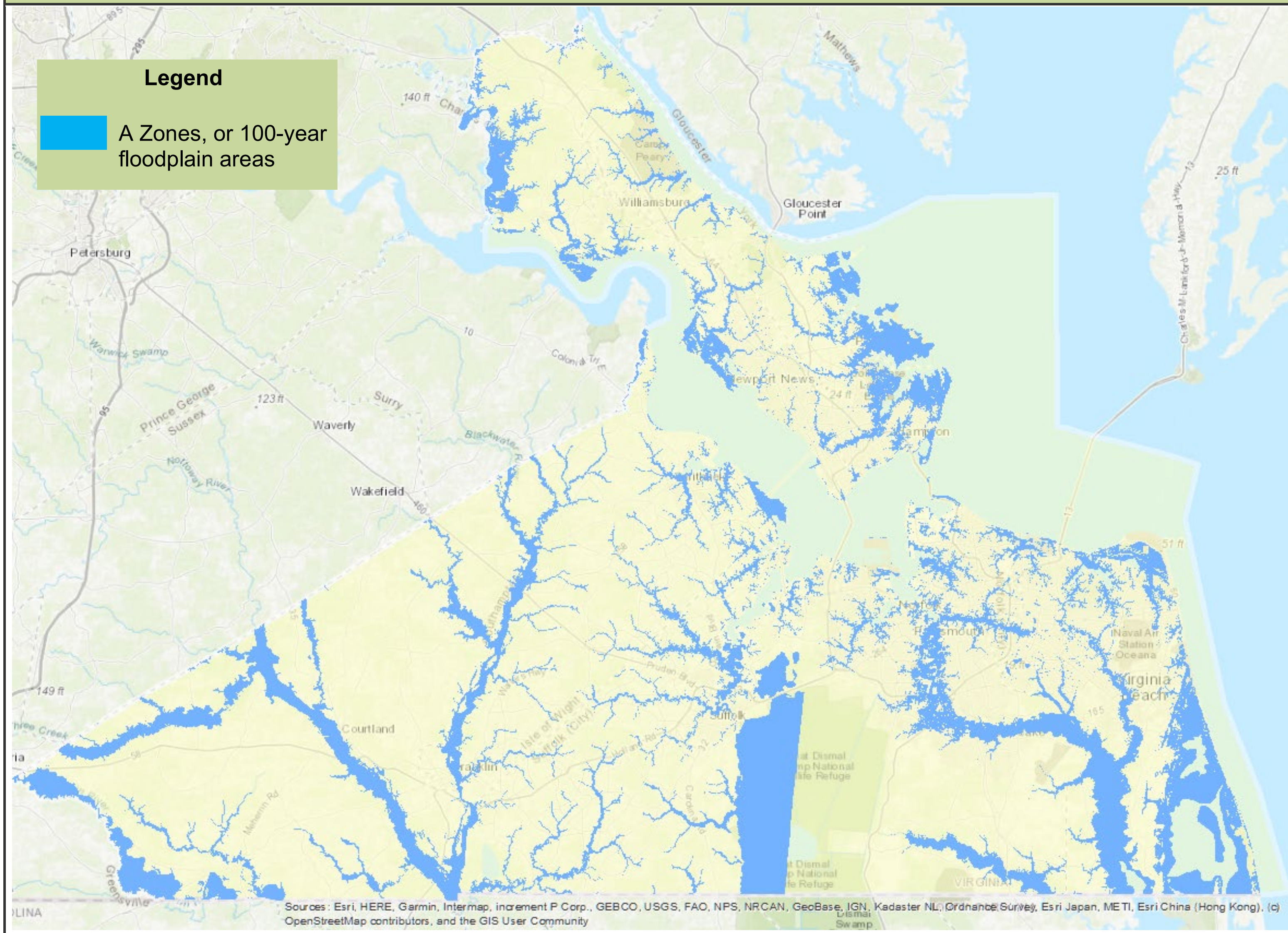
Figure 4.2 shows the 500-year flood hazard area with a 0.2-percent annual chance of flooding) and floodways, which are the channels of rivers or other watercourses and the adjacent land areas that must be reserved in order to discharge the base flood. Floodways are typically reserved for the fastest and strongest flows during the base flood.

Figure 4.3 shows the LiMWA, which delineates the Coastal A Zone, and the Coastal V Zone, or coastal high hazard area, an area of special flood hazard which is subject to high velocity waters from tidal surge or hurricane wave wash.

Figure 4.4a shows the most recent storm surge hazard areas that can be expected as the result of Category 1, 2, 3, and 4 hurricanes, based on the Sea, Lake and Overland Surge from Hurricanes (SLOSH) model. SLOSH is a computerized model run by the NWS to estimate storm surge heights resulting from hypothetical hurricanes by taking into account the maximum of various category hurricanes as determined by pressure, size, forward speed, and sustained winds. The regional analysis represents the composite maximum water inundation levels for a series of parallel tracks making landfall at various points along the coast. The SLOSH model, therefore, is best used for defining the “worst case scenario” of potential maximum surge for particular locations as opposed to the regional impact of one singular storm surge event.

Figure 4.4b shows the Virginia Hurricane Evacuation Routes for Hampton Roads. Termed the “Know Your Zone” initiative, this map and the effort to get the information engrained into residents’ minds prior to impending hurricane-related flooding or high winds, emphasizes the importance of warning and evacuating residents and visitors well before weather conditions deteriorate. When a storm is approaching, emergency managers will determine which zones are most at risk considering the intensity, path, speed, tides and other meteorological factors. Emergency managers at the state and local level will work with local media and use social media and other tools to notify residents of impacted zones and what they should do to stay safe. Depending on the emergency, being safe might mean staying at home, a short trip to higher ground, or traveling to a different region of the state. Given the geography of the region and the reliance of the transportation system on tunnels and bridges, early evacuation is a crucial element in public safety.

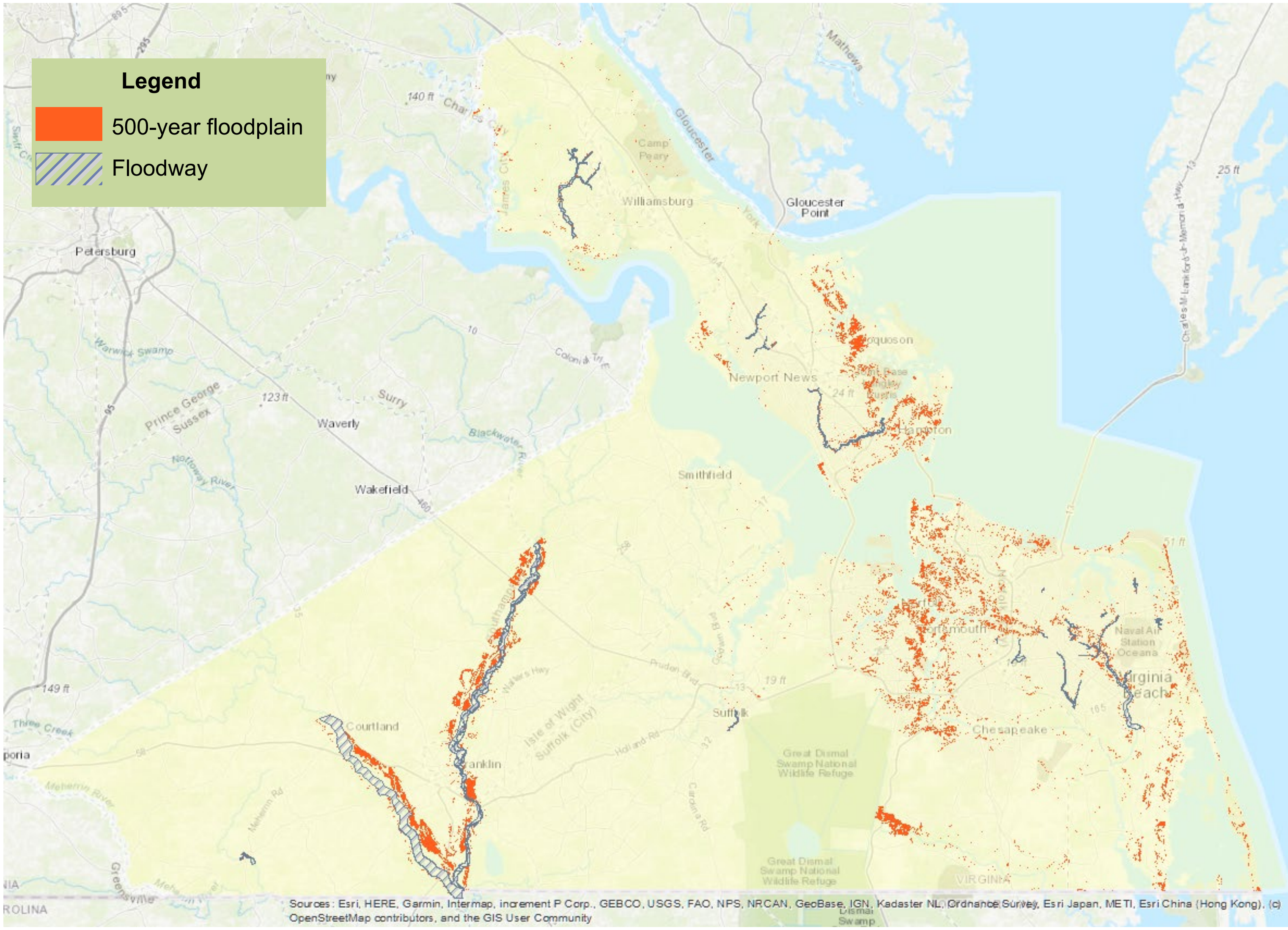
FIGURE 4.1: 100-YEAR FLOOD HAZARD AREAS



2021

Source: Federal Emergency Management Agency, 2021

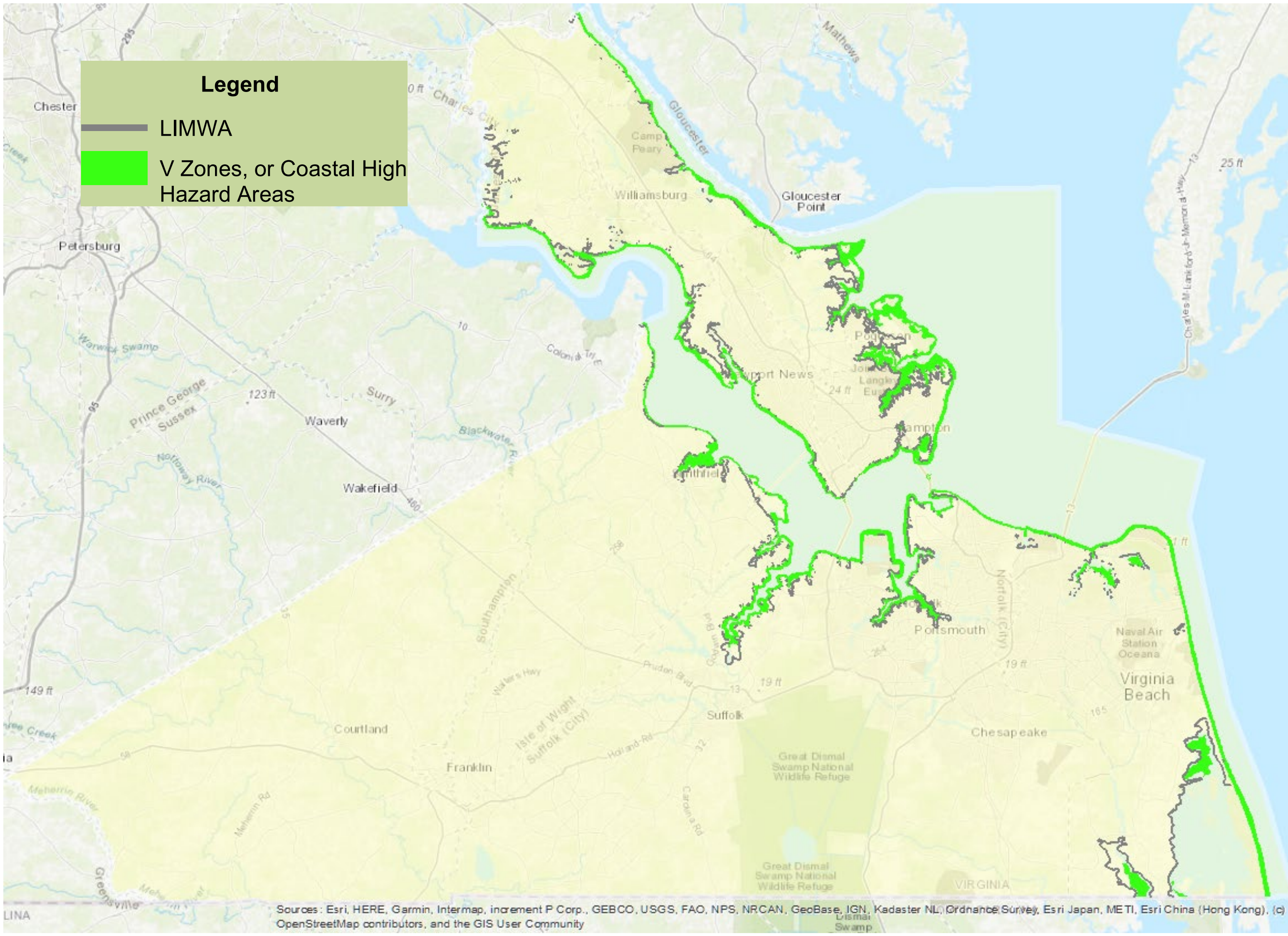
FIGURE 4.2: 500-YEAR FLOOD HAZARD AREAS AND FLOODWAYS



2021

Source: Federal Emergency Management Agency, 2021

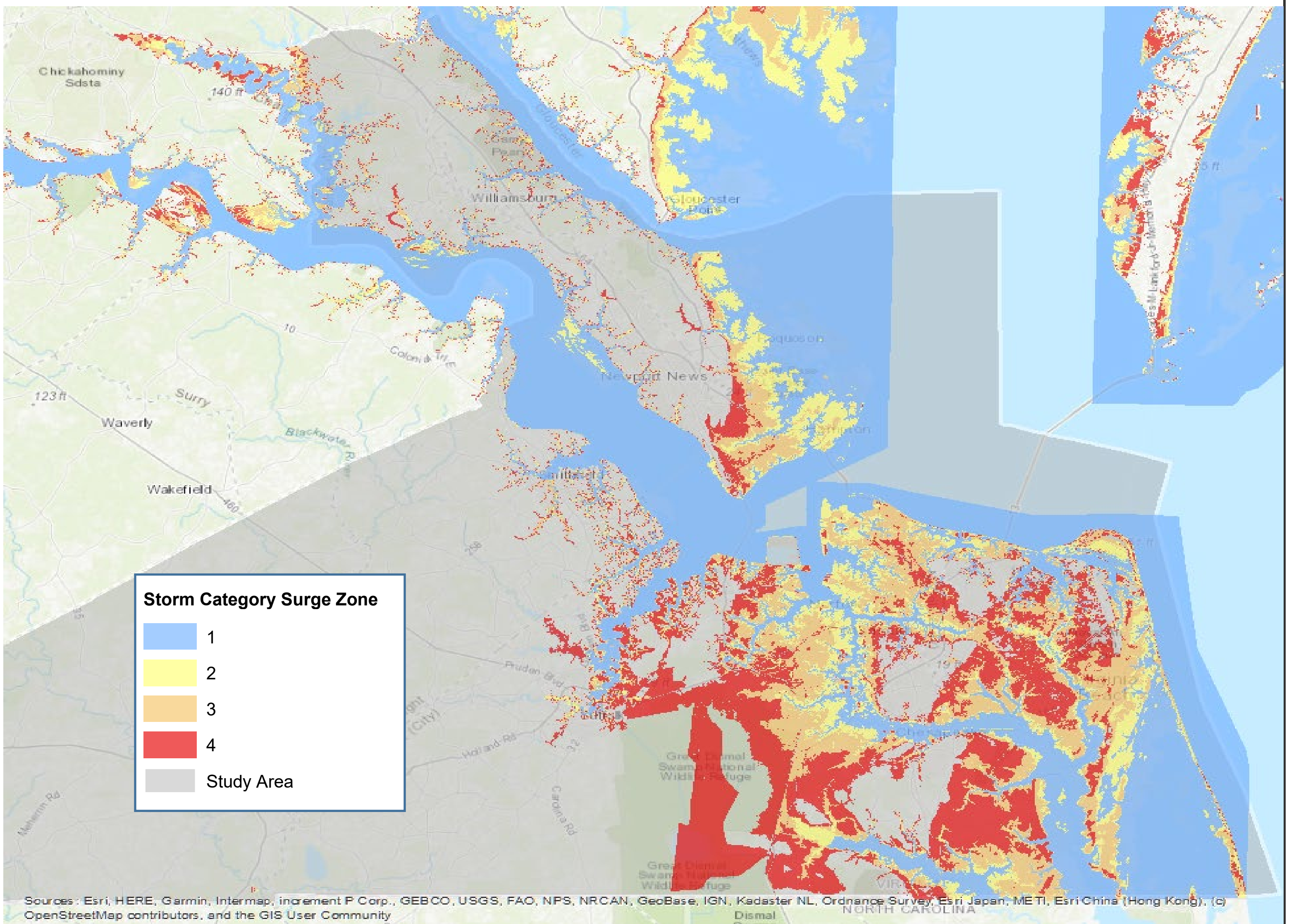
FIGURE 4.3: COASTAL HIGH HAZARD AREAS (V ZONES) AND LIMITS OF MODERATE WAVE ACTION (LIMWA)



2021

Source: Federal Emergency Management Agency, 2021

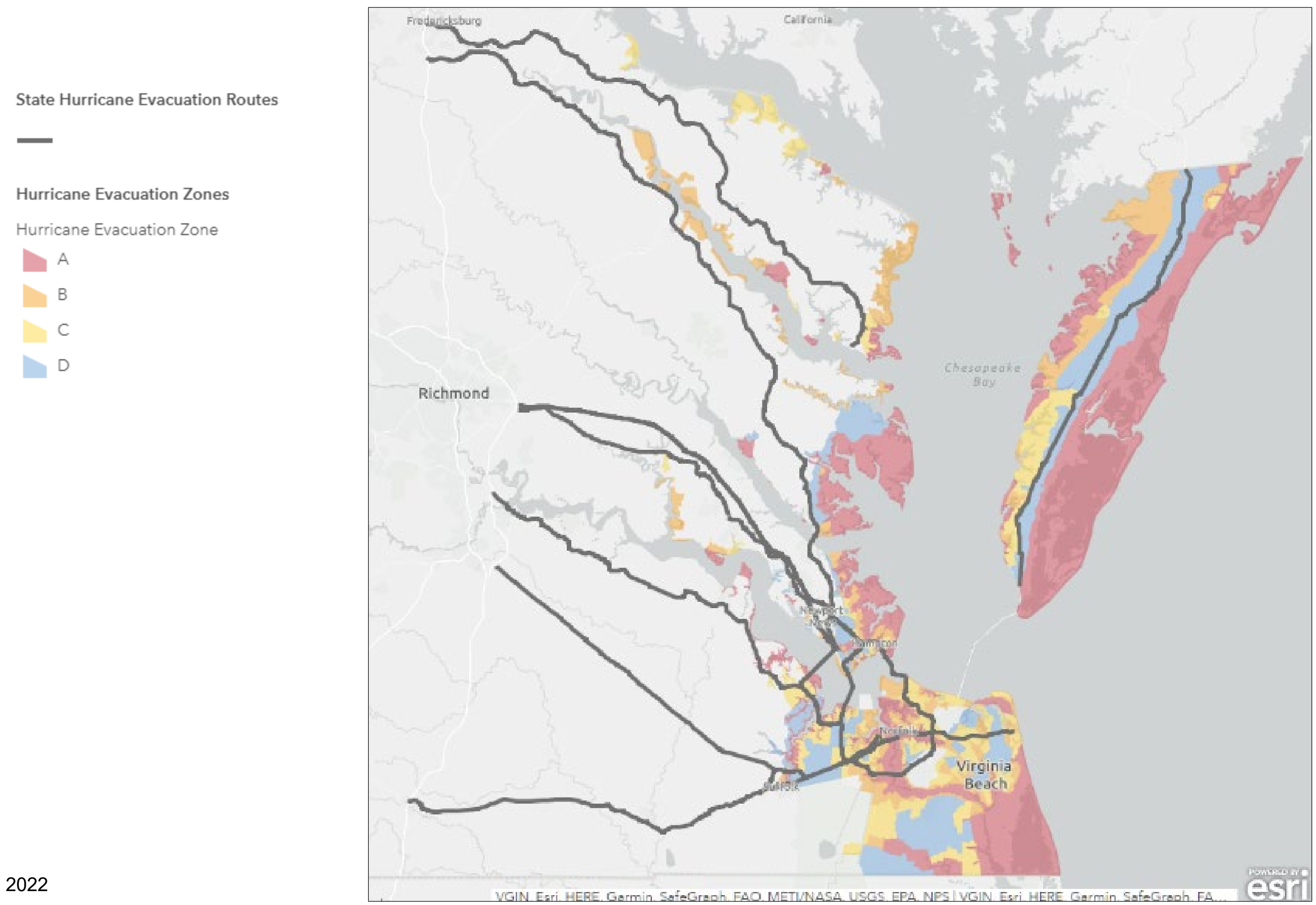
FIGURE 4.4A: HAMPTON ROADS STORM SURGE ZONES



2021

Source: U.S. Army Corps of Engineers, Norfolk District, 2021.

FIGURE 4.4B: VIRGINIA HURRICANE EVACUATION ROUTES



Source: Virginia Department of Emergency Management, 2022.

In addition to floodplains, tidal and non-tidal wetlands within all of Hampton Roads' watersheds help store floodwaters, reduce erosion and filter pollutants. Wetlands are the transition area between aquatic and terrestrial habitats. A primarily low, marshy area, a wetland is saturated or even submerged all or part of the year, with soils that support unique plant and animal life. Wetlands work as a natural measure to help slow down the rising water from storms that may cause flooding, which is accomplished by acting as a giant sponge, absorbing and holding water during storms. Fast moving water is slowed by vegetation and temporarily stored in wetlands. Wetlands also filter pollutants carried by stormwater, which can be trapped by wetland vegetation. These excess nutrients are then used by the plants to promote growth.

Wetlands are resting, nesting, breeding, and spawning areas for many species of fish, shellfish, as well as other plant and animal life. More than one half of all threatened and endangered species depend on wetlands at one point of their life cycle. Hampton Roads, though located entirely within the Coastal Plain, spans a diverse range of habitats, including sandy ocean beaches, salt marshes of the Chesapeake Bay, wind tidal fresh marshes, dry sandhills, seasonally wet ponds and blackwater swamps. These habitats support many rare and significant plant communities and rare species, including:

Mabee's Salamander	*Ambystoma mabeei*	State threatened
Tiger Salamander	*Ambystoma tigrinum*	State endangered
Piping Plover	*Charadrius melodus*	State & Federal threatened
Wilson's Plover	*Charadrius wilsonia*	State endangered
Red-cockaded Woodpecker	*Dryobates borealis*	State & Federal endangered
Peregrine Falcon	*Falco peregrinus*	State threatened
Gull-billed Tern	*Gelochelidon nilotica*	State threatened
Black Rail	*Laterallus jamaicensis*	State endangered & Federal threatened
Yellow Lance	*Elliptio lanceolata*	State & Federal threatened
Atlantic Pigtoe	*Fusconaia masoni*	State & Federal threatened
Northeastern Beach Tiger Beetle	*Cicindela dorsalis dorsalis*	State & Federal threatened
Atlantic Sturgeon	*Acipenser oxyrinchus*	State & Federal endangered
Roanoke Logperch	*Percina rex*	State & Federal endangered
Eastern Big-eared Bat	*Corynorhinus rafinesquii macrotis*	State endangered
Little Brown Myotis	*Myotis lucifugus*	State endangered
Northern long-eared Myotis	*Myotis septentrionalis*	State & Federal threatened
Tricolored bat (=Eastern pipistrelle)	*Perimyotis subflavus*	State endangered
Loggerhead (Sea Turtle)	*Caretta caretta*	State & Federal threatened
Canebrake Rattlesnake	*Crotalus horridus [Coastal Plain population]*	State endangered
Chicken Turtle	*Deirochelys reticularia*	State endangered
Eastern Glass Lizard	*Ophisaurus ventralis*	State threatened
Sensitive Joint-vetch	*Aeschynomene virginica*	State & Federal threatened
Harper's fimbry	*Fimbristylis perpusilla*	State endangered
Small Whorled Pogonia	*Isotria medeoloides*	State endangered & Federal threatened
New Jersey Rush	*Juncus caesariensis*	State threatened
Narrow-leaved Spatterdock	*Nuphar sagittifolia*	State threatened
Reclining Bulrush	*Scirpus flaccidifolius*	State threatened

Source: Virginia Department of Conservation and Recreation, Natural Heritage Program, April 2022

Coastal wetlands absorb the erosive energy of waves, thus reducing further erosion. The vegetation provides a buffer to the shoreline from the wave action while the root systems provide support to help hold the soil together. Once plant material is removed or destroyed, the erosion potential increases dramatically. When any type of wetlands are filled in or drained, the areas designed by nature to control floodwaters from damaging storms, extreme high tides, and extreme precipitation are lost.

Existing natural area preserves in the region include: Antioch Pines; Blackwater Ecological Preserve; Blackwater Sandhills; Cypress Bridge; False Cape; Grafton Ponds; North Landing River; Northwest River; and, South Quay Sandhills. There are approximately 236,660 acres of conserved lands in the region, with the largest concentrations in Chesapeake, Suffolk, Virginia Beach, and York County. Conservation targets of special significance in the Hampton Roads region include:

- Pine barren communities;
- Seasonal depression ponds and other significant wetlands;
- Large blocks of old-growth cypress-tupelo swamps;
- Habitat for rare reptiles and amphibians;
- Lands along the Northwest and North Landing rivers; and
- Forestland along the Blackwater, Meherrin and Nottoway rivers.

SIGNIFICANT HISTORICAL EVENTS

Many flood events that have occurred in the region have been the result of coastal storms, tropical storms or hurricanes. Other localized flooding occurs when heavy rains fall during high tide causing waters that would normally drain quickly to back up because of the tides. Based on historical and anecdotal evidence, it is clear that there is a relatively high frequency of flooding in the region. Some of the notable flood events to impact Hampton Roads are discussed below.

The "**Dreadful Hurricane of 1667"** occurred on September 6th. This system is considered one of the most severe hurricanes to ever strike Virginia. On September 1st, this same storm was reported in the Lesser Antilles. The hurricane devastated St. Christopher as no other storm had done before. The "great storm" went on to strike the northern Outer Banks of North Carolina and southeastern Virginia. The wind turned from the northeast to due south and finally to the west, which suggested a track similar to the August 1933 hurricane. This 1667 hurricane lasted about 24 hours and was accompanied by very violent winds and tides. Approximately 10,000 houses were blown over. Area crops (including corn and tobacco) were beat into the ground. Many cattle drowned in area rivers and bays by the twelve foot storm surge and many people had to fleet the region. The foundations of the fort at Point Comfort were swept into the river. A graveyard of the First Lynnhaven parish church tumbled into the waters. Twelve days of rain followed this storm across Virginia. This system is blamed for the widening of the Lynnhaven River. Ships in regional rivers sustained great damage.

The Storm of 1749 is one of the most notable storms to occur in the region. It was responsible for the formation of Willoughby Spit, a formation of land approximately two miles long and a quarter mile wide. This storm created a 15-foot storm surge that flooded much of the region.

On **March 1-3, 1927** a nor'easter hit the region with high winds gusting to 62 mph at Cape Henry and 52 mph at Norfolk. Heavy snow fell across North Carolina into Virginia and travel was delayed for two to three days. In Virginia Beach, high tide and heavy surf on March 2 inflicted considerable damage. The beaches in some places were washed back 50 feet and denuded of the overlying sand, exposing the clay beneath.

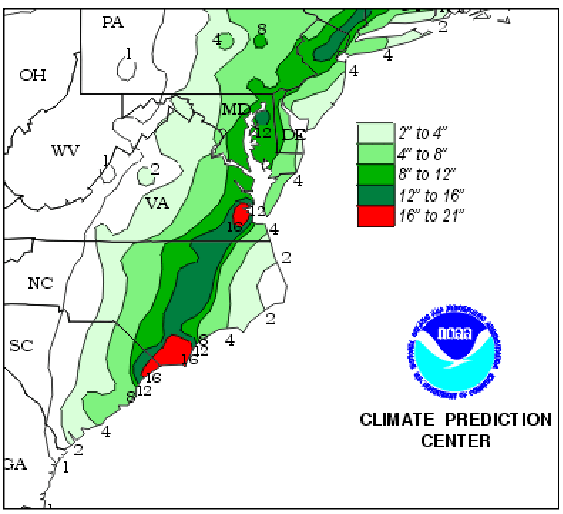
The Chesapeake-Potomac hurricane struck the region on **August 23, 1933** and created a high tide in Norfolk of 9.69 feet above Mean Lower Low Water (MLLW), a record for the area. Eighteen people were killed by this storm that also flooded downtown Norfolk and destroyed homes at Ocean View. Winds were recorded at 70 mph in Norfolk, 82 mph at Cape Henry, and 88 mph at the Naval Air Station in Norfolk.

Flooding of **August 13-18, 1940**, was the result of four significant rainfall events within a three-week period. During this historical flood for the region, the Blackwater River crested at 21.9 feet, approximately 10 feet above flood stage for the City of Franklin. One of the primary causes of this flood event was an unnamed tropical cyclone that meandered across the southeast United States for four days before dissipating on August 15. Rains began in earnest in Virginia on August 13 as the storm entered the state from the west. Deluges flooded locations statewide with 4.76 inches of rainfall being measured in Hampton Roads. The Meherrin River at nearby Emporia reached a flood of record stage on August 17 when the river crested at 31.5 feet, 8.5 feet above flood stage. A total of 16 deaths in Virginia and neighboring states are directly attributed to this flood event.

On **April 11, 1956**, a severe nor'easter gave gale winds (greater than 40 mph) and unusually high tides to the Tidewater Virginia area. At Norfolk, the strongest gust was 70 mph. The strong northeast winds blew for almost 30 hours and pushed up the tide, which reached 4.6 feet above normal in Hampton Roads. Thousands of homes were flooded by the wind-driven high water and damages were large. Two ships were driven aground. Waterfront fires were fanned by the high winds. The flooded streets made access to firefighters very difficult, which added to the losses.

The Ash Wednesday storm of 1962 produced very severe flooding throughout the Hampton Roads region partly because it occurred during "Spring Tide" (sun and moon phase to produce a higher than normal tide). The storm moved north off the coast past Virginia Beach and then reversed its course moving again to the south and bringing with it higher tides and waves which battered the coast for several days. The storm's center was 500 miles off the Virginia Capes when water reached nine feet at Norfolk and seven feet on the coast. Huge waves toppled houses into the ocean and broke through Virginia Beach's concrete boardwalk and sea wall. Houses on the bay side also saw extensive tidal flooding and wave damage. The beaches and shorefront had severe erosion. Locals indicated that the damage from this storm was worse in Virginia Beach than that caused by the 1933 Hurricane. The islands of Chincoteague and Assateague on the Eastern Shore were completely submerged. Receding water exposed hundreds of thousands of dead chickens drowned by the flooding. The Virginia Department of Health (VDH) indicated that it was an extreme health hazard and asked all women, children, and elderly to evacuate. A million dollars in damage was done to NASA's Wallops Island launch facility and an estimated $4 million in wind and flood damages occurred in the City of Hampton. Winds were recorded at speeds up to 70 mph causing 40-foot waves at sea. This storm also produced Virginia's greatest 24-hour snowfall with 33 inches and the greatest single storm snowfall with 42 inches (these were recorded in the mountainous western region of the Commonwealth).

In September of 1999, **Hurricane Floyd** was responsible for wind and flood damage in the Hampton Roads region. Several trees were uprooted as wind speeds were recorded between 50 and 80 mph across the region. This event brought over 10 inches of rain to Chesapeake, and approximately 13 inches to the Southampton County/City of Franklin area, and occurred just two weeks after Tropical Storm Dennis had saturated the area with 6.2 inches of rain. Hurricane Floyd caused the Great Dismal Swamp to overflow its banks creating flooding along the Northwest River. In Suffolk, during Hurricane Floyd in 1999, Speight's Run spillway was compromised rendering Turlington Road impassable. Other dams in Suffolk were overtopped by what was reported as 8 feet of water. In western Tidewater, primary routes out-of-service due to flooding included U.S. Highway 58 near Franklin and Interstate 95 south of Petersburg to Emporia. Riverine flooding was extensive and prolonged throughout the Chowan River Basin with the Blackwater, Meherrin and Nottoway Rivers all exceeding flood stage. Water levels within the City of Franklin were estimated to be more than four feet above the previous flood of record, which occurred in August 1940, making it the new flood of record. Gage height indicated that the water reached a height of 26.27 feet on September 18, 1999. By early morning on September 16, the Blackwater River had made its way to Main Street bringing four to five feet of water to even the higher elevations of Downtown Franklin, and floodwaters continued to rise at a rate of approximately six inches per hour. Approximately 100 homes and 182 businesses were totally destroyed as a result of the flooding. Floodwaters did not begin to recede until September 21, and home and business owners were not able return to their properties and begin to evaluate their losses until September 28. The flooding was a 500-year flood of record for parts of the basin. Also, there were enormous agricultural/crop losses due to the flooding.



Rainfall totals from Hurricane Floyd.
Source: NOAA Climate Prediction Center, 1999

On **October 17, 1999**, a flash flood, which resulted from very heavy rainfall associated with Hurricane Irene, ranged from five to nine inches in the City of Franklin and Southampton County. The precipitation resulted in numerous flooded roads and road closures due to high water. Specific problem areas in Franklin included: a ditch along Armory Drive near the Wal-Mart Shopping Plaza where fast-moving water and drainage issues caused some road erosion; and flooding near the library caused problems along Second Avenue.

In September of 2003, **Hurricane Isabel** caused widespread flooding, comparable to that caused by the 1933 hurricane and the Ash Wednesday Storm of 1962. Hurricane Isabel proved to be the costliest disaster in Virginia's history. The storm produced a high storm surge (four to five feet in Southside Hampton Roads) which inundated the tidal portions of the region's creeks and rivers. Damage from flooding was extensive to structures and infrastructure in the planning area. The NFIP processed more than 24,000 Isabel claims in six states and the District of Columbia, totaling nearly $405 million. As a result of polluted runoff, VDH forbade gathering shellfish in the Virginia portion of the Chesapeake Bay, and rivers flowing into the bay. On September 18, 2003, Hurricane Isabel made landfall off the coast of northeast North Carolina. The hurricane, which had originally been a Category 5 storm, reached Chesapeake as a weak Category 1 storm. The magnitude of Hurricane Isabel's impact on the region was historic with rain, storm surge, and wind severely affecting many areas. Rainfall from Hurricane Isabel averaged four to seven inches over large portions of eastern North Carolina, east-central Virginia, and Maryland.

Although no damage was reported in the NCEI records, several streets in Franklin flooded as a result of precipitation associated with **Tropical Storm Ernesto** during the first four days of **September, 2006**. Ernesto strengthened throughout the day on Thursday, August 31 with maximum sustained winds reaching 70 mph. The Tropical Storm made landfall in Brunswick County, North Carolina near Long Beach at 1130 PM on Thursday, August 31. Ernesto moved north across the Coastal Plain of North Carolina on Friday, September 1, reaching southeastern Virginia as a Tropical Depression during the late afternoon on Friday. The system became extratropical late Friday evening as it moved across eastern Virginia. The Blackwater River crested at 15.61 feet according to stream gage data.

Between **October 7 and 10, 2006**, a strong low pressure system off the North Carolina coast coupled with an upper level cutoff low to dump intense rainfall across portions of southeastern Virginia and western Tidewater. Rainfall amounts in excess of 10 inches resulted in numerous road closures and moderate to major river flooding from late Friday, October 6th through Saturday, October 7th. In Franklin, the Blackwater River flooded much of downtown Franklin. Numerous businesses and residences sustained water damage, with estimates of property damage totaling approximately $4 million and crop damage estimated at $700,000. The Blackwater River crested October 10, 2006, at 22.77 feet.

Downtown Franklin during the October, 2006 flood. Source: City of Franklin photo

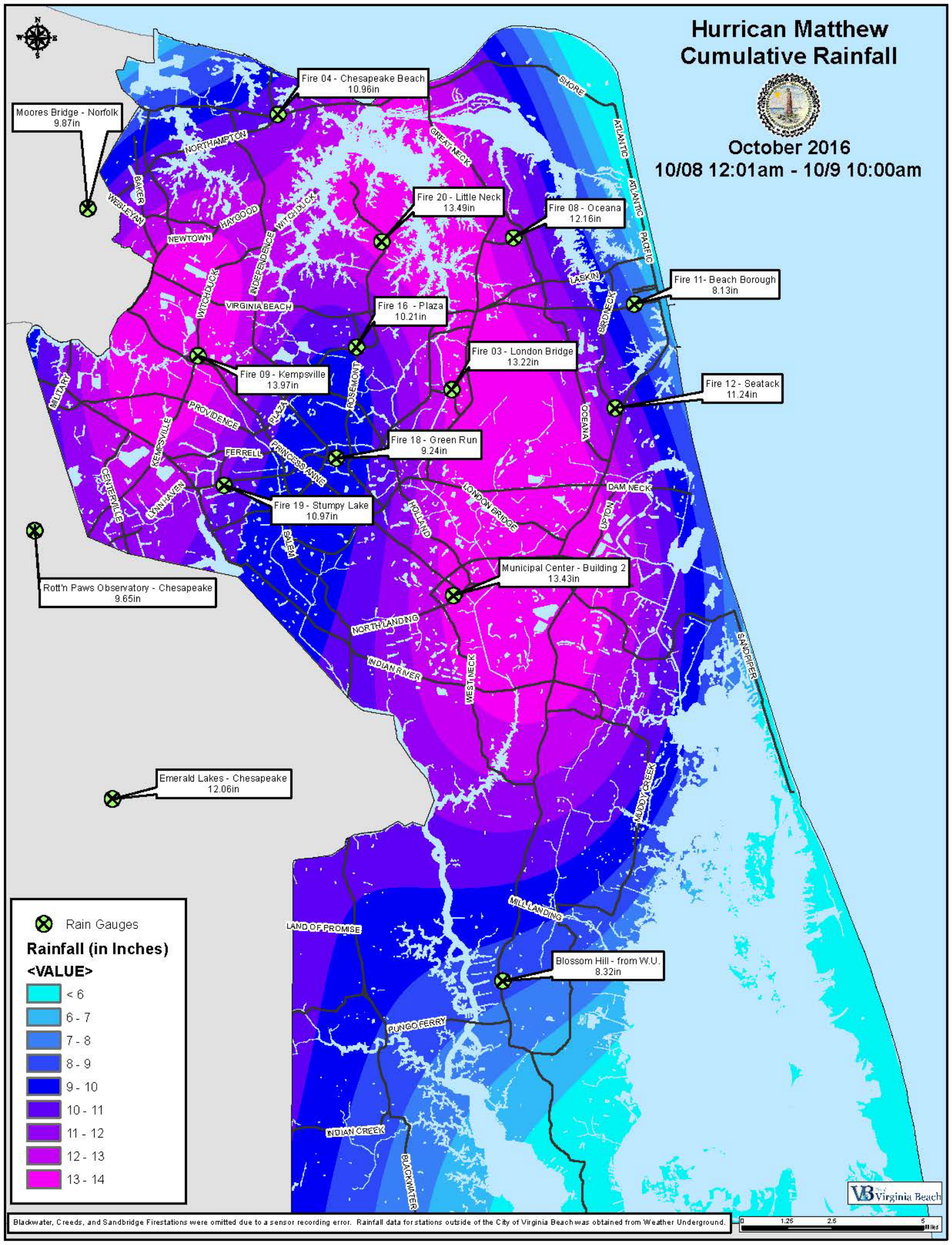
The November **2009 Mid-Atlantic nor'easter** (or "Nor'Ida") was a powerful storm that caused widespread flooding throughout the region. Persistent onshore flows brought elevated water levels for four days. At Sewells Point, a max storm tide of 7.74 feet MLLW was recorded on November 13th, the third highest recorded tide of all time at that location. Widespread coastal damage and major flooding occurred as a result of seven inches of rainfall and large wind-driven waves impacting beaches. Damage in Virginia exceeded $38.8 million, of which 64% was in Norfolk alone. According to the NWS, 7.4 inches of rain fell in Norfolk between November 11 and 13. Hurricane-force winds also affected the region, with a peak gust of 75 mph recorded at Oceana.

In August 2011, **Hurricane Irene** moved northward over the Outer Banks of North Carolina and just off the Virginia coast, producing heavy rains which caused widespread flooding across most of south central and southeast Virginia Saturday morning, August 27th into early Sunday morning, August 28th. Storm total rainfall generally ranged from six to as much as 12 inches. Heavy rains associated with Hurricane Irene produced widespread lowland flooding across much of Southside Hampton Roads, including roadways which were washed out or closed. Great Bridge reported 10.75 inches of rain. Deep Creek reported 9.72 inches of rain. Very heavy rainfall ranged from five to nine inches in the City of Franklin and Southampton County. The precipitation resulted in numerous flooded roads and road closures due to high water. Fort Monroe estimated wind and water caused an estimated $2.2 million in damage to properties leased by the Fort Monroe Authority.

At the end of October 2012, **Tropical Cyclone Sandy** moved northward well off the Mid Atlantic Coast producing heavy rain which caused flooding across much of eastern and southeast Virginia. Storm total rainfall ranged from four inches to as much as 10 inches across the area. Numerous roads were closed due to flooding. Storm total rainfall ranged from three to six inches across Chesapeake. Although the storm did not cause the destruction locally that it did in the northeast, it remains a significant rain and coastal flood event for parts of the Hampton Roads region.

In early October 2016, the combination of the tropical moisture from **Hurricane Matthew**, combined with a cold front moving across the middle Atlantic, allowed for heavy rain to fall from North Carolina through Southeast Virginia. Some locations across the Tidewater region of Virginia received more than 10 inches of rain for the storm total. This created considerable flooding across the region with many roads becoming impassible and some even washed out. According to the National Weather Service, Deep Creek in Chesapeake recorded 10.01 inches on October 9; areas in Norfolk and Portsmouth recorded just shy of 10 inches by late on October 8, or the morning of October 9. Rainfall totals on the Peninsula ranged from 5 to 9 inches. **Figure 4.5** shows the cumulative rainfall totals for Virginia Beach. The rainfall and resultant flooding resulted in 5,576 Virginia homeowners and renters applying to FEMA for disaster assistance. As of January 2017, more than $7.4 million in individual housing assistance grants and nearly $1.6 million in other needs assistance had been approved for residents of the 7 designated cities: Chesapeake, Hampton, Newport News, Norfolk, Portsmouth, Suffolk and Virginia Beach. In addition to the FEMA grants, and SBA loans, the NFIP paid out $46.8 million to 2,263 claimants to settle Flood Insurance Claims. The *Virginia Pilot* reported that Matthew damaged roughly 2,000 structures at a cost of about $30 million. In Virginia Beach in particular, the extraordinarily heavy rainfall overwhelmed the existing drainage system and left infrastructure incapable of performing to design expectations. The storm has marked a turning point for City leaders as they prioritize flood mitigation projects in coming years.

FIGURE 4.5: HURRICANE MATTHEW CUMULATIVE RAINFALL, VIRGINIA BEACH 2016



Source: City of Virginia Beach

Table 4.2 provides information on significant flood events documented by the NCEI between 1995 and December 2020 for the study area, representing the most recent data available. These events resulted in two reported deaths and one reported injury, and $189,684,000 million in property damages reported to the NCEI. Additional unreported property damages are likely. Additional data on repetitive flood losses is provided in Chapter 5. Bolded events in **Table 4.2** are described in additional detail above.

TABLE 4.2: SIGNIFICANT FLOOD EVENTS (1995 - 2021)

LOCATION	DATE OF OCCURRENCE	TYPE OF EVENT	DEATHS/ INJURIES	PROPERTY DAMAGE	DETAILS
SURRY COUNTY	1/19/1996	Flood	0/0	-	1 to 2 feet of water on Rte. 10 between Surry and Bacon Castle Rd.
SOUTHAMPTON	6/11/1996	Flash Flood	0/0	-	Heavy rain in 3 hours caused road closures in the Sebrell area.
NORFOLK	6/18/1996	Flood	0/0	-	Heavy rain in 2 hours caused road closures in the Ocean View and Willoughby Spit sections of Norfolk.
VIRGINIA BEACH	6/18/1996	Flood	0/0	$10,000	Heavy rain in a few hours caused road closures in Lynnhaven and Oceanfront sections of Northern Virginia Beach.
VIRGINIA BEACH	6/20/1996	Flood	0/0	-	Heavy rain in 1 hour caused road closures in the Alanton and Oceana sections of Virginia Beach.
NORFOLK and VIRGINIA BEACH	7/18/1996	Flash Flood	0/0	-	Heavy rain in 6 hours caused road closures with people trapped in cars along the 300-400 block of East Little Creek Road and along Campostella Road. Flooding was also reported in the Kempsville area along Indian River Road and Princess Anne Road. High water was reported in the Oceanfront area along Atlantic Avenue.
CHESAPEAKE	7/18/1996	Flash Flood	0/0	-	Heavy rain in a few hours resulted in water along Bainbridge Boulevard and Freeman Avenue and a split of Interstate 64 and 264.
VIRGINIA BEACH	7/18/1996	Flash Flood	0/0	-	Heavy rain in a few hours resulted in flooding in the Kempsville area along Indian River Road and Princess Anne Road and the Oceanfront area along Atlantic Avenue.
NORFOLK	7/31/1996	Flood	0/0	-	Streets were flooded due to two storms in an afternoon.
NEWPORT NEWS, YORK/POQUOSON, NORFOLK/HAMPTON/ PORTSMOUTH, AND VIRGINIA BEACH	4/23/1997	Coastal Flood	0/0	-	Moderate coastal flooding caused tides to peak at 5.8ft above the Mean Lower Low Water especially in Willoughby Spit, Ghent, and downtown sections of Norfolk, the Old-Town section of Portsmouth, the Buckroe Beach and Grandview sections of Hampton, and the Sandbridge section of Virginia Beach. Minor coastal flooding was reported in Newport News and York county.
NORFOLK AND VIRGINIA BEACH	6/3/1997	Coastal Flood	0/0	-	Minor to moderate flooding resulted in loss of part of the boardwalk and a couple lifeguard stands in Virginia Beach and several streets flooded in downtown Portsmouth and downtown Norfolk.
VIRGINIA BEACH, YORK/POQUOSON, NORFOLK/HAMPTON/ PORTSMOUTH, AND NEWPORT NEWS	10/19/1997	Coastal Flood	0/0	-	Minor to moderate flooding resulted in streets being closed and water in a few houses in Norfolk, downtown Portsmouth, Sandbridge and Sandfiddler areas of Virginia Beach. Minor flooding was reported in Newport News and York County.
VIRGINIA BEACH, NEWPORT NEWS, NORFOLK, AND YORK	1/27/1998	Coastal Flood	0/0	$1,500,000	A Nor'easter caused high tides and moderate coastal flooding combined with gale and storm force winds. A couple houses were damaged and power outages were scattered across the Hampton Roads area.
NORFOLK, HAMPTON, PORTSMOUTH, VIRGINIA BEACH, NEWPORT NEWS, AND YORK/POQUOSON	2/4/1998	Coastal Flood	0/0	$75,000,000	A Nor'easter caused gale & storm force winds & high tides that resulted in moderate to severe coastal flooding with damage to buildings, road closures, & scattered power outages especially in Norfolk, Virginia

TABLE 4.2: SIGNIFICANT FLOOD EVENTS (1995 - 2021)					
LOCATION	DATE OF OCCURRENCE	TYPE OF EVENT	DEATHS/ INJURIES	PROPERTY DAMAGE	DETAILS
					Beach, and Hampton. Willoughby & Ocean View had the most damage.
NORFOLK, CHESAPEAKE, VIRGINIA BEACH, SUFFOLK, and PORTSMOUTH	7/24/1999	Flash Flood	0/0	-	Roads were flooded including Hampton Boulevard. Parts on Interstate 264, Ballahack Road, and Military Highway in Chesapeake were flooded. Many other roads were flooded and impassable.
VIRGINIA BEACH, NORFOLK, CHESAPEAKE, AND PORTSMOUTH	8/14/1999	Flash Flood	0/0	-	Primary roads and underpasses were flooded including Route 13 in Chesapeake.
VIRGINIA BEACH, NORFOLK, CHESAPEAKE, SUFFOLK, AND PORTSMOUTH	9/7/1999	Flash Flood	0/0	-	A line of thunderstorms caused flooding on roads.
SUFFOLK	9/7/1999	Flash Flood	0/0	-	Road (1500 block Camp Pond Road) flooded out.
CHESAPEAKE, ISLE OF WIGHT, SUFFOLK, NORFOLK, FRANKLIN, SOUTHAMPTON, PORTSMOUTH, NEWPORT NEWS, HAMPTON, YORK, JAMES CITY, POQUOSON, SURRY COUNTY AND WILLIAMSBURG	**9/15/1999**	**Flash Flood**	**0/0**	**$35,000**	**Hurricane Floyd caused heavy rain and widespread flooding and flash flooding across eastern Virginia. 12 to 18 inches of rain fell in the Tidewater region. Numerous roads were washed out and several rivers exceeded flood stage including the Chowan River Basin and the Blackwater, Meherrin, and Nottoway Rivers. There were enormous agricultural losses due to flooding.**
SUFFOLK, SOUTHHAMPTON, ISLE OF WIGHT, FRANKLIN, NORFOLK, VIRGINIA BEACH, CHESAPEAKE, PORTSMOUTH, NEWPORT NEWS, POQUOSON, YORK, AND HAMPTON	**10/17/1999**	**Flash Flood**	**0/0**	**-**	**Heavy rainfall associated with Hurricane Irene caused flooded roads and road closures.**
JAMES CITY	7/19/2000	Flash Flood	0/0	-	Heavy rain caused flooding and standing water across the intersection of Routes 30 and 60 near Toano.
HAMPTON, NEWPORT NEWS	7/24/2000	Flash Flood	0/0	$350,000	Heavy rain caused 35 residences to be evacuated due to high water on Scoggin Circle and Grimes Road in the Buckroe Beach section of Hampton. Widespread flooding of main and secondary roads was reported in Newport News.
SOUTHAMPTON, POQUOSON, YORK AND SURRY COUNTY	7/24/2000	Flash Flood	0/0	-	Flooding on secondary roads and several roads washed out. Three interstate off-ramps were closed due to flooding in York.
NORFOLK	7/26/2000	Flash Flood	0/0	-	Heavy rain flooded roadways and caused closure of underpasses on Tidewater Drive in downtown Norfolk. Flooding also occurred at Chesapeake Boulevard and Chesapeake Street in the East Ocean View section of Norfolk.
SUFFOLK	7/30/2000	Flash Flood	0/0	-	Heavy rain caused flooding of Kings Fork Road in the western part of the city.
SOUTHAMPTON CO AND SURRY CO	8/3/2000 – 8/4/2000	Flash Flood	0/0	$2,000	Heavy rain caused flooding on Route 58 near Drewryville and two minor accidents

TABLE 4.2: SIGNIFICANT FLOOD EVENTS (1995 - 2021)					
LOCATION	DATE OF OCCURRENCE	TYPE OF EVENT	DEATHS/ INJURIES	PROPERTY DAMAGE	DETAILS
					on Route 308 were due to high water. Heavy rain caused flooding on Route 31 between Dendron and Scotland. Flooding also occurred on Route 10 in Surry.
PORTSMOUTH, AND NORFOLK	8/11/2000	Flash Flood	0/0	-	Flooding caused the closure of Interstate 264 at Frederick Boulevard. The intersections of Granby Street and Brambleton Avenue, Princess Anne Road and Monticello Avenue, and City Hall Avenue and Granby Street were all closed due to high standing water in Norfolk. Also, underpasses on Campostella Avenue, Tidewater Drive and Colley Avenue were closed due to accumulated water.
VIRGINIA BEACH	8/14/2000	Flash Flood	0/0	-	Widespread flooding caused the closure of several roads in the vicinity of Princess Anne Plaza. Sections of Rosemont Road were closed due to flooding.
SOUTHAMPTON COUNTY AND SURRY COUNTY	9/1/2000	Flash Flood	0/0	-	Several roads flooded. Route 10 under water near the Surry/Prince George county line.
NORFOLK	9/5/2000	Flash Flood	0/0	-	Heavy rain caused the side of an underpass wall to slide into the road at Granby Street and Interstate 64 resulting in road closure.
SOUTHAMPTON / FRANKLIN	9/5/2000	Flood	0/0	$3,000	The Nottoway and Blackwater Rivers flooded and caused some road closures including: Route 653 from Route 719 to Cary's Bridge, Route 619 at the intersection of Route 629, Route 614 from Route 622 to the Isle of Wight county line, and Route 651 (Indian Town Road) from Route 35 at Hancock Peanut to Route 652.
SUFFOLK AND ISLE OF WIGHT	6/16/2001	Flash Flood	0/0	-	Flooding caused one road closure near Whaleyville. Knoxville Road, Rose Drive, and numerous other secondary roads were impassable around Windsor.
NORFOLK	7/23/2001	Flash Flood	0/0	-	One car was submerged at the underpass on Colley Avenue and 21st Street and roads were covered with water.
SOUTHAMPTON	8/18/2001	Flash Flood	0/0	-	Flooding resulted in impassable roads and high water on Route 35.
HAMPTON AND NEWPORT NEWS	6/14/2002	Flash Flood	0/0	-	Streets were flooded and water was shooting out of a manhole cover.
VIRGINIA BEACH, NORFOLK, HAMPTON, AND NEWPORT NEWS	8/28/2002	Flash Flood	0/0	-	Heavy rains caused roads closures along Rosemont at the Virginia Beach Boulevard and around Kings Grant area. A car stalled in deep water. Union street and areas near City Hall and Granby were flooded in Norfolk. A section of West Mercury Boulevard and Powhatan Parkway in Hampton were closed due to high water. Roads were closed at the intersection of 27th and Buxton streets and flood barricades were in place at the City Line Apartment Complex in Newport News.
VIRGINIA BEACH AND NORFOLK	10/11/2002	Flash Flood	0/0	-	Atlantic Avenue was closed in Virginia Beach between 42nd and 65th streets due to flooding. The intersection of Tidewater Drive and Virginia Beach Boulevard in Norfolk were flooded.

TABLE 4.2: SIGNIFICANT FLOOD EVENTS (1995 - 2021)					
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NEWPORT NEWS, YORK/POQUOSON, NORFOLK/HAMPTON/ PORTSMOUTH, AND VIRGINIA BEACH	4/10/2003	Storm Surge/tide	0/0	-	Flooding occurred at high tide resulting in water in some streets portions of the Middle Peninsula and Hampton Roads.
NEWPORT NEWS AND YORK	7/19/2003	Flash Flood	0/0	-	Heavy rain caused street flooding near Leesville Mill Subdivision. Route 17 was reported closed at intersection with Route 173 due to street flooding.
NEWPORT NEWS	8/5/2003	Flash Flood	0/0	-	6 families had to be evacuated due to flash flooding.
POQUOSON	8/17/2003	Flash Flood	0/0	-	High water occurred on Poquoson and Huggins roads, and also in Hunts Neck are and in yards.
SUFFOLK, HAMPTON, NEWPORT NEWS, NORFOLK, AND PORTSMOUTH	**9/3/2003**	**Flash Flood**	**0/0**	**-**	**Streets were flooded in northern Suffolk. Many roads closed due to high water, including 27th and Buxton Streets in Newport News and the 8000 block of Hampton Boulevard in Norfolk.**
NEWPORT NEWS AND YORK	5/19/2004	Flash Flood	0/0	-	High water on Warwick Boulevard between 36th and 50th Street and at Center and Jefferson Avenue, and underpasses along Main Street and Center Avenue. Dare Road reported closed due to high water in York.
NEWPORT NEWS	5/22/2004	Flash Flood	0/0	-	High water at Flint Drive and Tillerson Drive.
PORTSMOUTH	6/10/2004	Flash Flood	0/0	-	High water at Airline Boulevard and I-264 and at intersection of Oregon and Dakota Roads.
CHESAPEAKE	7/4/2004	Flash Flood	0/0	-	A section of Route 17 in the Great Dismal Swamp Area was washed out due to rain.
NORFOLK, ISLE OF WIGHT CO, SURRY CO	7/25/2004	Flash Flood	0/0	-	Streets were flooded in downtown Norfolk including Waterside Drive. Lawnes Creek Bridge on Route 10 near Rushmere and several other roads were reported closed due to flooding in Isle of Wight. Route 617 closed due to flooding in Surry County.
SURRY COUNTY	7/29/2004	Flash Flood	0/0	-	Road closed on Route 611 near the intersection of Highway 40 due to flooding.
NORFOLK AND PORTSMOUTH	8/2/2004	Flash Flood	0/0	-	Some streets were flooded including the intersection of Park Avenue and Virginia Beach Boulevard and at the intersection of Robinhood Road and I-64 Underpass. Duke and Randolph Streets reported closed due to high water. Flooding on I-264 and Portsmouth Boulevard in Portsmouth.
CHESAPEAKE	7/13/2005	Flash Flood	0/0	-	One half mile of Murray Drive near Fentress in the Green Haven subdivision was underwater.
SUFFOLK, CHESAPEAKE, PORTSMOUTH, AND NORFOLK	8/9/2005	Flash Flood	0/0	-	College Drive and Camelia Drive flooded in Suffolk. Parts of Taylor Road were flooded in Chesapeake. Numerous roads were closed including Hampton Boulevard with vehicles flooded in Norfolk. Effingham and London Boulevard and the entrance to Route 264 at Frederick Boulevard were flooded in Portsmouth.
NORFOLK / HAMPTON / PORTSMOUTH…, NORFOLK, SUFFOLK, PORTSMOUTH, CHESAPEAKE, HAMPTON, NEWPORT	10/8/2005	Flood	0/0	-	Street flooding reported at Hampton Boulevard and Terminal Boulevard, Granby Street and Tidewater Drive, 900 Block of East Oceanview Avenue, Virginia Beach Boulevard and Brambleton, Princess Anne and Monticello Avenue. Areas of flooding

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NEWS, AND POQUOSON					were reported along sections of Route 58, on College Drive in the College Square Section, and on Kilby Shores Drive in Suffolk. The 56th block of Cranny Brook Road, Bunch Boulevard at Dwight Avenue, Powhatan and Vahallia, Scott Drive at Westhaven, 264 West bound off ramp, and Gateway Drive were closed due to flooding in Portsmouth. Bruce Road was closed near Tyre Neck Road in Western Branch part of Chesapeake. Grimes Road and Lee Street were under water in Hampton. Buxton Avenue was closed at 25th Street in Newport News. North Lawson Road was flooded in Poquoson.
CHESAPEAKE, NORFOLK, PORTSMOUTH, SUFFOLK, AND VIRGINIA BEACH	6/14/2006	Flash Flood	0/0	-	Heavy rain from the remnants of Tropical Storm Alberto caused flash flooding and road closures and the closure of Bainbridge Boulevard near the Triple Decker Bridge in Chesapeake. Brambleton Avenue near Route 264 overpass was closed and flooding occurred at Texas Avenue in the Norvell Heights area in Norfolk. The 2000 block of Frederick Boulevard was closed due to flash flooding in Portsmouth. The 2500 block of Pruden Boulevard was closed due to flash flooding in Suffolk. Atlantic Avenue between 49th and 71st streets was closed in Virginia Beach due to flash flooding.
YORK, HAMPTON, ISLE OF WIGHT, AND NEWPORT NEWS	6/23/2006	Flood	0/0	-	High water on several roads including Main Street in Isle of Wight.
SUFFOLK, NORFOLK, VIRGINIA BEACH, CHESAPEAKE, SOUTHAMPTON, FRANKLIN, YORK, PORTSMOUTH, HAMPTON, JAMES CITY CO, SURRY CO AND NEWPORT NEWS	**9/1/2006**	**Flash Flood**	**0/0**	**-**	**Numerous streets flooded with a couple feet of water including Route 600 between Routes 614 to 623 in Southampton, Route 264 ramp to Frederick Boulevard in Portsmouth, London Bridge Road and Corporate Landing Street in Virginia Beach, Route 64 at Mercury Boulevard in Hampton, Route 664 at 35th street to Jefferson Avenue in Newport News, and Route 632 in James City. Route 630 in Surry County closed.**
YORK / POQUOSON	**9/1/2006**	**Coastal Flood**	**0/0**	**$1,900,000**	**Tides of 4 to 5 feet above normal caused significant property damage across portions of the Virginia Peninsula and Middle Peninsula near the Chesapeake Bay and adjacent tributaries.**
NORFOLK AND YORK	**10/6/2006**	**Coastal Flood**	**0/0**	**$200,000**	**Strong onshore winds caused moderate coastal flooding during high tide and caused road closures and power outages in western portions of the southern Chesapeake Bay.**
SOUTHAMPTON, ISLE OF WIGHT, FRANKLIN, SURRY COUNTY AND JAMES CITY	**10/7/2006**	**Flash Flood**	**0/0**	**$8,800,000**	**Intense rainfall caused river flooding, road closures, and power outages in western portions of the southern Chesapeake Bay. HWY 460 was closed from Ivor to the Sussex county line. HWY 258 and parts of HWY 460 near Windsor in Isle of Wight. The Blackwater River flooded much of downtown Franklin where numerous businesses**

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					and residences sustained water damage. Crop damage and road closures in Surry County.
NORFOLK, YORK, CHESAPEAKE, SUFFOLK, AND VIRGINIA BEACH	11/22/2006	Coastal Flood	0/0	$225,000	Strong onshore winds caused moderate coastal flooding during high tide and caused road closures across portions of eastern and southeast Virginia including the intersection of Tidewater Drive and Brambleton Avenue and the intersection of Virginia Beach Boulevard and Tidewater Drive. The 700 block of North Main Street and East Constance Road in the 100 block between North Main and Katherine Street were closed due to high water in Suffolk.
NORFOLK AND VIRGINIA BEACH	6/26/2007	Flash Flood	0/0	-	Heavy rain caused flash flooding on roads and in underpasses including Tidewater Drive underpasses. Flooding was reported on Virginia Beach Blvd and Kempsville Road in Virginia Beach.
PORTSMOUTH AND NORFOLK	4/21/2008	Flash Flood	0/0	-	Heavy rains caused flash flooding and road closures across portions of southeast Virginia.
SUFFOLK	5/5/2009	Flash Flood	0/0	-	Isolated thunderstorm produced heavy rain which caused flash flooding across portions of Suffolk. High water was reported at the 3800 Block of Whaleyville Boulevard in Whaleyville.
SOUTHAMPTON	8/5/2009	Flash Flood	0/0	-	Isolated thunderstorms produced heavy rains which caused flash flooding across portions of Southampton county and a section of State Highway 186 was flooded and partially closed.
PORTSMOUTH, CHESAPEAKE, AND NORFOLK	8/12/2009	Flash Flood	0/0	-	Scattered thunderstorms produced heavy rain which caused flash flooding and road closures across portions of southeast Virginia. Gracie Road and State Highway 407 were flooded in Chesapeake. Westbound Route 264 at the downtown tunnel was closed from Norfolk to Portsmouth. Road was flooded at South Brambleton Road and Kimball Terrace near the Exit 11A interchange of Interstate 264 in Norfolk.
HAMPTON	8/13/2009	Flash Flood	0/0	-	Isolated thunderstorm produced heavy rain which caused flash flooding across portions of Hampton.
NEWPORT NEWS	8/14/2009	Flash Flood	0/0	-	Isolated thunderstorm produced heavy rain which caused flash flooding across portions of Newport News.
NORFOLK	8/22/2009	Flash Flood	0/0	-	Scattered thunderstorms produced heavy rain which caused flash flooding and road closures in numerous locations downtown, including the Ghent area and in the vicinity of Old Dominion University.
CHESAPEAKE, ISLE OF WIGHT, NEWPORT NEWS, NORFOLK, VIRGINIA BEACH, YORK, SURRY COUNTY AND SUFFOLK	**11/12/2009**	**Coastal Flood**	**0/0**	**$39,250,000**	**A Nor'easter produced moderate to severe coastal flooding across much of eastern and southeastern Virginia causing flooding of streets, homes, and businesses. Tidal flooding took out the clubhouse north of the Godwin Bridge, and destroyed a number of piers in Suffolk. The flooding was extensive, well above what was experienced in Isabel, in the Long Creek, Lynnhaven**

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LOCATION	DATE OF OCCURRENCE	TYPE OF EVENT	DEATHS/ INJURIES	PROPERTY DAMAGE	DETAILS
					Colony and Bay Island areas of Virginia Beach. In Surry County, several streets, homes and businesses were flooded in low lying areas of the county close or directly exposed to the James River. Many decks and piers were damaged or destroyed.
CHESAPEAKE, NORFOLK, VIRGINIA BEACH, AND YORK	12/19/2009	Coastal Flood	0/0	$40,000	A coastal low pressure area produced moderate to severe coastal flooding across much of eastern and southeast Virginia and several streets, homes and businesses were flooded in low lying areas
VIRGINIA BEACH, PORTSMOUTH, AND HAMPTON	7/29/2010	Flash Flood	0/0	-	Scattered thunderstorms produced flash flooding across portions of southeast Virginia and numerous roads were flooded in north Virginia Beach, the City of Hampton, and the City of Portsmouth.
PORTSMOUTH, HAMPTON, YORK, NORFOLK, AND CHESAPEAKE,	9/30/2010	Flash Flood	0/0	-	Thunderstorms produced flash flooding and caused road closures including Portsmouth Boulevard, County Street, Effingham Street, and the Interstate 264 Exit at Effingham.
VIRGINIA BEACH, CHESAPEAKE, FRANKLIN, ISLE OF WIGHT, NORFOLK, PORTSMOUTH, SOUTHAMPTON, SUFFOLK, YORK, HAMPTON, JAMES CITY, NEWPORT NEWS, SURRY COUNTY AND JAMES CITY COUNTY	**8/27/2011**	**Flood**	**0/0**	**-**	**Hurricane Irene produced heavy rains which caused widespread flooding and either closed or washed out roadways. Rainfall ranged from four to twelve inches across the region.**
SURRY COUNTY	9/7/2011	Flash Flood	0/0	-	The combination of the remnants from Tropical Storm Lee and a frontal boundary draped over the region caused heavy rain which produced flash flooding. Blackwater swamp rose and flooded a road. Portions of Carsley Road were impassable due to high water.
SOUTHAMPTON	9/9/2011	Flood	1/1	-	The driver of a vehicle drowned after his vehicle went into a swamp in Southampton county. The passenger was able to escape from the vehicle.
VIRGINIA BEACH	9/28/2011	Flash Flood	0/0	-	Scattered thunderstorms caused heavy rain which produced flash flooding and flooded Jeanna Street and Shore Drive.
ISLE OF WIGHT, NEWPORT NEWS, AND YORK	5/15/2012	Flash Flood	0/0	-	Scattered thunderstorms produced heavy rain and flash flooding resulting in flooding on several roads and high water west of Carrollton in Isle of Wight. In Newport News, flooding was reported on Interstate 64 at Jefferson Avenue. Several accidents were reported near the Patrick Henry Mall. The underpasses at Main Street and Center Avenue were flooded several feet. Winterhaven Drive had several cars floating. There was significant flooding off of Harpersville Road. There was flooding at the Virginia Living Museum. Three feet of water was reported on a road in the Coventry Subdivision in York.
NEWPORT NEWS AND HAMPTON	8/25/2012	Flash Flood	0/0	$2,000,000	Scattered thunderstorms produced heavy rain which caused flash flooding which

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LOCATION	DATE OF OCCURRENCE	TYPE OF EVENT	DEATHS/ INJURIES	PROPERTY DAMAGE	DETAILS
					resulted in flooding on Warwick Boulevard, Main Street, Deep Creek Road and cars were submerged on Warwick Boulevard just west of Mercury Boulevard in Newport News. An apartment building was flooded in Hampton.
HAMPTON	8/28/2012	Flash Flood	0/0	-	Scattered thunderstorms produced heavy rain which caused flash flooding. Fox Hill Road was almost impassable at Mercury Boulevard due to flooding. Other roads were closed or impassible and an apartment complex was evacuated.
SOUTHAMPTON	8/28/2012	Flood	0/0	-	Scattered thunderstorms produced heavy rain which caused flooding and road closures mainly western sections along and south of Route 58.
ISLE OF WIGHT, VIRGINIA BEACH, YORK, SUFFOLK, NEWPORT NEWS, CHESAPEAKE, NORFOLK, SURRY COUNTY AND JAMES CITY COUNTY	**10/28/2012**	**Coastal Flood**	**0/0**	**$2,144,000**	**Tropical Cyclone Sandy produced very strong winds which caused moderate to severe coastal flooding especially on the James River, York River, Chesapeake Bay, and at Sewells Point. Some streets were flooded in Chesapeake. Water levels reached 2.5 to 3.5 feet above normal along the James River up into Surry County.**
NEWPORT NEWS, JAMES CITY, ISLE OF WIGHT, HAMPTON, CHESAPEAKE, WILLIAMSBURG, PORTSMOUTH, SUFFOLK, YORK, VIRGINIA BEACH, AND NORFOLK	**10/29/2012**	**Flood**	**0/0**	**-**	**Tropical Cyclone Sandy produced very strong winds which caused flooding and closed numerous roads.**
YORK	7/21/2013	Flash Flood	0/0	-	Scattered thunderstorms produced heavy rain which caused flash flooding. Flooding was reported along Farm Road just off of Route 17. Oriana Road (Route 620) was flooded just north of Newport News Airport. Two to three inches of water was over roadway along Route 17 just south of the Coleman Bridge.
NORFOLK, PORTSMOUTH, AND CHESAPEAKE	5/16/2014	Flood	0/0	-	Heavy rain caused flooding during high tide. Numerous roads were closed due to high water. The first floor of some apartments and a couple of cars were under water in Ghent. Norfolk Public Schools experienced flooding inside some of their buildings.
VIRGINIA BEACH	7/9/2014	Flood	0/0	-	Scattered severe thunderstorms produced heavy rain which caused minor flooding on Sandbridge Road.
NORFOLK, ISLE OF WIGHT, AND PORTSMOUTH	7/10/2014	Flood	0/0	-	Scattered severe thunderstorms produced heavy rain which caused some minor flooding on Windsor Boulevard in Windsor and Elm Street in Portsmouth.
VIRGINIA BEACH	7/15/2014	Flood	0/0	-	Scattered severe thunderstorms produced heavy rain which caused some minor flooding at the intersection of Baxter Road and Princess Anne Road and on Mill Dam Road near First Colonial Road.
SUFFOLK	7/24/2014	Flash Flood	0/0	-	Scattered thunderstorms produced heavy rain which caused flash flooding on Clay Street with water flowing into homes in

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					Suffolk. A car was partially submerged in high water in the Pleasant Hill area.
ISLE OF WIGHT, NEWPORT NEWS, PORTSMOUTH, NORFOLK, CHESAPEAKE, AND HAMPTON	9/8/2014	Flood	0/0	-	Showers and scattered thunderstorms produced locally heavy rainfall and resulted in flooding across portions of southeast Virginia. Several roads were flooded or impassable over northeast Isle of Wight county. Several roads were flooded in southern portions of Newport News, including 26th Street near Interstate 664, and Warwick Boulevard and 35th Street. Also, several streets were flooded around Mercury Boulevard. An apartment complex was evacuated in Hampton. Heavy rain closed several roads and underpasses across the region.
SURRY COUNTY	7/11/2015	Flood	0/0	-	Scattered thunderstorms produced heavy rain. There were multiple reports of water over the road along Route 10 in Surry.
VIRGINIA BEACH, NORFOLK, HAMPTON, POQUOSON, YORK, CHESAPEAKE, ISLE OF WIGHT, NEWPORT NEWS, JAMES CITY, SURRY AND SUFFOLK	10/2/2015	Coastal Flood	0/0	1,000,000	A tidal departure of 3 to 4 feet resulted in moderate flooding along the Atlantic coast and Chesapeake Bay. A combination of Hurricane Joaquin near the Bahamas and strong high pressure over New England produced strong onshore winds over the Mid-Atlantic. The strength and duration of the onshore winds produced moderate coastal flooding along the Atlantic Coast and Chesapeake Bay.
VIRGINIA BEACH	1/23/2016	Coastal Flood	0/0	-	A tidal departure of 2.5 to 3.5 feet resulted in moderate coastal flooding along the Atlantic Ocean and Chesapeake Bay. The peak water level at the Chesapeake Bay Bridge Tunnel was 5.72 feet at 606 am on January 23.
CHESAPEAKE	7/1/2016	Flash Flood	0/0	-	Scattered showers and thunderstorms in advance of a cold front produced heavy rain and caused flash flooding across portions of eastern and southeast Virginia. Rainfall totals ranged from five to as much as eleven inches in areas where flash flooding occurred.
CHESAPEAKE, NORFOLK, PORTSMOUTH	7/19/2016	Flood, Flash Flood	0/0	-	Scattered thunderstorms in advance of a cold front produced heavy rain and caused flash flooding across portions of southeast Virginia. Flooding on Bainbridge Blvd at Rte 13; water covering Olney Rd with vehicles stuck in water; streets flooded on Old Town Portsmouth with vehicles trapped.
VIRGINIA BEACH, NORFOLK	7/31/2016	Flash Flood	0/0	-	Heavy rain from thunderstorms caused flash flooding, with rainfalls ranging between 2 and 7 inches. 2800 block of Shore Drive closed, roads closed near Fairfield Shopping Center, Little Creek/Ft Story, and streetlights out in Ocean View.
PORTSMOUTH, SUFFOLK, CHESAPEAKE, NORFOLK, VIRGINIA BEACH, ISLE OF WIGHT, SOUTHAMPTON, FRANKLIN	9/21/2016	Flood	0/0	$1,085,000	The combination of a stalled frontal boundary and the remnant low pressure area that was Tropical Storm Julia, produced heavy rain which caused flooding across much of southeast Virginia from Wednesday morning, September 21st into early Thursday morning, September 22nd. Numerous roads washed out or closed.

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ISLE OF WIGHT, FRANKLIN, SUFFOLK SOUTHAMPTON, NORFOLK, PORTSMOUTH, CHESAPEAKE, YORK, NORFOLK, NEWPORT NEWS, HAMPTON, JAMES CITY, VIRGINIA BEACH, POQUOSON, SURRY	**10/8/2016**	**Flood, Flash Flood, Coastal Flood**	**1/0**	**$56,140,000**	**The combination of a cold front moving through the mid-Atlantic and Post Tropical Cyclone Matthew tracking northeast just off the coast, produced heavy rain which caused flash flooding. Strong northeast or north winds over southeast Virginia causes coastal flooding over the study area. Heavy rain caused an extended period of significant flooding. Numerous roads were impassable or closed for several days, and many homes and businesses were impacted. Numerous roads were impassable or closed, and some small creeks or streams were out of their banks due to heavy rain causing flash flooding. Coastal storm tides of 2 to 3.5 feet above astronomical tide levels were common, with only minor beach erosion reported. The maximum storm tide reached 5.86 feet MLLW at Sewalls Point, which resulted in moderate coastal flooding.**
CHESAPEAKE	3/31/2017	Flash Flood	0/0	-	Knee high water was reported at Sparrow Intermediate School.
VIRGINIA BEACH	7/24/2018	Flood	0/0	-	Numerous roads were flooded and closed for several days across much of central and eastern portions of Virginia Beach due to heavy rain.
VIRGINIA BEACH	8/6/2018	Flood	0/0	-	High water was reported on Interstate 64 at Mile marker 291. Vehicle accident was reported due to the high water.
NORFOLK	8/11/2018	Flash Flood	0/0	-	Neighborhood roadways were flooded. Rainfall total of 2.19 inches was measured in 45 minutes. Colley Avenue was closed due to flooding at the underpass. One vehicle was caught in the flood waters.
CHESAPEAKE, VIRGINIA BEACH	8/20/2018	Flood	0/0	-	Thunderstorms caused heavy rain that flooded roads.
HAMPTON	9/9/2018	Flood	0/0	-	Road was closed due to flooding at Coliseum Drive and Merchant Lane. Radar estimates indicated that two to four inches of rain had fallen in the area.
JAMES CITY COUNTY, YORK COUNTY	10/12/2018	Flash Flood	0/0	-	Showers and scattered thunderstorms associated with Tropical Cyclone Michael produced heavy rain which caused flash flooding across portions of central and south central Virginia and the Middle Peninsula. Several roads remained impassable or closed across much of the county due to lingering flooding. Route 737 was flooded at Otey Drive.
CHESAPEAKE, NORFOLK	6/7/2019	Flash Flood	0/0	-	Slow moving thunderstorms produced intense rainfall of 4 to 6 inches resulting in flash flooding on June 7th. Flooding was reported at Triple Decker Bridge underpass at Bainbridge Boulevard and Highway 113 in South Norfolk. Monticello Drive and 16th Street were closed due to flooding.
NORFOLK, CHESAPEAKE	8/7/2019	Flash Flood	0/0	-	Thunderstorms produced heavy rain which caused flash flooding. Reported along Chesapeake Boulevard, Johnstons Road, and Auburn Drive, at the intersection of 26th and 27th Streets, Granby Street and

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					Colonial Avenue, and outside of WTKR studio. Also, portions of Boush Street were impassible. Oxford Street and Newport Avenue and streets in Ocean View were impassible due to high water.
VIRGINIA BEACH	8/22/2019	Flood	0/0	-	Minor street and roadway flooding was reported.
NORFOLK, VIRGINIA BEACH, YORK COUNTY, SURRY COUNTY	9/6/2019	Coastal Flood	0/0	-	Very strong northeast to north winds associated with Hurricane Dorian produced tidal anomalies between 2.5 and 3.5 feet over the southern Chesapeake Bay. This caused moderate coastal flooding over portions of the study area. Sewells Point reached 5.87 feet MLLW at 342 pm on September 6. Some streets were flooded and closed, and vehicles were stranded in the Ghent area.
YORK COUNTY, JAMES CITY COUNTY, SURRY COUNTY	10/11/2019	Coastal Flood	0/0	-	Persistent north or northeast winds, along with high waves, produced tidal anomalies between 2.0 and 3.0 feet over the York and James Rivers. This caused moderate coastal flooding. Yorktown USCG Station reached 5.24 feet MLLW.
VIRGINIA BEACH, NORFOLK	11/17/2019	Coastal Flood	0/0	-	Very strong northeast to north winds produced tidal anomalies between 2.0 and 3.0 feet over the southern Chesapeake Bay. This caused minor to moderate coastal flooding over portions of Virginia Beach and Norfolk. Chesapeake Bay Bridge Tunnel reached 5.88 feet MLLW. Some streets were flooded.
JAMES CITY COUNTY	5/19/2020	Coastal Flood	0/0	-	Minor to moderate tidal flooding occurred over portions of James City county along the James River. Jamestown reached 4.72 feet MLLW.
YORK COUNTY, JAMES CITY COUNTY	5/29/2020	Flash Flood	0/0	-	Right lane of Interstate 64 East at Mile Marker 240 was closed due to high water. Portions of Merrimac Trail were impassible due to high water.
PORTSMOUTH, CHESAPEAKE	6/20/2020	Flash Flood	0/0	-	In Portsmouth, total rainfall of 3.38 inches was reported, with 3.00 inches of rain reported in one hour. Several roads were flooded.
VIRGINIA BEACH	7/1/2020	Flash Flood	0/0	-	Interstate 264 East and West bound lanes were flooded. Two lanes were closed due to high water. Total rainfall between 3.37 inches and 4.05 inches was reported across the area.
VIRGINIA BEACH	8/4/2020	Coastal Flood	0/0	-	Strong south to southeast winds associated with Tropical Storm Isaias resulted in moderate (perhaps some locally major) tidal flooding over portions of Virginia Beach adjacent to Back Bay.
VIRGINIA BEACH, CHESAPEAKE	8/6/2020	Flash Flood	0/0	-	Flash flooding was reported in the Dam Neck area of Virginia Beach. Numerous cars were flooded. Rainfall total of 5.50 inches was reported. Some water was reported in garages and starting to enter homes.
CHESAPEAKE, VIRGINIA BEACH, NORFOLK	8/11/2020	Flash Flood	0/0	-	Water over the roadway reported near Chesapeake Square Mall, and along Great Neck Rd. Several streets were flooded in the city of Norfolk with water almost up to

TABLE 4.2: SIGNIFICANT FLOOD EVENTS (1995 - 2021)					
LOCATION	**DATE OF OCCURRENCE**	**TYPE OF EVENT**	**DEATHS/ INJURIES**	**PROPERTY DAMAGE**	**DETAILS**
					car windows near Redgate Avenue in Ghent.
JAMES CITY COUNTY, YORK COUNTY, NEWPORT NEWS, SURRY COUNTY, SOUTHAMPTON COUNTY, ISLE OF WIGHT COUNTY	8/15/2020	Flash Flood	0/0	-	All north and south lanes were closed on Route 614 near John Tyler Memorial Highway due to flooding, Dare Rd had lane closures, multiple roads in Newport News and York County impassible, portions of Rte 10, Rte 616, roads in Colony Pines neighborhood closed, and flooding the Rushmere area.
ISLE OF WIGHT COUNTY, SURRY COUNTY, SOUTHAMPTON COUNTY, YORK COUNTY	9/9/2020	Flash Flood	0/0	-	Windsor Elementary School partially flooded (no damages reported), Post Office in Isle of Wight Co flooded, multiple roads closed, washed out or impassable; water rescues performed and cars stranded in Smithfield/Isle of Wight County.
JAMES CITY COUNTY, VIRGINIA BEACH, ISLE OF WIGHT COUNTY, PORTSMOUTH	9/18/2020	Flash Flood	0/0	-	Post Tropical Cyclone Sally tracking northeast across the Southeast United States and off the Mid Atlantic Coast produced heavy rain which caused flash flooding across portions of southeast Virginia. Multiple road closures, including Centerville Road, Brick Bat Road, Nike Park Rd, and roads in Virginia Beach. One person rescued from car in Lansdowne, Virginia Beach.
ISLE OF WIGHT COUNTY, HAMPTON, NORFOLK, CHESAPEAKE, YORK COUNTY, SURRY COUNTY, SOUTHAMPTON COUNTY, NEWPORT NEWS, WILLIAMSBURG, JAMES CITY COUNTY, VIRGINIA BEACH, SUFFOLK, PORTSMOUTH, FRANKLIN	11/12/2020	Flood, Flash Flood	0/0	-	Deep tropical moisture streaming northward into the mid-Atlantic region combined with the approach of a cold front and low pressure, produced heavy rain which caused flash flooding across portions of central and southeast Virginia. Numerous roads were impassible or closed due to continued flooding from heavy rainfall throughout the study area, including standing water on portions of interstate highways.
YORK COUNTY	12/24/2020	Flash Flood	0/0	-	Intersection of Airport Road and Mooretown Road was closed due to high water over the roadway.
TOTAL			**2/1**	**$189,684,000**	

Source: NCEI (1995 to January, 2021 data)

PROBABILITY OF FUTURE OCCURRENCES

Flooding remains a highly likely occurrence throughout the identified flood hazard and storm surge areas of the Hampton Roads region. Smaller floods caused by heavy rains and inadequate drainage capacity will be frequent, but not as costly as the large-scale floods caused by hurricanes and coastal storms, which may occur at less frequent intervals.

FLOODING DUE TO IMPOUNDMENT FAILURE/HIGH HAZARD DAM

Flooding in the region is also possible as the result of a dam that malfunctions or is overtopped. There are approximately 80,000 dams in the United States today, the majority of which are privately owned. Other owners include state and local authorities, public utilities and federal agencies. The benefits of dams are numerous: they provide water for drinking, navigation and agricultural irrigation. Dams also provide hydroelectric power, create lakes for fishing and recreation, and save lives by preventing or reducing floods.

Lake Burnt Mills in Suffolk.
Photo source: City of Suffolk

Though dams have many benefits, they also can pose a risk to communities if not designed, operated and maintained properly. In the event of a dam failure, the energy of the water stored behind even a small dam is capable of causing loss of life and great property damage if development exists downstream of the dam. The failure of dams has the potential to place large numbers of people and great amounts of property in harm's way.

Flooding due to impoundment failure refers to a collapse, overtopping, breaching, or other failure that causes an uncontrolled release of water or sludge from an impoundment, resulting in downstream flooding. Dam or levee failures can occur with little warning. Intense storms may produce a flood in a few hours or even minutes from upstream locations. Flash floods can occur within six hours of the beginning of heavy rainfall, and impoundment failure may occur within hours of the first signs of breaching. Other failures and breeches can take much longer to occur, from days to weeks, because of debris jams or the accumulation of melting snow.

Failure of dams may result in catastrophic localized damages. Vulnerability to dam failure is dependent on dam operations planning and the nature of downstream development. Depending on the elevation and storage volume of the impoundment, the impact of flooding due to dam failure may include loss of human life, economic losses such as property damage and infrastructure disruption, and environmental impacts such as destruction of habitat. Flooding following a dam failure may occur due to any one or a combination of the following causes:

- Prolonged periods of rainfall and flooding;
- Inadequate spillway capacity;
- Internal erosion caused by embankment or foundation leakage or piping, or earth movement resulting from an earthquake;
- Improper maintenance, including failure to remove trees, repair internal seepage problems, replace lost material from the cross section of the dam and abutments, or maintain gates, valves, or other operational components;
- Improper design, including the use of improper construction materials and construction practices;
- Negligent operation, including failure to remove or open gates or valves during high flow periods;
- Failure of upstream dams on the same waterway;
- High winds, which can cause significant wave action and result in substantial erosion; or
- Intentional criminal acts.

Dams are classified by DCR, with a hazard potential depending on the downstream losses estimated in event of failure. Hazard potential is not related to the structural integrity of a dam but strictly to the potential for adverse downstream effects if the dam were to fail. State regulatory requirements administered by DCR, such as the frequency of dam inspection, the standards for spillway design, and the extent of emergency operations plans, are dependent upon the dam classification. **Table 4.3** provides additional information on these classes and the possible effects on downstream areas if failure were to occur.

TABLE 4.3: VIRGINIA DAM CLASSIFICATION SYSTEM

HAZARD POTENTIAL	DESCRIPTION	INSPECTION
High (Class I)	Failure will cause probable loss of life or serious economic damage (to buildings, facilities, major roadways, etc.)	Annual, with inspection by a professional engineer every 2 years.
Significant (Class II)	Failure may cause loss of human life or appreciable economic damage (to buildings, secondary roadways, etc.)	Annual, with inspection by a professional engineer every 3 years.
Low (Class III)	Failure would result in no expected loss of human life, and cause no more than minimal economic damage	Annual, with inspection by a professional engineer every 6 years.

Source: 2018 Commonwealth of Virginia Hazard Mitigation Plan

The owner of each regulated high, significant, or low hazard dam is required to apply to DCR for an Operation and Maintenance Certificate. The application must include an assessment of the dam by a licensed professional, an Emergency Action Plan, and the appropriate fee(s), submitted separately. An executed copy of the Emergency Action Plan or Emergency Preparedness Plan must be filed with the appropriate local emergency official and the Virginia Department of Emergency Management. The Virginia Soil and Water Conservation Board, a division of DCR, issues Regular Operation and Maintenance Certificates to the dam owner for a period of six years. If a dam has a deficiency but does not pose imminent danger, the board may issue a Conditional Operation and Maintenance Certificate, during which time the dam owner is to correct the deficiency. After a dam is certified by the board, annual inspections are required either by a professional engineer or the dam owner, and the Annual Inspection Report is submitted to the regional dam safety engineer.

Dam risk can be classified as incremental, non-breach or residual risk. Incremental risk is the risk (likelihood and consequences) to the pool area and downstream floodplain occupants that can be attributed to the presence of the dam should the dam breach prior or subsequent to overtopping, or undergo component malfunction or misoperation, where the consequences considered are over and above those that would occur without dam breach. The consequences typically are due to downstream inundation, but loss of the pool can result in significant consequences in the pool area upstream of the dam. Non-breach risk is the risk in the reservoir pool area and affected downstream floodplain due to 'normal' dam operation of the dam (e.g., large spillway flows within the design capacity that exceed channel capacity) or 'overtopping of the dam without breaching' scenarios. Residual risk is the risk that remains after all mitigation actions and risk reduction actions have been completed. With respect to dams, FEMA defines residual risk as "risk remaining at any time" (FEMA, 2015, p A-2). It is the risk that remains after decisions related to a specific dam safety issue are made and prudent actions have been taken to address the risk. It is the remote risk associated with a condition that was judged to not be a credible dam safety issue.[1]

At this time, limited information is available to conduct an analysis of incremental, non-breach and residual risk relative to the high hazard potential dams in the region. Please refer to Section 3.11: Flooding Due to Impoundment Failure of the *2018 Commonwealth of Virginia Hazard Mitigation Plan*, as amended, for

[1] FEMA, Rehabilitation of High Hazard Potential Dams Grant Program Guidance, June 2020

additional information regarding the statewide approach to dam risk. That section of the state's plan is hereby incorporated by reference.

The Commonwealth of Virginia relies upon FEMA's definition of risk: "Risk is the product of the likelihood of a structure being loaded, adverse structural performance, and the magnitude of the resulting consequences." Risk data are compiled in the state's Dam Safety Inventory System (DSIS) for each high hazard dam. DCR, VDEM and local emergency and planning staff are given copies of emergency action plans and plans include detailed information on risk to the following:

- Dwellings
- Schools
- Hospitals
- Businesses
- Railroads:
- Utilities:
- Parks:
- Golf Course
- Public Trails
- Emergency Infrastructure.

The summary impacts shown in **Table 4.4** are drawn from the information in DSIS and the EAPs for the high hazard potential dams, These data represent how Virginia summarizes significant economic, environmental and social impacts from a dam incident. Factors considered in risk assessment include the population at risk, land use, inspection condition assessment and any missing studies such as stability analyses under normal and extreme loading conditions (seismic and hydrologic), and any measures underway that affect the operational status, such as drawdowns or temporary pumps and siphons, when dams are compromised.

LOCATION AND SPATIAL EXTENT

Owners of impounding structures are required to have dam break inundation zone maps that meet the standards of the Virginia Impounding Structure Regulations. The properties that are identified within the dam break zone are recorded in the dam safety emergency action plan for that impoundment. DCR is pursuing efforts to make this information available in a digital form, but it is not currently available for all dams. The *2018 Commonwealth of Virginia Hazard Mitigation Plan* indicates that such data would greatly improve ability to identify impact and vulnerability due to dam inundation.

Table 4.4 lists the high hazard dams in the study area from DCR's database and includes key details regarding each dam's basic characteristics, Emergency Action Plan status and a summary of expected impacts resulting from dam failure. Three dams with a "poor" condition rating (Harwood's Mill Dam, Little Creek Dam in James City County, and Godwin's Millpond Dam in Suffolk) are considered to have a greater risk of flooding and are a potential target for mitigation action.

TABLE 4.4: HIGH HAZARD DAMS IN THE HAMPTON ROADS REGION									
COMMUNITY	NAME OF DAM	DAM TYPE	YEAR BUILT	PRIMARY PURPOSE	TOP HEIGHT (FEET)	TOP CAPACITY (ACRE FEET)	EMERGENCY ACTION PLAN STATUS (LAST APPROVAL DATE)	SUMMARY IMPACTS	MOST RECENT CONDITION ASSESSMENT
York County	Harwood's Mill Dam	Earth	1919	Water Supply	27	5,845	Active (08/18/2016)	172 homes, 21 roadways	Poor
York County	Waller Mill Dam	Earth	1965	Recreation & Water Supply	40	7,274	Expired (8/25/2005)	3 homes, 1 business, 3 roadways, 1 downstream dam	Fair
James City County	Little Creek Dam	Earth	1980	Water Supply	67	32,143	Active (4/26/2016)	2 homes, 2 roadways	Poor
James City County	Diascund Creek Dam	Earth	1961	Water Supply	35	29,093	Active (08/18/2016)	208 homes, 25 roadways	Fair
Williamsburg	Lake Matoaka Dam	Earth	1694	Recreation	24	587	Expired (04/30/2008)	7 homes, 2 businesses, 4 utilities, 1 roadway	Fair
Norfolk	Lake Whitehurst	Gravity	1900	Water Supply	26	4,200	Expired (5/31/2011)	none listed	Fair
Virginia Beach	Lake Smith Dam	Earth	1885	Water Supply	15.35	1,385	Expired (5/31/2012)	352 homes, 2 roadways, 1 downstream dam	Fair
Virginia Beach	Little Creek Reservoir	Earth	1899	Water Supply	7.6	1,819	Expired (5/31/2011)	none listed	Fair
Chesapeake	Chesapeake Energy Center Bottom Ash Dam	Earth	1955	Coal Ash Storage	20	56	Active (11/14/2018)	none listed	Satisfactory
Suffolk	C-Pond Dam	Earth	1962	Other	52	29,800	Active (04/24/2020)	287 homes, 4 roadways, 1 downstream dam	Satisfactory
Suffolk	Godwin's Millpond Dam	Earth	1960	Water Supply	14	214	Expired (03/14/2013)	1 home, 3 businesses, 1 road	Poor
Suffolk	Lake Burnt Mills	Earth	1942	Water Supply	46.5	18,500	Active (09/16/2019)	310 homes, 8 roadways, 1 downstream dam	Fair
Suffolk	Lake Cohoon	Earth	1919	Water Supply	28.8	9,300	Active (07/13/2015)	39 homes, 1 business, 1 railroad, 5 roadways, 1 downstream dam	Satisfactory
Suffolk	Lake Kilby	Earth	1892	Water Supply	18.6	3,400	Active (07/13/2015)	1 downstream dam	Satisfactory
Suffolk	Lake Meade Dam	Gravity	1958	Water Supply	25	9,281	Active (08/10/2020)	86 homes, 29 businesses, 5 railroads, 2 parks, 17 roadways	Satisfactory
Suffolk	Speight's Run Dam	Earth	1957	Water Supply	25.7	4,000	Active (07/13/2015)	2 downstream dams	Satisfactory
Suffolk	Western Branch	Earth	1963	Recreation & Water Supply	41	35,300	Active (09/16/2019)	310 homes, 8 roadways	Satisfactory
Isle of Wight County	ASB Pond	Earth	1901	Other	16.7	1,103	Active (4/24/2020)	52 homes, 7 roads, 1 downstream dam	Fair

TABLE 4.4: HIGH HAZARD DAMS IN THE HAMPTON ROADS REGION									
COMMUNITY	NAME OF DAM	DAM TYPE	YEAR BUILT	PRIMARY PURPOSE	TOP HEIGHT (FEET)	TOP CAPACITY (ACRE FEET)	EMERGENCY ACTION PLAN STATUS (LAST APPROVAL DATE)	SUMMARY IMPACTS	MOST RECENT CONDITION ASSESSMENT
Isle of Wight County	B-1 Pond Dam	Earth	1950	Other	13	668	Expired (12/17/2013)	54 homes, 6 roadways	Satisfactory
Isle of Wight County	B-2 Pond Dam	Earth	1901	Other	15.3	1,668	Expired (12/17/2013)	54 homes, 6 roadways	Satisfactory
Newport News	Lee Hall Reservoir Dam	Gravity	1893	Water Supply	23.7	4,640	Active (1/31/2019)	861 homes, 1 business, 3 schools, 2 parks, 28 roadways	Satisfactory

Source: Virginia Department of Conservation and Recreation, Dam Safety Inventory System, May 2021

Appendix H contains a list of all dams in the study area from the DCR database, as well as the DCR Dam Safety Data Sheet for each high hazard dam, ordered alphabetically by dam name. Each data sheet includes general characteristics, watershed information, technical basics, hydrology/hydraulics data, inspection dates and condition, EAP quick reference data, potential impacts and a detailed map of each impoundment. Section 3.11 of the *2018 Commonwealth of Virginia Hazard Mitigation Plan* is also hereby adopted by reference, specifically the information regarding dams in the region.

SEA LEVEL RISE AND LAND SUBSIDENCE

BACKGROUND

Global sea level is determined by the volume and mass of water in the world's oceans. Sea level rise occurs when the oceans warm or ice melts, bringing more water into the oceans. Sea level rise caused by warming water or thermal expansion is referred to as steric sea level rise, while sea level rise caused by melting snow and ice is called eustatic sea level rise. The combination of steric and eustatic sea level rise is referred to as absolute sea level rise. Absolute sea level rise does not include local land movements. Additionally, while it is often represented as a global average, absolute sea level rise varies from place to place as a result of differences in wind patterns, ocean currents, and gravitational forces.

The primary consequences of continuing sea level rise are interrelated and include:

Increased Coastal Erosion – Sea level rise influences the on-going processes that drive erosion, in turn making coastal areas ever more vulnerable to both chronic erosion and episodic storm events (Maryland Commission on Climate Change, 2008). Secondary effects of increased erosion include increased water depths and increased sediment loads which can drown seagrass and reduce habitat and food sources for fish and crabs. Increased wave action contributes to the increased erosion as the wave energy attacks intertidal and upland resources.

Inundation of Normally Dry Lands – The loss of coastal upland and tidal wetlands through gradual submergence or inundation is likely over time. Wetlands can provide protection from erosion, subdue storm surges, and provide a nursery and spawning habitat for fish and crabs. Without impediments, such as hardened shorelines, and with a slow enough rate of sea level rise, wetlands can normally migrate upland. However, if barriers are present and sea level rise outpaces upland migration, wetlands can drown in place (*Virginia Governor's Commission on Climate Change*, 2008). Many communities in the region have noted an influx of requests in recent years for bulkhead repair as a result of more frequent inundation behind failing bulkheads. Tidal wetlands are slowly migrating landward. The loss of wetlands means increased coastal and shoreline erosion, reduced storm surge protection, and reduction in nursery and spawning habitat for fish and crabs.

Coastal Flooding – An increase in duration, quantity, and severity of coastal storms results in increased flood damages to infrastructure. Increased sea level and/or land subsidence increases the base storm tide, which is the storm surge plus astronomical tide (Boon, Wang, and Shen, undated). Ultimately, sea level rise increases the destructive power of every storm surge. Minor storms that may not have caused damage in the past will begin to affect infrastructure in the future (Boon, et al, undated). Higher wave energy from higher storm tides will translate each storm's destructive forces landward. The damage caused by major storms becomes increasingly costly. Sea level rise will threaten the longevity and effectiveness of stormwater drainage systems and other infrastructure, especially during significant rain events that occur during high tides such as that which may be caused by a nor'easter.

Saltwater Intrusion – As sea level rises, the groundwater table may also rise, and saltwater may intrude into freshwater aquifers. This impact may have secondary impacts related to drinking water and agriculture, even for home gardeners.

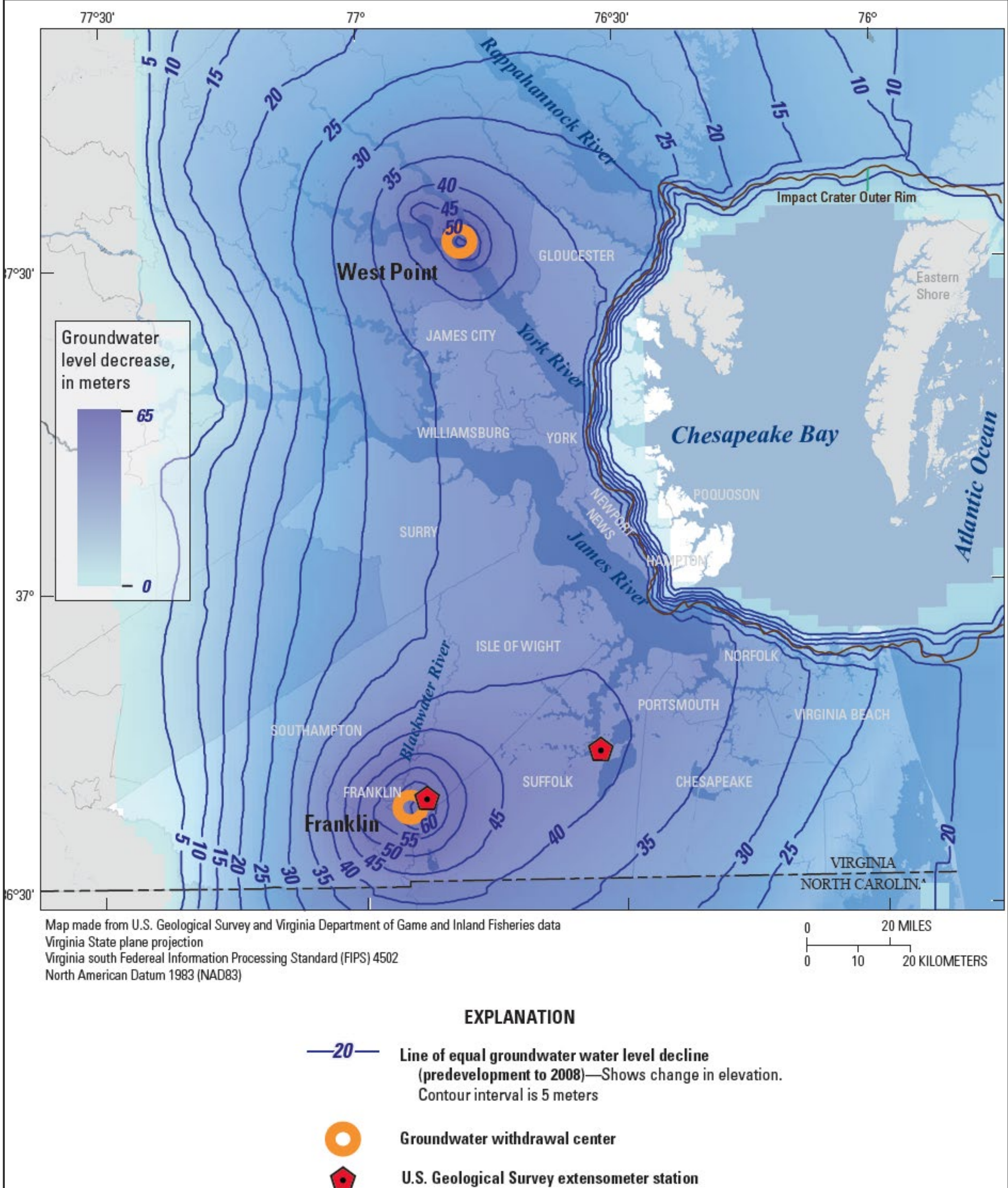
LOCATION AND SPATIAL EXTENT

According to the Old Dominion University Center for Sea Level Rise, sea level rise has a very localized spatial extent related to past development activities. Historically, many of the region's large and small waterways were filled, creating developable land upon which infrastructure, residences and businesses were constructed. Subsequently, as sea level has risen, these areas have been the first to experience the effects. Water begins to retrace ancient flow paths, flooding neighborhood streets and stormwater outfalls. The outfalls are then less capable of handling rainfall runoff because the pipes must also accommodate rising sea water. This phenomenon exacerbates and prolongs flood events.

Several factors are influencing the rates of sea level rise relative to land in the Hampton Roads region, including an increased volume of water in the oceans from melting ice. Some scientists believe that thermal expansion of a gradually warming ocean increases ocean volume. The rate of sea level rise is relative to the land adjacent to the sea; land subsidence is the downward movement of the earth's crust. The Hampton Roads region is experiencing both regional subsidence (along the east coast of the United States) and local subsidence, exacerbating the effects of storms. Subsidence alone can damage wetland and coastal marsh ecosystems and damage infrastructure, but when combined with sea level rise, the effects can be even more devastating.

Local subsidence is believed to be the result of settlement or compaction of subsurface layers resulting from groundwater withdrawals and glacial isostatic rebound (USGS, *Land Subsidence and Relative Sea-Level Rise in the Southern Chesapeake Bay Region*, 2013). Groundwater withdrawals in the region, primarily seen near the pumping centers of Franklin and West Point, decrease pressure and therefore water levels in the aquifer system. As a result, the aquifer system compacts and the land surface subsides. Borehole extensometers, like the one in Franklin, Virginia measure compaction or expansion of aquifer thickness. Scientists also use surface monitoring data such as that from tidal stations, geodetic surveying and remote sensing in an effort to determine how much land subsidence can be attributed to aquifer compaction. **Figure 4.6** illustrates the spatial extent of changes in groundwater level in the Hampton Roads region that are thought to contribute to land subsidence.

FIGURE 4.6: GROUNDWATER LEVEL DECREASES FROM 1900 TO 2008



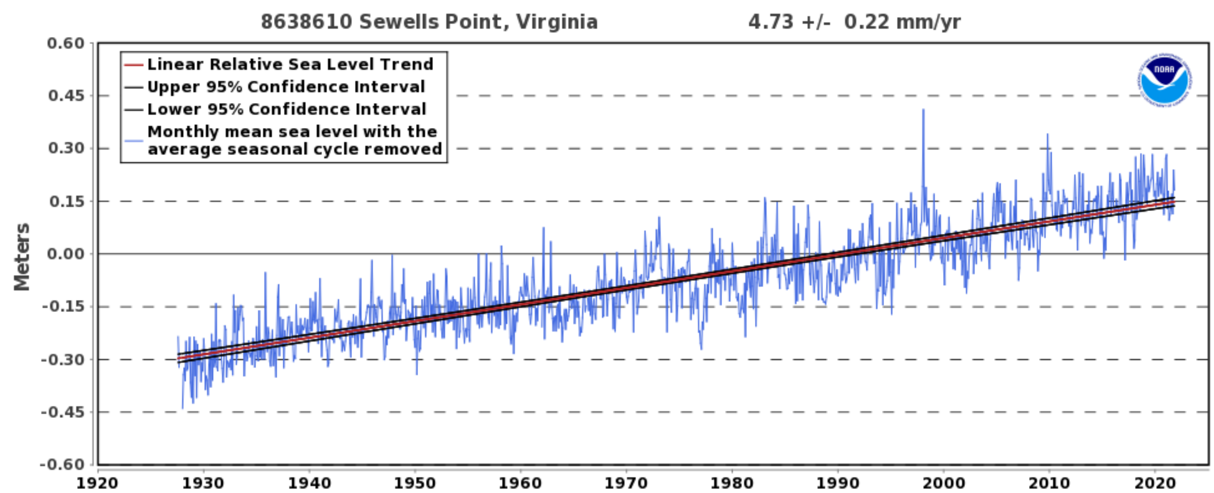
2013

Source: USGS, Land Subsidence and Relative Sea-Level Rise in the Southern Chesapeake Bay Region, 2013

NOAA has compiled data from regional tide gauges to document the rates of sea level rise. There are four local stations with data pertinent to the region, and the rates of sea level rise range from 1.23 feet to 1.98 feet per 100 years.

At Sewell's Point, Naval Station Norfolk, the local NOAA tide station with the longest period of record, the mean sea level trend is 4.73 millimeters/year with a 95% confidence interval of +/- 0.22 mm per year, based on monthly mean sea level data from 1927 to 2020 (**Figure 4.7**). This rate is equivalent to a change of 1.55 feet in 100 years. The plot shows the monthly mean sea level without the regular seasonal fluctuations due to coastal ocean temperatures, salinities, winds, atmospheric pressures, and ocean currents. The long-term linear trend is also shown, including its 95 percent confidence interval.

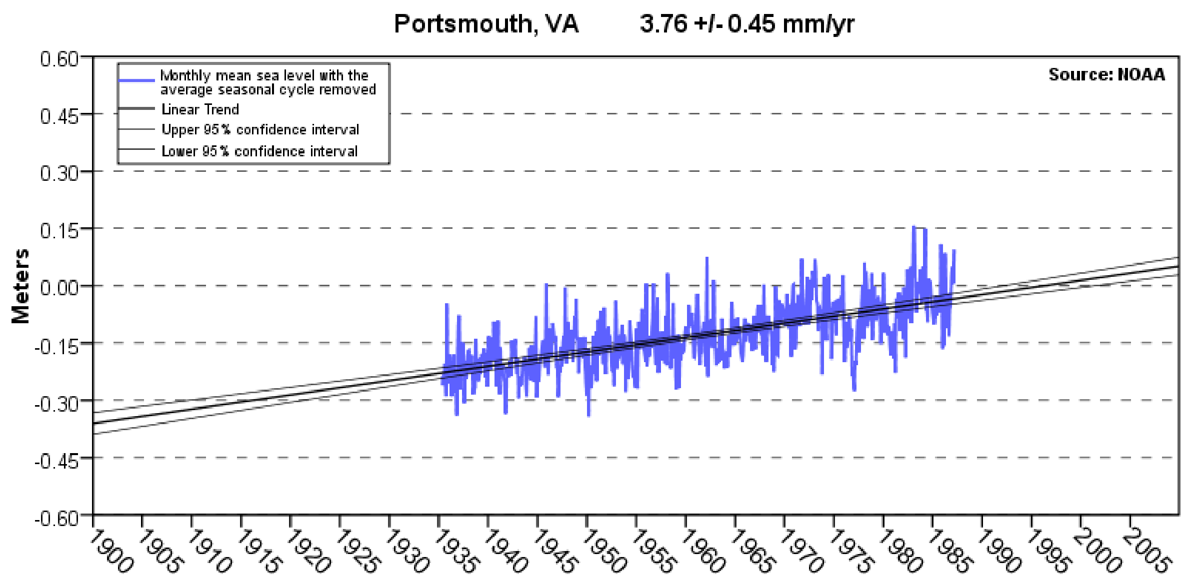
FIGURE 4.7: MEAN SEA LEVEL TREND, SEWELLS POINT, VIRGINIA



Source: NOAA, 2021

At Downtown Portsmouth, the mean sea level trend is 3.76 millimeters/year with a 95% confidence interval of +/- 0.45 mm/year based on monthly mean sea level data from 1935 to 1987 (**Figure 4.8**). This rate is equivalent to a change of 1.23 feet in 100 years.

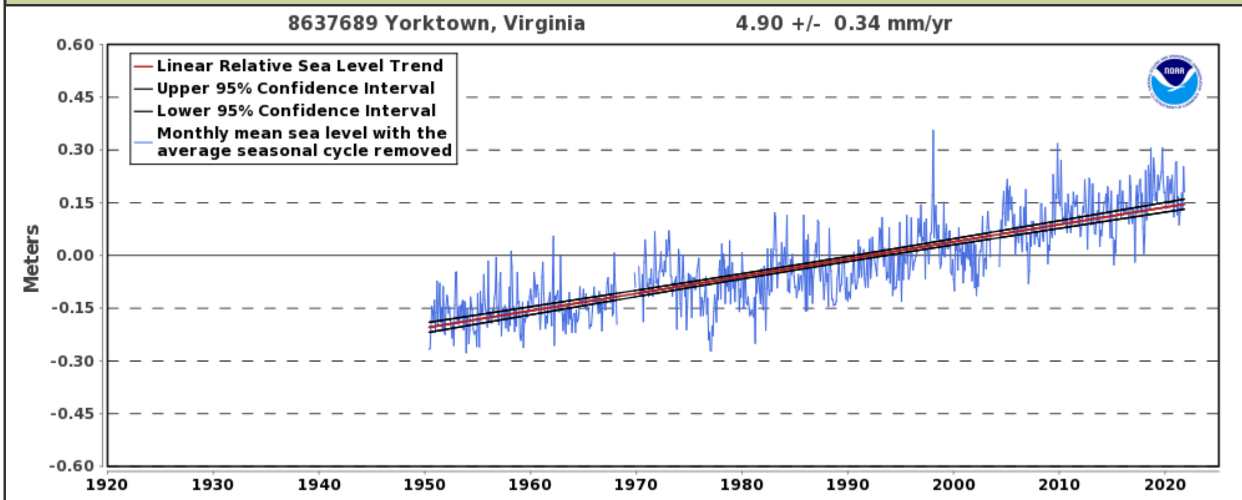
FIGURE 4.8: MEAN SEA LEVEL TREND, PORTSMOUTH, VIRGINIA



Source: NOAA, 2021

At Yorktown, Virginia, as shown in **Figure 4.9**, the mean sea level trend is 4.90 millimeters/year with a 95-percent confidence interval of +/- 0.34 mm/yr based on monthly mean sea level data from 1950 to 2020, which is equivalent to an increase of 1.61 feet in 100 years.

FIGURE 4.9: MEAN SEA LEVEL TREND, YORKTOWN, VIRGINIA



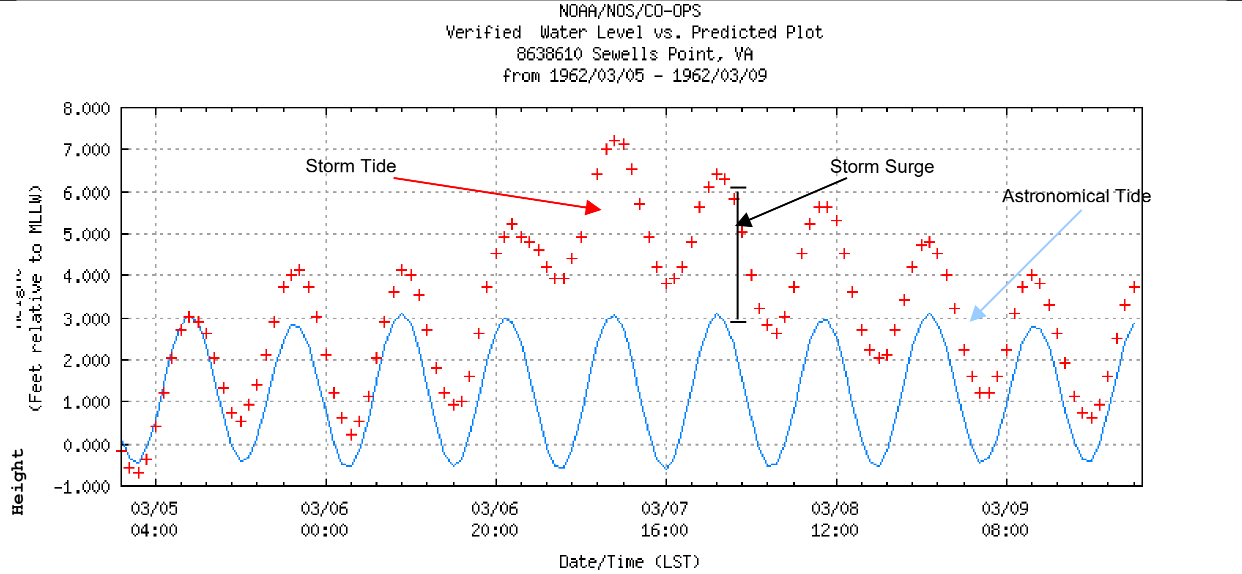
Source: NOAA, 2021

SIGNIFICANT HISTORICAL EVENTS

Unlike wildfires, earthquakes or coastal storms, the impacts of sea level rise are not felt or recorded in a matter of hours or days, but instead are slowly observed, recorded, and experienced over decades and centuries. However, scientists at VIMS have gathered data from several historical storms and made careful comparisons in an effort to highlight the historical impact of sea level rise locally.

The **Ash Wednesday Storm of 1962** produced a peak storm tide of approximately 7.2 feet MLLW at Sewell's Point (see **Figure 4.10**). If that same storm were to occur at mean high tide in 2030, using the sea level rise rates calculated above for Sewell's Point, the astronomical tide would be approximately one foot higher. Since the storm tide is obtained by adding the storm surge to the astronomical tide, the same storm could then produce a storm tide of over 8 feet MLLW. By comparison, Hurricane Isabel in 2003 produced a storm tide of 7.887 feet MLLW and caused an immense amount of damage.

FIGURE 4.10: ASTRONOMICAL AND STORM TIDES FOR 1962 STORM



Source: NOAA, 2008

Similarly, Boon (undated) concluded that sea level rise contributed to the similarity of two storms, the **August 1933 hurricane** and **Hurricane Isabel** in 2003. The storms had comparable peak storm tides of 8.018 feet MLLW (1933) and 7.887 feet MLLW (2003), and both peaks occurred very shortly before or after astronomical high tide, yet the 1933 storm occurred during spring tides and Isabel during neap tides. As a result, the storm surge in the 1933 storm was much higher and, all things being equal, the data would not have shown the storm surge that it did for Isabel had it not been for the constant adjustment of MLLW to account for as much as 1.35 feet of sea level rise between August, 1933 and September, 2003 (**Table 4.5**).

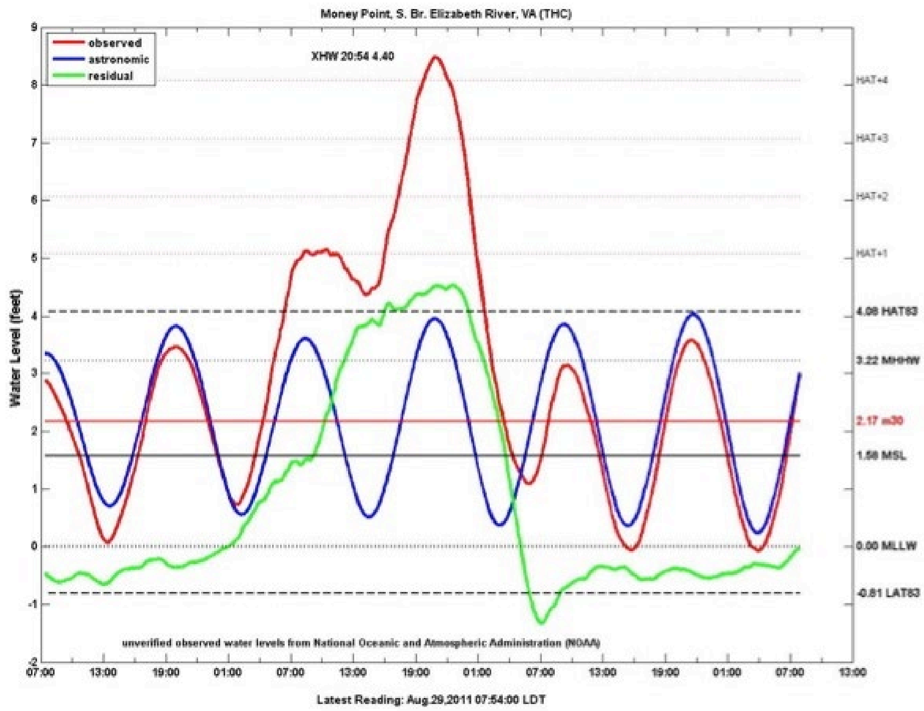
TABLE 4.5: AUGUST 1933 HURRICANE AND HURRICANE ISABEL (BOON, UNDATED)

STORM	STORM TIDE (HEIGHT IN FEET ABOVE MLLW)	STORM SURGE (HEIGHT IN FEET ABOVE NORMAL)	MEAN WATER LEVEL (HEIGHT IN FEET ABOVE MLLW)
August 1933	8.018	5.84	0.95
Isabel – September 2003	7.887	4.76	2.30
1933 -2003	0.131	1.08	-1.35

A mere tropical depression, **Ernesto** struck Hampton Roads on September 1, 2006. At Sewells Point, the storm surge reached a peak of about four feet above monthly mean sea level for the lunar month, but occurred at low tide. Boon (*Ernesto: Anatomy of a Storm Tide,* undated) concludes that if the peak storm surge had occurred at high tide, the storm tide peak would have reached seven feet MLLW, or just 0.9 feet below Isabel's peak storm tide.

Scientists have also focused on data from Money Point, Virginia, on the southern branch of the Elizabeth River near Portsmouth. In *Sea Level Rise and Coastal Infrastructure: Prediction, Risks and Solutions*, Bilal M. Ayyub and Michael S. Kearney observe that during the extratropical storm event which occurred in mid-November 2009, the maximum extratidal storm tide height of 4.69 feet at Money Point exceeded the extratidal height of 4.43 feet observed there during Hurricane Isabel. Again, during Hurricane Irene in 2011, the VIMS Tidewatch tool showed that Money Point experienced the highest water levels in the area, at 4.4 feet above highest astronomical tide. **Figure 4.11** shows observed water levels (red), predicted astronomic tide (blue), and the storm surge (green).

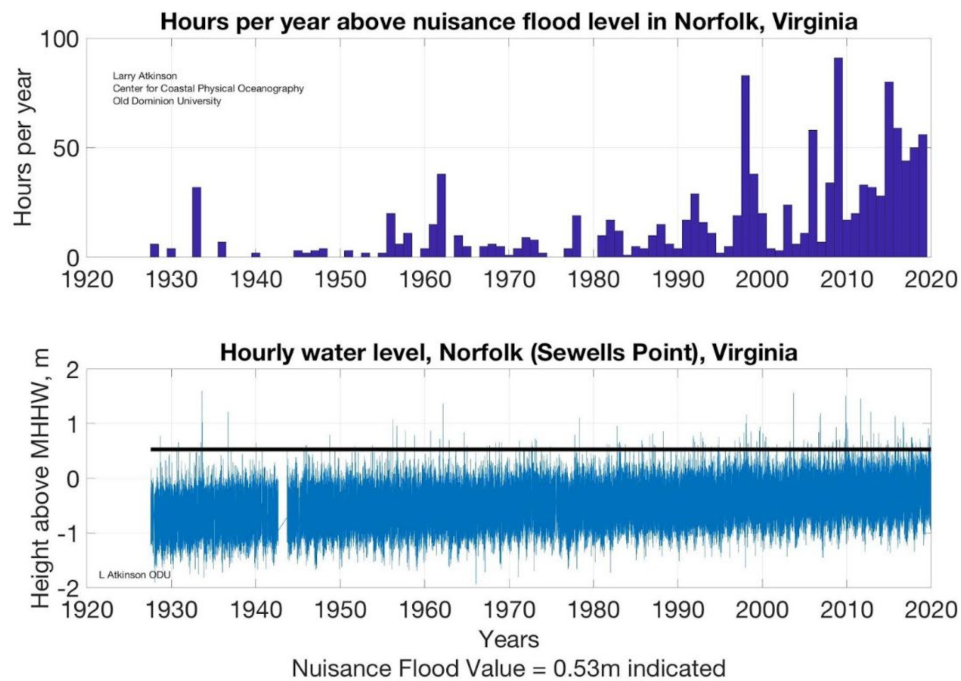
FIGURE 4.11: HURRICANE IRENE, TIDEWATCH DATA FOR MONEY POINT, VA



Source: Virginia Institute of Marine Science, 2011

The impacts of sea level rise are being felt on an almost daily basis in many parts of Hampton Roads. Dr. Larry Atkinson at the Old Dominion University Center for Coastal Physical Oceanography, compiled **Figure 4.12** which graphically shows the increasing problem of nuisance flooding in Norfolk. Nuisance flooding, sometimes referred to as "sunny day flooding" is a water level value determined by the NWS in collaboration with regional emergency managers. Regionally, that level is 0.53 meters (1.7 feet) above Mean Higher High Water: the horizontal black line in the lower panel of Figure 4.12. The upper panel shows there are occasional years with abnormally high hours of flooding. These are typical during a major hurricane or northeasters with long durations in the area. There is a slow, steady increase from about 2005. Based on this plot some exposed parts of Hampton Roads can expect at least 40 to 50 hours of nuisance flooding per year in the coming years. The lower panel shows the hourly water level since 1927.

FIGURE 4.12: NUISANCE FLOODING IN NORFOLK

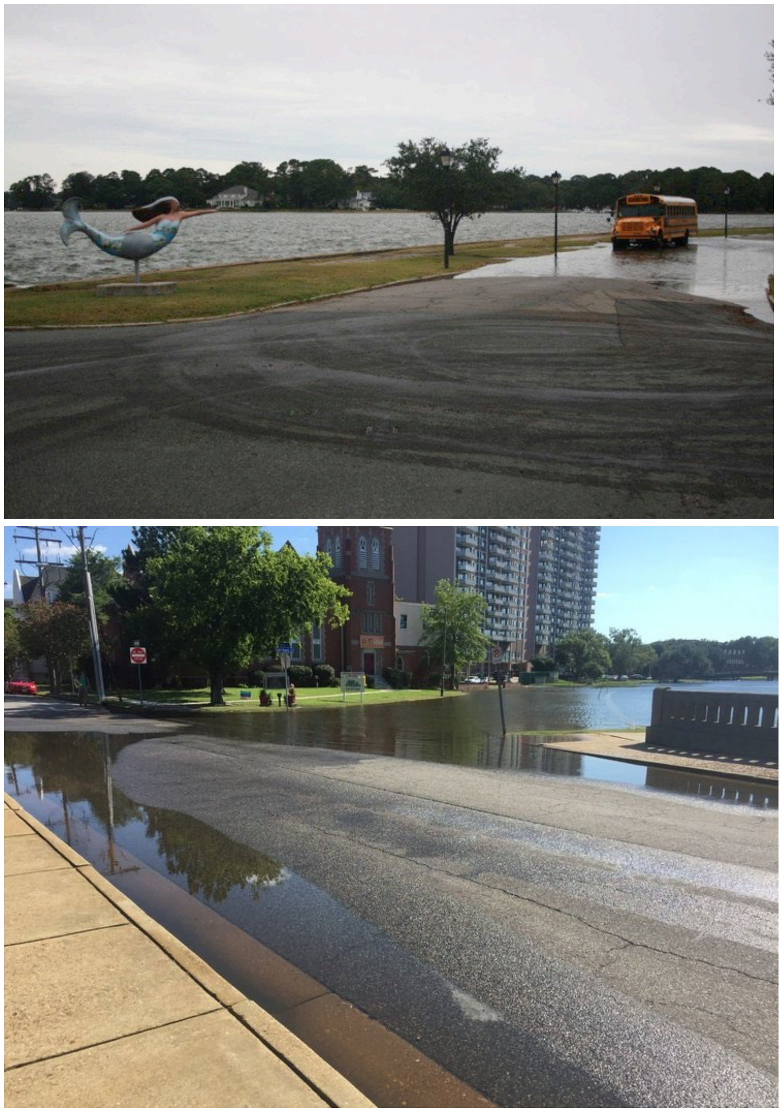


Source: L. Atkinson Online Blog, Old Dominion University, March 2020

The impacts of sea level rise are similar to the effects of flooding outlined above, but the frequency and severity of flooding can be expected to continue to increase, which has longer-term effects.

As nuisance flooding increases, Hampton Roads' population is becoming more accustomed to driving through salt-water flooded roads, cleaning out flooded buildings, and working through the impacts of each minor flood. But the longer-term economic impacts discussed above for flooding are slowly becoming more apparent. More communities must commit to long-term capital expenditures on flood mitigation and infrastructure rather than new investments in economic development, for example. More property owners must spend their wages on flood insurance, flood repair, and flood mitigation rather than on tangible goods. And the real estate market suffers when structures are subject to repetitive flooding with increasing frequency. Even nuisance flooding of crawl spaces or garages detracts from the ability of a house in a repetitive flood loss area to accrue value in the long-term. Days out of school for students locally are increasing annually due to flooding, and the impact on students and parents is sobering from an economic standpoint.

Impacts on the environment are apparent as shoreline erosion from more frequent shoreline inundation contributes to loss of trees, wetland grasses and other valuable habitats of the intertidal zone. Damage to these sensitive features is important because it could affect the important local seafood industry which relies on the intertidal zone as a fish and shellfish nursery, and because of the difficulty of recreating these habitats elsewhere. Also, eroded shorelines are more vulnerable to damage from severe flood events in the future.



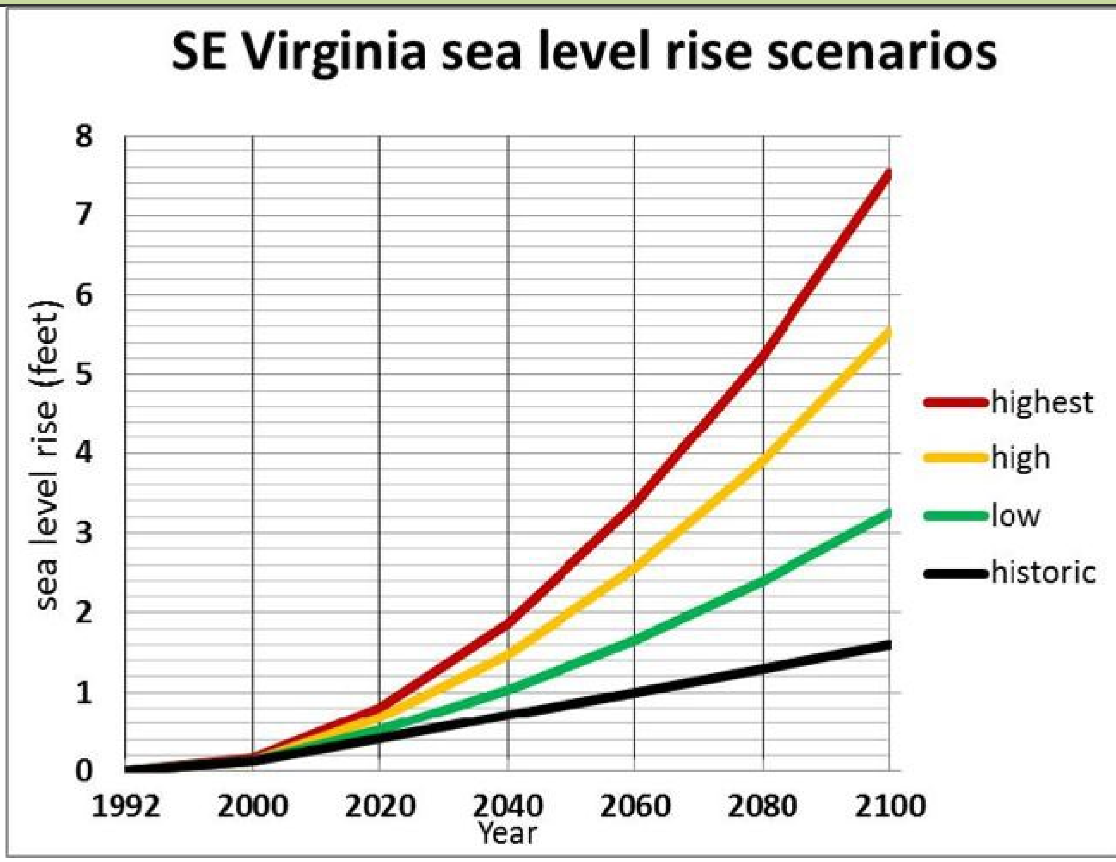
Nuisance flooding in Norfolk.

Source: Wetlands Watch

PROBABILITY OF FUTURE OCCURRENCE

In a report to the Virginia General Assembly in 2013 entitled *Recurrent Flooding Study for Tidewater Virginia*, VIMS presented four scenarios of sea level rise. Each scenario, as shown in **Figure 4.13** represents a possible trajectory for sea level rise in the region. The lowest, historic scenario is based on observed rates of rise and does not account for any acceleration. The low scenario incorporates some acceleration using assumptions about future greenhouse gas emission. The high scenario is based on the upper end of projections from semi-empirical models using statistical relationships in global observations of sea level and air temperature. And the highest scenario is based on consequences of global warming, ice-sheet loss and glacial melting. Each scenario was customized for conditions in southeastern Virginia, including using estimates for subsidence. The report concludes that regional planners should anticipate a 1.5-foot rise in sea level above the 1992 datum within the next 20 to 50 years (2033-2063). According to the VIMS report, "sea level rise will make it easier for the current patterns of weather events to generate damaging flood events in the future. Increases in storm intensity and/or frequency will only aggravate that circumstance."

FIGURE 4.13: SOUTHEAST VIRGINIA SEA LEVEL RISE SCENARIOS

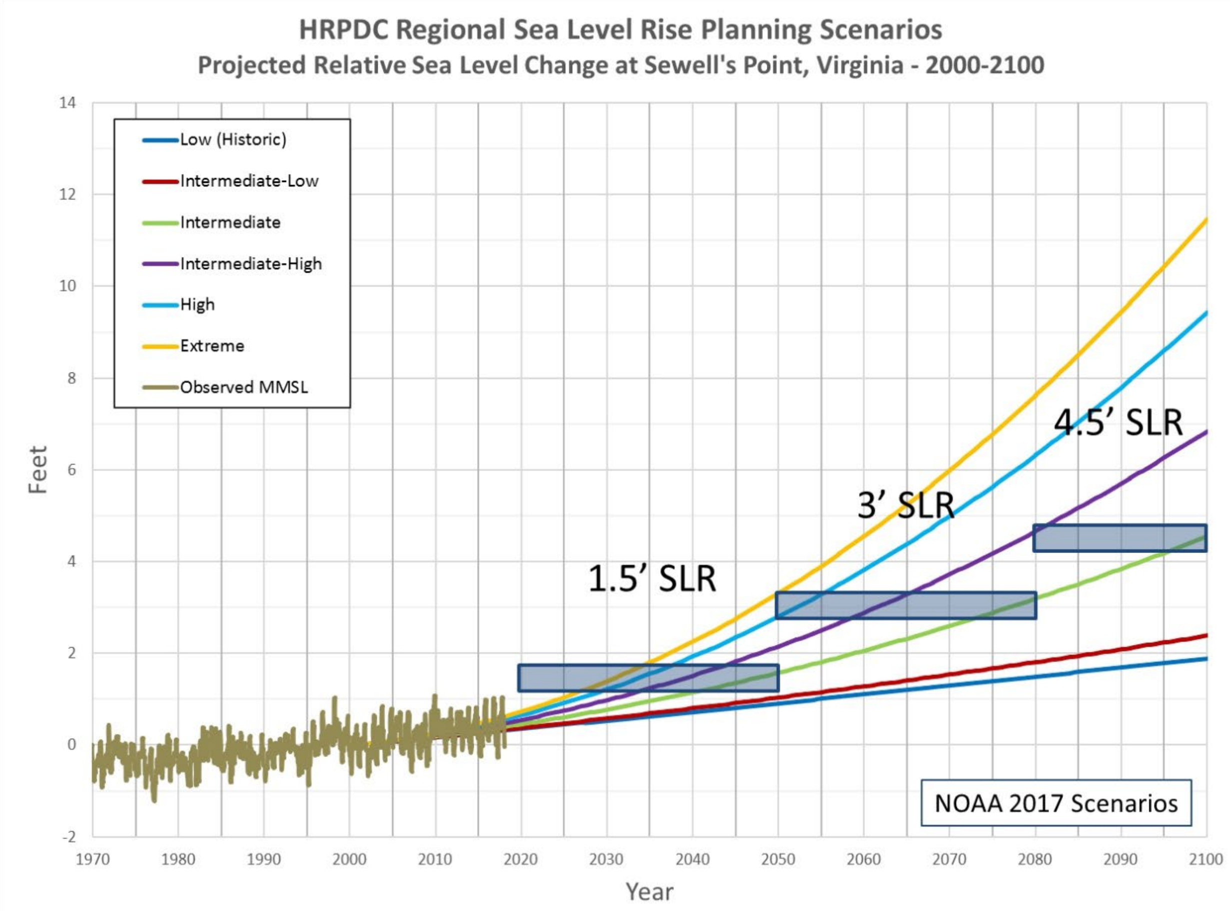


Source: VIMS, Recurrent Flooding Study for Tidewater Virginia, 2013 HRPDC web site, accessed May 19, 2021.

Following issuance of the 2013 study by VIMS and subsequent discussion, on October 18, 2018, the HRPDC approved and adopted a resolution encouraging local governments within the region to consider adopting policies that incorporate sea level rise into planning and engineering decisions. The approved Sea Level Rise Planning Policy and Approach incorporates and expounds on the concepts in the 2013 report and adds three unique time-based planning horizons. The policy recommends the following relative sea level rise scenarios as depicted in **Figure 4.14**:

- 1.5 ft above current mean higher high water (MHHW) for near-term (2018-2050);
- 3 ft above current mean higher high water (MHHW) for mid-term (2050-2080); and
- 4.5 ft above current mean higher high water (MHHW) for long-term (2080-2100).

FIGURE 4.14: SOUTHEAST VIRGINIA SEA LEVEL RISE SCENARIOS



Source: HRPDC web site, accessed May 19, 2021.

The rationale behind this important resolution of agreement is that sea level rise is projected to be significant for Hampton Roads. Factoring it into planning and design decisions will reduce risk and damage from flooding and storm surge. Significant advances in climate modeling and analysis of observed trends support development of new sea level rise projections at the local level that are improvements above previously recommended projections. A regional consensus on values and approaches for sea level rise planning can, therefore, provide support for local efforts, assist with regional coordination, and encourage state and federal agencies to adopt similar standards.

The document also recommends selecting appropriate sea level rise curves and designs based on the risk tolerance and costs associated with individual projects. HRPDC staff is working to develop more specific implementation recommendations for categories of projects and policies.

TROPICAL/COASTAL STORM

BACKGROUND

Hurricane Isabel approaches North Carolina and Virginia in September of 2003. Photo source: NASA

Hurricanes and tropical storms are characterized by closed circulation developing around a low-pressure center in which the winds rotate counter-clockwise in the Northern Hemisphere and with a diameter averaging 10 to 30 miles across. A tropical cyclone refers to any such circulation that develops over tropical waters. Tropical cyclones act as a mechanism to transport built-up heat from the tropics toward the poles. In this way, they are critical to the earth's atmospheric heat and moisture balance. The primary damaging forces associated with these storms are high-level sustained winds, heavy precipitation, and tornadoes. Coastal areas are particularly vulnerable to storm surge, wind-driven waves, and tidal flooding which can prove more destructive than cyclone wind[2].

The key energy source for a tropical cyclone is the release of latent heat from the condensation of warm water. Their formation requires a low-pressure disturbance, warm sea surface temperature, rotational force from the spinning of the earth, and the absence of wind shear in the lowest 50,000 feet of the atmosphere. The majority of hurricanes and tropical storms form in the Atlantic Ocean, Caribbean Sea, and Gulf of Mexico during the official Atlantic hurricane season, which encompasses the months of June through November. The peak of the Atlantic hurricane season is September 10th. The Atlantic Ocean averages about 10 storms annually, of which six reach hurricane status (NASA Earth Observatory online at: http://earthobservatory.nasa.gov).

As a hurricane develops, barometric pressure (measured in millibars or inches) at its center falls and winds increase. If the atmospheric and oceanic conditions are favorable, it can intensify into a tropical depression. When maximum sustained winds reach or exceed 39 miles per hour (mph), the system is designated a tropical storm, given a name, and is monitored by the National Hurricane Center in Miami, Florida. When sustained winds reach or exceed 74 mph the storm is deemed a hurricane. Hurricane intensity is further classified by the Saffir-Simpson Hurricane Wind Scale which rates hurricane intensity on a scale of one to five, with five being the most intense. The wind scale, recently revised to remove storm surge ranges, flooding impact and central pressure statements, is shown in **Table 4.6**.

[2] For purposes of this risk assessment, coastal flood hazards associated with hurricanes and tropical storm events are included under the "flood" hazard.

TABLE 4.6: SAFFIR-SIMPSON HURRICANE WIND SCALE		
CATEGORY	MAXIMUM SUSTAINED WIND SPEED (mph)	DAMAGE SUMMARY
1	74–95	Very dangerous winds will produce some damage.
2	96–110	Extremely dangerous winds will cause extensive damage.
3	111–129	Devastating damage will occur
4	130–156	Catastrophic damage will occur.
5	157 +	Catastrophic damage will occur.

Source: National Hurricane Center

Categories 3, 4, and 5 are classified as "major" hurricanes, and while hurricanes within this range comprise only 20% of total tropical cyclones making landfall, they account for over 70 percent of the damage in the United States. **Table 4.7** describes the damage that could be expected for each hurricane category.

TABLE 4.7: HURRICANE DAMAGE CLASSIFICATIONS		
STORM CATEGORY	DAMAGE LEVEL	DESCRIPTION OF DAMAGES
1	MINIMAL	Well-constructed frame homes could have damage to roofs, shingles, vinyl siding and gutters. Large branches of trees will snap and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days.
2	MODERATE	Well-constructed frame homes could sustain major roof and siding damage. Many shallowly rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected with outages that could last from several days to weeks.
3	EXTENSIVE	Well-built framed homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes.
4	EXTREME	Well-built framed homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months.
5	CATASTROPHIC	A high percentage of framed homes will be destroyed, with total roof failure and wall collapse. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months.

Source: National Hurricane Center web site, 2015

Storm surge is a large dome of water often 50 to 100 miles wide and rising anywhere from four to twenty feet. The storm surge arrives ahead of the storm's actual landfall and the more intense the hurricane is, the sooner the surge arrives. Water rise can be very rapid, posing a serious threat to those who have not yet evacuated flood-prone areas. A storm surge is a wave that has outrun its generating source and become a long period swell. The surge is always highest in the right-front quadrant of the direction in which the hurricane is moving. As the storm approaches shore, the greatest storm surge will be to the north of the hurricane eye. Such a surge of high water topped by waves driven by hurricane force winds can be devastating to coastal regions, causing severe beach erosion and property damage.

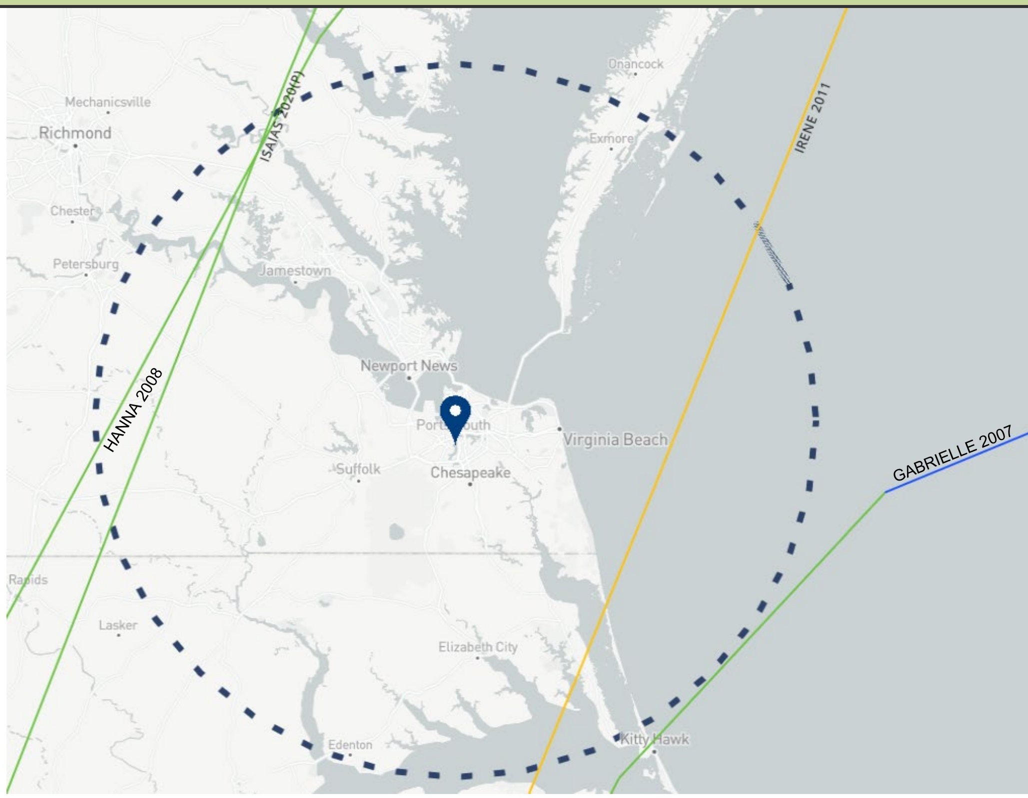
Storm surge heights and associated waves are dependent upon the shape of the continental shelf (narrow or wide) and the depth of the ocean bottom (bathymetry). A narrow shelf, or one that drops steeply from the shoreline and subsequently produces deep water close to the shoreline, tends to produce a lower surge but higher and more powerful storm waves. Damage during hurricanes may also result from spawned tornadoes and inland flooding associated with heavy rainfall that usually accompanies these storms. For the purposes of this report, the storm surge impacts in the region are discussed under the Flooding hazard.

LOCATION AND SPATIAL EXTENT

Hampton Roads is in an area that can expect to experience hurricane damage in any given year. Since the mid-1800s, numerous tropical cyclones have affected Virginia, causing the deaths of over 225 people and costing the Commonwealth more than a billion dollars in damages.

A total of 76 significant storms have passed within 75 miles of Hampton Roads since 1851 (**Figures 4.15 and 4.16**). Two Category 3 hurricanes passed within 75 miles of the region (unnamed storms in 1879 and 1899), eight were Category 2 hurricanes, 16 were Category 1 hurricanes and 50 were tropical storms. Tropical and extratropical depressions are not mapped in these figures.

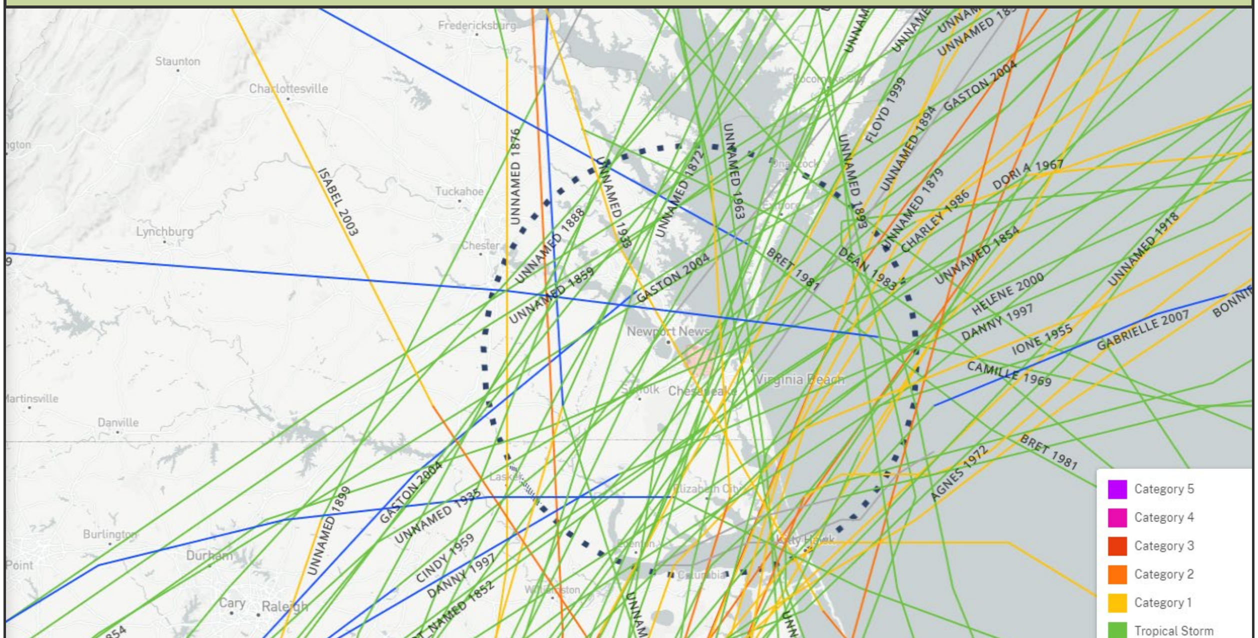
FIGURE 4.15: HISTORICAL STORM TRACKS WITHIN 75 MILES OF HAMPTON ROADS SINCE 2005



May, 2021

Source: NOAA Historical Hurricane Tracks, May 2021. Extratropical storms and Tropical Depressions at the time they passed within the radius are not included.

FIGURE 4.16: HISTORICAL STORM TRACKS WITHIN 75 MILES OF HAMPTON ROADS, 1851-2005



May, 2021

Source: NOAA Historical Hurricane Tracks, May, 2021

In Hampton Roads, the negative impacts of wind from the Category 1 and 2 hurricane events the area has experienced are consistent with the damage described in Table 4.7. Wind damage in the region from events in recent memory has been marked by a large number of downed trees, damage to roofs, siding and signs, power outages of typically less than a week as a result of downed power lines and trees across lines, and wind-blown debris damage and accumulation. Downed trees can temporarily block roadways, impeding transportation; however, these blockages are typically repaired swiftly by Virginia Department of Transportation (VDOT) and local roadway maintenance crews. Business interruptions resulting from power outages are commonplace and many restaurants and cold storage facilities can be negatively impacted, especially by prolonged outages. Commodities such as ice and gas are in high demand to power both home and business generators. Since wind and flood events typically occur simultaneously, the combined impacts are more devastating in flood-prone areas. Roof damage from wind can subsequently result in rain damage to structures, as well. Combined storm surge and wind impacts to shorefront areas at Virginia Beach, Norfolk, and Hampton may make some homes and businesses uninhabitable for days to weeks at a time.

SIGNIFICANT HISTORICAL EVENTS

The NWS began keeping weather records on January 1, 1871. Prior to that, information on past hurricanes and tropical storms to impact the Hampton Roads region were taken from ships logs, accounts from local citizens, newspapers, and other sources. There are several historical references to major storms that affected coastal Virginia in the 1600's and 1700's. Some of these storms were strong enough to alter land masses, including the widening of the Lynnhaven River (September 6, 1667) and formation of Willoughby Spit (October 19, 1749). These reports also indicate severe flooding caused by these storms (12-15 feet of flooding in some cases).

Better records have been kept since 1871. One of the first storms to be well documented was a hurricane in **October 1878** that resulted in Cobb and Smith Islands on the Eastern Shore being completely submerged.

One of the worst storms to impact the region occurred in August 1933 when a hurricane known as the **Chesapeake-Potomac Hurricane of 1933** passed just west of the Hampton Roads area. The storm made landfall in northeastern North Carolina and moved northwest. This hurricane produced the record high tide for the area which exists today, at a level of 9.69 feet above MLLW. The highest sustained wind was 88 mph at the Naval Air Station (NAS). Less than a month later, another hurricane struck the area with winds again clocked at 88 mph at NAS, but tides only rose to 8.3 feet above MLLW.

Another unnamed storm occurred in **September of 1944** creating the fastest one-minute wind speed to ever be recorded in the area of 134 mph at Cape Henry. Gusts were estimated to be 150 mph. The local NWS office recorded 72 mph winds with gusts to 90 mph.

Although the center of circulation for **Hurricane Hazel** in 1954 did not pass within 75 miles of the region, wind speeds of 78 mph were recorded at Norfolk Airport with gusts up to 100 mph and an unofficial reading of 130 mph was also reported in Hampton.

In 1960, **Hurricane Donna** passed through the region with a fastest one-minute wind speed of 73 mph at Norfolk Airport, 80 mph at Cape Henry and estimated 138 mph at Chesapeake Light Ship. Lowest pressure of 28.65 inches holds the area record for a tropical storm. Three deaths were documented in association with this hurricane.

On August 27, 1998, **Hurricane Bonnie** tracked over the region after passing over the northern Outer Banks. Winds speeds were sustained at 46 mph with gusts to 64 mph at Norfolk International Airport. Four to seven inches of rain combined with near hurricane force winds knocked out power to 320,000 customers across Virginia. Highest tide was recorded at 6.0 feet above MLLW. This was the most significant storm to impact the region since Hurricane Donna in 1960.

On September 6, 1999, downgraded **Hurricane Floyd** passed directly over Virginia Beach on a track similar to Hurricane Donna in 1960. Wind speeds were recorded at 31 mph with gusts to 46 mph. Rainfall amounts of 12-18 inches were recorded in portions of eastern Virginia, causing extensive flooding in the Southside Hampton Roads region.

In the 1990s, several storms had a less direct path over Hampton Roads, but nonetheless impacted the weather severely. In 1996, **Hurricanes Bertha and Fran** impacted the region, followed by **Hurricane Danny** in 1997, **Hurricane Bonnie** in 1998, and **Hurricanes Dennis, Floyd, and Irene** in 1999. Although each of these storms was downgraded by the time they reached Hampton Roads, they each created problems for the region when they passed through, and two resulted in Federal Disaster declarations (Bonnie and Floyd) for the region. **Tropical storms Helene** in 2000 and **Kyle** occurred in 2002, and of course, **Hurricane Isabel** caused $1.6 billion damage in the region in 2003, and claimed 33 lives (*The Virginian Pilot,* 9/4/06). During Isabel, wind speeds of 54 mph with gusts to 75 mph in Norfolk and significant beach erosion were reported.

Of the five storms that have passed through the region since the original Hazard Mitigation Plans were developed (Alberta, Ernesto, Barry, Gabrielle, Hanna and Irene), Hanna initially appeared to forecasters to have the worst characteristics. **Tropical Storm Hanna** tracked up the Mid-Atlantic coast on September 6, 2008, with maximum sustained winds around 50 mph. Hanna originally made landfall near the border of North and South Carolina around 3:20 am on the 6th. The storm tracked across eastern North Carolina during the early afternoon hours before turning northeast across southeastern Virginia later in the afternoon. Hanna eventually tracked across the Chesapeake Bay and into Delaware during the evening hours. With the track of Hanna being to the east, the strongest winds were also confined to the east of Hampton Roads. The highest sustained wind of 55 mph with a peak gust of 68 mph was recorded at the 3rd Island Bay Bridge Tunnel. Minimum pressure of 991 MB was recorded at the 3rd Island Bay Bridge Tunnel. Coastal storm tides of two feet or less above astronomical tide levels were common, with only minor beach erosion reported. Near the coast, as well as inland, tropical storm winds knocked down numerous trees and power lines, as well as caused minor structural damage. No fatalities or injuries were attributed to the winds.

Contrary to expectations and forecasts, however, **Ernesto** in early September 2006 proved very damaging because of coastal flooding. State officials blamed Ernesto for six deaths across Virginia and an estimated $33 million in statewide damage (*The Virginian Pilot,* 9/4/06). Additional discussion of the regional flood-related impacts from Ernesto is shown in Table 4.2.

Hurricane Irene, in late August 2011, first struck the U.S. as a Category 1 hurricane in eastern North Carolina, then moved northward along the Mid-Atlantic Coast. Wind damage in coastal North Carolina, Virginia, and Maryland was moderate, with considerable damage resulting from falling trees and power lines. Irene made its final landfall as a tropical storm in the New York City area and dropped torrential rainfall in the Northeast that caused widespread flooding. Irene was the first hurricane to hit the U.S. since Ike in September 2008. Irene's landfall in eastern North Carolina and path northward were accurately predicted more than four days in advance by NOAA's National Hurricane Center, which used information from weather satellites, hurricane models, aircraft observations, and other data.

Flooding at the "Triple Decker Bridge" resulting from Hurricane Sandy.

Photo credit: City of Chesapeake

Hurricane Sandy, in October 2012, was again expected to bring extreme hurricane conditions to southeastern Virginia. Fortunately, the storm track veered away from the Virginia coast and spared the region much of the devastation wrought in the northeast. Some areas of Virginia were included in the Presidentially-Declared Disaster for the storm, but Hampton Roads saw little more than flooding in low-lying areas and limited wind damage, and therefore was not among declared communities.

After landfall along the northwestern coast of Florida on June 7, 2013, **Tropical Storm Andrea** moved northeastward with additional acceleration across northeastern Florida and southeastern Georgia, with the center passing over Savannah, Georgia. During this time, the storm maintained an intensity of 40 knots, with the strongest winds occurring mainly over water to the east and southeast of the center. As the cyclone moved into South Carolina, it started to merge with a baroclinic zone, which caused Andrea to become extratropical over northeastern South Carolina. The center of the post-tropical cyclone moved rapidly across eastern North Carolina and southeastern Virginia, over the Atlantic near the New Jersey coast, and across eastern Long Island to eastern Massachusetts. One traffic incident related to the storm appears to have caused one death in Virginia, but the location of the accident was not reported in the National Hurricane Center Tropical Cyclone Report on the storm.

August 4, 2020 – The center of **Tropical Storm Isaias** tracked north just inland of the Middle Atlantic Coast from late Monday night, August 3rd through Tuesday morning, August 4th. The tropical storm produced tropical storm force winds and associated wind damage across portions of eastern Virginia. Tropical storm winds downed and uprooted several trees and power lines, produced significant structural damage, and caused power outages across the county. Wind gust of 67 mph was measured at NTU. Wind gust of 59 mph was measured at Virginia Beach. Property damage of $2.8 million was reported.

Table 4.8 shows the historical storm tracks within 75 miles of Hampton Roads since 1851 that are the basis for **Figures 4.15 and 4.16**. While Tropical Storm Arthur in 2014 does not appear to have tracked within the search radius used for **Table 4.9** and **Figure 4.16**, the storm nonetheless produced tropical storm force winds and locally heavy rainfall across portions of southeast Virginia from late Thursday night, July 3rd into midday Friday, July 4th. Rain bands associated with Arthur produced generally one to two inches of rainfall across portions of the Virginia Beach. Back Bay reported 1.30 inches of rain. A wind gust of 47 knots was measured at Oceana NAS, and a wind gust of 43 knots was measured at Lynnhaven. The gusts caused minor structural damage which was reported to total $5,000. Norfolk International Airport reported 1.46 inches of rain. A wind gust of 38 knots was measured at Norfolk NAS.

Three additional tropical storms caused damage in the study area over the past five years that deserve mention, despite the fact that their storm tracks did not fall within the parameters outlined for Figure 4.16 or Table 4.8:

September 2, 2016 - **Tropical Storm Hermine** moving northeast along the Southeast Coast then off the Mid Atlantic Coast produced tropical storm force winds, minor to moderate coastal flooding, and locally heavy rainfall across portions of Hampton Roads, the Middle Peninsula, and the Virginia Eastern Shore from Friday afternoon, September 2nd into Saturday night, September 3rd. Rain bands produced generally 2 to 4 inches of rainfall across the county. Norfolk reported 4.15 inches of rain. Norfolk South reported 3.77 inches of rain. Norfolk International Airport reported 2.68 inches of rain. The highest sustained wind of 39 knots with a peak wind gust of 48 knots was measured at Norfolk International Airport. Wind gust of 45 knots was measured at NAS Norfolk. Tropical storm wind gusts caused minor tree and structural damage. Coastal storm tides of 2 to 3.5 feet above astronomical tide levels were common, with only minor beach erosion reported. The maximum storm tide reached 6.16 feet MLLW at Sewells Point, which resulted in moderate coastal flooding Saturday morning into Saturday afternoon. Damages tallied $35,000 across the region.

September 5, 2019 - **Hurricane Dorian** tracking northeast along the North Carolina coast and just off the Virginia coast produced tropical storm winds and associated wind damage across portions of southeast Virginia. Tropical storm winds downed and uprooted several trees and power lines, produced minor structural damage, and caused power outages across the county. Wind gust of 55 mph was measured at Naval Auxiliary Landing Field Fentress in Chesapeake. Power poles were broken in some areas, and shingles were blown off the roof of a house. Damages of $340,000 were reported.

Damages attributed to Post Tropical Cyclone Michael in October of 2016 were attributed primarily to Flooding as described in the section above.

TABLE 4.8: HISTORICAL STORM TRACKS WITHIN 75 MILES OF HAMPTON ROADS (SINCE 1851)

DATE OF OCCURRENCE	STORM NAME	WIND SPEED (mph)	STORM CATEGORY AT LANDFALL
8/25/1851	UNNAMED	45	TROPICAL STORM
9/10/1854	UNNAMED	45	TROPICAL STORM
8/20/1856	UNNAMED	60	TROPICAL STORM
9/17/1859	UNNAMED	60	TROPICAL STORM
9/27/1861	UNNAMED	70	TROPICAL STORM
11/2/1861	UNNAMED	80	CATEGORY 1 HURRICANE
9/18/1863	UNNAMED	70	TROPICAL STORM
10/26/1872	UNNAMED	45	TROPICAL STORM
9/29/1874	UNNAMED	70	TROPICAL STORM
9/17/1876	UNNAMED	90	CATEGORY 1 HURRICANE
10/23/1878	UNNAMED	105	CATEGORY 2 HURRICANE
8/18/1879	UNNAMED	115	CATEGORY 3 HURRICANE
9/9/1880	UNNAMED	80	CATEGORY 1 HURRICANE
9/10/1881	UNNAMED	70	TROPICAL STORM
9/11/1882	UNNAMED	45	TROPICAL STORM
9/23/1882	UNNAMED	45	TROPICAL STORM
9/12/1883	UNNAMED	45	TROPICAL STORM
8/26/1885	UNNAMED	80	CATEGORY 1 HURRICANE
7/2/1886	UNNAMED	40	TROPICAL STORM
9/11/1888	UNNAMED	40	TROPICAL STORM
10/12/1888	UNNAMED	60	TROPICAL STORM
9/25/1889	UNNAMED	45	TROPICAL STORM
6/17/1893	UNNAMED	65	TROPICAL STORM
10/23/1893	UNNAMED	50	TROPICAL STORM

TABLE 4.8: HISTORICAL STORM TRACKS WITHIN 75 MILES OF HAMPTON ROADS (SINCE 1851)

DATE OF OCCURRENCE	STORM NAME	WIND SPEED (mph)	STORM CATEGORY AT LANDFALL
9/29/1894	UNNAMED	85	CATEGORY 1 HURRICANE
10/10/1894	UNNAMED	75	CATEGORY 1 HURRICANE
9/23/1897	UNNAMED	70	TROPICAL STORM
10/26/1897	UNNAMED	60	TROPICAL STORM
8/18/1899	UNNAMED	120	CATEGORY 3 HURRICANE
10/31/1899	UNNAMED	65	TROPICAL STORM
7/11/1901	UNNAMED	80	CATEGORY 1 HURRICANE
6/16/1902	UNNAMED	40	TROPICAL STORM
9/15/1904	UNNAMED	65	TROPICAL STORM
9/1/1908	UNNAMED	50	TROPICAL STORM
8/25/1918	UNNAMED	40	TROPICAL STORM
12/3/1925	UNNAMED	45	TROPICAL STORM
9/19/1928	UNNAMED	45	TROPICAL STORM
8/23/1933	UNNAMED	80	CATEGORY 1 HURRICANE
9/16/1933	UNNAMED	90	CATEGORY 1 HURRICANE
9/6/1935	UNNAMED	75	CATEGORY 1 HURRICANE
9/18/1936	UNNAMED	100	CATEGORY 2 HURRICANE
8/2/1944	UNNAMED	50	TROPICAL STORM
9/14/1944	UNNAMED	105	CATEGORY 2 HURRICANE
10/20/1944	UNNAMED	40	TROPICAL STORM
6/26/1945	UNNAMED	50	TROPICAL STORM
7/7/1946	UNNAMED	65	TROPICAL STORM
8/14/1953	BARBARA	105	CATEGORY 2 HURRICANE
8/31/1954	CAROL	100	CATEGORY 2 HURRICANE
8/12/1955	CONNIE	80	CATEGORY 1 HURRICANE
9/20/1955	IONE	70	TROPICAL STORM
7/10/1959	CINDY	40	TROPICAL STORM
7/30/1960	BRENDA	50	TROPICAL STORM
9/12/1960	DONNA	105	CATEGORY 2 HURRICANE
9/14/1961	UNNAMED	40	TROPICAL STORM
9/1/1964	CLEO	45	TROPICAL STORM
9/17/1967	DORIA	40	TROPICAL STORM
8/28/1971	DORIA	65	TROPICAL STORM
6/22/1972	AGNES	50	TROPICAL STORM
7/1/1981	BRET	60	TROPICAL STORM
9/30/1983	DEAN	65	TROPICAL STORM
9/14/1984	DIANA	60	TROPICAL STORM
9/27/1985	GLORIA	105	CATEGORY 2 HURRICANE
8/18/1986	CHARLEY	80	CATEGORY 1 HURRICANE
9/25/1992	DANIELLE	65	TROPICAL STORM
7/13/1996	BERTHA	75	CATEGORY 1 HURRICANE
7/24/1997	DANNY	45	TROPICAL STORM
8/28/1998	BONNIE	85	CATEGORY 1 HURRICANE
9/16/1999	FLOYD	80	CATEGORY 1 HURRICANE
9/24/2000	HELENE	45	TROPICAL STORM
10/12/2002	KYLE	45	TROPICAL STORM
9/18/2003	ISABEL	100	CATEGORY 2 HURRICANE
8/14/2004	CHARLEY	40	TROPICAL STORM
9/10/2007	GABRIELLE	40	TROPICAL STORM
9/06/2008	HANNA	70	TROPICAL STORM
8/28/2011	IRENE	75	CATEGORY 1 HURRICANE
8/4/2020	ISAIAS	69	TROPICAL STORM

Source: NOAA Historical Hurricane Tracks, May 2021

PROBABILITY OF FUTURE OCCURRENCES

It is likely that the region will be impacted by hurricanes and tropical storms in the future. Direct impacts from hurricanes category 3 and 4 intensity are rare in Hampton Roads due to 1) historical tracks remaining offshore or impacting land before reaching Hampton Roads; and 2) cooler Atlantic Ocean water temperatures north of Cape Hatteras, which diminish a storm's ability to maintain intensity, or intensify. A Category 5 hurricane is considered implausible in Hampton Roads due to the cooler water temperatures mentioned above. The effects of smaller hurricanes (Categories 1 and 2 with wind speeds from 74-110 mph) and tropical storms (sustained wind speeds of at least 39 mph and torrential rains) will be frequent, as storms making landfall along the North Carolina and Virginia coastlines could impact the region in any given year.

LANDSLIDE/COASTAL EROSION

BACKGROUND

Erosion is the gradual breakdown and movement of land due to both physical and chemical processes of water, wind, and general meteorological conditions. Natural, or geologic, erosion has occurred since the Earth's formation and continues at a very slow and uniform rate each year. Major storms such as hurricanes and tropical storms may cause more sudden, rapid erosion by combining heavy rainfall, high winds, heavy surf and storm surge to significantly impact riverbanks and the shoreline.

As it relates to natural hazards that threaten property damage, there are two types of erosion: riverine erosion and coastal erosion. The primary concern of both riverine and coastal erosion is the gradual removal of rock, vegetation and other sediment materials from riverbanks, stream beds and shorelines that result in soil instability and possible damages to property and infrastructure.

The average annual erosion rate on the Atlantic coast is roughly 2 to 3 feet per year; however, erosion rates vary greatly from location to location and year to year. A study by The Heinz Center (2000), *Evaluation of Erosion Hazards*, states that over the next 60 years, erosion may claim one out of four houses within 500 feet of the U.S. shoreline. It also states that nationwide, erosion may be responsible for approximately $500 million in property loss to coastal property owners per year, including both damage to structures and loss of land. To the homeowners living within areas subject to coastal erosion, the risk posed by erosion is comparable to the risk from flooding and other natural hazard events.

In Hampton Roads, shoreline, or coastal, erosion poses the most significant threat, and is a long-term hazard that undermines waterfront homes, businesses, public facilities and infrastructure along shorelines, even rendering structures uninhabitable or unusable. Shoreline erosion is driven by a number of natural influences such as sea level rise and land subsidence, large storms such as tropical storms, nor'easters and hurricanes, storm surge, flooding and powerful ocean waves. While coastal flooding in the region is typically a short term event, shoreline erosion in Hampton Roads may best be described as a relatively slow natural process occurring over the long term, with occasional major impacts wrought by coastal storm and flooding hazards. Manmade influences such as coastal development and some shoreline stabilization projects can exacerbate shoreline erosion, even when initially intended to minimize immediate erosive effects. Many older shoreline stabilization features in Hampton Roads are vulnerable to the effects of shoreline erosion and their failure can cause subsequent catastrophic failure of parking lots, port facilities, marinas, parks, garages, roads and other waterfront features. The features are not typically critical to the life, health and safety of residents, but nonetheless are costly and time-consuming to repair for both public and private entities. While not as sudden as other hazard events discussed in this plan, shoreline erosion influences the stability and condition of coastal property and beaches when other short-term hazard events occur. For example, erosive forces may undermine tree roots and revetments along a shoreline, exacerbating the effects of flooding and sea level rise.

In Hampton Roads' more vulnerable Atlantic Ocean and Chesapeake Bay shorelines, the same large waves that are capable of causing severe shoreline erosion often attract onlookers, tourists and surfers drawn to the waves' magnitude and power. Locally, fatalities then result when these people are unexpectedly caught up in the surf and strong offshore currents, or rip currents, hindering their return to shore.

A landslide is the downslope transport of a mass of soil and rock material and refers to a number of different varieties of ground movement landforms and processes. The primary driving force for a landslide is gravity, but other factors may contribute to the failure of a slope. Landslides are usually triggered by heavy rainfall, rapid snow melt, oversteepening of slopes by stream incision, or earthquakes, while certain man-made changes to the land, such as slope modification or drainage alteration, can greatly increase the likelihood of landslides. Sometimes a landslide may move slowly down a slope, but often the movement can occur without warning and be extremely fast. Soil creep and slumping cause property damage gradually, whereas rockslides and debris flows can sweep away people and property instantaneously. In the United States, landslides annually cause up to $2 billion in damages and take between twenty-five and fifty lives.[3]

Landslides occur in many manifestations and are usually classified according to the type of material involved and the mode of downslope movement. The material can range from loose earth to blocks of solid rock. These materials may then move downslope by falling, sliding or flowing. The following are some of the more important types of mass movement:

Rockfalls entail large blocks of bedrock breaking off a cliff face and tumbling downslope;

Rockslides occur when a detached section of bedrock slides down an inclined surface, frequently along a bedding plane;

Earthslides involve masses of soil moving down a slip face, usually on top of the bedrock;

Creep is the slow, continuous, imperceptible downslope movement of soil and rock particles;

Rotational slides or slumps result from the rotation of a cohesive unit of soil or rock down a slip surface, leaving a curved scarp; and

Debris flows develop on steep slopes as a result of heavy rainfall that saturates the soil, which under the extra weight and lubrication breaks loose and becomes a slurry that takes everything with it, including large trees and houses. Channeled debris flows can reach speeds approaching a hundred miles an hour and strike without warning.

Landslides are most common in the mountainous terrain of Virginia because of the presence of steep slopes and highly fractured bedrock over shallow soils. The lower-relief areas of the Piedmont and Coastal Plain also have landslides, but they are often smaller and generated by human disturbance, such as making an oversteepened road cut. The most disastrous landslide events have been associated with heavy rainfall along the steep slopes of the Blue Ridge Mountains and the Appalachians. Areas that are prone to mass movement include areas where landslides have occurred in the past; steep slopes with an angle greater than 30 degrees; and oversteepened cuts and fills, particularly due to home and road building. Research in North Carolina has revealed that about fifty-six percent of recent landslides happened on slopes that had been altered in some way by development.

Landslides are capable of destroying buildings, rupturing utility and other lifelines, while blocking transportation routes. Urban development can increase the damages caused by a landslide. Damages sustained by roads and highways during a landslide can result in long-term loss of use of certain transportation routes and contribute to increased traffic and emergency response times in the affected region. The soil movement that occurs during a landslide can destabilize structural supports for pipelines potentially resulting in pipeline ruptures and decreased or loss of service in a region.

The severity of a landslide is dependent on many factors including the slope and width of the area involved, the speed of the earth movement, and any structures or infrastructure directly in the path of the slide. Impacts of a landslide can range from a minor inconvenience to a life-threatening situation when automobiles and buildings are involved.

LOCATION AND SPATIAL EXTENT

Shoreline erosion is a significant concern in the Hampton Roads region. According to VIMS, the Atlantic and Chesapeake Bay coasts in the region are very dynamic in terms of shoreline change and sediment transport processes. VIMS and other agencies occasionally perform studies to determine long-term shoreline change patterns for various locations across the region. However, these studies are largely

[3]Virginia Department of Energy, 2021

intended to track shoreline and dune evolution through natural and manmade alterations, and are not designed to determine erosion rates or areas of coastal erosion. While FEMA does not map erosion hazard areas, FIRMs produced by the agency do indicate the highest risk areas for coastal flooding with significant wave action (termed V zones, velocity zones, or coastal high hazard areas)[4]. For purposes of this plan, areas identified as coastal high hazard zones on the FIRM are also assumed to be at risk of shoreline, or coastal, erosion.

Another factor in accurately determining specific shoreline erosion hazard areas is the continuous implementation of shoreline reinforcement or nourishment projects completed by federal, state and local government agencies. Typically, areas of high concern with regard to long term erosion are addressed through shoreline hardening or stabilization projects, such as seawalls, breakwaters and beach sand replenishment. For example, in 2002, the Virginia Beach Erosion Control and Hurricane Protection Project protected more than six miles from the imminent hazards of shoreline erosion through sand replenishment. Many other projects have been completed in the region and still others are pending approval and/or funding[5].

This photo, taken while the Virginia Beach Erosion Control and Hurricane Protection Project was underway, shows the significant difference between the unimproved area and the area of the widened beach berm already completed.

Source: City of Virginia Beach

HISTORICAL OCCURENCES

Shoreline erosion events typically occur in conjunction with hurricanes, tropical storms and nor'easters, so the list of "Ocean and Lake Surf" events provided from the NCEI database is not considered comprehensive (**Table 4.9**). Some of the damages listed duplicate damages shown for coastal flooding events and/or may apply to areas outside of the study area for this plan; however, the descriptive details indicate the nature of shoreline erosion damage (and fatalities) associated with this select group of events in Hampton Roads.

[4] For more information on FEMA V-zones, refer to the Flood hazard discussion within this section.
[5] In order to counter effects of coastal erosion, Virginia Beach's shoreline has been renourished annually since 1951.

TABLE 4.9: OCEAN AND LAKE SURF EVENTS (1993 - 2020)

LOCATION	DATE	TYPE OF EVENT	DEATHS/ INJURIES	PROPERTY DAMAGE	DETAILS
Virginia Beach	8/31/1993	Heavy Surf	1/0	$0	A 15-year-old boy drowned, presumably caught in a strong undertow, as Hurricane Emily was approaching the North Carolina coast.
Isle of Wight, Norfolk, Suffolk, Virginia Beach, Portsmouth	11/17/1994	Coastal Flooding	0/0	$655,000	Strong easterly flow between Hurricane Gordon, a category 1 storm meandering 150 miles south of Cape Hatteras, and a strong anticyclone over New England, caused significant coastal flooding and damage in Sandbridge. The worst flooding occurred on the 18th, when tides were running 4 feet above normal. The heaviest damage occurred along 14th Street, where 100 feet of the fishing pier washed away. Several homes suffered minor damage, with two requiring extra work to remain in place. A 1000-foot stretch of road and several protective steel bulkheads were damaged. Seas, which were as high as 18 feet 60 miles east of the Virginia Capes, and 7 feet near the mouth of the Chesapeake Bay, forced the Naval Carrier George Washington to remain 2 miles offshore Thursday night through Friday morning. The above-normal tides caused other minor flooding in Tidewater. The Nansemond River overflowed its banks in Suffolk, causing minor flooding. High tides on the James and Pagan Rivers, caused several roads to be under water in eastern Isle of Wight County on the 17th.
Isle of Wight, Norfolk, Suffolk, Virginia Beach	12/23/1994	Coastal Flooding	0/0	$65,000	A double-structured storm system produced minor coastal flooding in the Tidewater region on the 23rd. The effects were much less than expected as the main storm moved well east of the mid-Atlantic before curling northwest into Long Island. The secondary low pressure area was significantly weaker, but still produced northeast winds of 35 to 45 mph around Tidewater. High tides of 1 to 3 feet above normal caused most of the flooding. In the Sandbridge section of Virginia Beach, a beachfront home collapsed into the sea. The combination of pounding surf and wind from flow around Hurricane Gordon in late November and this event finished off the home. In addition, a few more bulkheads were flattened. Several roads in the Tidewater area had minor flooding, including Rescue Road in Smithfield (Isle of Wight Co).
Virginia Beach	8/13/1995	Rip Current	1/0	$0	Vacationer from New York drowned after venturing too far into severe rip current conditions.

TABLE 4.9: OCEAN AND LAKE SURF EVENTS (1993 - 2020)					
LOCATION	DATE	TYPE OF EVENT	DEATHS/ INJURIES	PROPERTY DAMAGE	DETAILS
Norfolk, Virginia Beach, Newport News, York County, Poquoson	4/24/1997	Coastal Flooding	0/0	$0	Moderate coastal flooding occurred across portions of the Hampton Roads area during the time of high tide April 23rd and continued into April 24th. The areas most seriously affected included the Willoughby Spit, Ghent, and downtown sections of Norfolk, the Old-Town section of Portsmouth, and Sandbridge at Virginia Beach. Tides peaked at 5.8 feet above Mean Lower Low Water (MLLW) at Sewells Point in Norfolk. Based on reports received from downtown Norfolk and the Grandview section of Hampton, tides were somewhat higher in the estuaries (Lafayette River, the Hague, the Harris and Back Rivers) draining into the Elizabeth River and Hampton Roads.
Norfolk, Virginia Beach, Portsmouth	6/3/1997	Coastal Flooding	0/0	$0	Minor to moderate flooding occurred across portions of Hampton Roads during high tide the evening of June 3rd. In Virginia Beach, officials reported part of a new boardwalk washed away and several lifeguard stands lost. Crawford Parkway in downtown Portsmouth was reported flooded and in downtown Norfolk, several streets were reported under water.
Norfolk, Virginia Beach, Portsmouth, Newport News, Poquoson	10/19/1997	Coastal Flooding	0/0	$0	Minor to moderate flooding occurred across portions of Hampton Roads during high tide Sunday, October 19th. Some minor flooding was reported in low-lying areas of Norfolk, with water in a few homes and a few streets closed. Minor flooding was also reported in downtown Portsmouth and in the Sandbridge and Sandfiddler areas of Virginia Beach. Tides peaked between 5.2 and 5.8 feet above MLLW at Sewells Point in Norfolk. Minor coastal flooding was reported in portions of Newport News and York county.
Norfolk, Virginia Beach, York County, Poquoson, Newport News	1/27/1998	Coastal Flooding	0/0	$1,500,000	A Nor'easter battered eastern Virginia on January 27th and 28th. Slow movement of the storm combined with the highest astronomical tides of the month resulted in an extended period of gale to storm force onshore winds which drove tides to 6.44 feet above MLLW at Sewells Point. Tide levels resulted in moderate coastal flooding throughout Hampton Roads. One house collapsed into the Atlantic Ocean at Sandbridge. Another home sustained severe damage. The rainfall combined with the gale and storm force winds resulted in scattered tree limbs downed across much of eastern Virginia. In addition, there were widely scattered power outages.

TABLE 4.9: OCEAN AND LAKE SURF EVENTS (1993 - 2020)

LOCATION	DATE	TYPE OF EVENT	DEATHS/ INJURIES	PROPERTY DAMAGE	DETAILS
Norfolk, Virginia Beach, York County, Poquoson, Newport News	2/4/1998	Coastal Flooding	0/0	$75,000,000	A Nor'easter battered eastern Virginia from February 3rd through the 5th. The slow movement of the storm resulted in an extended period of gale to storm force onshore winds which drove tides to 7.0 feet above MLLW at Sewells Point. Tide levels resulted in moderate to severe coastal flooding throughout Hampton Roads. Norfolk, Virginia Beach and Hampton reported some structural damage to buildings along the bay and coast, as well as significant beach erosion. Norfolk reported main roads and intersections under 3 feet of water or greater with many roads impassable. North facing areas in Willoughby and Ocean View suffered the greatest damage. In the Chick's Beach area of Virginia Beach, 4 condominiums were undermined by the tidal flooding, and residents of those buildings had to be evacuated. Twenty-nine house fires were also reported in Norfolk as a result of flood water shorting out furnaces. The rainfall combined with the gale and storm force winds resulted in some trees downed across much of eastern Virginia. In addition, there were widely scattered power outages.
Hampton	9/18/2003	Coastal Flooding, Heavy Surf			Hurricane Isabel caused historic flooding and severe erosion in the region. In Hampton, the coastal flooding, heavy surf and wave action breached the barrier beach at Factory Point.
Virginia Beach	1/29/2005	Heavy Surf	1/1	$0	A small boat with 2 men on board was heading out of Rudee Inlet. They made it through the first set of breakers then stopped the boat. A wave overtook them and flipped the boat. One man climbed onto and stayed with the overturned boat and was rescued. He was treated for mild hypothermia and later released. The other man died of hypothermia.
York County, Poquoson	9/1/2006	Coastal Flood	0/0	$1,900,000	Tides of 4 to 5 feet above normal combined with 6 to 8 foot waves caused significant damage to homes, piers, bulkheads, boats, and marinas across portions of the Virginia Peninsula and Middle Peninsula near the Chesapeake Bay and adjacent tributaries.
Norfolk, York County, Hampton	10/6/2006	Coastal Flood	0/0	$200,000	Strong onshore winds resulted in major coastal flooding during times of high tide. Tidal departures were 2.5 to 3.5 above normal during the event. A strong low pressure system off the North Carolina coast coupled with an upper level cutoff low to dump intense rainfall across portions of southeast Virginia. Rainfall amounts in excess of 10 inches resulted in numerous road closures and moderate to major river flooding from late Friday, October 6th through Saturday, October 7th. Up to 28,000 Dominion Virginia Power customers lost power during the event.

TABLE 4.9: OCEAN AND LAKE SURF EVENTS (1993 - 2020)

LOCATION	DATE	TYPE OF EVENT	DEATHS/ INJURIES	PROPERTY DAMAGE	DETAILS
Norfolk, Chesapeake York County, Hampton	11/22 and 11/23/2006	Coastal Flood	0/0	$145,000	Strong onshore winds caused moderate coastal flooding during times of high tide. Tidal departures were about 3 feet above normal during the event. An intense low pressure system off the North Carolina coast combined with an upper level cutoff low to provide very strong winds, heavy rains, and moderate coastal flooding across portions of eastern and southeast Virginia from late November 21st into afternoon November 23rd.
Virginia Beach	5/23/2009	Rip Current	1/0	$0	A man body boarding was caught up in a rip current and pulled offshore. Officials performed CPR, but it failed to revive the man and he died.
Isle of Wight, Chesapeake, Newport News, York County, Hampton	11/12/2009	Coastal Flood	0/0	$16,200,000	An intense Nor'easter produced moderate to severe coastal flooding across much of eastern and southeast Virginia and the Virginia Eastern Shore. The peak tide height at Money Point was 8.59 feet above MLLW, which was 6.17 feet above the astronomical tide. That tide height was 0.3 feet higher than the previous record storm tide measured at this location during Hurricane Isabel in September 2003.
Norfolk, Virginia Beach, York County, Chesapeake	12/19/2009	Coastal Flood	0/0	$30,000	A strong coastal low pressure area produced moderate to severe coastal flooding across much of eastern and southeast Virginia. The peak tide height at Money Point was 6.77 feet above MLLW. Several streets, homes and businesses were flooded in low lying areas close or directly exposed to the Chesapeake Bay. The peak tide height at Yorktown was 5.32 feet above MLLW. Several streets, homes and businesses were flooded in low lying areas of the county close or directly exposed to the Chesapeake Bay.
Virginia Beach	8/25/2011	Rip Current	1/0	-	A surfer who got caught in a rip current drowned in Virginia Beach.
Virginia Beach	6/16/2012	Rip Current	1/0	-	A man was caught up in a rip current and drowned in Virginia Beach.
Chesapeake, James City County, Newport News, York County, Norfolk, Isle of Wight, Virginia Beach, Suffolk, Hampton	10/28/2012	Coastal Flood	0/0	$2,060,000	Tropical Cyclone Sandy moving northward well off the Mid Atlantic Coast then northwest into extreme southern New Jersey produced very strong northeast winds followed by very strong west or northwest winds. The very strong winds caused moderate to severe coastal flooding across portions of eastern and southeast Virginia. Water levels reached 3.5 feet to around 4.5 feet above normal adjacent to the Chesapeake Bay resulting in moderate to severe coastal flooding. Flooding of streets due to the combination of rain and storm surge was widespread during the height of the storm. However, water levels were lower than Irene in 2011.

TABLE 4.9: OCEAN AND LAKE SURF EVENTS (1993 - 2020)					
LOCATION	DATE	TYPE OF EVENT	DEATHS/ INJURIES	PROPERTY DAMAGE	DETAILS
Chesapeake, James City County, Newport News, York County, Norfolk, Isle of Wight, Virginia Beach, Suffolk, Hampton, Poquoson	10/2-3/2015	Coastal Flood	0/0	$1,000,000 (Norfolk)	Anomalously strong/nearly stationary high pressure over New England produced strong onshore winds over the Mid-Atlantic. The strength and duration of the onshore winds produced moderate coastal flooding along the Atlantic Coast and Chesapeake Bay. A tidal departure of 3 to 4 feet resulted in moderate flooding along the Chesapeake Bay.
Virginia Beach	7/9/2019	Rip Current	1/0	-	A 35 year old male drown after being caught in a rip current while trying to save a child at False Cape State Park.
Norfolk, Virginia Beach, York County, Surry County	9/6/2019	Coastal Flood	0/0	-	Very strong northeast to north winds associated with Hurricane Dorian produced tidal anomalies between 2.5 and 3.5 feet over the southern Chesapeake Bay. This caused moderate coastal flooding over portions of Hampton Roads.
York County, James City County, Surry County	10/11/2019	Coastal Flood	0/0	-	The combination of low pressure sitting off the New Jersey coast and strong high pressure over southeast Canada resulted in persistent north or northeast winds over the region. Persistent winds and high waves produced tidal anomalies between 2 and 3 feet above normal high water levels.
Virginia Beach, Norfolk	11/17/2019	Coastal Flood	0/0	-	The combination of high pressure over northern New England and low pressure just off the Middle Atlantic Coast resulted in very strong northeast to north winds over the southern Chesapeake Bay, which caused minor to moderate coastal flooding.
James City County	5/19/2020	Coastal Flood	0/0	-	Combination of strong high pressure over New England and low pressure over southeast U.S. produced a persistent northeast or east wind into James River, which caused minor to moderate coastal flooding at Jamestown tidal gauge and some locations in the county. Minor to moderate tidal flooding occurred along James River. Jamestown reached 4.72 feet MLLW.
Virginia Beach	8/4/2020	Coastal Flood	0/0	-	The center of Tropical Storm Isaias tracked north just inland of the Middle Atlantic Coast from August 3-4. Winds caused moderate (perhaps some locally major) tidal/coastal flooding across portions of SE Virginia, including portions of Virginia Beach adjacent to Back Bay.
Totals			**7/1**	**$98,755,000**	

Source: NCEI, 2021

Analysis of the landslide hazard history in the Hampton Roads study area is limited by the availability of data and reporting of incidents; however, scientists at the Virginia Department of Energy (Virginia Energy) maintain a statewide database of incidents reported to the department since 2004. That database does not contain any historical incidents in the Hampton Roads region, although one incident in New Kent County is on the border with James City County, along the Chickahominy River. The Claytor landslide, as it was termed, was reported by the homeowner who reported movement started during Hurricane Irene (2011). Headscarp is 5 feet from porch steps, two 10-foot sections of seawall at base of slope have been either toppled or covered by sediment from previous landslides. This is a series of concave erosional scarps along the riverbank. Additional reports of landslides along the James River in Surry County, especially after Hurricane Isabel (2003), have been made to county officials, but additional details were not available.

While details are preliminary, State geologists suggest that evidence shows in the Richmond-Crater and Virginia Peninsula regions, there is a higher incidence of landslide initiation near the contact between the Eastover and the Yorktown Formations, two pervasive geological units in the Virginia Coastal Plain. Slopes can be further destabilized due to excess runoff from development, including stormwater drains and gutters.

PROBABILITY OF FUTURE OCCURENCES

Shoreline erosion over the long-term and short term will likely continue to occur in the Hampton Roads region. Shoreline erosion will be more immediate and severe during hurricanes, tropical storms and nor'easters.

TORNADO

BACKGROUND

A tornado is a violent windstorm characterized by a twisting, funnel-shaped cloud extending to the ground. Tornadoes are most often generated by thunderstorm activity when cool, dry air intersects and overrides a layer of warm, moist air forcing the warm air to rise rapidly. The damage caused by a tornado is a result of the high wind velocity and wind-blown debris, also accompanied by lightning or large hail. According to the NWS, tornado wind speeds normally range from 40 to more than 200 mph. The most violent tornadoes (EF5) have rotating winds of 200 mph or more and are capable of causing extreme destruction and turning normally harmless objects into deadly missiles.

Each year, an average of over 1,200 tornadoes is reported nationwide, resulting in an average of 80 deaths and 1,500 injuries (NOAA, 2002 and 2014). They are more likely to occur during the spring and early summer months of March through June and can occur at any time of day, but are likely to form in the late afternoon and early evening. Most tornadoes are a few dozen yards wide and touch down briefly, but even small short-lived tornadoes can inflict tremendous damage. Highly destructive tornadoes may carve out a path over a mile wide and tens of miles long.

Waterspouts are weak tornadoes that form over warm water and are most common along the Gulf Coast and southeastern states. Waterspouts occasionally move inland, becoming tornadoes that cause damage and injury. However, most waterspouts dissipate over the open water causing threats only to marine and boating interests. Typically, a waterspout is weak and short-lived, and because they are so common, most go unreported unless they cause damage.

The destruction caused by tornadoes ranges from light to devastating depending upon the intensity, size, and duration of the storm. Typically, tornadoes cause the greatest damages to structures of light or wood-framed construction such as residential homes (particularly mobile homes), and tend to remain localized in impact. The traditional Fujita Scale for tornadoes, introduced in 1971, was developed to measure tornado strength and associated damages. Starting in February of 2007, an "enhanced" Fujita (EF) Scale was implemented, with somewhat lower wind speeds at the higher F-numbers, and more thoroughly-refined structural damage indicator definitions. **Table 4.10** provides a summary of the EF Scale. Assigning an EF Scale rating to a tornado involves the following steps:

- Conduct an aerial and ground survey over the entire length of the damage path;
- Locate and identify damage indicators in the damage path;
- Consider the wind speeds of all damage indicators and assign an EF Scale category for the highest wind speed consistent with wind speeds from the other damage indicators;
- Record the basis for assigning an EF scale rating to a tornado event; and
- Record other pertinent data related to the tornado event.

TABLE 4.10: ENHANCED FUJITA (EF) SCALE FOR TORNADOES	
EF RATING	3 SECOND GUST (mph)
0	65-85
1	86-110
2	111-135
3	136-165
4	166-200
5	over 200

Source: NWS Storm Prediction Center

In Virginia, tornadoes primarily occur from April through September, although tornadoes have been observed in every month. Low-intensity tornadoes occur most frequently; tornadoes rated EF2 or higher are very rare in Virginia, although EF2, EF3, and a few EF4 storms have been observed. According to the *2018 Commonwealth of Virginia Hazard Mitigation Plan*, Virginia ranks 28th in terms of the number of tornado touchdowns reported between 1950 and 2006.

Tornadoes are high-impact, low-probability hazards. The net impact of a tornado depends on the storm intensity and the vulnerability of development in its path. Because the path of each tornado is unique to each event, general descriptions of impacts in Hampton Roads can be drawn from the impacts of previous storms (see also **Table 4.11** below). Communities rarely activate Emergency Operation Centers before tornadoes due to the short warning times, but after extreme events with catastrophic damage that displace a large number of residents, such activation may become necessary.

In Hampton Roads, a high intensity tornado, while unlikely, could be expected to impact almost everything within the storm's path: homes, especially those constructed prior to the use of building codes; infrastructure, especially above-ground power lines in the commercial zones and bridges throughout the region; cars and personal property; landscape elements such as trees, fences and shrubs; and even human lives. Downed trees can block roadways, impeding traffic and blocking access and egress if any of the region's thoroughfares are impacted. Manufactured homes are particularly vulnerable to damage in the event of tornadoes, as well, particularly if they were placed outside of flood zones and before building codes were in effect requiring foundation tie-downs.

Tornadoes associated with tropical cyclones are somewhat more predictable. These tornadoes occur frequently in September and October when the incidence of tropical storm systems is greatest. They usually form around the perimeter of the storm, and most often to the right and ahead of the storm path or the storm center as it comes ashore. These tornadoes commonly occur as part of large outbreaks and generally move in an easterly direction. Tracking and prior notification by the National Weather Service and local news media helps save lives locally.

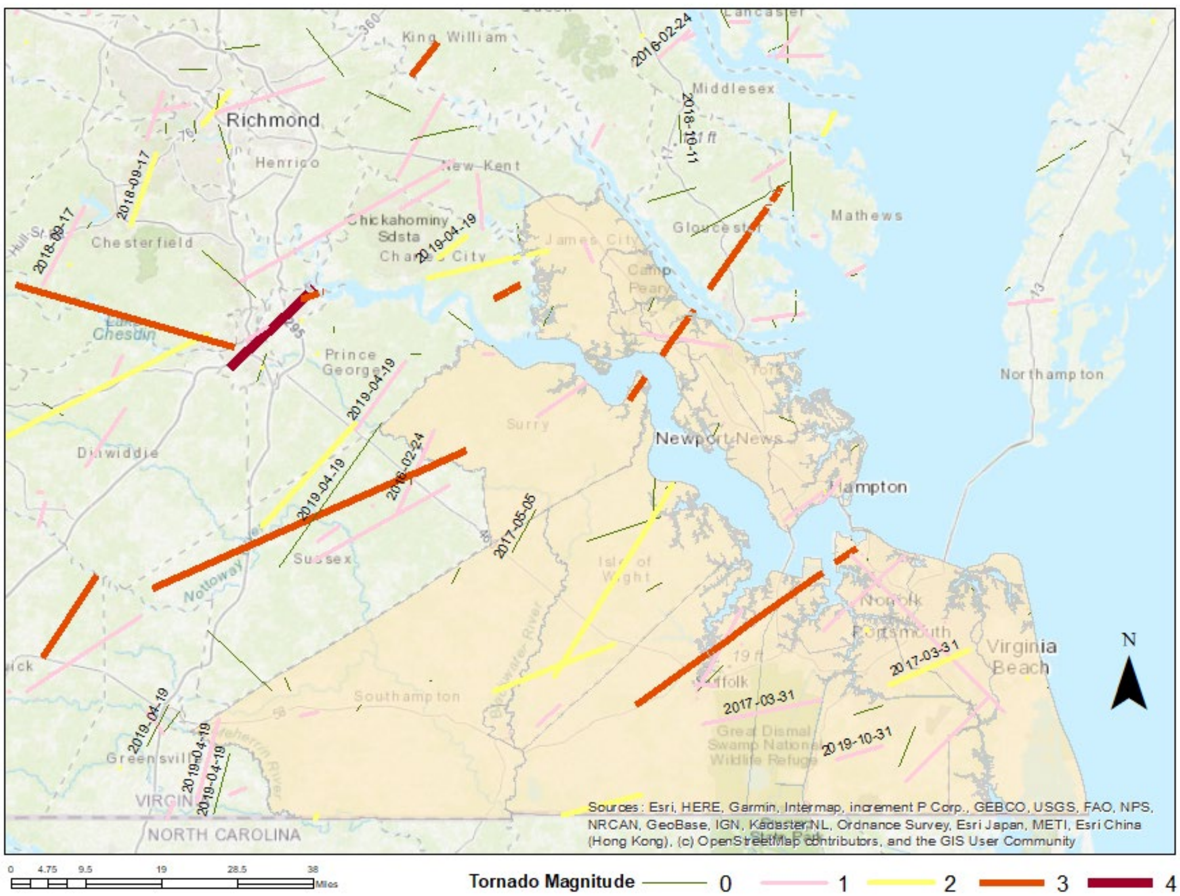
Most tornado strikes in the region have been EF0 or EF1 and the effects were somewhat less than as described above for severe storms. Critical damage to structures in the tornado's path is common, with indiscriminate damage to public-and privately-owned structures, some infrastructure, and downed trees that make transportation difficult. In areas adjacent to the path, minor damage, especially to roofs and windows from trees and flying debris, can also be expected. While downed trees may block transportation routes and result in power outages for some customers, these impacts are typically cleared within a few days.

LOCATION AND SPATIAL EXTENT

Tornadoes typically impact a relatively small area; however, it is impossible to predict where in the planning area a tornado may strike. Vulnerability of individual structures is based largely on building construction materials and standards, availability of safe rooms and advanced warning system capabilities. In cases involving intense tornadoes, the best defense against injury or death is a properly engineered safe room or tornado shelter, neither of which is standard practice in the region. Likewise, advanced warning system capabilities are limited to Reverse 911, Emergency Alert System warnings and NWS weather radio broadcasts.

Figure 4.17 illustrates the approximate location where confirmed tornadoes have touched down in and near the Hampton Roads region since 1950. The most recent tornadoes, between 2016 and 2019, are additionally notated with the date of their occurrence.

FIGURE 4.17: HISTORIC TORNADO TOUCHDOWNS AND TRACKS: 1950-2020



October, 2021

Source: NCEI, 2021

SIGNIFICANT HISTORICAL EVENTS

Hampton Roads has experienced 47 days with reported damaging tornadoes since 1995. The tornadoes occurring since 1995 had strengths up to EF3. Damage estimates for these tornadoes exceed $63.09 million. **Table 4.11** lists historical tornadoes that touched down in the study area (NCEI web site). Beginning with the Suffolk tornado in 2008, the magnitude rating switched to Enhanced Fujita Scale.

TABLE 4.11: TORNADOES IN HAMPTON ROADS, 1995 THROUGH 2021

LOCATION	DATE OF OCCURRENCE	MAGNITUDE	DEATHS/ INJURIES	PROPERTY DAMAGE	DETAILS
ISLE OF WIGHT	7/12/1996	F1	0	$25,000	Small tornado damaged 10-15 homes and several trees in Moorfield subdivision of Smithfield.
YORK	7/12/1996	F1	0	$15,000	Tornado cut a 2-mile-long path across part of Naval Weapons Station Yorktown. Numerous trees, homes and cars were damaged.
HAMPTON	9/4/1996	F0	0	$1,000	Weather personnel at Langley Air Force Base observed a small tornado about 1/2 mile north-northwest of their building. Minor damage to a few vehicles and tops of trees occurred.
CHESAPEAKE	7/24/1997	F1	0	$400,000	Tornado had a track of approximately 1 mile and was an estimated 50 yards in width.
NORFOLK	7/24/1997	F1	0	$400,000	Tornado path started in south Norfolk just south of Poindexter Street on Guerriere Street. The tornado then continued north-northeast into the Berkley Avenue Industrial Park before crossing into the southern portion of Norfolk and lifting after causing damage on Roseclair and Joyce Streets. One business, a car wash was destroyed, and six sustained major roof damage. One home was damaged in Chesapeake, with damage to a couple of additional structures in the Roseclair and Joyce Street areas of Norfolk.
NORFOLK	7/24/1997	F0	0	$100,000	Tornado first touched down west of Route 460 between Liberty Street and Indian River Road. The tornado tracked north-northeast across Indian River Road and across the eastern branch of the Elizabeth River before lifting east of Harbor Park and south of I-264. Minor damage to several structures, mostly residential.
CHESAPEAKE	4/9/1998	F0	0	$25,000	Tornado with speeds of 60-70mph in Chesapeake. Damage was seen just south of intersection of Dominion Boulevard and Great Bridge Boulevard. Several trees were downed/topped in the Riverwalk Subdivision. Damage to a couple of homes as a result of trees falling on them. Tornado moved east-northeast to just northwest of intersection of Volvo Parkway and Kempsville Road. Several trees were downed/topped in this area as well, with a couple of homes damaged by falling trees/limbs. Tornado appeared to remain just above ground, with all structural damage resulting from falling trees/limbs.
HAMPTON	9/4/1999	F2	0/6	$7,720,000	Tornado touchdown in the city of Hampton. Extensive structural damage in a 3 block area. Three apartment complexes and an assisted living facility condemned. Two

TABLE 4.11: TORNADOES IN HAMPTON ROADS, 1995 THROUGH 2021					
LOCATION	DATE OF OCCURRENCE	MAGNITUDE	DEATHS/ INJURIES	PROPERTY DAMAGE	DETAILS
					additional apartment complexes partially condemned. Many roofs were lifted off buildings and as many as 800 vehicles were reported damaged. This tornado formed in area ahead of tropical storm Dennis.
VIRGINIA BEACH	7/24/2000	F0	0	$20,000	A waterspout that formed over Back Bay came ashore at Campbell Landing Road and destroyed 20' x 30' foot outbuilding before dissipating. Many trees were blown down; camper shells and lawn furniture were tossed across neighborhood.
SUFFOLK	5/21/2001	F0	0	$25,000	Tornado occurred in 5000 block of Manning Road. Several small outbuildings destroyed including 30' wooden shed.
SUFFOLK	6/1/2001	F1	0	$15,000	Tornado touched down near Jackson Road. Tornado became a funnel cloud and then touched down again just south of Sleepy Hole Road and passed through Sleepy Hole Golf Club. Tornado continued north northeast through Chatham Woods with extensive damage along Burning Tree Lane.
NEWPORT NEWS	8/11/2001	F0	0	$50,000	Weak tornado damaged a couple of mobile homes and produced minor damage at townhouse complex near Fort Eustis.
SUFFOLK	2/22/2003	F0	0	$25,000	Several 50-60 foot trees were pushed over into houses. Numerous tree trunks were twisted and tops sheared off.
SOUTHAMPTON	5/9/2003	F0	0	$10,000	Damage to trees and outbuildings, and minor damage to home by a tornado in northwest Southampton County.
YORK	8/7/2003	F1	0	$20,000	Tornado damage occurred near Victory Boulevard and Running Man Trail, with about a dozen trees down. Damage to 4 houses from trees snapping off and falling on the homes.
VIRGINIA BEACH	8/8/2003	F0	0	$5,000	Tornado briefly touched down with minor damage reported at Salem Crossing Shopping Center.
NORFOLK	9/18/2003	F0	0	-	Brief tornado occurred in association with Isabel. No damage reported.
SOUTHAMPTON COUNTY	6/25/2004	F1	0	$2,000	F1 tornado downed numerous large trees in a swamp.
SUFFOLK	6/25/2004	F1	0	$2,000	F1 tornado downed numerous trees near intersection of Route 660 and Route 668.
SUFFOLK	6/25/2004	F0	0	$2,000	F0 tornado damage to trees on Cypress Chapel Road in Whaleyville.
CHESAPEAKE	8/14/2004	F0	0	$5,000	Tornado associated with Tropical Storm Charley damaged a fence and downed trees.
JAMES CITY COUNTY	8/30/2004	F0	0	$5,000	F0 tornado downed or damaged several trees.
JAMES CITY COUNTY	8/30/2004	F0	0	$5,000	F0 tornado downed or damaged several trees near Drummonds Field Subdivision and the James River.
POQUOSON	8/30/2004	F0	0	$5,000	F0 tornado downed trees on River Road and Wythe Creek Road.
HAMPTON	8/30/2004	F0	0	$5,000	F0 tornado damaged a shed and trees on Hall Road.
YORK COUNTY	8/30/2004	F0	0	$10,000	F0 tornado downed trees and damaged roofs at Pinewood Drive and Highway 134.

TABLE 4.11: TORNADOES IN HAMPTON ROADS, 1995 THROUGH 2021

LOCATION	DATE OF OCCURRENCE	MAGNITUDE	DEATHS/ INJURIES	PROPERTY DAMAGE	DETAILS
YORK COUNTY	8/30/2004	F0	0	$10,000	F0 tornado blew roof off of garage and damaged trees.
SOUTHAMPTON	7/2/2005	F0	0	-	F0 tornado touched down near Freemans Pond Road then crossed Route 460.
SOUTHAMPTON	7/8/2005	F1	0	$2,000	F1 tornado caused damage near Old Belfield Road.
VIRGINIA BEACH	7/14/2005	F0	0	$2,000	Brief tornado touchdown caused minor damage to golf practice facility and downed tree limbs near Dam Neck Road and Holland Road.
JAMES CITY	1/11/2006	F1	0/2	$20,000	F1 tornado caused intermittent damage at Jamestown Beach Campground and Foxfield subdivision. One trailer and pop-up camper were destroyed at campground and caused minor injuries to two occupants. Two townhomes suffered minor roof and siding damage in subdivision.
PORTSMOUTH	8/11/2006	F0	0	-	Waterspout near the mouth of the James River came on shore near Churchland High School. No damage or injuries were reported.
HAMPTON	8/11/2006	F0	0	-	Waterspout near mouth of the James River came on shore just south of Beach Road in Grandview section of Hampton.
SUFFOLK	4/28/2008	EF3	0/200	$30,000,000	A tornado touched down with damage first noted about 2 miles northeast of Lummis. The tornado crossed Route 58, downing trees as it moved northeast. The tornado strengthened just south of the intersection of Route 10 and Route 58, where it damaged several homes and an elementary school as well as downing numerous trees. The intense tornado crossed Route 58 again and then Route 10 before hitting the Freedom Plaza shopping center where it destroyed a strip mall and tossed around numerous cars. One car was impaled into a building adjacent to the strip mall. Thereafter, the tornado moved into 2 subdivisions east and northeast of Obici Hospital. Many homes were damaged with at least a dozen completely destroyed. The tornado then continued into Driver where it damaged a number of homes and businesses and downed numerous trees. The tornado then appeared to lift just north of Driver, although amateur video and pictures suggested that the tornado maintained close contact with the ground as it tracked northeast across northern portions of Portsmouth to the Norfolk Naval Air Station.
SOUTHAMPTON COUNTY	4/28/2008	EF0	0	$5,000	A brief tornado touched down about a half mile east of Capron off Highway 58 near Douglas Drive. Several trees were downed or snapped off.
PORTSMOUTH	4/28/2008	EF1	0	$60,000	The tornado moved from northeast Suffolk across northern portions of Portsmouth. The tornado maintained close contact with the ground and downed several trees and produced some structural damage. While in Suffolk, the tornado was rated as EF3, but in Portsmouth it was rated as EF1.

TABLE 4.11: TORNADOES IN HAMPTON ROADS, 1995 THROUGH 2021

LOCATION	DATE OF OCCURRENCE	MAGNITUDE	DEATHS/ INJURIES	PROPERTY DAMAGE	DETAILS
NORFOLK	4/28/2008	EF1	0	$100,000	The tornado maintained close contact with the ground as it moved from northern Portsmouth to the Norfolk Naval Air Station. The tornado damaged vehicles and a building at Pier 2, and numerous trees were blown down or snapped off. The tornado remained rated as EF1 from northern Portsmouth to the Norfolk Naval Air Station.
JAMES CITY COUNTY	4/28/2008	EF0	0	$200,000	A brief tornado touched down in James City county about 6 miles northwest of Jamestown. Several trees were uprooted or snapped off, and there was some minor damage to homes in the area.
ISLE OF WIGHT	4/28/2008	EF1	0	$184,000	A tornado touched down near Carrsville in southern Isle of Wight county. The tornado damaged eleven homes and six agricultural buildings along Harvest Drive and Eleys Lane.
FRANKLIN	9/26/2008	EF0	0	-	Brief tornado touchdown in an open field near S.P. Morton Elementary School. No damage reported.
ISLE OF WIGHT	4/20/2009	EF0	0	$5,000	EF0 tornado tracked along nearly 8-mile track from near Raynor east-northeast to approximately one mile northwest of Smithfield.
CHESAPEAKE	5/4/2009	EF0	0	$10,000	EF0 tornado touched down in Great Bridge section south of Cedar Road between Shillelagh Road and Battlefield Boulevard.
SOUTHAMPTON COUNTY	10/27/2010	EF0	0	$50,000	An EF0 tornado destroyed a carport, overturned a shed and downed several trees. Debris was scattered toward northeast about 100 yards.
SOUTHAMPTON COUNTY	4/16/2011	EF1	0	$30,000	Brief tornado touched down in southwest Southampton County. Numerous trees were snapped off and a few structures were damaged. The most significant damage was to a farm equipment shelter and a roof on a home.
JAMES CITY COUNTY	4/16/2011	EF3	0	$50,000	Tornado tracked from Surry County into Kingsmill section of James City County. Tornado tracked from James City County into York County.
YORK COUNTY	4/16/2011	EF3	0	$15,000	The tornado mainly affected the Yorktown Naval Weapons Station.
ISLE OF WIGHT COUNTY	4/16/2011	EF2	0	$300,000	Tornado damage was along a nearly continuous 20-mile damage path from east of Walters to just southwest of Smithfield. More than 2 dozen homes were damaged. Farm equipment was picked up and tossed around on several farms.
VIRGINIA BEACH	8/27/2011	EF0	0	$150,000	Weak tornado (EF0) severely damaged a home on Sandpiper Road. Minor damage to one other home.
HAMPTON	6/1/2012	EF1	0	$1,000,000	Tornado began on James River just east of Monitor Merrimac Bridge Tunnel. Its track went over Chesapeake Avenue, through downtown Hampton to Hampton Yacht Club before moving across Mercury Boulevard, then dissipating over the Chesapeake Bay.
ISLE OF WIGHT	1/11/2014	EF0	0	$40,000	The tornado touched down on Bob White Road just north of Woodland Drive, then continued northeast about 2 miles nearly paralleling Woodland Drive before lifting

TABLE 4.11: TORNADOES IN HAMPTON ROADS, 1995 THROUGH 2021					
LOCATION	DATE OF OCCURRENCE	MAGNITUDE	DEATHS/ INJURIES	PROPERTY DAMAGE	DETAILS
					near Quaker Road in Isle of Wight. The tornado touched down just north of Route 10, then continued northeast into Mogarts Beach area. Tornado was on the ground about 1.4 miles before dissipating over James River.
HAMPTON	1/11/2014	EF0	0	$100,000	Tornado touched down near Routten Road and Cabell Lane where around 50 trees were snapped and homes had 10 to 20 percent of their roof shingles blown off. The tornado traveled east northeast damaging the roof of Fox Hill Central Methodist Church and completely ripping roof off of the City of Hampton school maintenance compound on Windmill Point Road. Tornado moved to Canal Road snapping trees, damaging residential rooftops and blowing out windows of a car. Tornado continued on to completely destroy the Fox Hill Athletic Association Building on Grundland Drive, before ending at the Grandview Nature Preserve.
VIRGINIA BEACH	7/4/2014	EF0	0	$25,000	A brief EF-0 tornado associated with a squall from Hurricane Arthur touched down near Lynnwood in Virginia Beach. Numerous trees were snapped and uprooted along Lynndale Road and Kline Drive.
NORFOLK	7/4/2014	EF0	0	$5,000	Tornado touched down near the Forest Lawn Cemetery in Norfolk.
VIRGINIA BEACH	7/10/2014	EF0	0/10	$300,000	A weak tornado caused significant damage to a home from the roof being blown off. There was also damage to several other structures including a school gymnasium. A large pool window was blown out.
SURRY COUNTY	2/24/2016	EF1	0	$15,000	Tornado tracked from Sussex County into Surry County before lifting. Several trees were down, but no structural damage was observed.
SUFFOLK	3/31/2017	EF1	0	$200,000	An EF1 tornado touched down along and just west of White Marsh Road, about 2 miles southeast of downtown Suffolk. A number of trees were downed or snapped off, and one outbuilding was destroyed and its' debris damaged the adjacent house. Tornado crossed White Marsh Road, where it entered the Great Dismal Swamp, and was no longer visible. The tornado then tracked eastward into the Deep Creek area of Chesapeake.
CHESAPEAKE	3/31/2017	EF1	0	$50,000	Tornado tracked from the Great Dismal Swamp in Suffolk eastward to the Deep Creek section of Chesapeake. There was minor tornado damage on the east edge of the Dismal Swamp in the Deep Creek section.
CHESAPEAKE	3/31/2017	EF2	0	$3,900,000	EF0 tornado first touched down on Green Tree Road in Chesapeake causing damage to three warehouses. The tornado then quickly lifted off the ground and continued east. The tornado touched down again just east of Kempsville Road along Kemp Bridge Lane as an EF0 rapidly intensifying to EF1. On the east side of Kemp Bridge

TABLE 4.11: TORNADOES IN HAMPTON ROADS, 1995 THROUGH 2021					
LOCATION	DATE OF OCCURRENCE	MAGNITUDE	DEATHS/ INJURIES	PROPERTY DAMAGE	DETAILS
					Lane, several homes lost sections of their roofs and outer walls were removed. Winds were approximately 97 mph. The tornado intensified as it moved east destroying an empty mobile home and severely damaged a metal storage building. The tornado strengthened to an EF2 before striking Real Life Christian Church on Centerville Turnpike. The church, a large metal constructed building, was destroyed by the tornado as the sanctuary was completely demolished. The tornado weakened some as it continued to travel east and then northeast across Stumpy Lake. The tornado then tracked northeast into Virginia Beach.
VIRGINIA BEACH	3/31/2017	EF2	0	$4,000,000	Tornado emerged from Stumpy Lake along Elbow Road as an EF0 causing some significant damage to siding and shingles to homes just north of Elbow Road. The tornado crossed Round Hill Drive, and then Elbow Road itself as it re-intensified to an EF1. The tornado crossed Elbow Road as an EF1 causing significant damage to oak trees which fell trapping a car under numerous trees. Tornado continued as a weak EF1 to Salem Road causing some significant roof damage to homes. It briefly weakened as it moved northeast causing damage to siding and shingles along Starwood Arch, Antelope Place, Salem Lake Boulevard and Morning View Drive. Tornado intensified, crossed Centennial Circle damaging homes along Daiquiri Lane and Darrow Street. By the time the tornado crossed Rock Lake Loop, it had intensified back to EF1 intensity causing some severe roof damage to homes from Rip Rap Court to River Rock Arch. This is where the tornado reached its widest point, up to 350 yards wide, causing damage to around 100 homes in this area alone. Several homes in this area were damaged beyond repair as winds reached to 110 mph (high end EF1). The tornado continued northeast destroying the clubhouse and press box at the Lansdowne High School ball field. Several sets of bleachers were tossed well over 200 yards. The tornado weakened as it crossed Princess Anne Road and Tidewater Community College. The tornado moved across Rosemont Drive as an EF0 damaging numerous homes along Light Horse Loop and Storm Bird Loop. The last visible damage from the tornado was across Buckner Boulevard near the east end of Purebread Drive.
CHESAPEAKE	4/6/2017	EF0	0	$100,000	Touched down near Delia Drive where it destroyed an RV and stripped siding off a house. It moved north northeast and severely damaged a concession stand, a small barn and an outbuilding at Hickory Ridge Farm on Battlefield Boulevard. The tornado proceeded to cross Battlefield Boulevard then crossed Head of the River

TABLE 4.11: TORNADOES IN HAMPTON ROADS, 1995 THROUGH 2021					
LOCATION	DATE OF OCCURRENCE	MAGNITUDE	DEATHS/ INJURIES	PROPERTY DAMAGE	DETAILS
					Road where it reached its strongest point with an estimated wind speed of up to 80 mph. Numerous pine trees were snapped, blocking the road and taking down power lines. The tornado then crossed Beaverdam Road maintaining intensity near 75 mph. The tornado weakened as it crossed Land of Promise Road, but was still strong enough to down a pine tree into a house.
SOUTHAMPTON COUNTY	5/5/2017	EF0	0	$4,000	First touched down just north of Route 460 along Crumpler Toad just north of Ivor. The tornado continued north northeast, crossing adjacent Warrique Road and Aberdeen Road. The survey team found several trees uprooted along this route, with chunks of asphalt from nearby road construction found to be scattered in the field. The tornado continued north northeast into Surry County.
SURRY COUNTY	5/5/2017	EF0	0	$2,000	Uprooted several trees near and along Aberdeen Road before lifting just east of Walls Bridge Road.
JAMES CITY COUNTY	10/11/2018	EF1	0	$150,000	Touched down on the northern side of the Colonial Heritage Club just south of Norge. Tracked northwest toward Toano and downed several trees. One tree went through a house on Arthur Hill Road. A roof was blown off a house near Candle Station before the tornado lifted just to the east of Toano.
SOUTHAMPTON COUNTY	4/19/2019	EF1	0	$5,000	Tracked through Greensville County and into extreme southwest Southampton County. Tornado caused damage to several trees.
ISLE OF WIGHT COUNTY	4/19/2019	EF0	0	$15,000	Touched down near Mill Swamp Road and Wrens Mill Road in northern Isle of Wight County. The tornado tracked northward crossing King`s Landing Lane before continuing into the James River. Numerous trees, including large oak trees, were snapped or uprooted along the tornado path. One tree was downed on a house.
YORK COUNTY	4/19/2019	EF0	0	$150,000	Touched down near Colonial Parkway immediately east of the interchange with Queens Drive. The tornado tracked north northeast producing substantial tree damage, power line damage, and some home damage along Queens Drive. The tornado likely lifted north of Queens Lake.
NEWPORT NEWS	4/19/2019	EF0	0	$50,000	Likely touched down as a waterspout over Warwick River. The tornado tracked northeast through Sanford, Carriage Hill, and Denbigh. It produced mainly tree damage, particularly near Sanford Elementary, and destroyed a small shed. Tornado lifted before reaching Route 60 near Denbigh Village Center.
SUFFOLK	5/11/2019	EF1	0	$350,000	Touched down just east of Main Street in downtown Suffolk and quickly moved off to the east intersecting Route 58 twice before heading into the Great Dismal Swamp after moving through the Wilson Pines area. Numerous trees were snapped off or uprooted. At least 14 homes and 6

TABLE 4.11: TORNADOES IN HAMPTON ROADS, 1995 THROUGH 2021					
LOCATION	DATE OF OCCURRENCE	MAGNITUDE	DEATHS/ INJURIES	PROPERTY DAMAGE	DETAILS
					business were damaged with shingles torn off roofs, windows blown in, an air conditioner ripped from a roof, and at least one home had the roof impaled by a tree.
CHESAPEAKE	10/31/2019	EF1	0	$35,000	EF1 touched down near Benefit Road. It moved rapidly to the east northeast, producing mainly EF0 damage with numerous trees uprooted or large branches snapped off. The most widespread and significant damage of EF1 category occurred near or along Dewald Road where several large hardwood trees were uprooted and a camper was destroyed. Some roof, shingle, and spouting damage to homes was also observed. The tornado then lifted prior to reaching Route 168.
SOUTHAMPTON COUNTY	8/4/2020	EF2	0	$8,000,000	TS Isaias - Path of storm damage consistent with an EF2 tornado. Damage began near Southampton Power Station off General Thomas Highway and ended 4 miles north of Sebrell near Farmers Bridge Road. It first touched down in a wooded area and caused numerous trees to be snapped about 6 miles southeast of Courtland. The tornado then moved northeast and into Courtland, where it caused damage to numerous homes and businesses along Highway 58, including lifting the second story roof off a hotel building. Several vehicles were also overturned. The tornado then continued to travel northeast where more trees were snapped or uprooted. The tornado finally lifted just north of Sebrell near Farmers Bridge Road.
SUFFOLK	8/4/2020	EF1	0	$4,000,000	TS Isaias - Path of storm damage consistent with an EF2 tornado. The damage began near the Southampton Power Station off General Thomas Highway and ended 4 miles north of Sebrell near Farmers Bridge Road. The tornado first touched down in a wooded area and caused numerous trees to be snapped about 6 miles southeast of Courtland. The tornado then moved northeast and into Courtland, where it caused damage to numerous homes and businesses along Highway 58, including lifting the second story roof off a hotel building. Several vehicles were also overturned. The tornado then continued to travel northeast where more trees were snapped or uprooted. The tornado finally lifted just north of Sebrell near Farmers Bridge Road.
SUFFOLK	8/4/2020	EF0	0	$10,000	TS Isaias - Damage began west of Great Dismal Swamp and ended 3.5 miles southeast of Windsor just north of Highway 460. Damage was limited to snapped or uprooted trees along the path.
JAMES CITY COUNTY	8/4/2020	EF1	0	$100,000	TS Isaias - Tornado came onshore near River Oaks Road and Cypress Isle in Governor's Land producing tree damage. It intensified to 85-90 mph near the intersection of River Oaks Road and

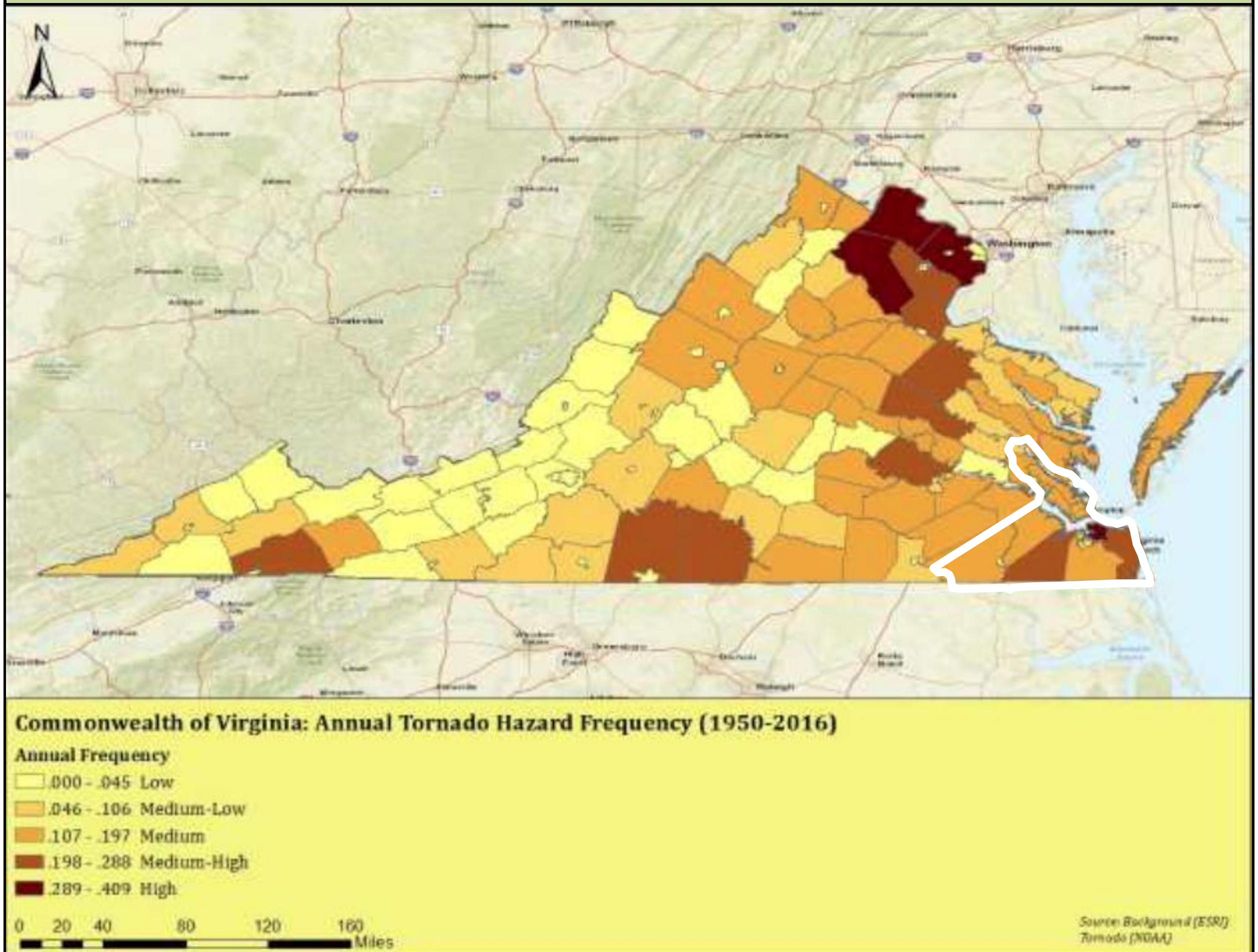
TABLE 4.11: TORNADOES IN HAMPTON ROADS, 1995 THROUGH 2021					
LOCATION	DATE OF OCCURRENCE	MAGNITUDE	DEATHS/ INJURIES	PROPERTY DAMAGE	DETAILS
					Barrets Pointe, where numerous trees were snapped, shingles were blown off roofs, a garage door caved in and a brick gable collapsed. The tornado continued across two fairways of the golf course and entered an area of woods, snapping trees and limbs, before lifting along River Ridge Drive.
SOUTHAMPTON COUNTY	9/29/2020	EF0	0	$50,000	The tornado touched down one half mile west of Black Creek Road. It briefly tracked to the east northeast before lifting just northwest of Burdette. The tornado snapped and uprooted several trees along Black Creek Road. Three outbuildings were damaged and a large tree fell on a home.
ISLE OF WIGHT COUNTY	9/29/2020	EF0	0	$20,000	The tornado touched down near the intersection of Five Forks Road and Blue Ridge Trail. The tornado traveled northeast for several miles before lifting near Orbit Road. The tornado snapped or uprooted numerous trees along its path and a carport was destroyed.
SUFFOLK	12/24/2020	EF1	0	$100,000	Damage began on the south side of Corinth Chapel Road and ended just west of the intersection of Corinth Chapel Road and Gates Road. Tornado caused significant damage to at least one home, uprooted and snapped off several large trees, and flipped over a large pickup truck.
SUFFOLK	12/24/2020	EF1	0	$225,000	Damage began on the south side of Dutch Road and ended along Lummis Road just north of the intersection with Box Elder Road. Tornado caused significant damage to at least six homes along Dutch Road, with shingles torn off roofs, and also damage to large trailer. Several large trees were uprooted along the damage path.
TOTAL			**0/218**	**$63.09 million**	

Source: NCEI, May 2021

PROBABILITY OF FUTURE OCCURRENCES

Figure 4.18 presents the results of a tornado frequency analysis performed as part of the *2018 Commonwealth of Virginia Hazard Mitigation Plan*. The analysis suggests that relative to the entire Commonwealth of Virginia, the region is considered to be “Medium” to “High” in terms of tornado frequency. The State plan emphasizes that historical data may contain meteorological biases that should be considered when viewing the results of the probability analysis shown in Figure 4.18. Increased population and advanced technology have likely led to the vastly higher numbers of low intensity tornadoes reported in recent decades, and more tornadoes are reported in areas of higher population because people are more likely to see and report the resultant damage. This map is also specific to Virginia, and “high frequency” in the Commonwealth is still relatively low frequency in parts of the Midwest and southern United States.

FIGURE 4.18: HISTORICAL TORNADO HAZARD FREQUENCY

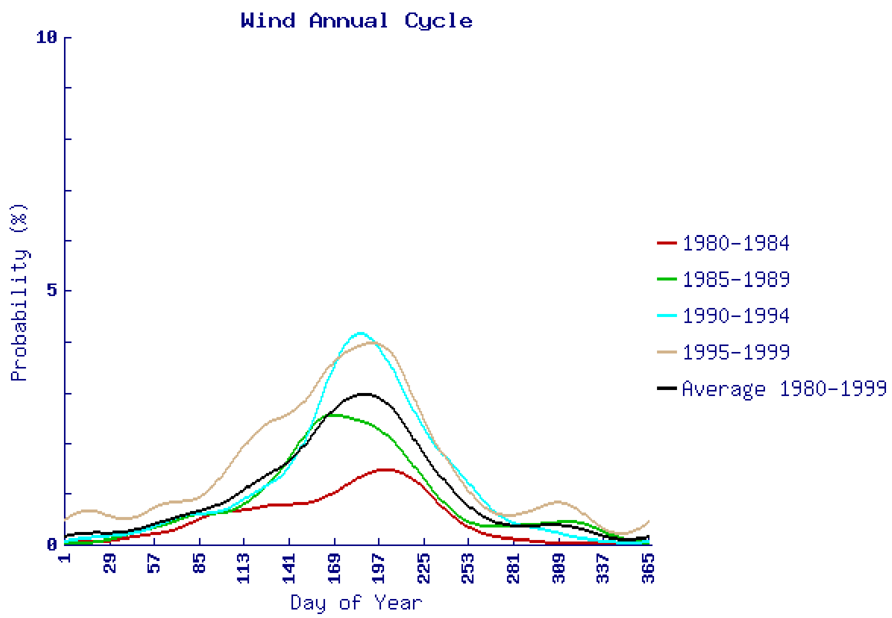


2018

Source: 2018 Commonwealth of Virginia Hazard Mitigation Plan

A tornado wind event could occur in Hampton Roads at any time of the year, but is most likely to occur from April to August, with peak probability in June, as can be seen in the Wind Annual Cycle for the region (**Figure 4.19**) below.

FIGURE 4.19: ANNUAL WIND CYCLE



Source: National Severe Storm Labs

WINTER STORMS

BACKGROUND

A winter storm can range from a moderate snow over a period of a few hours to blizzard conditions with blinding wind-driven snow that lasts for several days. Some winter storms may be large enough to affect several states, while others may affect only a single community. Many winter storms are accompanied by low temperatures and heavy and/or blowing snow, which can severely impair visibility.

In Hampton Roads, winter storms typically include snow, sleet, freezing rain, or a mix of these wintry forms of precipitation. Sleet—raindrops that freeze into ice pellets before reaching the ground—usually bounce when hitting a surface and do not stick to objects; however, sleet can accumulate like snow and cause a hazard to motorists. Freezing rain is rain that falls onto a surface with a temperature below freezing, forming a glaze of ice. Even small accumulations of ice can cause a significant hazard, especially on roads, power lines and trees. Ice storms have also occurred in the region, when freezing rain falls and freezes immediately upon impact.

A VDOT snowplow plows I-64 East.

Source: Photo by Tom Saunders, VDOT

Communications and power in the region can be disrupted for days, and even small accumulations of ice may cause extreme hazards to motorists and pedestrians. Perhaps one of the most common impacts of winter storms in the region is vehicle accidents and stranded, disabled vehicles. Unaccustomed to driving in snow and ice much of the year, drivers attempt to drive at normal speeds despite deteriorated road conditions. Lacking the large fleets of snowplows of some counties and municipalities further north, the region's secondary roads are not cleared as often or as quickly, and roads may remain unplowed or untreated for many days. This impacts persons with disabilities and others who may become housebound by severe winter storms. Most of the airports in the region also shut down for some time until the runways can be cleared.

Recent winter storms in the region have caused severe economic disruption with lengthy school and business closures, damage to vehicles and reduced community services for extended periods. In agricultural portions of the study area such as Southampton County, freezing temperatures may affect agricultural production, depending on when the event occurs relative to the growing periods of certain crops. Nor'easters often cause winter storms in the region, so the impacts of coastal flooding and shoreline erosion are also associated with winter storm events.

NCEI is now producing the Regional Snowfall Index (RSI) for significant snowstorms that impact the eastern two-thirds of the United States. The RSI is a regional snowfall impact scale that uses the area of snowfall, the amount of snowfall, and the number of people living within a snowstorm. Since the index uses population information, it attempts to quantify the societal impacts of a snowstorm. RSI has been calculated for large snowstorms back to 1900 and therefore the index puts a particular event into a century scale historical perspective (**Table 4.12**). A Category 5 snowstorm is a very rare event while Category 0 and 1 snowstorms are quite typical.

TABLE 4.12: REGIONAL SNOWFALL INDEX (RSI)			
CATEGORY	RSI RAW SCORE	APPROXIMATE PERCENT OF STORMS	DESCRIPTION
5	>18	1%	Extreme
4	10-18	2%	Crippling
3	6-10	5%	Major
2	3-6	13%	Significant
1	1-3	25%	Notable

Source: NCEI, 2021

RSI is calculated for specific regions. Only the snowfall within a particular region is used to calculate the index for that region. The Hampton Roads study area is within the Southeast study region for the RSI. The RSI differs from other indices because it includes population, which ties the index to societal impacts. Currently, the index uses population based on the 2000 Census.

Where available, the RSI value for specific storms is provided in the History section below.

SIGNIFICANT HISTORICAL EVENTS

According to the NCEI, Hampton Roads has experienced 23 significant winter storm events including snow and ice storms, since 1995 (**Table 4.13**). These events account for $20.15 million in reported property damages for the affected areas. The region received presidential disaster declarations from major winter storms in 1996 (the Blizzard of '96) and 2000. Some of the most significant winter storms to impact the region in the twentieth century are discussed below.

On **January 30-31, 1966**, a blizzard struck Virginia and the Northeast U.S. It was the second snowstorm to hit Virginia in a week. The first storm dumped nine inches in Norfolk. With fresh snow on the ground, arctic air settled in and temperatures dropped into the teens. The second storm dumped one to two feet of snow over a large part of the state. Intense winds and drifting snow continued and kept roads closed for several days after the storm. Temperatures dropped into the single digits with some falling below zero. Wind chill temperatures were dangerously low.

The **winter of 1976-1977** was the coldest winter on the East Coast of the past century. Storms across the state dropped a few more inches every few days to keep a fresh coating on the streets that were just clearing from the previous storms. The average temperature for the month of January in Norfolk was 29.2°F which was 12° below normal. The prolonged cold wave caused oil and natural gas shortages and President Carter asked people to turn thermostats down to conserve energy. The major elements of this winter were the cold temperatures. There was little snowfall associated with this winter in the region.

The "**Presidents Day Storm**" of February 1979 dropped seven inches on snow on Norfolk on February 18-19 and 13 inches of snow were recorded for the entire month. The following winter, 20 inches fell in Virginia Beach and a foot of snow fell in Norfolk in a storm that hit the region in February. On March 1, another foot of snow fell in Norfolk and the total snowfall amount of 41.9 inches for Norfolk was the snowiest winter ever recorded in eastern Virginia.

The "**Superstorm of March '93**," was also known as "**The Storm of the Century**" for the eastern United States, due to its large area of impact, all the way from Florida and Alabama through New England. Impacts in the Southside Hampton Roads region were not as severe, but this storm still caused major disruption across a large portion of the country.

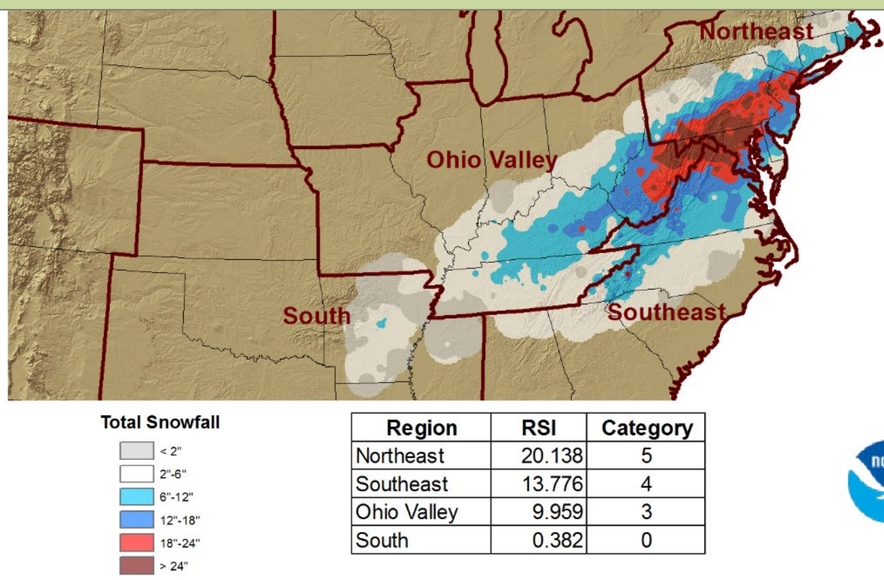
The "**1996 Blizzard**" from January 6 to January 13, 1996 affected much of the eastern seaboard. In Virginia, the winter storm left up to 36 inches of snow in portions of the state. In the Southside Hampton Roads region, most of the communities saw at least a foot of snow between January 6 and January 12.

A major ice storm at the end of **December 1998** resulted in approximately 400,000 customers being without power during the maximum outage period. Some customers were without power for about ten days during the holidays. Many accidents occurred due to slippery road conditions, especially bridges and overpasses and holiday travel. Many secondary roads were impassable due to fallen tree limbs or whole trees.

The **winter of 2010** was a memorable one for residents of Hampton Roads. The NWS winter climate data for 2010-2011 at Norfolk, indicate an average temperature of 38.9 degrees, or 3.2 degrees lower than the normal of 42.1 degrees. Total snowfall was 21.8 inches, which is remarkable when compared to the normal of 7.1 inches for an average winter. December 2010 was the 2nd-snowiest on record, at 17.8 inches, because most snow fell before January 1. There was 13.4 inches of snow for December 26, which is the fourth-biggest daily snowfall on record.[6] The December 26 winter storm created havoc on the roadways. Between midnight and 10 pm December 26, State Police recorded 421 traffic crashes, 296 disabled vehicles and 1,159 total calls for service in Hampton Roads, Eastern Shore, Williamsburg, Franklin and Emporia. The RSI ranking for the December, 2010 winter storm was a Category 2.

The **January 22-24, 2016 Winter Storm** was historic in its proportions across the northeastern United States and even in some parts of Virginia, with at least one reported death in Henry County, Virginia. From northern Virginia and into the panhandles of West Virginia and Maryland, and northeastward to the New York City area, historic amounts of snow fell, much of it blowing and drifting in the high winds. Power outages, storm damage and injuries were extreme in some areas. However, in Hampton Roads the storm's snowfall totals were merely noteworthy and not crippling, with the highest totals of 7.5 inches in James City County and 4 to 7 inches in Surry County. **Figure 4.20** shows the Regional Snowfall Index categories for the storm and how the categories varied across the various regions used in the indexing tool.

FIGURE 4.20: REGIONAL SNOWFALL INDEX, JANUARY 22-24, 2016



Region	RSI	Category
Northeast	20.138	5
Southeast	13.776	4
Ohio Valley	9.959	3
South	0.382	0

2016

Source: NOAA, 2021

Similarly, the snowstorm of **December 8-9, 2018** saw snowfall totals of almost two feet in parts of southwestern Virginia, but the accumulated snowfall in Hampton Roads ranged from virtually none in Virginia Beach and Chesapeake to 8.8 inches in Toano on the upper Virginia Peninsula.

[6] Source: *The Daily Press,* 3/11/2011, and NWS).

TABLE 4.13: WINTER STORM AND NOR'EASTER ACTIVITY (1995 - 2021)

DATE OF OCCURRENCE	TYPE OF EVENT	PROPERTY DAMAGE	DETAILS	RSI CATEGORY
1/6/1996	Winter Storm	$25,000	No description available.	5
2/2/1996	Winter Storm	$0	A winter storm tracked northeast from the Gulf Coast states to off the Virginia coast. It spread a mixture of snow, sleet and some freezing rain from the lower Chesapeake Bay southwest into south central Virginia. Snow developed on the back side of the storm with snow accumulations across Tidewater ranging from 4 to 8 inches.	2
2/16/1996	Winter Storm	$0	A storm tracked northeast from western South Carolina Thursday night to off the North Carolina coast Friday morning. Then it moved off north and spread heavy snow across Virginia.	
3/7/1996	Winter Storm	$0	A low pressure area developed over the Carolinas and then tracked off Virginia coast. It spread light snow across central and eastern Virginia.	
12/23/1998	Ice Storm	$20,000,000	A major ice storm affected central and eastern Virginia from Wednesday into Friday. A prolonged period of freezing rain and some sleet resulted in ice accumulations of one half inch to one inch in many locations. The heavy ice accumulations on trees and power lines caused widespread power outages across the region. Approximately 400,000 customers were without power during the maximum outage period. Some customers were without power for about ten days. Many accidents occurred due to slippery road conditions, especially bridges and overpasses. Many secondary roads were impassable due to fallen tree limbs or whole trees.	
1/19/2000	Winter Storm	$0	Two to three inches of snow fell overnight as an area of low pressure passed south of the region. The highest amounts were measured along a line from Caroline county in the north, through the City of Richmond, then along the southern shore of the James River to near the Newport News area. Snow briefly fell heavily after midnight, creating hazardous driving conditions.	1
1/25/2000	Winter Storm	$70,000	A significant winter storm dropped 8 to 12 inches of snow across portions of eastern Virginia. There was blowing and drifting of snow from winds which gusted over 40 mph at times. The snow mixed with sleet and freezing rain occasionally during the late morning hours. In Isle of Wight County, strong winds pushed the Pagan River onto South Church Street. Isle of Wight County snowfall totaled 7 to 8 inches. Winds gusting over 50 mph created some blowing snow in the late afternoon and evening hours. Eighty-four automobile accidents were reported during the storm in Virginia Beach alone. Portions of Interstate 264 were closed. Moderate beach erosion was experienced, especially in the Sandbridge area. Blowing sand closed portions of Sandfiddler Road. The U.S. Coast Guard rescued four crew members of a vessel four miles west of Cape Charles when their craft was caught in dangerously rough seas.	3
12/3/2000	Winter Storm	$50,000	A winter storm struck parts of extreme southern and southeastern Virginia. The storm affected a relatively small area, but the areas that had snow received some hefty totals. Windsor reported 4 inches of snowfall. Local law enforcement agencies reported scores of accidents, several of which involved injuries. Schools were closed the following day in Suffolk, Franklin and Isle of Wight County.	

TABLE 4.13: WINTER STORM AND NOR'EASTER ACTIVITY (1995 - 2021)				
DATE OF OCCURRENCE	TYPE OF EVENT	PROPERTY DAMAGE	DETAILS	RSI CATEGORY
2/22/2001	Winter Storm	$0	A winter storm produced 1 to 4 inches of snow across south central and eastern Virginia. Local law enforcement agencies reported numerous accidents, some of which involved injuries. Many schools were dismissed early on the day of the storm, and several schools in the area were either closed or had a delayed opening the following day due to slippery road conditions.	
1/2/2002	Winter Storm	$0	A winter storm produced 8 to as much as 12 inches of snow across south central and southeast Virginia. Local law enforcement agencies reported numerous accidents. Most schools in the area were closed Thursday and Friday due to very slippery road conditions.	
12/4/2002	Winter Storm	$0	A winter storm produced 1 to 4 inches of snow along with 1/4 to 1/2 inch of ice from south central Virginia northeast through the middle peninsula and Virginia northern neck. Numerous trees and power lines were reported down due to ice accumulations, resulting in scattered power outages. Local law enforcement agencies also reported numerous accidents. Some schools in the area were closed Thursday due to slippery road conditions.	
1/16/2003	Winter Storm	$0	A winter storm produced 4 to 8 inches of snow across portions of central and eastern Virginia. Local law enforcement agencies reported numerous accidents. Most schools in the area were closed Friday due to very slippery road conditions.	
2/15/2003	Winter Storm	$0	A winter storm produced 1 to 3 inches of snow, along with sleet and 1/4 to 1/2 inch of ice accumulation, across central and eastern Virginia. Local law enforcement agencies reported numerous accidents. Most schools in the area were closed Monday due to very slippery road conditions.	3
1/9/2004	Winter Storm	$0	Two to as much as five inches of snow fell across portions of central, south central, and southeast Virginia. The snow produced very slippery roadways, which resulted in several accidents.	
1/25/2004	Winter Storm	$0	Two to as much as four inches of snow and sleet fell across portions of eastern and southeast Virginia. The snow and sleet produced very slippery roadways, which resulted in numerous accidents and school closings for a few days.	
2/15/2004	Winter Storm	$0	One to three inches of snow fell across portions of south central and southeast Virginia. The snow produced very slippery roadways, which resulted in several accidents and school closings for a few days.	
12/26/2004	Winter Storm	$0	A winter storm produced a narrow band of six to as much as fourteen inches of snow across the Virginia Eastern Shore, Hampton Roads, and interior southeast Virginia. The snow caused very hazardous driving conditions, which resulted in numerous accidents. Smithfield in Isle of Wight county reported 12 inches and Isle of Wight reported 11 inches.	
1/30/2010	Winter Storm	$0	Low pressure moving off the coastal Carolinas produced between five and fifteen inches of snow across central and eastern Virginia from Friday night, January 29th, into Saturday night January 30th.	2
12/25/2010	Winter Storm	$0	Low pressure moving north just off the Mid Atlantic Coast produced between five and sixteen inches of snow across central and eastern Virginia from Saturday afternoon, December 25th, into Sunday evening December 26th. Snowfall amounts were generally between nine and fourteen inches across the region. Chesapeake reported 13.0 inches of snow.	2

TABLE 4.13: WINTER STORM AND NOR'EASTER ACTIVITY (1995 - 2021)				
DATE OF OCCURRENCE	**TYPE OF EVENT**	**PROPERTY DAMAGE**	**DETAILS**	**RSI CATEGORY**
1/21/2014	Winter Storm	$0	Coastal low pressure intensifying off the Mid Atlantic Coast produced a widespread two to five inches of snowfall from the Virginia Piedmont to the Virginia Eastern Shore.	
1/28/2014	Winter Storm	$0	Coastal low pressure intensifying off the Mid Atlantic Coast produced widespread snowfall ranging from two to ten inches of snowfall from the Virginia Piedmont to the Virginia Eastern Shore. Highest snowfall amounts were over southeast Virginia.	1
2/16/2015	Winter Storm	$0	Low pressure moving from the Southern Plains east northeast and off the Mid Atlantic Coast produced between four inches and nine inches of snow across central, south central and eastern Virginia from Monday afternoon, February 16th through early Tuesday morning, February 17th.	1
2/26/2015	Winter Storm	$0	Intensifying low pressure tracking from the Gulf of Mexico northeast and off the southeast and Mid Atlantic coast produced between three inches and nine inches of snow across eastern and southeast Virginia from late Wednesday night, February 25th into midday Thursday, February 26th.	
1/22/2016	Winter Storm	$0	Strong Low Pressure moving from the Southeast United States northeast and off the Mid Atlantic Coast produced between two and seven inches of snow and strong winds across the Virginia Eastern Shore, Middle Peninsula, and Interior Southeast Virginia. Sedley reported 5.0 inches of snow. City of Franklin reported 5.0 inches of snow. Courtland reported 4.0 inches of snow. Lightfoot had 7.5 inches of snow.	4
1/3/2018	Winter Storm	$0	Strong low pressure tracking northward just off the East Coast produced between three inches and fourteen inches of snow across Eastern Virginia. Snowfall totals ranged between four inches and nine inches across the county. Newport News reported 7.5 inches of snow. Fort Eustis reported 5.0 inches of snow.	1
1/17/2018	Winter Storm	$0	Low pressure tracking from the southeast United States northeast and off the Mid Atlantic Coast produced between two inches and seven inches of snow across south central and southeast Virginia. Snowfall totals ranged between two inches and three inches across the county. Bowers Hill reported 3.1 inches of snow.	
12/9/2018	Winter Storm	$0	Low pressure tracking northeast just off the southeast and Mid Atlantic coasts produced snowfall totals between three inches and fourteen inches across central, south central, and eastern Virginia. Snowfall totals generally ranged between four inches and nine inches across the county. Toano reported 8.8 inches of snow. Five Forks reported 6.5 inches of snow. Norge reported 6.0 inches of snow.	3
2/20/2020	Winter Storm	$0	Low pressure tracking from the Gulf Coast States east northeast and off the Southeast Coast produced snowfall totals between two inches and five inches across south central and southeast Virginia. Snowfall totals ranged from two inches to five inches across the county. Downtown Suffolk reported 4.0 inches of snow.	
28 Events		**$20,145,000**		

Source: NCEI, May, 2021

PROBABILITY OF FUTURE OCCURRENCES

Winter storms remain a likely occurrence for the region. While storms will be more likely to produce small amounts of snow, sleet or freezing rain, larger storms, though less frequent in occurrence, could also impact the region.

Historical evidence indicates that the region has been impacted by varying degrees of snow storms and ice storms over the last century. In terms of receiving measurable snowfall, the NCEI estimates that there is between 83.3 and 89.8 percent probability that the Southside Hampton Roads region will receive measurable snowfall in any given year, **Table 4.14**.

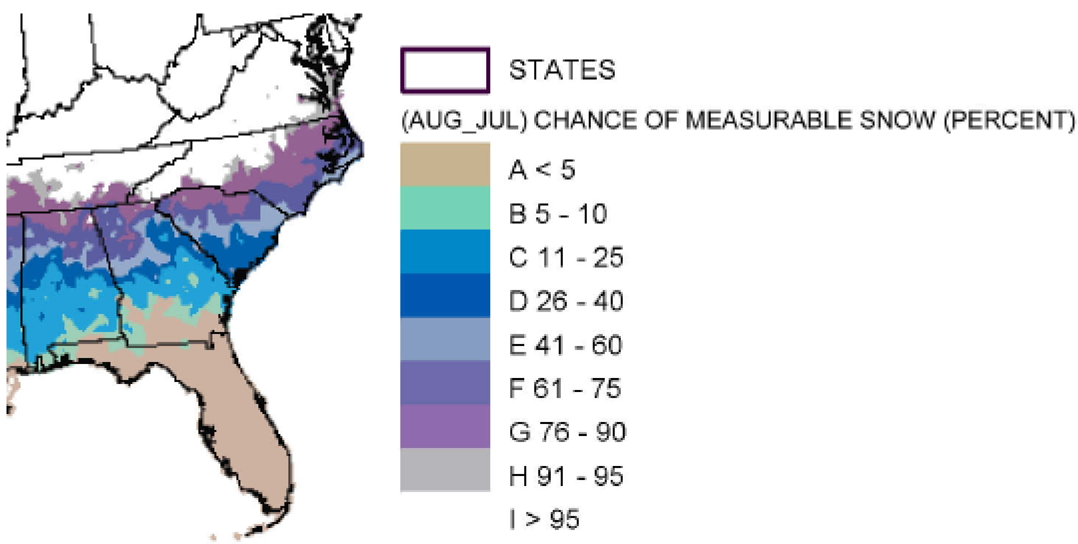
TABLE 4.14: PROBABILITY OF RECEIVING A MEASURABLE SNOWFALL

JURISDICTION	ANNUAL PROBABILITY	WINTER PROBABILITY	SPRING PROBABILITY	FALL PROBABILITY
Isle of Wight	83.3%	94.1%	25.0%	4.0%
Norfolk	89.8%	88.7%	36.4%	5.5%
Suffolk	No data	90.0%	63.6%	29.1%
Virginia Beach	84.0%	85.7%	23.5%	2.7%

Source: NOAA, (formerly) National Climatic Data Center, Snow Climatology Page, 2011

Figure 4.21 provides graphic evidence that the chance of snow annually is close to or equal to 100 percent in the rest of the study area.

FIGURE 4.21: CHANCE OF MEASURABLE SNOWFALL IN SOUTHEAST UNITED STATES (%)



undated

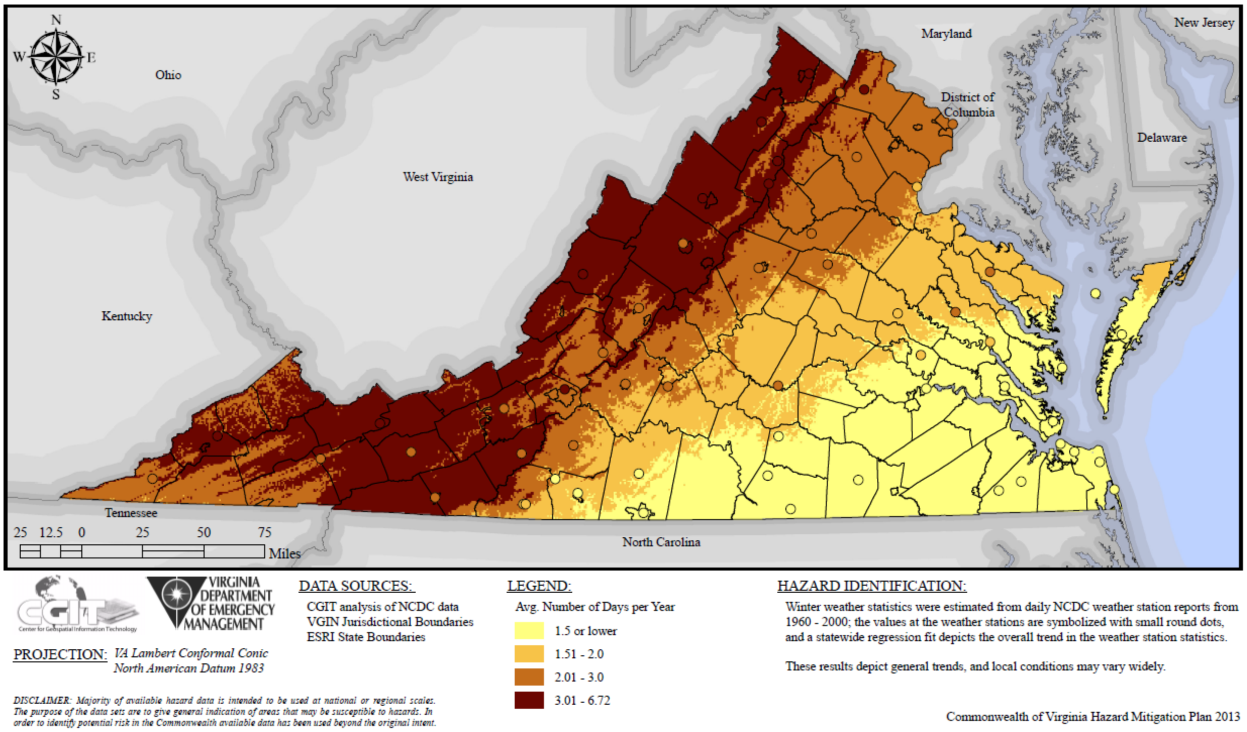
Source: NC State University, Climate Education web page: http://climate.ncsu.edu/edu/k12/.SEPrecip

Figure 4.22 indicates the average number of days the region will experience three or more days with at least three inches of snow. Data produced for the *2013 Commonwealth of Virginia Hazard Mitigation Plan* indicate the following frequency characteristics about winter storm characteristics for the region:

- 1.5 or fewer days per year with at least three inches of snow;
- 0.5 or fewer days per year with at least six inches of snow; and,

- three or fewer days per year entirely at or below 32°F.

FIGURE 4.22: AVERAGE NUMBER OF DAYS WITH AT LEAST THREE INCHES OF SNOW



2013

Source: 2013 Commonwealth of Virginia Hazard Mitigation Plan

EARTHQUAKE

An earthquake is the motion or trembling of the ground produced by sudden displacement of rock in the Earth's crust. Naturally occurring earthquakes result from crustal strain, volcanism, landslides or the collapse of caverns but can also be triggered by mine blasts or collapse or nuclear testing. Earthquakes can affect hundreds of thousands of square miles; cause damage to property measured in the tens of billions of dollars; result in loss of life and injury to hundreds of thousands of persons; and disrupt the social and economic functioning of the affected area.

Most property damage and earthquake-related deaths are caused by the failure and collapse of structures due to ground shaking. The level of damage depends upon the amplitude and duration of the shaking, which are directly related to the earthquake size, distance from the fault, site and regional geology.

Earthquakes are caused by the sudden release of accumulated energy, resulting in the rupture of rocks along fault planes in the Earth's lithosphere. The areas of greatest tectonic activity occur at the boundaries of the Earth's slowly moving tectonic plates, as these locations are subjected to the greatest strain from plates traveling in various directions and speeds. Deformation along plate boundaries causes strain in the rock and the consequent buildup of stored energy. When the built-up stress exceeds the rocks' strength, a rupture occurs. The rock on both sides of the fracture is snapped, releasing the stored energy and producing seismic waves, generating an earthquake.

Impacts from earthquakes can be severe and cause significant damage. Ground shaking can lead to the collapse of buildings and bridges, and disrupt utilities and critical lifelines. Death, injuries, and extensive property damage are possible from earthquakes. Some secondary hazards caused by earthquakes may include fire, hazardous material release, landslides, flash flooding, avalanches, tsunamis, and dam failure.

Smaller earthquakes occur much more frequently than larger earthquakes. These smaller earthquakes are generally not felt by people and cause little or no damage. Very large earthquakes can cause tremendous damage and may be followed by a series of aftershocks occurring in the region for weeks after the event. Aftershocks generally have a smaller magnitude than the main shock, but may still be powerful enough to cause additional damage.

Earthquakes are measured in terms of their magnitude or intensity. Magnitude is the amount of energy that is released by an earthquake. There are a number of ways that magnitude can be measured but probably the most familiar is the Richter scale, an open-ended logarithmic scale that describes the energy release of an earthquake through a measure of seismic wave amplitude (see **Table 4.15**). Each unit increase in magnitude on the Richter scale corresponds to a 10-fold increase in wave amplitude, or a 32-fold increase in energy. Intensity is most commonly measured using the Modified Mercalli Intensity (MMI) Scale based on direct and indirect measurements of seismic effects. The scale levels are typically described using Roman numerals, with a I corresponding to imperceptible (instrumental) events, IV corresponding to moderate (felt by people awake), to XII for catastrophic (total destruction).

Even though the original calculations developed by Richter to estimate earthquake magnitude have gone out of favor, newer formulae still retain the familiar Richter reporting methodology as shown in **Table 4.15**. Currently, the moment magnitude scale (MMS) is the primary reporting method used by the U.S. Geological Survey.[7]

[7] Source: https://energy.virginia.gov/geology/Earthquakes.shtml&sa=D&source=docs&ust=1641771610295397&usg=AOvVaw1u1SLzk6WWF7rtbguUKSjV

TABLE 4.15: RICHTER SCALE	
RICHTER MAGNITUDES	**EARTHQUAKE EFFECTS**
Less than 3.5	Generally not felt, but recorded.
3.5-5.4	Often felt, but rarely causes damage.
Under 6.0	At most slight damage to well-designed buildings. Can cause major damage to poorly constructed buildings over small regions.
6.1-6.9	Can be destructive in areas up to about 100 kilometers across where people live.
7.0-7.9	Major earthquake. Can cause serious damage over larger areas.
8 or greater	Great earthquake. Can cause serious damage in areas several hundred kilometers across.

Source: United States Geological Survey

The effect of an earthquake on people and structures on the Earth's surface is called the intensity. The intensity scale consists of a series of certain key responses such as people awakening, movement of furniture, damage to chimneys, and finally, total destruction. Although numerous intensity scales have been developed in the last several hundred years to evaluate the effects of earthquakes, the one currently used in the United States is the Modified Mercalli Intensity Scale. It was developed in 1931 by American seismologists Harry Wood and Frank Neumann. This scale, composed of 12 increasing levels of intensity that range from imperceptible shaking to catastrophic destruction, is designated by Roman numerals as shown in **Table 4.16**. The scale does not have a mathematical basis; instead, it is an arbitrary ranking based on observed effects.[8] The lower numbers of the intensity scale indicate the manner in which people perceive the earthquake. The higher numbers of the scale are based on observed structural damage. Structural engineers usually contribute information for assigning intensity values of VIII or above.

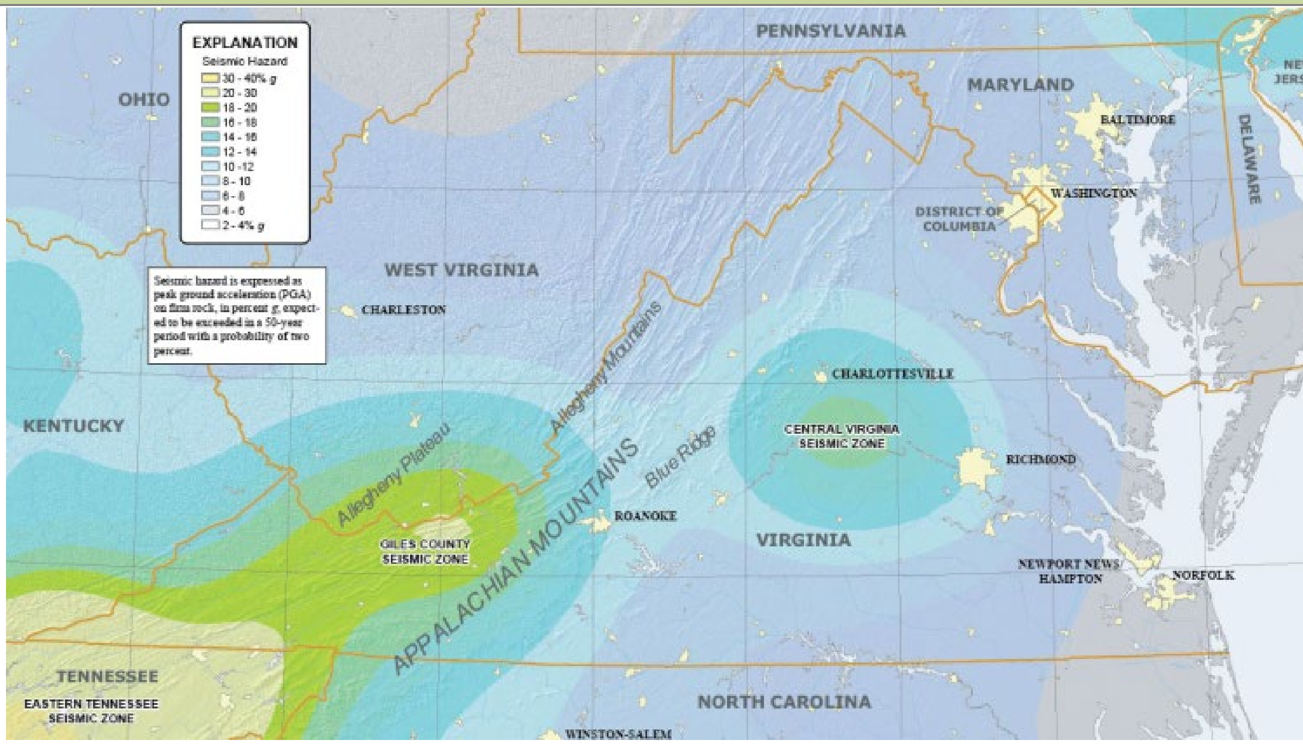
[8] Source: USGS online at: www.usgs.gov/natural-hazards/earthquake-hazards/science/modified-mercalli-intensity-scale?qt-science_center_objects=0#qt-science_center_objects

TABLE 4.16: MODIFIED MERCALLI INTENSITY SCALE FOR EARTHQUAKES			
SCALE	**INTENSITY**	**DESCRIPTION OF EFFECTS**	**CORRESPONDING RICHTER SCALE MAGNITUDE**
I	Instrumental	Detected only on seismographs	
II	Feeble	Some people feel it	<4.2
III	Slight	Felt by people resting; like a truck rumbling by	
IV	Moderate	Felt by people walking	
V	Slightly Strong	Sleepers awake; church bells ring	<4.8
VI	Strong	Trees sway; suspended objects swing, objects fall off shelves	<5.4
VII	Very Strong	Mild Alarm; walls crack; plaster falls	<6.1
VIII	Destructive	Moving cars uncontrollable; masonry fractures, poorly constructed buildings damaged	
IX	Ruinous	Some houses collapse; ground cracks; pipes break open	<6.9
X	Disastrous	Ground cracks profusely; many buildings destroyed; liquefaction and landslides widespread	<7.3
XI	Very Disastrous	Most buildings and bridges collapse; roads, railways, pipes and cables destroyed; general triggering of other hazards	<8.1
XII	Catastrophic	Total destruction; trees fall; ground rises and falls in waves	>8.1

Source: United States Geological Survey

Hampton Roads is in an area that could feel the effects of earthquakes in the Central Virginia Seismic Zone (see **Figure 4.23**), an area of frequent, yet very weak, earthquake activity located to the southwest of Charlottesville, at the New Madrid Fault in Missouri and at the Charleston Fault in South Carolina. During the last 200 years, both the New Madrid Fault and the Charleston Fault have generated earthquakes measuring greater than 8 on the Richter scale.

FIGURE 4.23: CENTRAL VIRGINIA SEISMIC ZONE



1993

Source: USGS

Earthquakes in the central and eastern U.S., although less frequent than in the western U.S., are typically felt over a much broader region. East of the Rockies, an earthquake can be felt over an area as much as ten times larger than a similar magnitude earthquake on the west coast. A magnitude 4.0 eastern U.S. earthquake typically can be felt at many places as far as 60 miles from where it occurred, and it infrequently causes damage near its source.[9] A magnitude 5.5 eastern U.S. earthquake usually can be felt as far as 300 miles from where it occurred, and sometimes causes damage out to 25 miles.

Earthquakes everywhere occur on faults within bedrock, usually several miles deep. Most bedrock beneath central Virginia was assembled as continents collided to form a supercontinent about 500-300 million years ago, raising the Appalachian Mountains. Most of the rest of the bedrock formed when the supercontinent rifted apart about 200 million years ago to form what are now the northeastern U.S., the Atlantic Ocean, and Europe.[10]

At well-studied plate boundaries like the San Andreas fault system in California, often scientists can determine the name of the specific fault that is responsible for an earthquake. In contrast, east of the Rocky Mountains this is rarely the case. The Central Virginia Seismic Zone is far from the nearest plate boundaries, which are in the center of the Atlantic Ocean. The seismic zone is laced with known faults but numerous smaller or deeply buried faults remain undetected. Even the known faults are poorly located at earthquake depths. Accordingly, few, if any, earthquakes in the seismic zone can be linked to named faults. It is difficult to determine if a known fault is still active and could slip and cause an earthquake. As in most other areas

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[9] Source: www.magma.geos.vt.edu/vtso/cvsz.html
[10] Source: www.magma.geos.vt.edu/vtso/cvsz.html

east of the Rockies, the best guide to earthquake hazards in the seismic zone is the earthquakes themselves.[11]

Earthquake activity in Virginia has generally been, with a few exceptions, low-magnitude but persistent. The first documented earthquake in Virginia took place in 1774 near Petersburg.[12] Historical data is supportive of the low risk assessment. Since 1774, there have been only three confirmed earthquake epicenters within 65 miles of Hampton Roads, one on the Delmarva Peninsula and two in the Hampton Roads area. Only minor structural damage as a result of these earthquakes has been reported in the region. Impacts of a severe, unlikely earthquake centered in Hampton Roads are unknown based on the historical record, but could be generalized from damage experienced in Louisa County during the August 2011 quake described below. Damage to local structures would likely be severe because buildings in the region are not typically designed to withstand high magnitude quakes. Underground infrastructure damage is also expected to be severe and could cause long-term power, water and sewer service interruptions in the region. Likewise, damage to bridges, tunnels and roads could disrupt transportation routes for much of the population.

On Tuesday afternoon, August 23, 2011, an earthquake with a moment magnitude of 5.8 occurred about 7 miles southwest of Mineral, Virginia, which is near Lake Anna in Louisa County. The earthquake was widely felt, with felt reports received from people as far away as Detroit, Atlanta, Boston, Toronto, and Montreal. Dozens of aftershocks up to magnitude 4.5 have been recorded, including a magnitude 4.2 aftershock approximately six hours after the main shock and a magnitude 4.5 aftershock about a day and a half later. The *Washington Post* reported that the two Dominion Virginia Power nuclear plants in North Anna, Va., 10 miles from the epicenter, shut down automatically when the quake hit. They lost power from the grid and switched to four diesel generators. Damage was greatest in Louisa County and several minor injuries occurred. Structural damage to buildings was significant in cities throughout central and eastern Virginia and Washington D.C., including damage to the Washington Monument and the Washington National Cathedral. Officials at Fort Monroe, in Hampton, Virginia, also reported some minor structural damage as a result of the quake.

The *Daily Press* and *Virginian-Pilot* newspapers reported a minor, but relatively rare, earthquake with its epicenter on the Peninsula August 3, 1995. According to the *Virginian-Pilot*, the quake measured 2.6 on the Richter scale. The Virginia Tech Seismological Observatory detected the quake with instrumentation in Goochland County west of Richmond, and in Blacksburg. The quake was centered under the York River near York River State Park. According to the *Daily Press*, people at Camp Peary in York County reported feeling the quake.

The Virginia Tech Seismological Observatory provides additional information on more recent events in Virginia, including a magnitude 4.0 shock that occurred on August 17, 1984. The epicenter was approximately 15 miles to the southeast of Charlottesville. The quake was felt from Washington, DC to the North Carolina border and from Staunton to Norfolk.

A magnitude 3.2 earthquake occurred Saturday, September 22, 2001, with the epicenter near Shadwell, just east of Charlottesville. The focal depth was within a few kilometers of the surface, and this produced a strong acoustic signal that local officials attributed to an aircraft in transonic flight. In fact, such explosive sounds are frequently associated with shallow earthquakes in eastern North America. Unlike the situation in California, the rocks in the upper few kilometers of the Earth's crust in the east are extremely efficient transmitters of high frequency seismic energy, and a proportion of this energy is converted to ordinary sound waves when the seismic waves reach the Earth's surface.

The USGS Earthquake Mapping Tool, online at https://earthquake.usgs177.gov/earthquakes/, does not indicate or show any earthquakes since 1774 with epicenters in the Hampton Roads area.

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[11] Source: www.magma.geos.vt.edu/vtso/cvsz.html

[12] Source: www.energy.virginia.gov/geology/Earthquakes.shtml

Earthquakes of significant magnitude are unlikely occurrences for Hampton Roads, though the proximity of the region to the Charleston Fault could increase the possibility of feeling some impact of a large earthquake if it were to occur along that fault line.

WILDFIRES

BACKGROUND

A wildfire is any fire occurring in a wildland area (i.e., grassland, forest, brush land) except for fire under prescription.[13] Wildfires are part of the natural management of the Earth's ecosystems, but may also be caused by natural or human factors. Over 80% of forest fires are started by negligent human behavior such as smoking in wooded areas or improperly extinguishing campfires. The second most common cause for wildfire is lightning.

There are three classes of wildland fires: surface fire, ground fire, and crown fire. A surface fire is the most common of these three classes and burns along the floor of a forest, moving slowly and killing or damaging trees. A ground fire (muck fire) is usually started by lightning or human carelessness and burns on or below the forest floor. Crown fires spread rapidly by wind and move quickly by jumping along the tops of trees. Wildland fires are usually signaled by dense smoke that fills the area for miles around.

A 2008 fire sparked by logging equipment in the Great Dismal Swamp National Wildlife Refuge lasted 121 days and cost more than $10 million. It was the longest and most expensive wildfire in Virginia history.
Photo Source: U.S. Fish and Wildlife Service

Fire probability depends on local weather conditions, outdoor activities such as camping, debris burning, and construction, and the degree of public cooperation with fire prevention measures. Drought conditions and other natural disasters (such as hurricanes, tornadoes and lightning) increase the probability of wildfires by producing fuel in both urban and rural settings. Forest damage from hurricanes and tornadoes may block interior access roads and fire breaks, pull down overhead power lines, or damage pavement and underground utilities.

The impacts of wildfire in the Hampton Roads region are both economic and environmental. From an economic perspective, fires destroy most homes, businesses and infrastructure in their path. The population displacement and subsequent rebuilding consumes valuable resources of private and public entities. Communities in the region spend significant capital funds both fighting wildfires and training staff, and preparing equipment and infrastructure to fight wildfire. Wildfire also endangers the lives and safety of firefighters and citizens. Loss of life is a possible impact of severe wildfire in the region, although the lack of mountainous terrain makes escape somewhat easier.

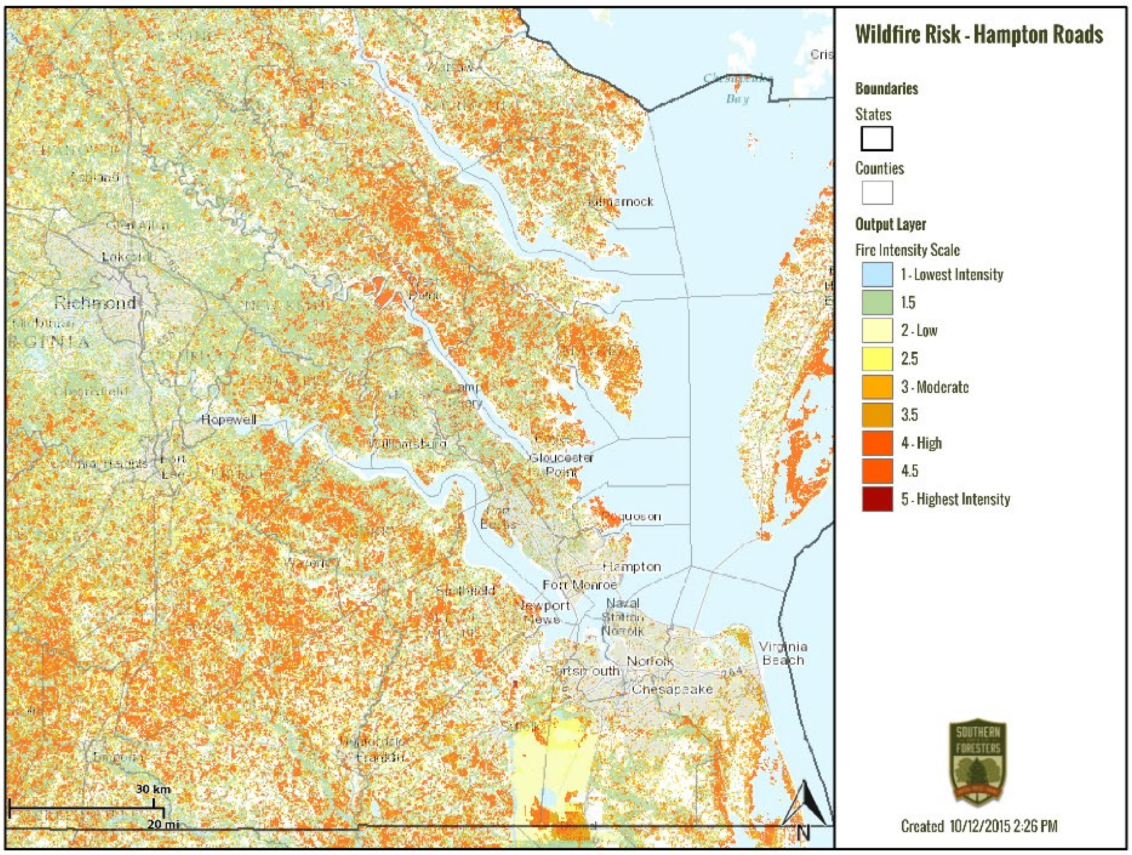
The region's air, water and soil environments are all altered by wildfire, and even wildfire in adjacent regions. Dense smoke and the fine particles and gases inside the smoke pose a risk to human health. Smoke irritates the eyes and respiratory system and can cause bronchitis or aggravate heart or lung disease even for residents hundreds of miles downwind. Wildfires raise the temperature of forest soils and potentially wipe away organic value of the soil. And although soils do eventually recover, the impact on watersheds in the interim can be detrimental to the region's water bodies. Burned organic matter in soils may negatively affect infiltration and percolation making soil surfaces water repellant. If water is unable to infiltrate, runoff quantity increases and infiltration to groundwater decreases. Both of these factors may negatively impact water quality downstream.

[13] Prescription burning, or "controlled burn," undertaken by land management agencies is the process of igniting fires under selected conditions, in accordance with strict parameters.

LOCATION AND SPATIAL EXTENT

In July 2003, the Virginia Department of Forestry (VDOF) released a GIS-based wildfire risk assessment for the Commonwealth of Virginia. The data are now part of the Southern Foresters web site at www.southernwildfirerisk.com that serves as a portal for data from several southern states. While this assessment of wildfire risk is not recommended for site-specific determinations of wildfire vulnerability, the data were used in this plan as an indicator of general hazard exposure within the region, as shown in **Figure 4.24**. Risk assessment designation involved several inputs, including slope, aspect, land cover, distance to railroads, distance to roads, population density, and historical fire occurrence. Potential wildfire risk areas are presented in two categories indicating the relative level of threat to the area as high or moderate. Areas without a high or moderate designation are considered to be at low risk of wildfire.

FIGURE 4.24: WILDFIRE THREAT



Source: Southern Foresters, 2013

Aerial imagery indicates that the areas classified as high wildfire threat are lightly developed wooded areas, including some marshland and other forms of undeveloped land. The moderate wildfire threat areas include both undeveloped and developed land.

SIGNIFICANT HISTORICAL EVENTS

According to VDOF records, the agency responded to 190 events between 2010 and 2020, the most recent year for which data were available. These data were compiled from completed VDOF fire reports, and do not reflect every brush and woods fire occurrence in the region for this time period. Many more fires are likely to have occurred during this timeframe that local fire departments responded to and were able to contain quickly and efficiently. Because the documented events required state-level assistance from VDOF, they are considered significant events for the purposes of this plan. Only minor property damages have been recorded as resulting from wildfire events. **Table 4.17** shows damages from wildfire events in the region between 2002 and 2020. In the period between 2010 and 2020, the fire that caused the most property damage occurred on July 9, 2018 in Southampton County as a result of equipment malfunction. Damages totaled $250,000, but only .5 acre was burned. In that same time period, there were six wildfires that burned 50 acres or more and property damages from those fires combined totaled just $50,250. Sixteen wildfires in that time period were caused by lightning.

TABLE 4.17: HAMPTON ROADS WILDFIRE OCCURRENCES (2002-2020)

YEAR	FREQUENCY	ACRES DAMAGED	COST OF DAMAGE ($)	VALUE OF RESOURCES PROTECTED ($)
2002	72	592	$89,800	$4,718,200
2003	9	42	$1,600	$0
2004	19	26	$50	$500,000
2005	19	130	$750	$1,370,000
2006	41	298	$69,950	$7,315,000
2007	40	188	$600	$1,950,000
2008	31	141	$500	$0
2009	12	47	not provided	not provided
2010	40	381	$33,450	not provided
2011	18	199	$11,000	not provided
2012	12	91	$9,200	not provided
2013	13	31	$15,900	not provided
2014	17	61	$1,200	not provided
2015	18	146	$49,900	not provided
2016	10	78	$1,700	not provided
2017	21	60	$34,100	not provided
2018	19	149	$278,950	not provided
2019	10	21	$60,600	not provided
2020	12	77	$4,300	not provided
TOTALS	**433**	**2758**	**$663,550**	**n/a**

Source: VDOF, 2021

GREAT DISMAL SWAMP FIRE THREAT AND HISTORY

On the western edge of the City of Chesapeake's border lies the Great Dismal Swamp Wildlife Refuge, 111,000 acres of complete uninterrupted wilderness and swamp owned and managed by the U.S. Fish and Wildlife Service. While the City has very limited development in close proximity to the Refuge borders and does not actively manage fire or fire threats on federal lands, there are several unique factors which could present a large wildfire risk to the cities of Chesapeake and Suffolk:

- Limited road access means many thousands of acres are completely inaccessible for normal fire apparatuses. Most of the refuge is only accessible by canal.
- Dangerous soil conditions for fires. The soils within the refuge are primarily peat soils. Peat forms when plant material, usually in marshy areas, is inhibited from decaying fully by acidic and anaerobic conditions. Peat has high carbon content and can burn under low moisture conditions.

> Once ignited by the presence of a heat source (e.g., a wildfire penetrating the subsurface), it smolders. These smoldering fires can burn undetected for very long periods of time (months, years and even centuries), propagating in a creeping fashion through the underground peat layer.

In 1923 a lightning strike within the Refuge ignited a fire that burn uncontrolled for three years. This fire became known as “The Great Conflagration” and burned over 150 square miles of the refuge. Yellow peat smoke filled the air around Hampton, Newport News, and Norfolk during this period. Since the mid-1940s, fire prevention and suppression techniques have reduced both the number and magnitude of fires within the refuge and adjacent areas. However, several notable fires during this period are summarized in **Table 4.18**.

On August 4, 2011, lighting struck and ignited much of the dead trees and brush that remained from the 2008 fire. Aided by a drought that had dried plants and the soil, the Lateral West fire steadily grew. This fire produced dense smoke as the peat soil burned (**Figure 4.25**). Shortly after the fire started, Hurricane Irene dumped 12 inches of rain in 24 hours, but that did not put out the fire which burned for another two and a half months.

FIGURE 4.25: GREAT DISMAL SWAMP LATERAL WEST FIRE, 2011

Source: NASA Satellite, 2011

An active fire management program is housed on the refuge. Seasonal activities include the planning and implementation of controlled burns, and wildfire suppression. The zone program conducts burns nine months a year, and averages 35 burn days a year. Burns are conducted in a wide range of habitat types, including marsh, grasslands, pocosins, and upland pine and hardwood forest.

TABLE 4.18: GREAT DISMAL SWAMP NOTABLE FIRES

YEAR/FIRE NAME	BRIEF DESCRIPTION
1923-1926 Great Conflagration	Consumed nearly 100,000 acres; it was sparked by logging debris. (*Virginian Pilot* online)
1955 Easter Sunday Fire	Started along the railroad within the northern part of the current refuge and burned nearly 150 square miles, reaching the Portsmouth city line.
1967 South of Feeder Ditch	Someone burning debris ignited this fire that burned 1,350 acres.
1988 April Fools Fire	Escaped prescribed fire burned 640 acres along the state boundary south of Lake Drummond.
1993 Clay Hill Road Fire	Lightning caused fire that burned 150 acres of pine stands near the refuge's western boundary in Suffolk.
1993 Portsmouth Ditch Fire	Fire of unknown origin burned 75 acres adjacent the refuge in Chesapeake.
2004 Corapeake Road Fire	Lightning caused fire started on NC State Natural Area land and spilled over onto the refuge burning 286 acres.
2006 West Drummond Fire	Lightning strike caused fire that burned 535 acres of maple/gum stand north of Interior Ditch.
2008 South One Fire	The South One Fire was started when logging equipment working in fallen Atlantic White Cedar and logging slash caught fire. The fire grew to 4,884 acres before being contained three months later. The fire burned through slash on the surface of the ground and crept deep into the organic peat soils where it continued to smolder and spread ultimately igniting additional vegetation on the surface. The fire cost more than 10 million dollars to suppress.
2011 Lateral West Fire	Largest fire in recent history sparked by lightning on August 4. Burned for 111 days and consumed 6,300 acres.

Source: U.S. Fish & Wildlife Service, 2014

The 2008 South One Fire burns in the distance. Photo source: Salter's Creek Consulting, Inc.

Today, lightning is the cause of most wildfires at Great Dismal Swamp National Wildlife Refuge. A typical summer afternoon thunderstorm can often result in hundreds of lightning strikes on the refuge. Most of the time, the strikes do not create a wildfire, but surface and ground fires occur on average 2.6 times each year. In the spring, early season lightning events provide the best chance for large fire growth under dry, windy conditions. In the summer months, more frequent lightning brings more starts, but less chance of large fire growth due to higher humidity and greenness of vegetation.

PROBABILITY OF FUTURE OCCURRENCES

Wildfires remain a highly likely occurrence for the region, though most will likely continue to occur in less urban areas and be small in size before being contained and suppressed. Wildfire at Great Dismal Swamp National Wildlife Refuge is similarly a highly likely occurrence.

DROUGHT

BACKGROUND

Drought is a natural climatic condition caused by an extended period of limited rainfall beyond that which occurs naturally in a broad geographic area. High temperatures, high winds and low humidity can worsen drought conditions, and make areas more susceptible to wildfire. Human demands and actions can also hasten drought-related impacts.

A USGS streamflow gaging station at the Ogeechee River near Eden, Georgia in July 2000 illustrates the drought conditions that can severely affect water supplies, agriculture, stream water quality, recreation, navigation and forest resources.

Photo source: USGS

Droughts are frequently classified as one of the following four types: meteorological, agricultural, hydrological or socio-economic. Meteorological droughts are typically defined by the level of "dryness" when compared to an average or normal amount of precipitation over a given period of time. Agricultural droughts relate common characteristics of drought to their specific agricultural-related impacts. Emphasis tends to be placed on factors such as soil water deficits, water needs based on differing stages of crop development, and water reservoir levels. Hydrological drought is directly related to the effect of precipitation shortfalls on surface and groundwater supplies. Human factors, particularly changes in land use, can alter the hydrologic characteristics of a basin. Socio-economic drought is the result of water shortages that limit the ability to supply water-dependent products in the marketplace.

In Hampton Roads, droughts can have economic, environmental and social impacts. Economic impacts include loss of income for farmers dependent on crop harvests, especially in the western portion of the region, irrigation costs for farms and gardens, higher costs of feed and water for farm animals, and impacts to farm supply businesses such as tractor sales. Wildfire resulting from drought can impact timberland. Water utilities may have additional costs to treat and provide limited water supplies, and food prices in general may be driven higher. Environmental impacts in the region may include loss or destruction of fish and wildlife habitat, and lack of food or drinking water for wild animals and resultant disease in those populations, migration of wildlife, and poor soil quality which may lead to soil erosion. Social impacts may result from changes in lifestyle associated with chronic drought and associated water restrictions. Severe drought often causes anxiety or depression about economic effects of drought in farming communities, health problems related to poor water quality and fewer recreational activities if drought continues and water supplies are curtailed.

The drought severity classification table (**Table 4.19**), shows the ranges for Palmer Drought Severity Index (PDSI) for each dryness level. Other indicators are also used, such as USGS weekly streamflow data and a standardized precipitation index. Short-term drought indicator blends focus on 1-3 month precipitation. Long-term blends focus on 6-60 months.

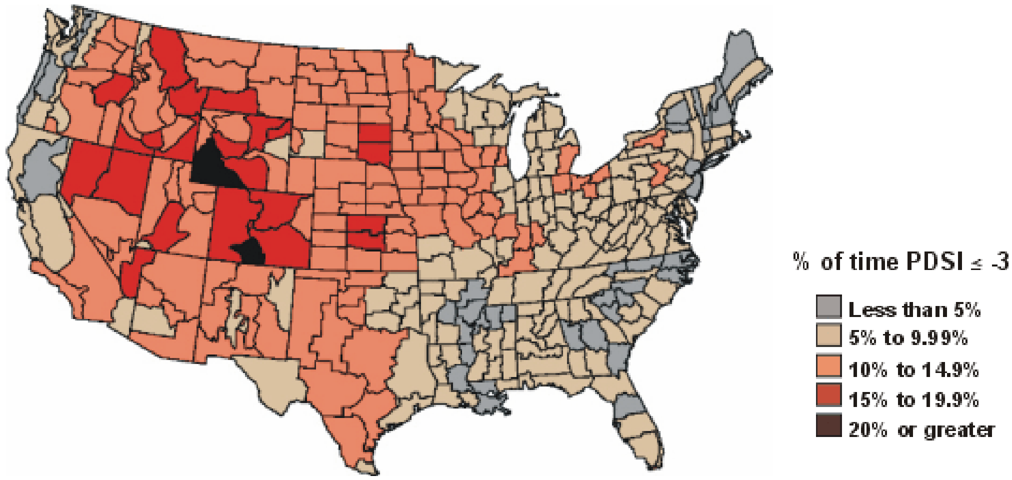
TABLE 4.19: DROUGHT CLASSIFICATION

Category	Description	Possible Impacts	Palmer Drought Severity Index (PDSI)
D0	Abnormally Dry	Going into drought: • short-term dryness slowing planting, growth of crops or pastures Coming out of drought: • some lingering water deficits • pastures or crops not fully recovered	-1.0 to -1.9
D1	Moderate Drought	• Some damage to crops, pastures • Streams, reservoirs, or wells low, some water shortages developing or imminent • Voluntary water-use restrictions requested	-2.0 to -2.9
D2	Severe Drought	• Crop or pasture losses likely • Water shortages common • Water restrictions imposed	-3.0 to -3.9
D3	Extreme Drought	• Major crop/pasture losses • Widespread water shortages or restrictions	-4.0 to -4.9
D4	Exceptional Drought	• Exceptional and widespread crop/pasture losses • Shortages of water in reservoirs, streams, and wells creating water emergencies	-5.0 or less

Source: National Drought Mitigation Center

Figure 4.26 shows the PDSI summary map for the United States from 1895 to 1995. PDSI drought classifications are based on observed drought conditions and range from -0.5 (incipient dry spell) to -4.0 (extreme drought). As can be seen, the Eastern United States has historically not seen as many significant long-term droughts as the Central and Western regions of the country.

FIGURE 4.26: PALMER DROUGHT SEVERITY INDEX, 1895-1995, PERCENT OF TIME IN SEVERE AND EXTREME DROUGHT



Source: National Drought Mitigation Center

LOCATION AND SPATIAL EXTENT

Drought typically impacts a large area that cannot be confined to geographic boundaries; however, some regions of the United States are more susceptible to drought conditions than others. According to Figure 4.26, Virginia is in a zone representing 5 percent to 9.99 percent of the time with PDSI less than or equal to -3 (-3 indicating severe drought conditions), meaning that drought conditions are a relatively low to moderate risk for the Hampton Roads region. The region would be uniformly exposed to this hazard and the spatial extent of that impact could potentially be large. However, drought conditions typically do not cause significant damage to the built environment. Agricultural areas in Chesapeake, Isle of Wight County, James City County, York County and Southampton County are more likely to be impacted by drought, especially in the early stages. As water restrictions are put in place as a result of acute water shortages, impacts on urban consumers increase (use restrictions, drinking water supply effects and saltwater intrusion).

SIGNIFICANT HISTORICAL EVENTS

The drought of record for Virginia occurred in 1931 when the statewide average rainfall amount was 7.64 inches compared to an average mean rainfall amount of 17.89. This was during this period that also saw the Great Dust Bowl that helped lead to the Great Depression.

Since 1993, the NCEI has recorded only 2 instances of drought to impact the Southside Hampton Roads region (**Table 4.20**). Though instances are recorded on a monthly basis by the NCEI, events are usually part of ongoing drought conditions that last several months or years.

TABLE 4.20: OCCURRENCES OF DROUGHT, 1993 THROUGH 2016		
LOCATION	**DATE OF OCCURRENCE**	**DETAILS**
17 jurisdictions, including Isle of Wight	10/31/1993	Unusually dry weather during the summer and early fall led to many communities in southeastern Virginia to place water conservation measures into effect in October 1993.
20 jurisdictions, including Isle of Wight, James City County, Williamsburg, and Suffolk	9/1/1997	A very dry period from May through September resulted in drought-like conditions across much of central and eastern Virginia. Monthly rainfall departures from normal for Norfolk included: -2.21 inches in May, -2.73 inches in June, -3.05 inches in August, and -1.93 inches in September. This caused significant crop damage throughout much of the area which was estimated to be around $63.8 million. Damages reported in the study area were $9.2 million.
Hampton Roads	10/1/2000	Although not technically a drought, much of eastern Virginia experienced extremely dry conditions during the month of October. Norfolk International Airport also received only .01 inches of precipitation during the month. This was the driest month ever recorded at Norfolk. A very wet summer prevented a more hazardous fire situation than would normally be experienced under such dry conditions. However, several small brush fires were reported over the region. Crops also were able to withstand the lack of rainfall due to a very wet summertime. No damages reported.

Source: NCEI

In addition to this official drought record, periods of drought-like conditions are also known to have impacted the region in 1997, 2002, 2003, 2005, 2007, 2008, and 2010. Water restrictions have been put into place as far back as 1997 and shallow wells have lost water in the region. Additional historical accounts were available for the most recent droughts in 2002, 2007, 2008 and 2010.

August, 2002: Drought

During the summer of 2002, Virginia experienced significant drought impacts due to precipitation deficits that dated to 1999 in most areas of the Commonwealth. While this drought did not reach the level of severity of the drought of record (1930-1932), increases in water demands when compared to the 1930's resulted in significant impacts to all sectors of Virginia's economy and society. The intensity of these drought impacts peaked in late August 2002. Wildfire indices were at levels previously unrecorded in Virginia, the vast majority of Virginia agricultural counties had applied for Federal drought disaster designation, stream flows reached periods of record lows, and thousands of individual private wells failed. During the third week of August several public water supply systems across the Commonwealth were on the brink of failure. Several large municipal systems, such as Charlottesville and Portsmouth, had less than sixty days of water supply capacity remaining in reservoirs. Several smaller rural systems that rely primarily on withdrawals from free-flowing streams, such as the towns of Farmville and Orange, had at most a few days of water supply available and were forced to severely curtail usage.

According to Commonwealth of Virginia records, a declaration of a State of Emergency Due to Extreme Drought Conditions was executed by the Governor of Virginia on August 30, 2002. The Executive Order was to be effective from August 30, 2002 through June 30, 2003. The 2002 drought resulted in several changes to the way Virginia predicts and responds to drought. In 2005, Isle of Wight County sought federal disaster drought aid because of drought conditions effecting crop production.

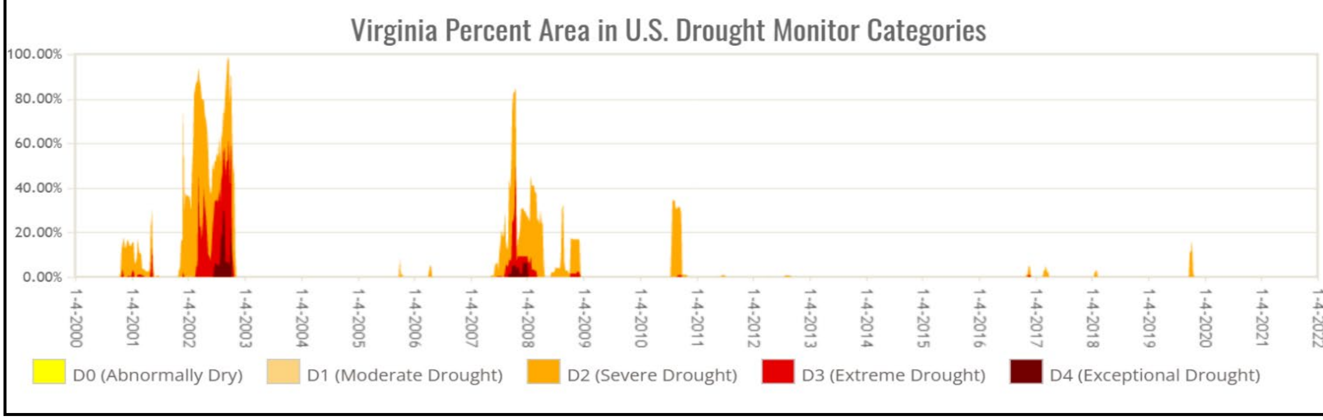
September, 2007: Drought
A statewide drought in late summer, early fall 2007 came very close to setting a 130-year statewide low precipitation record. Late October rainfall was helpful, but impacts to livestock, peanuts, hay and cotton were experienced and many crop insurance claims were made in Southeast Virginia.

Summer, 2008: Hydrologic Drought
Low stream flow in summer 2008 resulted in severe hydrologic drought.

Summer, 2010: Drought
Below average rainfall across much of the state resulted in 67 localities requesting the Governor's assistance in obtaining a Federal disaster designation due to drought. Crop yields were well below average with particular emphasis on corn and soybeans.

Figure 4.27 provides a time series of U.S. Drought Monitor Categories since 2000 for the Commonwealth of Virginia, highlighting times when Virginia was in Extreme, Severe or Exceptional drought categories.

FIGURE 4.27: VIRGINIA DROUGHT HISTORY, 2000 - 2021



Source: National Drought Mitigation Center, 2021

PROBABILITY OF FUTURE OCCURRENCES

Based on current and seasonal outlook drought maps available through the National Drought Mitigation Center, Hampton Roads is not currently in an area of abnormally dry conditions as of October 2021. Based on past events, the Hampton Roads region could possibly experience recurring drought conditions when precipitation falls below normal for extended periods of time.

EXTREME HEAT

BACKGROUND

A heat wave is defined as a prolonged period of excessive heat, often combined with excessive humidity. Extreme heat is defined as temperatures that hover 10 degrees or more above the average high temperature for the region and last for several weeks. A heat wave combined with a drought is particularly dangerous.

Extreme heat combined with high relative humidity slows evaporation, limiting the body's ability to efficiently cool itself. Overexposure may result in heat exhaustion or stroke, which could lead to death. The Centers for Disease Control and Prevention state that excessive heat exposure caused 8,015 deaths in the United States between 1979 and 1999.

In Hampton Roads, humid conditions resulting from maritime air masses may also add to the discomfort of high temperatures. Health risks to residents in the region exposed to extreme heat include dehydration, heat cramps, fainting, heat exhaustion and heat stroke. According to the NWS, heat is the leading weather-related killer in the United States, although no deaths have been reported for the historical events described below. The elderly and those with medical conditions such as diabetes are most at-risk, along with those who work outdoors in hot, humid weather.

The impact of excessive heat is most prevalent in urban areas, where urban heat-island effects prevent inner-city buildings from releasing heat built up during the daylight hours. Secondary impacts of excessive heat are severe strain on the electrical power system and potential brownouts or blackouts.

LOCATION AND SPATIAL EXTENT

For excessive heat, the NWS uses heat index thresholds as criteria for the issuance of heat advisories and excessive heat warnings. NWS heat advisory bulletins inform citizens of forecasted extreme heat conditions. The bulletins are based on projected or observed heat index values and include:

- Excessive Heat Outlook when there is a potential for an excessive heat event within three to seven days.
- Excessive Heat Watch when conditions are favorable for an excessive heat event within 12 to 48 hours but some uncertainty exists regarding occurrence and timing.
- Excessive Heat Warning/Advisory when an excessive heat event is expected within 36 hours.

These products are usually issued when confidence is high that the event will occur. A warning implies that conditions could pose a threat to life or property, while an advisory is issued for less serious conditions that may cause discomfort or inconvenience, but could still lead to threat to life and property if caution is not taken.

Extreme heat typically impacts a large area that is normally not confined to any geographic boundaries, although urban heat island effects can exacerbate effects in urbanized areas. Hampton Roads is uniformly exposed to this hazard and the spatial extent of that impact is potentially large. Extreme heat typically does not cause significant damage to the built environment, with the exception of road buckling. Summertime temperatures in Hampton Roads region can easily climb into the high 90 to low 100 degree Fahrenheit range with high humidity rates. Coastal areas may experience slightly (1 to 2 degrees) lower temperatures at some times as a result of late day sea breezes or lower water temperatures, depending on the season.

SIGNIFICANT HISTORICAL EVENTS

While temperature extremes occur fairly frequently in the region, the NCEI has only recorded three extreme temperature events recorded that have impacted the region as shown below. The committee acknowledges that there have been other, unrecorded extreme heat events during the period since 1950; however, records on these events are not available from the communities and were not reported through the NCEI or NWS.

August 1-31, 1995: Heat Wave
There were 22 injuries and $100 property damage associated with this heat wave that gripped the region.

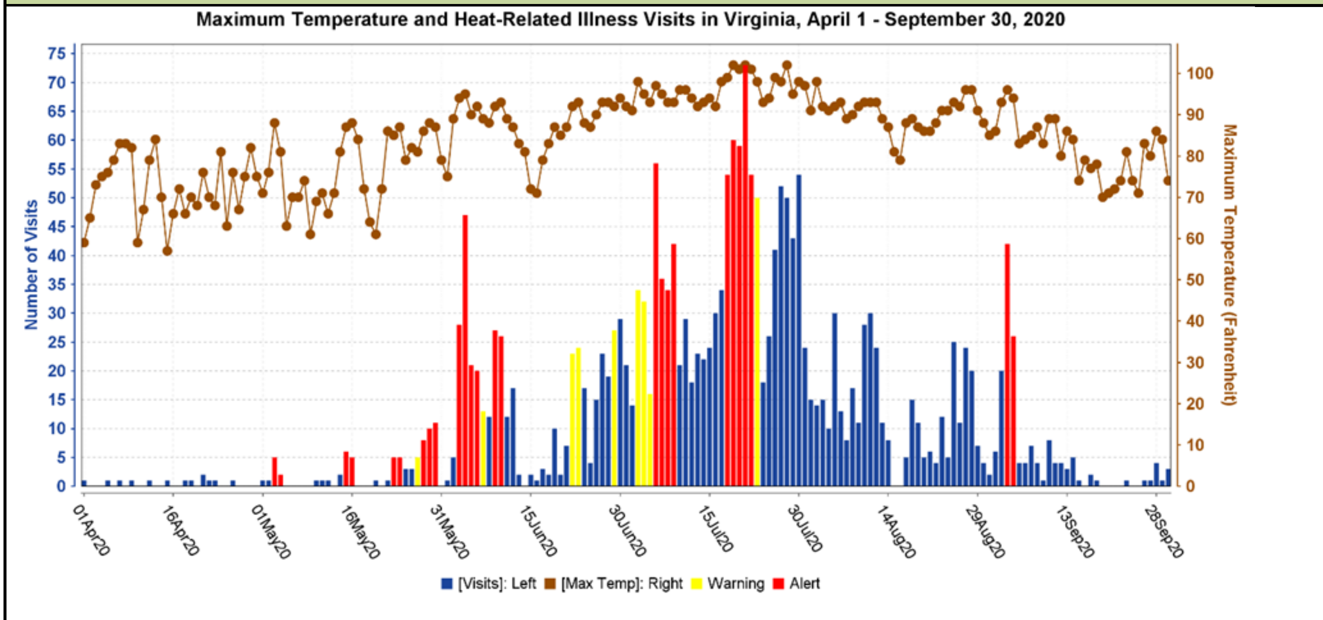
May 18−21, 1996: Extreme Heat
An early-season, four-day heat wave produced record or near record high temperatures across central and eastern Virginia. High temperatures were in the 80s and low 90s across the region on May 18. Then, on May 19, May 20 and May 21, high temperatures were in the 90s throughout the area. May 20 was the hottest of the four days as readings climbed into the mid- to upper-90s. Norfolk International Airport set a record with 98 degrees. The heat wave was responsible for numerous reports of heat exhaustion and forced many non-air conditioned schools to close or have early dismissals. There were no reported property damages, fatalities, or injuries.

The NWS reported that the summer of 2010 (June - August) had an average temperature of 81.1 degrees Fahrenheit, ranking it as the warmest on record. Previously, the warmest summer on record had averaged 80.0 degrees Fahrenheit in 1994.

July 21–23, 2011: Excessive Heat
An extended period of excessive heat and humidity occurred across most of central and eastern Virginia from July 21st to July 23rd. High temperatures ranged from 96 to 103 degrees during the afternoons, with heat index values ranging from 110 to 119. Overnight lows only fell into the lower 70s to lower 80s.

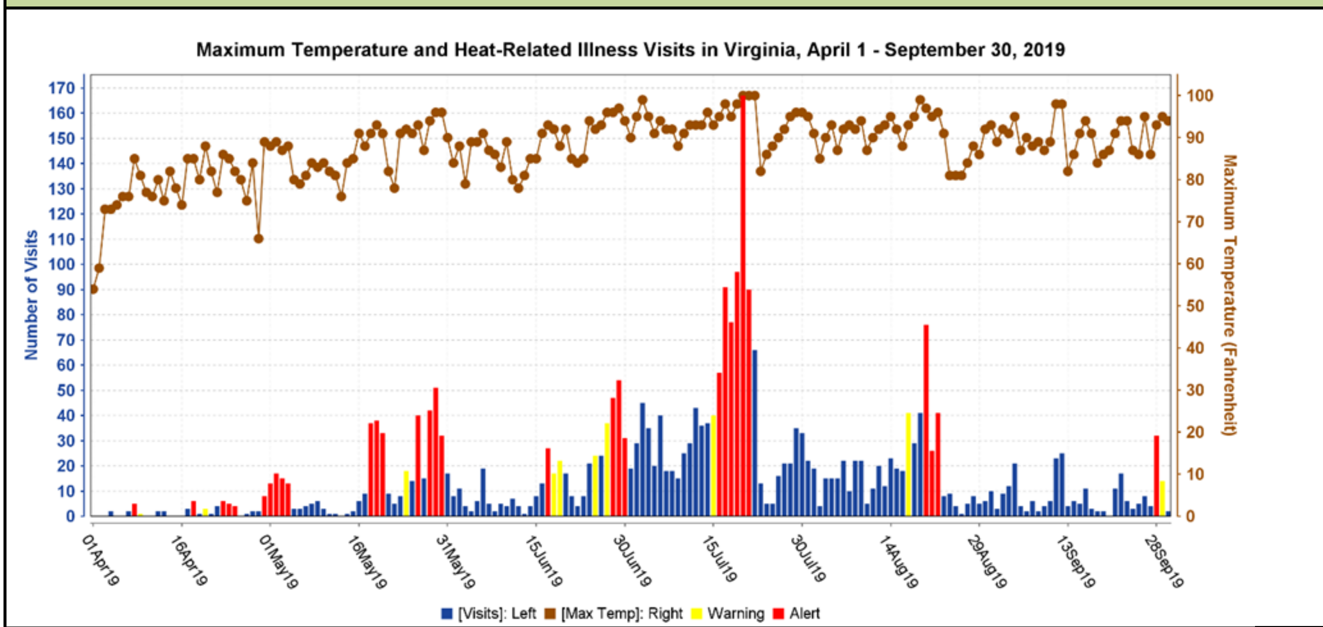
The VDH receives data on visits to emergency departments and urgent care centers in Virginia for purposes of public health surveillance. These data are analyzed through a syndromic surveillance system, known as ESSENCE, to monitor the health of the community and identify emerging trends of public health concern. In response to extreme heat, the Office of Epidemiology, Division of Surveillance and Investigation conducts surveillance for heat-related illness. While these data are not readily available by jurisdiction, the statewide data provide insights about significant extreme heat dates, the maximum temperatures and the number of hospital visits for heat-related illness, **Figures 4.28 through 4.32.**

FIGURE 4.28: MAXIMUM TEMPERATURE AND HEAT-RELATED ILLNESS VISITS IN VIRGINIA, 2020



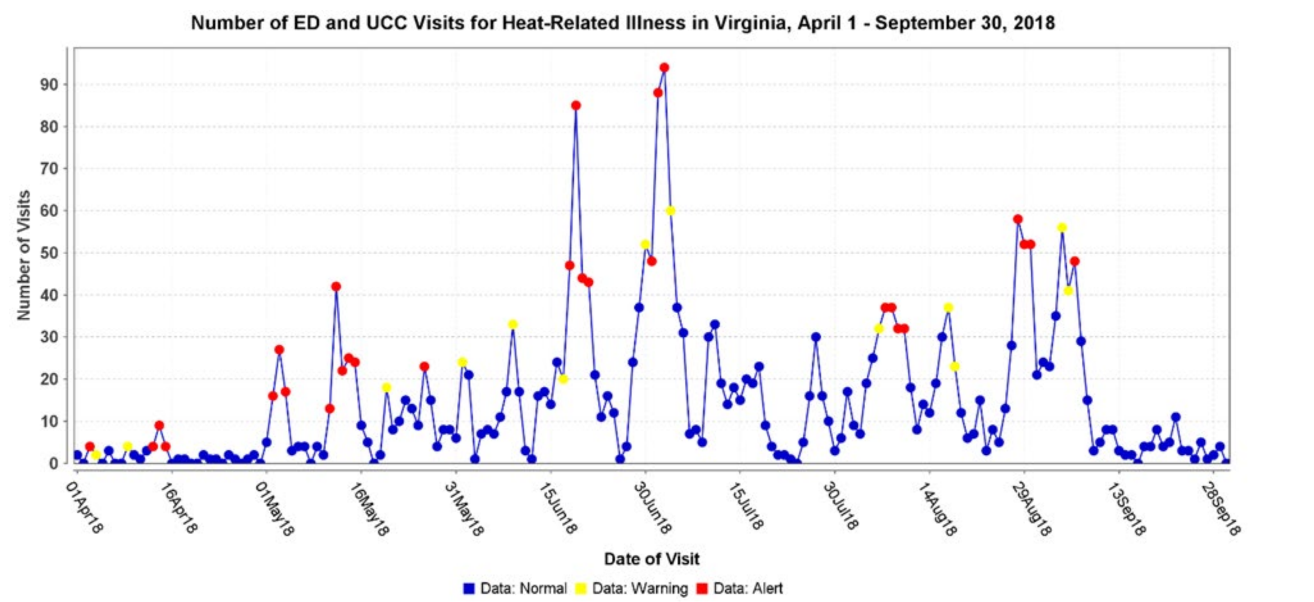
Source: VDH, accessed online 2021 https://www.vdh.virginia.gov/surveillance-and-investigation/syndromic-surveillance/weather-surveillance/.

FIGURE 4.29: MAXIMUM TEMPERATURE AND HEAT-RELATED ILLNESS VISITS IN VIRGINIA, 2019



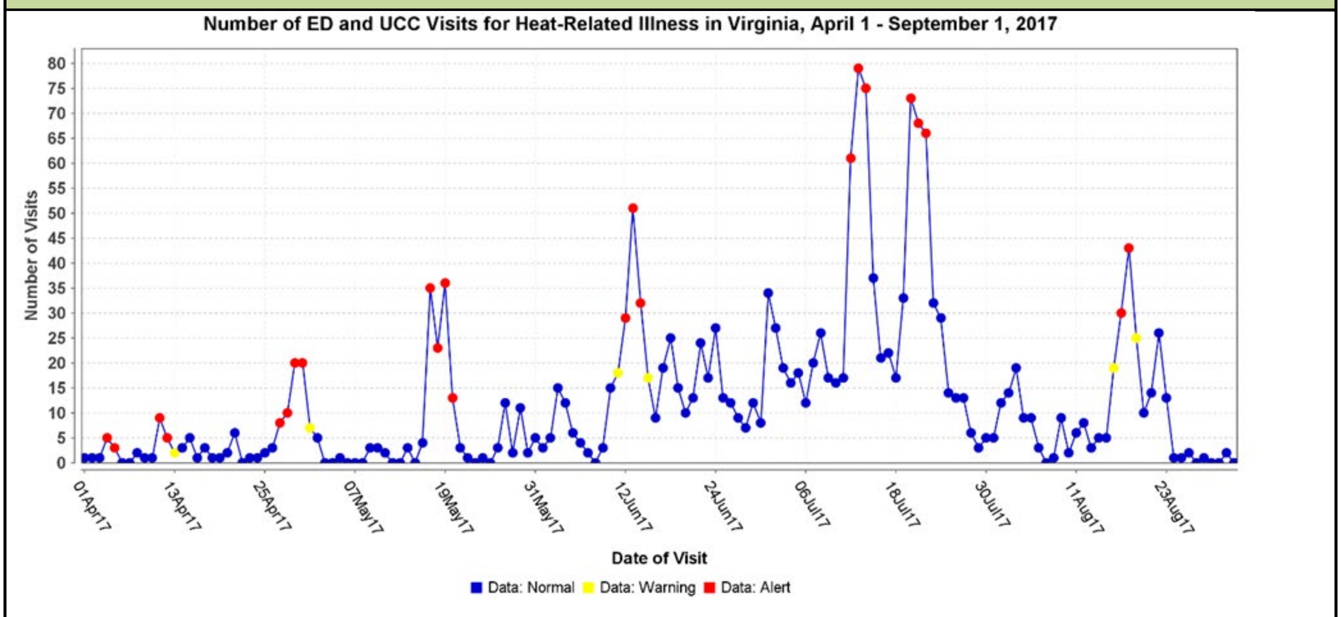
Source: VDH, accessed online 2021 https://www.vdh.virginia.gov/surveillance-and-investigation/syndromic-surveillance/weather-surveillance/.

FIGURE 4.30: MAXIMUM TEMPERATURE AND HEAT-RELATED ILLNESS VISITS IN VIRGINIA, 2018



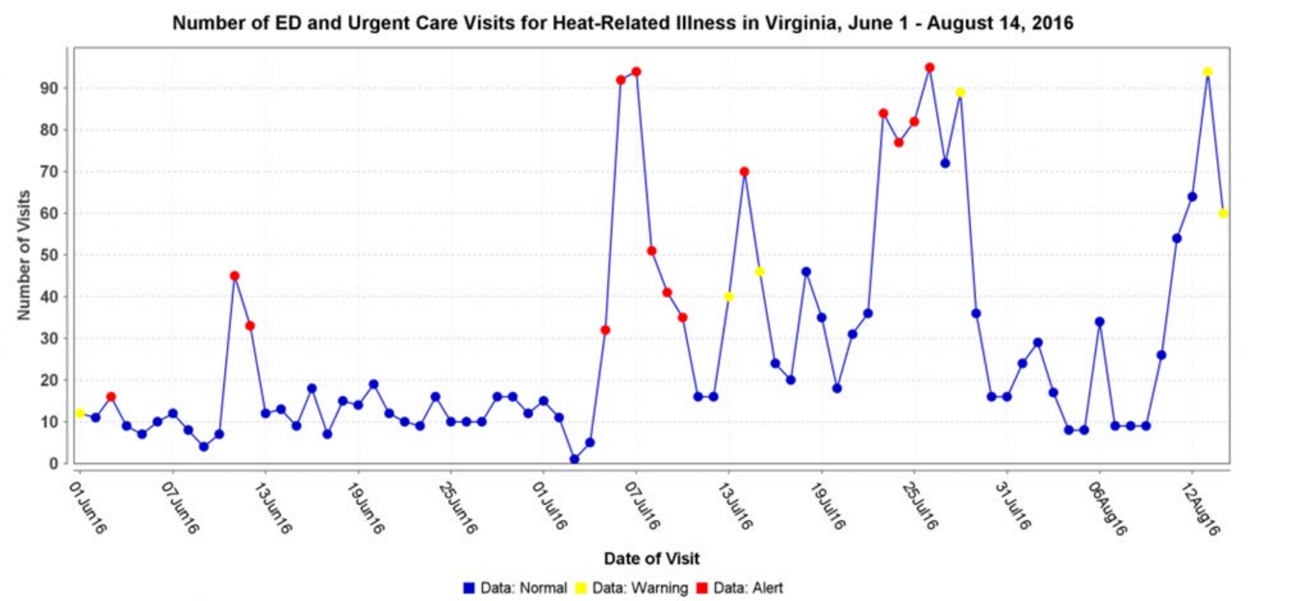
Source: VDH, accessed online https://www.vdh.virginia.gov/surveillance-and-investigation/syndromic-surveillance/weather-surveillance/.

FIGURE 4.31: MAXIMUM TEMPERATURE AND HEAT-RELATED ILLNESS VISITS IN VIRGINIA, 2017



Source: VDH, accessed online https://www.vdh.virginia.gov/surveillance-and-investigation/syndromic-surveillance/weather-surveillance/.

FIGURE 4.32: MAXIMUM TEMPERATURE AND HEAT-RELATED ILLNESS VISITS IN VIRGINIA, 2016



Source: VDH, accessed online https://www.vdh.virginia.gov/surveillance-and-investigation/syndromic-surveillance/weather-surveillance/.

PROBABILITY OF FUTURE OCCURRENCES

It is highly likely that the Hampton Roads region will experience periods of extreme heat in the future.

HAZARDOUS MATERIAL INCIDENTS

BACKGROUND

Hazardous material (HAZMAT) incidents can apply to fixed facilities as well as mobile, transportation-related accidents in the air, by rail, on the Nation's highways and on the water. Approximately 6,774 HAZMAT events occur each year, 5,517 of which are highway incidents, 991 are railroad incidents and 266 are due to other causes (FEMA, 1997). In essence, HAZMAT incidents consist of solid, liquid and/or gaseous contaminants that are released from fixed or mobile containers, whether by accident or by design, as with a terrorist attack. A HAZMAT incident can last hours to days, while some chemicals can be corrosive or otherwise damaging over longer periods of time. In addition to the primary release, explosions and/or fires can result from a release, and contaminants can be extended beyond the initial area by persons, vehicles, water, wind and wildlife.

City of Portsmouth Hazardous Materials Response Team.
Photo source: City of Portsmouth

HAZMAT incidents can also occur as a result of, or in tandem with natural hazard events, such as floods, hurricanes, tornadoes and earthquakes, which can also hinder response efforts. In the case of Hurricane Floyd in September 1999, communities in Eastern North Carolina were faced with flooded junkyards, disturbed cemeteries, deceased livestock, floating propane tanks, uncontrolled fertilizer spills and a variety of other environmental pollutants that caused widespread toxicological concerns.

Hazardous material incidents can include the spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping or disposing into the environment of a hazardous material, but exclude: (1) any release which results in exposure to poisons solely within the workplace; (2) emissions from the engine exhaust of a motor vehicle, rolling stock, aircraft, vessel or pipeline pumping station engine; (3) release of source, byproduct, or special nuclear material from a nuclear incident; and (4) the normal application of fertilizer.

Hazardous material incidents may include chemical agents, or compounds with unique chemical properties that can produce lethal or damaging effects in humans, animals and plants. Chemical agents can exist as solids, liquids or gases depending on temperature and pressure. Most chemical agents are liquid and can be introduced into an unprotected population relatively easily using aerosol generators, explosive devices, breaking containers or other forms of covert dissemination. Dispersed as an aerosol, chemical agents have their greatest potential for inflicting mass casualties. Chemical agents can have an immediate effect or a delayed effect of several hours to several days, and are broadly categorized as lethal or incapacitating. Fortunately, the compounds are difficult to deliver in lethal concentrations, difficult to produce, and dissipate rapidly outdoors.

Shippers are relying more heavily on other types of transportation to move hazardous materials. The Department of Transportation reported that the use of trucks and water carriers had climbed sharply between 1997 and 2002. The volume of hazardous materials shipped by trucks increased 21 percent to 1.16 billion tons by 2002, while the amount carried by rail rose 7 percent to 109 million tons. During that period, the volume of hazardous material moving by water climbed 36 percent to 228 million tons, according to the department's Bureau of Transportation Statistics. Between 2002 and 2007, truck and rail shipments of hazardous materials again increased by 3 percent and 19 percent, respectively; but, water shipment volume decreased by 34 percent to 150 million tons, which is below the 1997 volume carried by water. Data for 2017 indicate that hazardous materials shipments of over 2.9 trillion tons were transported, in order of highest to lowest volume, by truck (61%), by rail (3%), and by water (<1%). For comparison purposes, the Port of Virginia reports that in 2019, their cargo was moved 65% by truck, 34% by rail and 3% by barge.

In Hampton Roads, the negative impacts of hazardous materials incidents are dependent on the nature of the materials involved. While each chemical transported locally has unique qualities, there are generally three types of impacts: 1) economic, 2) environmental and 3) life/safety impacts to residents and first responders.

Economic impacts are likely greatest from potential large-scale incidents involving the port of Hampton Roads. Incidents that may result in port closure are unlikely, but even an event that blocks the port or a portion of the port for some period of time would have dire impacts on the port's ability to move commodities in or out of the entire region by train, ship or truck. Large spills or large fires have consequently high costs associated with response, control and cleanup. While local governments may only absorb some of those costs, economic costs to other industries would occur. Local emergency planners are especially aware of flammable crude oil transports in the York County portion of the planning area. Recent derailments involving this commodity, such as the one in Lynchburg in 2015, are high profile events as they often involve large spills and large fires.

Lesser, but still significant, economic impacts from HAZMAT incidents in the region could include the costs of litigation to resolve large spills, traffic control problems and lost time and wages for travelers impacted by roadway spills or incidents, as well as the impacts of corrosives such as sodium hydroxide on bridge and roadway infrastructure. In cases where evacuations are necessary to protect human life and safety, lost wages can be significant. For example, a natural gas leak in a downtown business district could result in evacuation of downtown businesses and shut down transportation routes. Derailment of a single train carrying hazardous materials shuts down the rail line to other trains for a long period of time, as well, which has economic consequences for numerous carriers, suppliers and buyers.

As intermodal transportation from overseas increases through the region, shipping through the port is growing and that increases highway traffic and rail traffic. The potential economic costs of hazardous materials incidents are, consequently, increasing in the region.

There are potential impacts to the health and safety of residents and travelers through Hampton Roads, as well. Response personnel are trained to respond in a variety of situations, but can nonetheless be exposed to harmful vapors or come into contact with hazardous chemicals. There is a potential for large-scale evacuations of businesses and residents if raw chemicals are released into the air or water under certain conditions that could endanger human health.

Environmental impacts of highest concern in Hampton Roads include the results of spills of petroleum products into the region's waterways. The region's emergency managers have contingency plans in place with the U.S. Coast Guard and others, and conduct regular training and exercises to prevent and then control further damage or secondary damage from fire or contaminant(s) spreading to sensitive environmental areas and critical infrastructure. However, a spill could still impact water quality, aquatic life and valuable wetlands along the shoreline. There is also a potential for hazardous materials incidents along roadways or railroads to impact groundwater with subsequent well water impacts for residents. Local emergency managers also noted the region's valuable migratory bird corridors, which could potentially be impacted by airborne contaminants, and the occurrence of illegal dumping which contributes hazardous materials to waterways, floodplains, wetlands, and forests without the benefit of appropriate response and cleanup.

LOCATION AND SPATIAL EXTENT

The Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA) was created to increase public awareness of the existence of hazardous materials in the community. The Act is a freestanding title in the Superfund Amendments and Reauthorization Act of 1986 (SARA), and requires certain facility owners/operators to routinely report the presence, quantity, and releases of hazardous materials at their facility. The Act also provides an avenue in which this information can be disseminated to the public, as well as requiring state and local governments to undertake planning measures to respond to emergencies involving those materials.

As a result, each community in Hampton Roads has identified a Local Emergency Planning Committee (LEPC) to take on the responsibilities of hazardous materials planning. These plans reside with the Emergency Coordinator of the community and provide detailed outlines of hazardous materials response and identification. Key components of the plans include the following that address the location and spatial extent of hazardous materials within the community:

- Identification of routes that are used for transportation of extremely hazardous materials, types of hazardous materials and facility locations of the materials; and,
- Identification of critical facilities which have additional risk due to proximity of transportation routes or fixed facilities.

HISTORICAL OCCURRENCES

The Federal Railroad Administration, Office of Safety Analysis, maintains accident reports for railroad accidents with damages greater than $8,500. In Hampton Roads, there have been 24 accidents involving hazardous material cars since 1998. The worst accident was in Suffolk in 2006, when one rail car suffered $18,212 of damage and 7 people had to be evacuated. Of the 24 accidents in the past decade, 6 rail cars carrying hazardous materials were damaged, and there was no record of hazardous materials being released.

There have been 596 documented HAZMAT events in Hampton Roads since 1998 (**Appendix I**), based on information from the U.S. Department of Transportation, Pipeline and Hazardous Materials Safety Administration, Office of Hazardous Materials Safety Incidents Report Database. There were no fatalities, and 15 injuries associated with these events, and a total of $1,238,922 damage. The worst event was in 2013 in Norfolk, when 4,500 gallons of ferric chloride spilled on the highway, causing $340,000 damages.

PROBABILITY OF FUTURE OCCURRENCES

Future occurrences of HAZMAT incidents, accidents or issues within Hampton Roads are considered to be highly likely.

PANDEMIC FLU OR COMMUNICABLE DISEASE

An influenza pandemic is an epidemic of an influenza virus that spreads on a worldwide scale and infects a large proportion of the human population. In contrast to the regular seasonal epidemics of influenza, these pandemics occur irregularly. Pandemics can cause high levels of mortality.

Influenza pandemics occur when a new strain of influenza virus is transmitted to humans from another animal species. Species that are thought to be important in the emergence of new human strains are pigs, chickens, and ducks. These novel strains are unaffected by any immunity people may have to older strains of human influenza and can therefore spread extremely rapidly and infect very large numbers of people.

The Centers for Disease Control and Prevention (CDC) uses a Pandemic Intervals Framework to describe the progression of an influenza pandemic, as shown in **Table 4.21**. This framework is used to guide influenza pandemic planning and provides recommendations for risk assessment, decision-making, and action in the United States. These intervals provide a common method to describe pandemic activity which can inform public health actions. The duration of each pandemic interval might vary depending on the characteristics of the virus and the public health response.

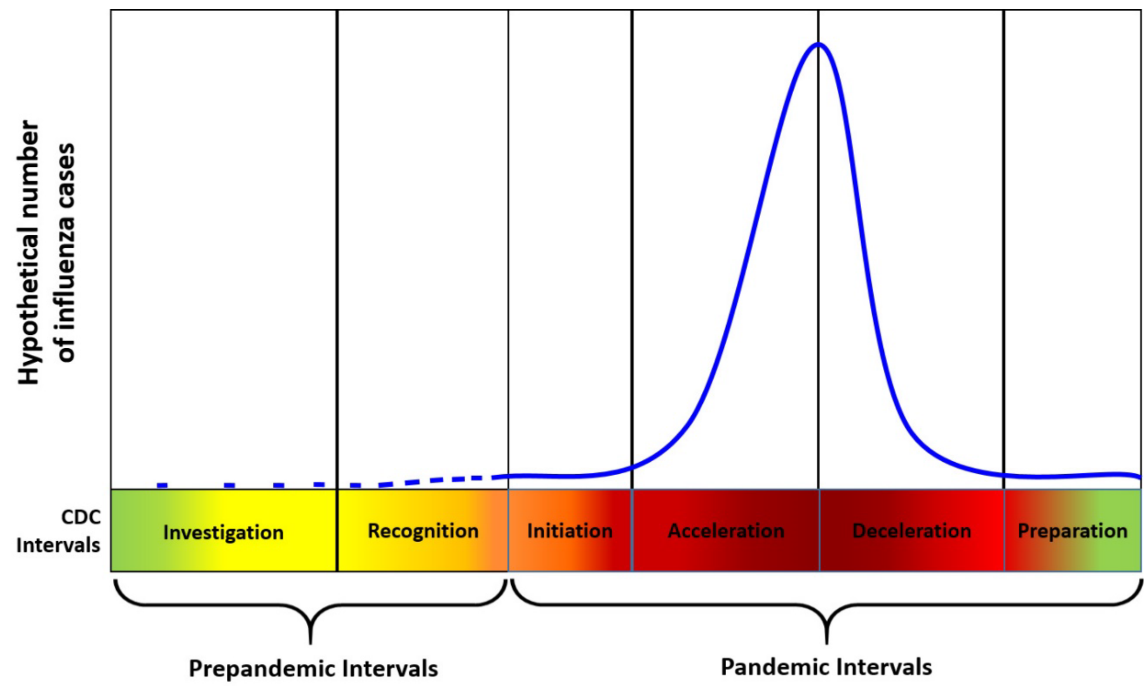
TABLE 4.21: CDC PANDEMIC INTERVALS FRAMEWORK

Interval	Description
1) Investigation of cases of novel influenza A virus infection in humans	When novel influenza A viruses are identified in people, public health actions focus on targeted monitoring and investigation. This can trigger a risk assessment of that virus
2) Recognition of increased potential for ongoing transmission of a novel influenza A virus	When increasing numbers of human cases of novel influenza A illness are identified and the virus has the potential to spread from person-to-person, public health actions focus on control of the outbreak, including treatment of sick persons.
3) Initiation of a pandemic wave	A pandemic occurs when people are easily infected with a novel influenza A virus that has the ability to spread in a sustained manner from person-to-person.
4) Acceleration of a pandemic wave	The acceleration (or “speeding up”) is the upward epidemiological curve as the new virus infects susceptible people. Public health actions at this time may focus on the use of appropriate non-pharmaceutical interventions in the community (e.g., school and child-care facility closures, social distancing), as well the use of medications (e.g., antivirals) and vaccines, if available. These actions combined can reduce the spread of the disease, and prevent illness or death.
5) Deceleration of a pandemic wave	The deceleration (or “slowing down”) happens when pandemic influenza cases consistently decrease in the United States. Public health actions include continued vaccination, monitoring of pandemic influenza A virus circulation and illness, and reducing the use of non-pharmaceutical interventions in the community (e.g., school closures).
6) Preparation for future pandemic waves	When pandemic influenza has subsided, public health actions include continued monitoring of pandemic influenza A virus activity and preparing for potential additional waves of infection. It is possible that a 2nd pandemic wave could have higher severity than the initial wave. An influenza pandemic is declared ended when enough data shows that the influenza virus, worldwide, is similar to a seasonal influenza virus in how it spreads and the severity of the illness it can cause.

Source: CDC 2021, accessed online at: https://www.cdc.gov/flu/pandemic-resources/national-strategy/intervals-framework.html

Figure 4.33 provides a graphical illustration of the intervals for a hypothetical virus pandemic.

FIGURE 4.33: PANDEMIC INTERVAL FRAMEWORK



Source: CDC 2021, accessed online at: https://www.cdc.gov/flu/pandemic-resources/national-strategy/intervals-framework.html

Communicable diseases are illnesses spread by bacteria or viruses that are spread from one person to another through contact with bodily fluids, blood products, contaminated surfaces, insect bites or through the air. Examples include HIV, hepatitis A, B, and C, Salmonella, measles, and blood-borne illnesses. Mitigation of spread may include testing, vaccination, and educating the public on methods of transmission.

LOCATION AND SPATIAL EXTENT

A pandemic is characterized by human-to-human spread of the virus over a very wide area, crossing international boundaries and affecting a large number of people. While many countries may not be affected early on in a pandemic, the CDC collaborates with the World Health Organization (WHO) and other international agencies to monitor and assess influenza viruses and illness. These organizations send strong signals to the public when research indicates a pandemic is imminent in their country, region, state or locality, and that the time to finalize the communication and implementation of planned mitigation measures is short.

Previous pandemics have been characterized by waves of activity spread over months and separated by oceans. Once the level of disease activity drops, a critical communications task is balancing this information with the possibility of another wave. Pandemic waves can be separated by months and an immediate "at-ease" signal may be premature. Pandemic waves can also be specific to a country or a subregion or state within a country, making local messaging a critical component in controlling the spread of the virus.

In our modern global economy that is focused on international trade and shipping, business and leisure travel to other countries can help spread an early-phase pandemic across the globe far more quickly than in past centuries. While quarantines and travel restrictions may help restrict the spread in later intervals, the damage wrought by virus carriers early on is irreversible.

In the Eastern Virginia Health District, the VDH indicates that Hepatitis B and C, Salmonella and Campylobacteriosis are the most commonly reported communicable diseases during the period 2013 to 2018, the most recent data available. **Table 4.22** summarizes the VDH data for the region during this period. Hepatitis B and C are viruses that cause an infection that attacks the liver and leads to inflammation. The infection is spread by blood products such as unclean needles, and most people have no symptoms. Campylobacteriosis is an infection by the Campylobacter bacterium, a common bacterial infection of humans, often a foodborne illness. The bacteria produce an inflammatory diarrhea or dysentery syndrome, mostly including cramps, fever and pain. Salmonella bacteria have a similar food-related source and cause upset stomach, diarrhea, fever, and pain and cramping in the belly.

TABLE 4.22: COMMUNICABLE DISEASE IN VIRGINIA'S EASTERN HEALTH DISTRICT

Year	Top Four Diseases	Number of Cases
2013	Campylobacteriosis	119
	Hepatitis B, chronic	291
	Hepatitis C, chronic	1295
	Salmonellosis	266
2014	Campylobacteriosis	104
	Hepatitis B, chronic	285
	Hepatitis C, chronic	1486
	Salmonellosis	268
2015	Campylobacteriosis	194
	Hepatitis B, chronic	332
	Hepatitis C, chronic	1764
	Salmonellosis	279
2016	Campylobacteriosis	222
	Hepatitis B, chronic	309
	Hepatitis C, chronic	2643
	Salmonellosis	267
2017	Campylobacteriosis	209
	Hepatitis B, chronic	371
	Hepatitis C, chronic	2751
	Salmonellosis	284
2018	Campylobacteriosis	226
	Hepatitis B, chronic	387
	Hepatitis C, chronic	2424
	Salmonellosis	302

Source: VDH, October 2021, accessed at: https://www.vdh.virginia.gov/data/communicable-diseases/

SIGNIFICANT HISTORICAL EVENTS

Flu pandemics have occurred throughout history. There have been about three influenza pandemics in each century for the last 300 years. Since 1918, five significant events stand out, each with different characteristics.

1918 – 1919: H1N1 Pandemic
Illness from the 1918 flu pandemic, also known as the Spanish flu, came on quickly. Some people felt fine in the morning but died by nightfall. People who caught the Spanish Flu but did not die from it often died from complications caused by bacteria, such as pneumonia. Approximately 20% to 40% of the worldwide population became ill, and an estimated 50 million people died, including early 675,000 people in the United States. Unlike earlier pandemics and seasonal flu outbreaks, the 1918 pandemic flu saw high mortality rates among healthy adults. In fact, the illness and mortality rates were highest among adults 20 to 50 years old. The reasons for this remain unknown.

1957 – 1958: H2N2 Pandemic
In February 1957, a new flu virus was identified in the Far East. Immunity to this strain was rare in people younger than 65. A pandemic was predicted. To prepare, health officials closely monitored flu outbreaks. Vaccine production began in late May 1957 and was available in limited supply by August 1957.
In the summer of 1957, the virus came to the United States quietly with a series of small outbreaks. When children returned to school in the fall, they spread the disease in classrooms and brought it home to their families. Infection rates peaked among school children, young adults, and pregnant women in October 1957. By December 1957, the worst seemed to be over. However, a dangerous “second wave” of illness came in January and February of 1958. Most influenza–and pneumonia–related deaths occurred between September 1957 and March 1958. Although the 1957 pandemic was not as devastating as the 1918 pandemic, about 69,800 people in the United States died. The elderly had the highest rates of death.

1968 – 1969: H3N2 Pandemic
In early 1968, a new flu virus was detected in Hong Kong. The first cases in the United States were detected as early as September 1968. Illness was not widespread in the United States until December 1968. Deaths from this virus peaked in December 1968 and January 1969. Those over the age of 65 were most likely to die. The number of deaths between September 1968 and March 1969 was 33,800, making it the mildest flu pandemic in the 20th century. The same virus returned in 1970 and 1972. Several reasons may explain why fewer people in the United States died as a result of this virus:

- The virus was similar in some ways to the 1957 pandemic flu virus. This might have provided some immunity.
- The virus hit in December of 1968, when school children were on vacation. This caused a decline in flu cases because children were not at school to infect one another. This also prevented it from spreading into their homes.
- Improved medical care and antibiotics that are more effective for secondary bacterial infections were available for those who became ill.

2009 – 2010: H1N1 Pandemic
In the spring of 2009, a new flu virus spread quickly across the United States and the world. The first U.S. case of H1N1 (swine flu) was diagnosed on April 15, 2009. By April 21, the CDC was working to develop a vaccine for this new virus. On April 26, the U.S. government declared H1N1 a public health emergency. By June, 18,000 cases of H1N1 had been reported in the United States. A total of 74 countries were affected by the pandemic. H1N1 vaccine supply was limited in the beginning. People at the highest risk of complications got the vaccine first.

By November 2009, 48 states had reported cases of H1N1, mostly in young people. That same month, over 61 million vaccine doses were ready. Reports of flu activity began to decline in parts of the country, which gave the medical community a chance to vaccinate more people. An estimated 80 million people were vaccinated against H1N1, which minimized the impact of the illness. The CDC estimates that 43 million to 89 million people had H1N1 between April 2009 and April 2010. They estimate between 8,870 and 18,300 H1N1 related deaths. On August 10, 2010 the WHO declared an end to the global H1N1 flu pandemic.

March 2020 - 2021: SARS-CoV-2 or COVID-19

In early 2020, a novel, infectious respiratory disease began to spread worldwide and eventually impacted all aspects of life throughout the world for over a year. Scientists determined that COVID-19 spread by droplets or aerosols from the nose and mouth when an infected person coughed, sneezed or exhaled. Airborne transmission also happened in indoor spaces without good ventilation, especially with infected people breathing heavily, like when singing or exercising. Infected people were able to spread the disease before having symptoms or feeling sick, and asymptomatic people could also spread the disease without ever exhibiting a single symptom. Several variants circulated globally as the virus mutated over time. In the case of COVID-19, the variants were determined to be more contagious.

Symptoms of COVID-19 could appear 2 to 14 days after exposure and included fever, cough, shortness of breath, chills, headache, muscle pain, sore throat, fatigue, congestion, or loss of taste or smell. Other less common symptoms included gastrointestinal symptoms like nausea, vomiting, or diarrhea. Even after recovering from the virus, many people experienced lingering symptoms such as fatigue, cough or joint pain. The elderly, those living in group settings (*e.g.,* nursing homes, jails) and people of any age with serious underlying medical conditions such as lung disease or diabetes, were at highest risk for developing complications from COVID-19. Fully effective and dependable treatments for the virus were limited.

Mitigation of COVID-19 depended on wearing protective masks, distancing from others who were able to transmit disease, washing hands to prevent disease spread, contact tracing to warn those who may have had exposure, and rapid development of testing measures to determine COVID-positive populations. Despite public health campaigns to prevent spread, the disease sickened millions and killed over 884,000 in the United States alone by February 2022.[14] The virus also impacted the Hampton Roads region as shown in **Table 4.23**.

[14] CDC web site, February, 2022, accessed online at: https://covid.cdc.gov/covid-data-tracker/#datatracker-home

TABLE 4.23: COVID-19 CUMULATIVE RATES PER 100,000 BY VIRGINIA LOCALITIES				
SUBREGION	**JURISDICTION**	**CASE RATE**	**HOSPITALIZATION RATE**	**FATALITY RATE**
Peninsula	Hampton	19,315	675	194
	Newport News	19,323	577	182
	Poquoson	18,063	392	196
	Williamsburg	10,322	550	85
	James City County	17,743	450	129
	York County	13,270	247	127
Southside	Norfolk	16,450	812	159
	Portsmouth	20,937	1,151	276
	Suffolk	19,116	1,051	275
	Virginia Beach	18,980	833	145
	Chesapeake	19,246	611	158
Western Tidewater	Isle of Wight County	18,465	811	247
	Franklin	30,525	1,060	549
	Southampton County	17,912	584	425
	Surry County	15,865	846	219

Source: VDH web site, February 2022 accessed online at: /www.vdh.virginia.gov/coronavirus/covid-19-in-virginia/

In addition to the pandemic history described above, several pandemic flu threats have occurred that did not prove as dangerous as the events described above. When the 1976 swine flu was identified at Fort Dix, New Jersey it was called the "killer flu." Experts were concerned because they thought the virus was similar to the 1918 Spanish flu. To prevent a major pandemic, the United States launched a vaccination campaign. In fact, the virus—later named "swine flu"—never moved outside the Fort Dix area. Later, research on the virus showed that it would not have been as deadly as the 1918 flu if it had spread.
In 1997, at least a few hundred people caught H5N1 (avian flu) in Hong Kong. Like the 1918 pandemic, most severe illness affected young adults. Eighteen people were hospitalized. Six of those people died. This avian flu was unlike other viruses because it passed directly from chickens to people. Avian flu viruses usually spread from chickens to pigs before passing to humans. To prevent the virus from spreading, all chickens in Hong Kong—approximately 1.5 million— were slaughtered. Because this flu did not spread easily from person to person, no human infections were found after the chickens were killed.

PROBABILITY OF FUTURE OCCURRENCES

Based on historical experience and the fact that at the time of this planning process an ongoing pandemic threatens public health, the region is expected to experience waves of pandemic flu and communicable disease outbreak in the future.

RADON EXPOSURE

Radon is a colorless, odorless naturally-occurring gas that forms by the radioactive decay of uranium, thorium, or radium, found in certain types of rocks, soil, and groundwater. Radon is found naturally in the atmosphere in trace amounts, where it disperses rapidly and is generally not a health issue. Radon exposure becomes dangerous in confined areas, where the gas can accumulate, and the inert gas can be inhaled into the lungs where it adheres to lung tissue.

Under the earth's surface, radon may be transported as a soil gas or dissolved in ground water. It can enter a building via cracks in solid floors, construction joints, cracks in walls, gaps in suspended floors, gaps around service pipes and drains, cavities inside walls or through the water supply. Well water used for bathing or washing can potentially carry radon, especially if faucets are aerated. Due to less ventilation, radon concentrations in buildings are typically higher in the winter. Any home, school or workplace may have a radon problem, whether it is new or old, well-sealed or drafty, or with or without a basement. The U.S. Environmental Protection Agency (EPA) estimates that nearly one out of every 15 homes in the U.S. is estimated to have elevated annual average levels of indoor radon,[15] and that nearly one in five schoolrooms has a short-term radon level above the actionable level.[16]

The concentration of radon in buildings is highly variable and is based on the underlying rocks or sediments, weather and construction methods. The amount of radon emitted by a particular soil is controlled by the underlying rock type, the concentration of uranium, thorium, or radium in the rock or sediment, and the permeability of the rock, sediment and soil. [17]

The EPA recommends taking action to reduce radon in homes, schools or other buildings that have a radon level at or above 4 picocuries per liter (pCi/L) of air (a "picocurie" is a common unit for measuring the amount of radioactivity). That level of risk is more than 10 times the average outdoor level, more than receiving the equivalent radiation of 200 chest x-rays per year, and almost five times the average non-smoker's risk. A radon level of 40 pCi/L is more than the risk of a 2 pack-a-day smoker.

IMPACTS

The EPA indicates that radon is estimated to cause about 21,000 lung cancer deaths per year in the United States.[18] When a person breathes in radon, radioactive particles from radon gas can get trapped in the lungs, emitting radiation. Over time, these radioactive particles increase the risk of lung cancer. People who smoke and are exposed to radon are at a greater risk of developing lung cancer. Damage may be undetected for years before health problems appear.
The chances of getting lung cancer from radon depend primarily on:

- How much radon is in one's home–the location where you spend most of your time (e.g., the main living and sleeping areas);
- The amount of time spent in the home;
- Whether one is a smoker or has ever smoked;
- Whether one burns wood, coal, or other substances that add particles to the indoor air; and
- Combinations of these factors that multiply the impacts.

Lung cancer may start with a nagging cough, shortness of breath or wheezing. Other symptoms such as coughing up blood, chest pain or weight loss may also present. There are no medical tests to test the

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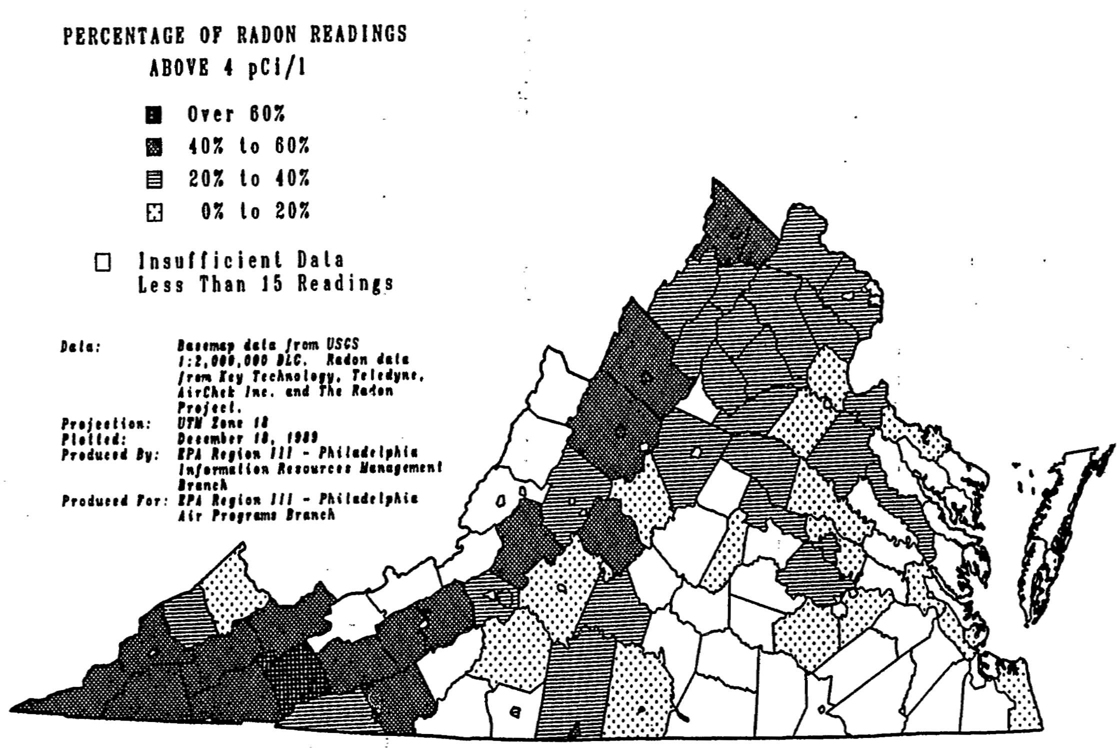
[15] *EPA's Map of Radon Zones, Virginia.* Radon Division, Office of Radiation and Indoor Air, September, 1993.
[16] EPA Radon in Schools, accessed 4/23/21 online at: https://www.epa.gov/radon/radon-schools
[17] Born, Rebecca Skye. *Radon in Yorktown Formation Sediments and Petersburg Granite, Eastern Virginia.* Undergraduate Thesis, College of William & Mary, April 1994.
[18] EPA, *A Citizen's Guide to Radon: The Guide to Protecting Yourself and Your Family from Radon,* EPA 402/K-12/002, 2016.

body for radon exposure, but doctors can check for signs of lung cancer and homes can be easily tested for radon levels.

SIGNIFICANT HISTORICAL EVENTS

Radon exposure from ground sources happens over a long period of time, often remaining undetected, thus historical "events" are rarely quantifiable. Section 307 and 209 of the 1988 Indoor Radon Abatement Act directed the EPA to identify areas of the United States that have the potential to produce elevated levels of radon. As part of this study, two data sources were analyzed in Virginia: 1) indoor radon data from 1,156 random homes were sampled in the winter of 1991-1992 (results shown in **Table 4.24**); and 2) non-random commercial data compiled by EPA Region 3 were examined as shown in **Figure 4.34**.

FIGURE 4.34: VENDOR SCREENING, INDOOR RADON DATA FOR VIRGINIA



1993

Source: EPA's Map of Radon Zones, Virginia. Radon Division, Office of Radiation and Indoor Air, September, 1993.

TABLE 4.24: SCREENING INDOOR RADON DATA								
	EPA 1991-1992, Residential				Alpha Energy Laboratories January 2001 to June 2020			
Jurisdiction	**Number of Tests**	**Mean (pCi/L)**	**% >4 pCi/L**	**%>20 pCi/L**	**Number of Tests**	**Mean (pCi/L)**	**% >4 pCi/L**	**%>10 pCi/L**
Hampton	7	0.3	0	0	38	1.97	10.5	5.2
Newport News	13	0.7	0	0	153	1.32	3.9	0
Poquoson	1	0.4	0	0	6	1.00	0	0
Williamsburg	1	1.0	0	0	30	2.29	10.0	3.3
James City County	1	1.0	0	0	614	3.59	27.0	5.2
York County	3	0.6	0	0	55	1.32	1.8	1.8
Norfolk	14	0.8	0	0	136	1.24	1.5	1.5
Portsmouth	6	0.4	0	0	35	0.97	0	0
Suffolk	3	0.1	0	0	58	0.99	0	0
Virginia Beach	39	0.5	3	0	236	1.22	2.1	1.3
Chesapeake	23	0.3	0	0	106	0.96	0.9	0
Isle of Wight County	1	0.9	0	0	20	1.56	10.0	0
Franklin	No data	No data	No data	No data	6	0.83	0	0
Southampton County	2	0.5	0	0	14	0.99	0	0
Surry County	1	0.6	0	0	5	1.00	0	0

Source: EPA's Map of Radon Zones, Virginia. Radon Division, Office of Radiation and Indoor Air, September, 1993.

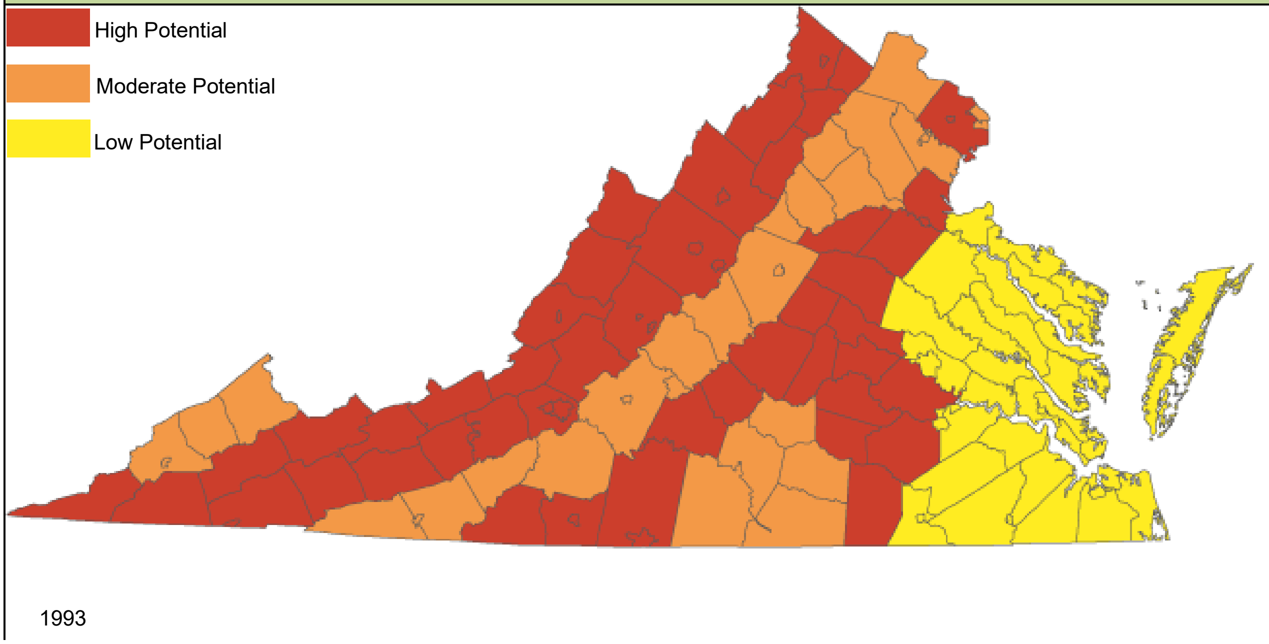
Source: Non-random test results by private business, accessed 2021 online: https://getresults.doctorhomeair.com/fmi/webd/Alpha_ResultsInArea

LOCATION AND SPATIAL EXTENT

The types and distribution of lithologic units and other geologic features in an assessment area are of primary importance in determining radon potential. Rock types that are most likely to cause indoor radon problems include carbonaceous black shales, glauconite bearing sandstones, certain kinds of fluvial sandstones and fluvial sediments, phosphorites, chalk, karst-producing carbonate rocks, certain kinds of glacial deposits, bauxite, uranium-rich granitic rocks, metamorphic rocks of granitic composition, silica-rich volcanic rocks, many sheared or faulted rocks, some coals, and certain kinds of contact metamorphosed rocks. Rock types least likely to cause radon problems include marine quartz sands, non carbonaceous shales and siltstones, certain kinds of clays, silica-poor metamorphic and igneous rocks, and basalts. Uranium and radium are commonly found in heavy minerals, iron-oxide coatings on rock and soil grains, and organic materials in soils and sediments. Less common are uranium associated with phosphate and carbonate complexes in rocks and soils, and uranium minerals.

Figure 4.35 provides the EPA's map of Radon Zones for Virginia, released in 1993. The map is based on an assessment of five factors that are known to be important indicators of radon potential: indoor radon measurements, geology, aerial radioactivity, soil parameters and foundation types.

FIGURE 4.35: U.S. EPA MAP OF RADON ZONES IN VIRGINIA

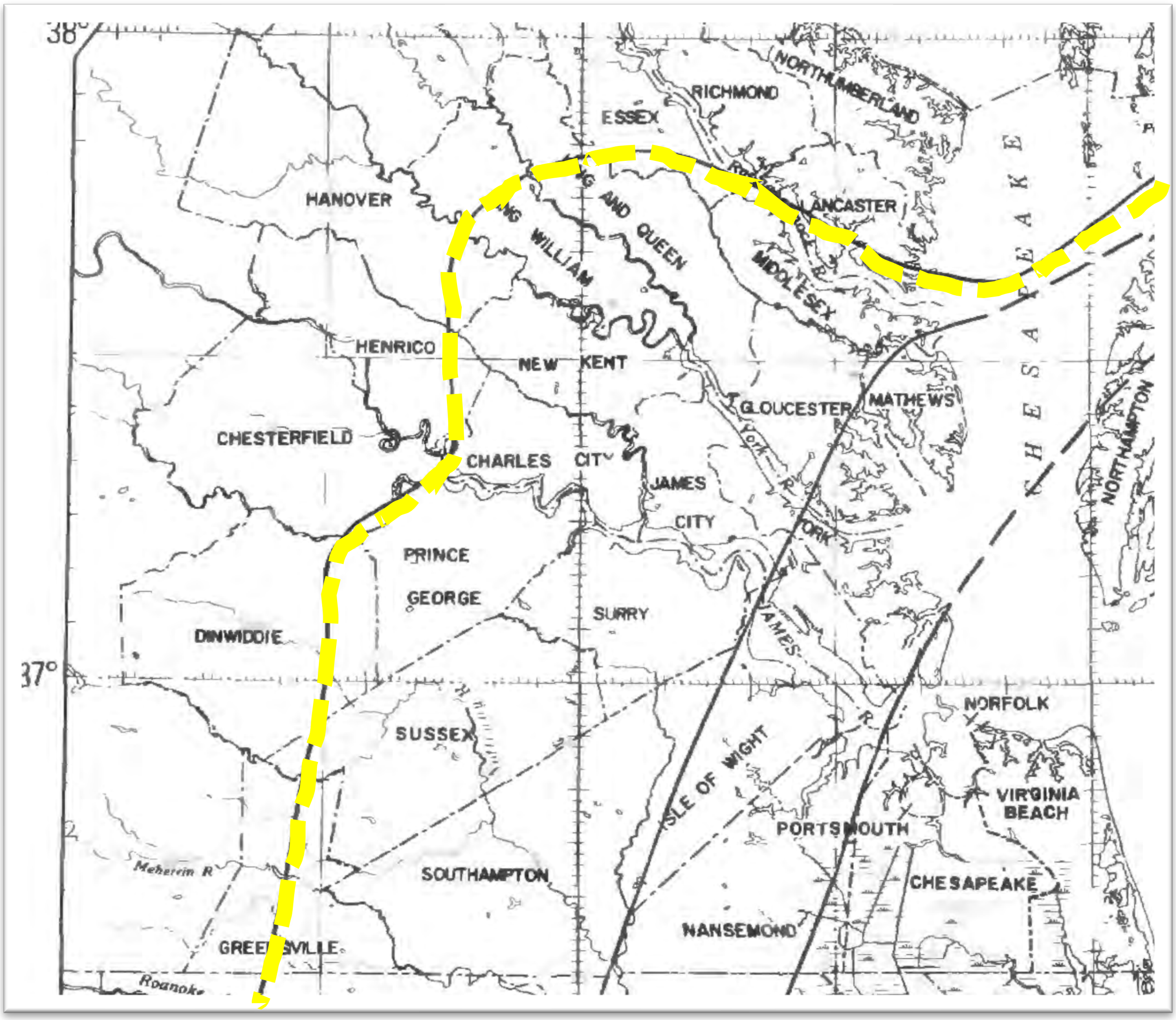


Source: Virginia Department of Energy, as modified from US EPA's Map of Radon Zones, Virginia. Radon Division, Office of Radiation and Indoor Air, September, 1993.

The Coastal Plain of Virginia (see Figure 3.2), includes all of the communities in Hampton Roads and is ranked low in geologic radon potential. In general, the upper Tertiary to Quaternary-aged sediments of the Coastal Plain have low radon potential. However, recent studies of radon potential in the sediments and marine fossils of the Yorktown Formation, a 4 to 5 million-year-old widespread geological unit in the Coastal Plain, could be a source for elevated levels of indoor radon. The Yorktown Formation is a marine unit, meaning the sediments that it is made of were once deposited underwater when sea-level was much higher than it is today (see **Figure 4.36**). It is characterized by shelly, sometimes diatomaceous, locally phosphatic, quartz sand, silt and clay.[19] As a marine unit, it holds whale bones, in particular, that are mixed into the sand/clays. The bones that accumulate in the Yorktown Formation are perhaps able to enrich themselves under certain geochemical conditions with heavy metals that might be in the water. And the high permeability of the sediments allows for radon movement and dispersion. These hypotheses are part of ongoing research at the College of William and Mary.[20] Future updates to this plan should include results of such research, particularly if the findings point to changes in the relative vulnerability presented in Figure 4.35 above.

[19] *US EPA's Map of Radon Zones, Virginia.* Radon Division, Office of Radiation and Indoor Air, September, 1993.
[20] Email exchanges with Anne Witt, Geohazards Specialist, Virginia Department of Mines, Minerals and Energy, Spring 2021.

FIGURE 4.36: WESTERNMOST EXTENT OF THE YORKTOWN FORMATION (YELLOW LINE)



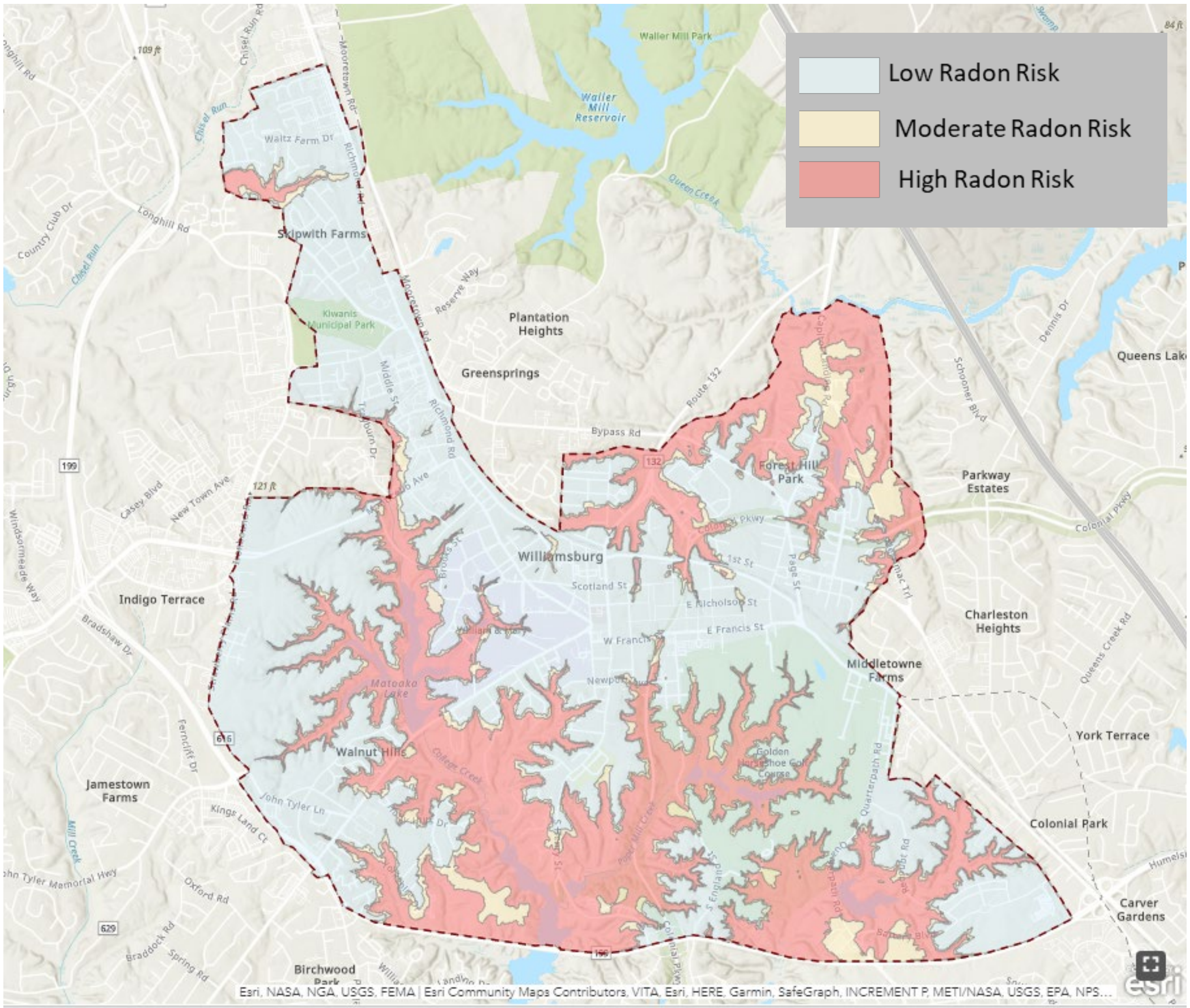
1980

Source: Ward, Lauck W. and Blake W. Blackwelder. Stratigraphic Revision of Upper Miocene and Lower Pliocene Beds of the Chesapeake Group, Middle Atlantic Coastal Plain. Geological Survey Bulletin 1482-D, U.S. Department of the Interior, 1980.

Further analysis by researchers in the Department of Geology at William & Mary has led to the creation of a more detailed map of Williamsburg and the relative radon risk for that community. According to their research, homes built within and slightly above Yorktown sediments may have higher radon levels. In Williamsburg, homes built on ground with adjacent elevations less than 58 feet are predicted to have the highest risk.[21] **Figure 4.37** shows the relative radon risk in Williamsburg.

[21] Berquist, Rick, Jim Kaste, Dorian Miller. ArcGIS Storymap online at: https://storymaps.arcgis.com/stories/10f6d3d7c0014a1087fe3ef14f306520

FIGURE 4.37: RADON RISK IN WILLIAMSBURG



2021

Source: Berquist, Rick, Jim Kaste, Dorian Miller. ArcGIS Storymap online at: https://storymaps.arcgis.com/stories/10f6d3d7c0014a1087fe3ef14f306520

In 1994, an undergraduate student at the College of William & Mary studied radon emittance from the Yorktown Formation[22]. The Yorktown Formation was selected for her study as a possible source of radon because the fossilized bones in the sediments contain uranium-238, a radioactive element that decays to form radon gas. The researcher installed alpha-track radon detectors to determine concentrations of the gas being emitted as a decay product at two sites in the College Woods neighborhood. While the purpose of the study was statistical analysis of the results against previous tests of radon in the Yorktown Formation, the student found that the radon concentrations remained high and are statistically equivalent to other research.

[22] Born, Rebecca Skye. *Radon in Yorktown Formation Sediments and Petersburg Granite, Eastern Virginia.* Undergraduate Thesis, College of William & Mary, April 1994.

VULNERABILITY ASSESSMENT

Contents

2022 UPDATE

Each of the hazards was reviewed and updated to reflect both the revised information obtained for the updated *Hazard Identification and Analysis* section and the most recent modeling and data collection, primarily for flood. Discussion of vulnerability to Sea Level Rise and Land Subsidence has been updated using the region's most well-regarded sources. All hazard names were edited to provide consistency with the *Hazard Identification and Analysis*. Tables were updated to include new data, where available. The hazards were reranked according to new feedback from the committee and to reflect the new color-coded, matrix-based ranking system that graphically demonstrates likelihood versus consequence. The tables at the end of the section regarding Conclusions on Hazard Risk were all updated. Figures were updated to reflect current conditions. In addition, each hazard was assessed for two new components of risk: social vulnerability and the impacts of climate change.

INTRODUCTION

The *Vulnerability Assessment* section builds on the information provided in the *Hazard Identification and Analysis* section by identifying community assets and development trends in the region, then assessing the potential impact and amount of damage (loss of life and/or property) that could be caused by each hazard event addressed in the risk assessment. The primary objective of this level of vulnerability assessment is to prioritize hazards of concern to the region, adding to the foundation for mitigation strategy and policy development. Consistent with the preceding sections, the following hazards are addressed in this assessment:

- FLOODING
- FLOODING DUE TO IMPOUNDMENT FAILURE/HIGH HAZARD DAM
- SEA LEVEL RISE AND LAND SUBSIDENCE
- TROPICAL/COASTAL STORM
- LANDSLIDE/COASTAL EROSION
- TORNADO
- WINTER STORM
- EARTHQUAKE
- WILDFIRE
- DROUGHT
- EXTREME HEAT
- HAZARDOUS MATERIALS INCIDENT
- PANDEMIC FLU OR COMMUNICABLE DISEASE
- RADON EXPOSURE

To complete the vulnerability assessment, best available data were collected from a variety of sources, including local, state and federal agencies, and multiple analyses were applied through qualitative and quantitative means (further described below). Additional work will be done on an ongoing basis to enhance, expand, and further improve the accuracy of the baseline results, and it is expected that this vulnerability assessment will continue to be refined through future plan updates as new data and loss estimation methods become available.

The findings presented in this section with regard to vulnerability were developed using best available data, and the methods applied have resulted in an approximation of risk. These estimates should be used to understand relative hazard risk and the potential losses that may be incurred; however, uncertainties are inherent in any loss estimation methodology, arising from incomplete knowledge concerning specific hazards and their effect on the built environment, as well as incomplete data sets and from approximations and simplifications that are necessary in order to provide a meaningful analysis. Further, most data sets contain relatively short periods of record which increases the uncertainty of any statistically-based analysis.

METHODOLOGIES USED

Two distinct risk assessment methodologies were used in the formation of this vulnerability assessment. The first consists of a ***quantitative*** analysis that relies upon best available data and technology, while the second approach consists of a somewhat ***qualitative*** analysis that relies on the local knowledge and rational decision making skills of local officials. Upon completion, the methods are combined to create a "hybrid" approach for assessing hazard vulnerability for the region that allows for some degree of quality control and assurance. The methodologies are briefly described and introduced here and are further illustrated throughout this section.

QUANTITATIVE METHODOLOGY

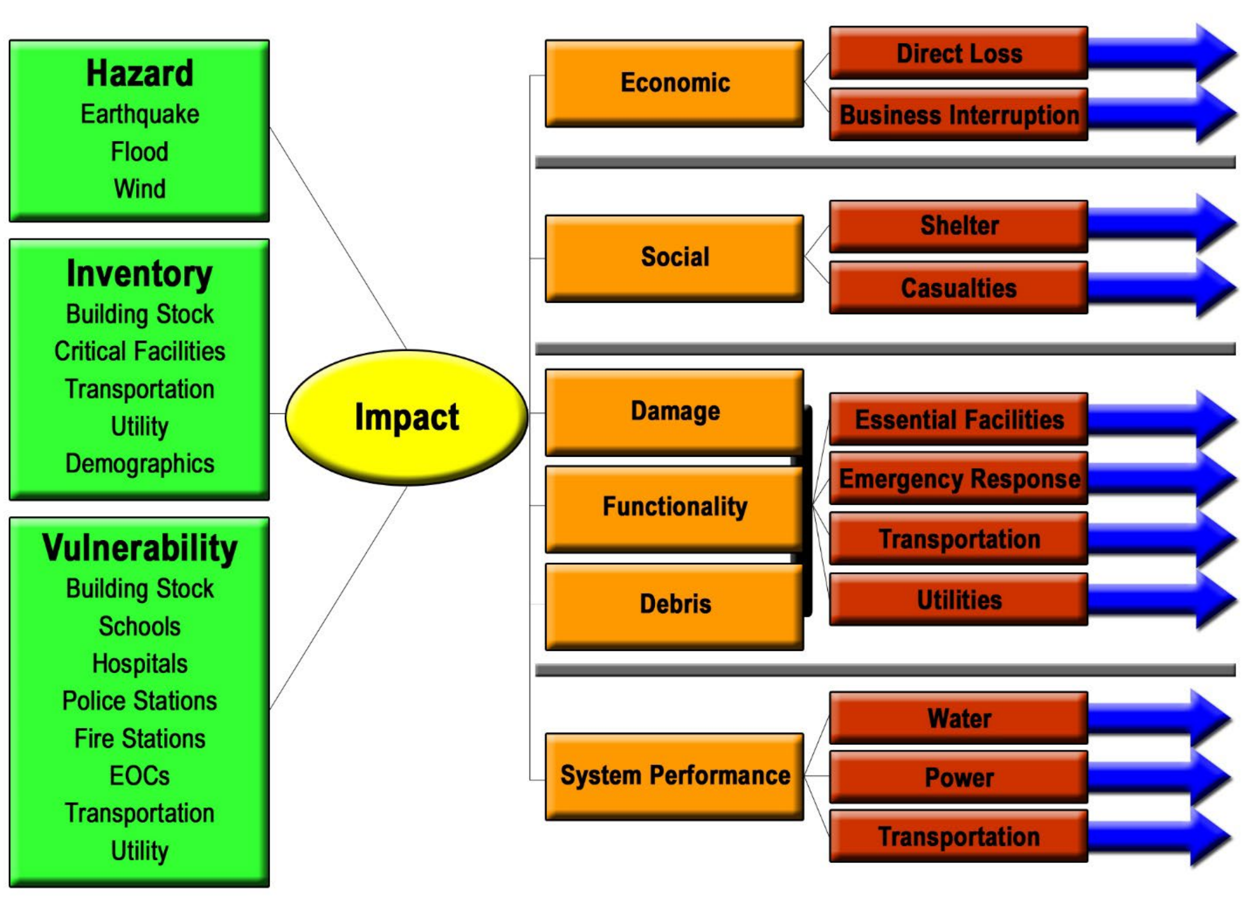
The quantitative assessment involved the use of the most recent version of Hazards U.S. Multi-Hazard (Hazus) software, a geographic information system (GIS)-based loss estimation tool available from FEMA, along with a statistical risk assessment methodology for hazards outside the scope of Hazus. For the flood hazard, the quantitative assessment incorporates a detailed GIS-based approach. When combined, the results of these vulnerability studies are used to form an assessment of potential hazard losses (in dollars) along with the identification of specific community assets that are deemed at-risk.

Explanation of Hazus and Statistical Risk Assessment Methodology

Hazus is FEMA's standardized loss estimation software package, built on an integrated GIS platform using a national inventory of baseline geographic data (including information on the region's general building stock and dollar exposure). Originally designed for the analysis of earthquake risks, FEMA expanded the program in 2003 to allow for the analysis of multiple hazards: namely the flood and wind (hurricane wind) hazards. By providing estimates on potential losses, Hazus facilitates quantitative comparisons between hazards and assists in the prioritization of hazard mitigation activities.

Hazus uses a statistical approach and mathematical modeling of risk to predict a hazard's frequency of occurrence and estimated impacts based on recorded or historic damage information. The Hazus risk assessment methodology is parametric, in that distinct hazard and inventory parameters—such as wind speed and building type—were modeled using the Hazus software to determine the impact on the built environment. **Figure 5.1** shows a conceptual model of Hazus methodology. More information on Hazus loss estimation methodology is available through FEMA at www.fema.gov/hazus.

FIGURE 5.1: CONCEPTUAL MODEL OF HAZUS METHODOLOGY



Source: FEMA

This risk assessment used Hazus to produce regional profiles and estimated losses for three of the hazards addressed in this section: flooding, tropical/coastal storm winds, and earthquake. For each of these hazards, Hazus was used to generate probabilistic "worst case scenario" events to show the extent of potential damages. Both earthquake and wind were modeled using Hazus Level 1 and flood was modeled using Hazus Level 2.

Explanation of GIS-based (Non-HAZUSMH) Risk Assessment Methodology

For hazards outside the scope of Hazus, a statistical risk assessment methodology was designed and in previous plans, this method was applied to generate potential loss estimates. The approach was based on the same principles as Hazus, but did not rely on readily available automated software. Historical data were compiled for each hazard to relate occurrence patterns with existing hazard models. Statistical evaluations were then applied to generate annualized losses.

The use of the statistical risk assessment methodology was used in previous plans to provide a determination of estimated annualized loss[1] for several hazards. However, in recent years, the historical data from which these conclusions were made have become less reliable. For example, damages for wildfire were not reported for two recent reporting periods, and the communities reviewing the historical damage data from the NCEI expressed concern that the damages were severely underestimated. Until

[1] By annualizing estimated losses, the historic patterns of frequent smaller events are coupled with infrequent but larger events to provide a balanced presentation of the long-term risk.

more reliable historical damage data can be provided, planners determined that a qualitative methodology for examining historical losses and making conclusions about future risk was needed as shown below to supplement the quantitative analysis.

Despite the shortcomings of certain historical data, this analysis included collection of and updates to relevant GIS data from local, state and national sources. These sources include each community's GIS department, FEMA, VDOF, and NOAA. Once all data were acquired, GIS was used to demonstrate and spatially analyze risks to people, public buildings and infrastructure. Primary data layers included geo-referenced point locations for public buildings, critical facilities, and infrastructure elements. Using these data layers, risk was assessed and described by determining the parcels and/or point locations that intersected with the delineated hazard areas.

QUALITATIVE METHODOLOGY

The qualitative assessment relies less on technology and more on historical and anecdotal data, community input, and professional judgment regarding expected hazard impacts. The group used a scoring matrix to summarize risk by placing each hazard in a color-coded graph that ranks hazards individually by consequence on the y-axis and likelihood on the x-axis. Risk level ranking was based on historical and anecdotal data, as well as input from committee members. This ranking was done collaboratively in Workshop #1 for each hazard; results are found at the end of this section.

While the quantitative assessment focuses on using best available data, computer models and GIS technology, this qualitative ranking system relies more on historical data, local knowledge, and the general consensus of the planning committee. The results allow identified hazards to be ranked against one another.

SOCIAL VULNERABILITY ANALYSIS

The National Risk Index (NRI) is a relatively new dataset and online application from FEMA that identifies communities most at risk to various natural hazards. For each of the 18 natural hazards explored in the NRI, risk is calculated by multiplying each hazard's expected annual losses by social vulnerability (a consequence enhancing component of risk that measures the susceptibility of social groups to the adverse impacts of natural hazards) and dividing by community resilience (a consequence reduction component of risk that measures the ability of a community to plan for, absorb, recover from and adapt to the impacts of hazards). In other words:

Risk = Expected Annual Loss x Social Vulnerability x (1/Community Resilience)

In the risk equation, each component is represented by a unitless index score that depicts a community's score relative to all other communities at the same level. The Risk Index score is a unitless index and represents a community's relative risk in comparison to all other communities at the same level. All calculations are performed separately at two levels—County and Census tract—so scores are relative only within their level. It must be stressed that scores are relative, representing a community's relative position among all other communities for a given component and level. Scores are not absolute measurements and should be expected to change over time either by their own changing measurements or changes in other communities.

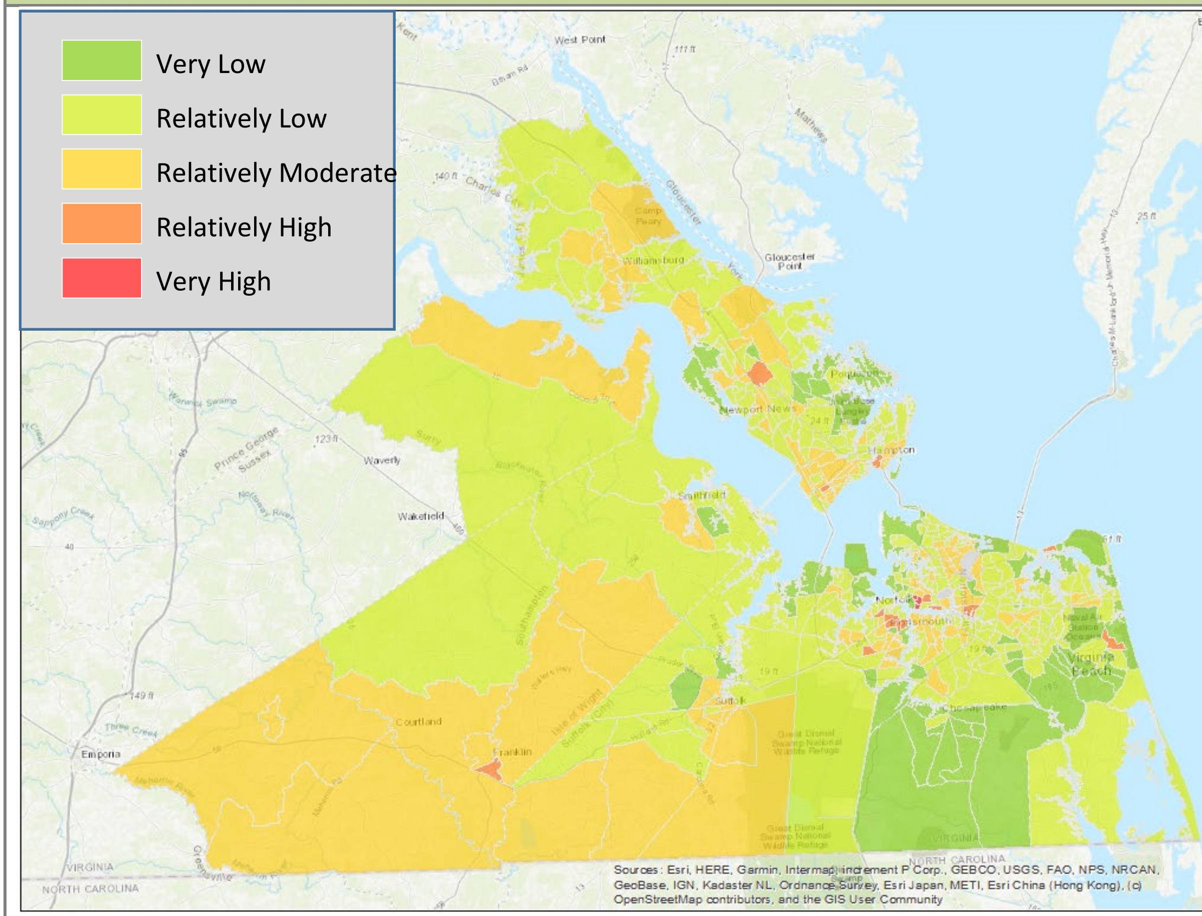
For every score, there is also a qualitative rating that describes the nature of a community's score in comparison to all other communities at the same level, ranging from “Very Low” to “Very High.” Because all ratings are relative, there are no specific numeric values that determine the rating. For example, a community's Risk Index score for a single hazard could be 8.9 with a rating of “Relatively Low,” but its Social Vulnerability score may be 11.3 with a rating of “Very Low.” The rating is intended to classify a community for a specific component in relation to all other communities at the same level.

Source data for the social vulnerability component are derived from the University of South Carolina's Hazards and Vulnerability Research Institute (HVRI) Social Vulnerability Index (SoVI). SoVI is a location-specific assessment of social vulnerability that utilizes 29 socioeconomic variables that contribute to a community's reduced ability to prepare for, respond to, and recover from hazards:

Median gross rent for renter-occupied housing units
Median age
Median dollar value of owner-occupied housing units
Per capita income
Average number of people per household
% population under 5 years or age 65 and over
% civilian labor force unemployed
% population over 25 with <12 years of education
% children living in married couple families
% female
% female participation in the labor force
% households receiving Social Security benefits
% unoccupied housing units
% families with female-headed households with no spouse present
% population speaking English as second language (with limited English proficiency)
% Asian population
% African American (Black) population
% Hispanic population
% population living in mobile homes
% Native American population
% housing units with no car available
% population living in nursing facilities
% persons living in poverty
% renter-occupied housing units
% families earning more than $200,000 income per year
% employment in service occupations
% employment in extractive industries (e.g., farming)
% population without health insurance (County SoVI only)
Community hospitals per capita (County SoVI only)

Figure 5.2 maps the foundational social vulnerability using the factors above, without analysis of resilience or loss data for a particular hazard. This map is used to interpret social vulnerability for hazards not specifically addressed in the NRI such as Flooding Due to Impoundment Failure/High Hazard Dam. The map data are also used to rate mitigation actions for those hazards. This plan uses the full NRI dataset to produce maps of relative social vulnerability to several of the prominent natural hazards, including: flooding, tropical/coastal storms, and tornadoes.

FIGURE 5.2: RELATIVE SOCIAL VULNERABILITY IN THE STUDY AREA



2021

Source: FEMA and SoVI, 2021

SUMMARY

Using both the qualitative and quantitative analyses to evaluate the hazards that impact the region provided planning committee members with a dual-faceted review of the hazards. This allowed officials to recognize those hazards that may potentially be costly, but also to plan and prepare for hazards that may not cause much monetary damage, but could put a strain on the local resources needed to recover.

All conclusions of the vulnerability assessment completed for the region are presented in “Conclusions on Hazard Risk” at the end of this section. Qualitative findings for each hazard are detailed in the hazard-by-hazard vulnerability assessment that follows, beginning with an overview of general asset inventory and exposure data for each jurisdiction.

OVERVIEW OF VULNERABILITY

GENERAL ASSET INVENTORY

The total dollar exposure of buildings within the study area is estimated to be over $204 billion. This figure is based on an estimated 560,000 buildings located throughout the region based on the HAZUS default inventory (**Table 5.1**). The data provide an estimate of the aggregated replacement value for the region's assets and indicate that at least 60 percent of the structures are of wood construction.

TABLE 5.1: EXPOSURE OF THE BUILT ENVIRONMENT

SUBREGION	COMMUNITY	BUILDING INVENTORY BY TYPE OF CONSTRUCTION			
		WOOD	MANUFACTURED HOMES	MASONRY, CONCRETE, STEEL	TOTAL
Peninsula	Hampton	$9,758,587,000	$40,526,000	$6,003,186,000	$15,802,299,000
	Newport News	$12,425,313,000	$109,107,000	$8,710,073,000	$21,244,493,000
	Poquoson	$1,220,563,000	$8,625,000	$527,619,000	$1,756,807,000
	Williamsburg	$975,728,000	$0	$1,044,932,000	$2,020,660,000
	James City County	$7,292,959,000	$71,375,000	$3,881,678,000	$11,246,012,000
	York County	$6,449,455,000	$18,669,000	$3,220,222,000	$9,688,346,000
Southside	Norfolk	$14,517,438,000	$33,010,000	$14,710,171,000	$29,260,619,000
	Portsmouth	$6,019,526,000	$16,861,000	$3,927,817,000	$9,964,204,000
	Suffolk	$6,570,498,000	$55,335,000	$3,526,244,000	$10,152,077,000
	Virginia Beach	$36,520,390,000	$89,026,000	$20,584,308,000	$57,193,724,000
	Chesapeake	$17,861,554,000	$106,931,000	$9,915,247,000	$27,883,732,000
Western Tidewater	Isle of Wight County	$2,857,414,000	$95,999,000	$1,611,477,000	$4,564,890,000
	Franklin	$525,235,000	$0	$422,564,000	$947,799,000
	Southampton County	$1,138,139,000	$57,923,000	$687,433,000	$1,883,495,000
	Surry County	$509,304,000	$26,917,000	$259,858,000	$796,079,000
TOTAL		**$124,642,103,000**	**$730,304,000**	**$79,032,829,000**	**$204,405,236,000**

Source: Hazus

ESSENTIAL FACILITIES

There is no universally accepted definition of what constitutes essential facilities and infrastructure, nor is one associated with FEMA and DMA 2000 planning requirements. However, for purposes of this Plan, essential facilities and infrastructure are identified as "*those facilities or systems whose incapacity or destruction would present an immediate threat to life, public health, and safety or have a debilitating effect on the economic security of the region*." The data source for this update was Hazus, which provides a consistent set of facility types across the study area, and is publicly accessible. This typically includes the following facilities and systems based on their high relative importance for the delivery of vital services, the protection of special populations, and other important functions in the region:

- Emergency Operations Center (EOC)
- Hospital and medical care facilities
- Police stations and fire stations
- Public schools designated as shelters
- Hazardous materials facilities
- Water (and wastewater) facilities
- Energy facilities (electric, oil and natural gas)
- Communication facilities

Table 5.2 shows the results of an overlay analysis of the essential facilities that are located in the 100-year floodplain, 500-year floodplain, and the Storm Surge Zone for a Category 3 hurricane. Many of these facilities are addressed in the Mitigation Action Plan, through targeted mitigation actions, or more generalized actions calling for additional study and analysis of the building plans and future vulnerability of these facilities.

TABLE 5.2: CRITICAL FACILITIES LOCATED IN HAZARD AREAS

SUBREGION	COMMUNITY	FLOOD WAY	100-YEAR FLOODPLAIN	500-YEAR FLOODPLAIN	STORM SURGE ZONE
Peninsula	Hampton		4 fire (inc. 2 LAFB), 5 schools	EOC, 3 fire (inc. 1 FMA), 1 police, 8 schools	17 hazmat, 2 EOCs, 14 fire (inc. LAFB & FMA), 3 medical, 6 police, 54 schools (inc. LAFB)
	Newport News		2 hazmat, 1 fire (Eustis)	2 medical, 1 school	16 hazmat, 4 fire (inc. Eustis), 2 medical, 2 police, 17 schools
	Poquoson		EOC, 1 fire, 1 police, 1 school	1 fire, 1 school	EOC, 2 fire, 1 police, 4 schools
	York County		1 fire		28 hazmat, 2 fire, 1 school
Southside	Norfolk		10 hazmat, 2 fire, 6 schools	4 fire, 2 medical, 4 police, 14 schools	30 hazmat, EOC, 20 fire, 8 medical, 9 police, 103 schools
	Portsmouth		EOC, 14 hazmat, 2 fire, 2 police	1 hazmat, 1 fire, 1 medical, 4 schools	15 hazmat, EOC, 9 fire, 2 medical, 2 police, 39 schools
	Suffolk				9 hazmat, 1 fire, 1 medical, 8 schools
	Virginia Beach		2 fire	4 schools	3 hazmat, EOC, 21 fire (inc. Ft Story), 1 medical, 4 police, 117 schools
	Chesapeake		29 hazmat, 3 fire, 4 schools	4 hazmat, 5 schools	59 hazmat, EOC, 10 fire, 5 police, 52 schools
	Franklin	22 hazmat	34 hazmat, 1 fire		
	Southampton County	EOC, 1 police			
	Town of Courtland		EOC, 1 police	4 hazmat, 1 police, 1 school	
REGION TOTAL		**24**	**129**	**68**	**537**

FLOODING

The vulnerability assessment for the flood hazard includes the findings of the qualitative assessment conducted, an overview of NFIP statistics, repetitive loss properties (as defined and identified by the NFIP), estimates of potential losses, and future vulnerability.

As described in detail in the *Hazard Identification and Analysis* section, the NCEI has records for 87 significant flood events in the past 25 years (1995 to 2020) for the region, amounting to approximately $190 million in reported property damage. Also discussed in the *Hazard Identification and Analysis* are historic storms such as Hurricanes Isabel, Floyd and the 1933 hurricane that each caused notable flooding in the region. Historically, Hampton Roads is vulnerable to the flood hazard and flood events, which occur on a frequent basis.

NFIP STATISTICS AND REPETITIVE LOSS PROPERTIES

Table 5.3 provides basic background information regarding the communities in the study area that participate in the NFIP. As shown in Table 5.3, the communities in the Hampton Roads region joined the NFIP throughout the 1970s, 1980s and into the 1990s. In order to join the NFIP, each participating jurisdiction is required to adopt and enforce its own floodplain management ordinance. As a result, structures built after joining the NFIP are assumed to be less vulnerable to flood hazards than those built prior to joining, assuming other environmental conditions remain constant.

The towns of Capron, Dendron and Newsoms do not participate in the NFIP. The Town of Capron, in Southampton County, is located approximately 2 miles from the nearest SFHA of Three Creek. The southern and eastern parts of the Town of Dendron in Surry County are mapped SFHA; however, the town was suspended from the NFIP in December, 1992. Upon closer examination in the VFRIS, there do not appear to be any structures in the SFHA of Dendron. Although a very small portion of Newsoms is mapped in the SFHA, town leadership has chosen not to participate in the NFIP despite numerous entreaties from State officials since the original Flood Hazard Boundary Map for the area was issued in 1977. Using VFRIS, there appears to be one structure in the SFHA of Darden Mill Run, near Old Chapel Road.

TABLE 5.3: NFIP DATA FOR PARTICIPATING COMMUNITIES			
SUBREGION	COMMUNITY	NFIP ENTRY DATE	CURRENT EFFECTIVE FIRM DATE
Peninsula	Hampton	1/15/1971	5/16/16
	Newport News	5/2/1977	12/9/2014
	Poquoson	5/16/1977	12/16/2014
	Williamsburg	11/20/1981	12/16/15
	James City County	2/6/1991	12/16/2015
	York County	12/16/1988	1/16/2015
Southside	Norfolk	8/1/1979	12/17/17
	Portsmouth	7/2/1971	8/3/2015
	Suffolk	11/16/1990	8/3/2015
	Virginia Beach	4/23/1971	1/16/2015
	Chesapeake	2/2/1977	12/16/2014
Western Tidewater	Isle of Wight County	8/19/1991	12/2/2015
	Smithfield	12/5/1990	12/2/2015
	Windsor	8/1/1990	12/2/15
	Franklin	8/15/1980	9/4/2002
	Southampton County	12/15/1982	9/4/2002
	Boykins	4/1/1982	9/4/2002
	Branchville	3/30/1979	9/4/2002
	Courtland	7/5/1982	9/4/2002
	Ivor	11/4/2002	No special flood hazard area identified
	Surry County	11/02/1990	05/04/2015
	Claremont	10/16/1990	05/04/2015

Source: NFIP Community Status Book, May 19, 2021

Table 5.4 provides more detailed information on the number of flood insurance policies and the value of those policies for NFIP-participating communities in the study area, as well as the change in policy number and coverage since 2015.

TABLE 5.4: NFIP POLICY DATA FOR PARTICIPATING COMMUNITIES

SUBREGION	COMMUNITY	POLICIES IN FORCE 2015	POLICIES IN FORCE 2021 (PERCENT CHANGE)	INSURANCE IN FORCE 2015	INSURANCE IN FORCE 2021 (PERCENT CHANGE)	TOTAL CLAIMS 1978-2021	TOTAL CLAIM PAYMENTS 1978-2021
Peninsula	Hampton	11,076	9,972 (-10%)	$2,752,401,900	$2,646,416,900 (-4%)	5,775	$74,750,291
	Newport News	2,515	1,853 (-26%)	$627,732,100	$518,802,300 (-17%)	1,026	$23,139,496
	Poquoson	3,310	3,168 (-4%)	$877,069,600	$886,785,200 (1%)	4,217	$71,678,445
	Williamsburg	47	41 (-13%)	$11,971,100	$12,761,400 (7%)	18	$118,850
	James City County	1,006	960 (-5%)	$275,598,300	$282,972,600 (3%)	359	$6,310,238
	York County	3,394	3,134 (-8%)	$980,284,400	$945,982,400 (-3%)	1,567	$33,851,809
Southside	Norfolk	12,324	11,804 (-4%)	$3,203,123,000	$3,282,155,900 (2%)	5,962	$68,344,791
	Portsmouth	3,618	3,935 (9%)	$884,828,100	$999,844,500 (13%)	1,704	$19,769,707
	Suffolk	943	1,002 (6%)	$280,794,800	$316,318,300 (13%)	223	$5,069,727
	Virginia Beach	24,200	23,636 (-2%)	$6,453,533,800	$6,776,920,000 (5%)	6,182	$103,426,658
	Chesapeake	8,841	8,714 (-1%)	$2,383,084,100	$2,511,538,200 (5%)	2,570	$27,028,316
Western Tidewater	Isle of Wight County	397	323 (-19%)	$116,904,100	$100,242,300 (-14%)	149	$4,724,311
	Smithfield	108	85 (-21%)	$32,979,900	$26,319,200 (-20%)	42	$608,217
	Windsor	6	6 (0%)	$1,204,000	$1,715,000 (42%)	0	$0
	Franklin	148	106 (-28%)	$39,465,400	$31,938,100 (-19%)	103	$5,312,419
	Southampton County	127	126 (-1%)	$26,582,600	$27,916,700 (5%)	78	$2,974,777
	Boykins	7	6 (-14%)	$1,901,500	$1,723,800 (-9%)	0	$0
	Branchville	0	0 (0%)	$0	$0 (0%)	0	$0
	Courtland	20	23 (15%)	$5,822,600	$7,828, 800 (34%)	5	$39,366
	Ivor	1	0 (-100%)	$350,000	$0 (-100%)	0	$0
	Surry County	25	27 (8%)	$7,135,400	$7,651,000 (7%)	45	$1,488,980
	Claremont	16	18 (13%)	$4,319,800	$4,279,900 (-1)%	38	$1,273,693

Source: NFIP data dated April 30, 2015 and April 13, 2021.

Reducing the number of repetitive loss (RL) properties insured by the NFIP is a nationwide emphasis of FEMA. The NFIP defines an RL as any insurable building for which two or more claims of more than $1,000 were paid by the NFIP within any rolling 10-year period, since 1978.[2] A repetitive loss property may or may not be currently insured by the NFIP. Per NFIP data provided by the Virginia Department of Conservation and Recreation in June 2015 and some additional data provided by FEMA for some communities, a total of 4,832 RL properties as defined by the NFIP have been identified within the study area communities. These properties have experienced a total of $148 million individual insured losses for the structure and contents combined. The average payment for each qualifying claim was $10,900. In 2015, there were 4,408 residential properties (98 percent) and 106 non-residential properties on the list; that ratio is presumed to be applicable now but the data were not available to verify.

The NFIP also designates severe repetitive losses (SRL) in a community. As defined by the Flood Insurance Reform Act of 2004, SRLs are 1- to 4-family residences that have had four or more claims of more than $5,000 or at least two claims that cumulatively exceed the building's value. The Act created new funding mechanisms to help mitigate flood damage for these properties. The study area communities have 502 SRL properties identified by the NFIP, with a total of 1,621 losses. Total payments for these 502 properties were over $39 million. **Table 5.5a** provides summary details for the communities with regard to each community's repetitive losses. The number of residential versus commercial repetitive loss properties is similar to those ratios in the previous hazard mitigation plan.

TABLE 5.5a: NFIP REPETITIVE LOSS PROPERTIES

REGION	COMMUNITY	REPETITIVE FLOOD LOSSES			
		NUMBER OF PROPERTIES	VALUE OF LOSSES	NUMBER OF LOSSES	AVERAGE PAYMENT PER CLAIM
Peninsula	Hampton (2015)	936	$48,166,174	2,541	$18,956
		SEVERE REPETITIVE FLOOD LOSSES			
		70	$10,407,881	365	$28,515
	Newport News (2015)	121	$13,037,268	294	$44,344
		SEVERE REPETITIVE FLOOD LOSSES			
		3	$189,943	11	$17,268
	Poquoson (2021)	795	Not provided	2,466	Not provided
		SEVERE REPETITIVE FLOOD LOSSES			
		204	Not provided	Not provided	Not provided
	Williamsburg (2015)	4*	$104,271	9	$11,586
	James City County	35	$2,345,563	95	$24,690
		SEVERE REPETITIVE FLOOD LOSSES			
		2	$146,768	8	$18,346
	York County (2015)	236	$15,330,549	560	$27,376
		SEVERE REPETITIVE FLOOD LOSSES			
		11	$1,772,861	50	$35,457
Southside	Norfolk (2020)	942	$32,321,814	2,217	$14,440
		SEVERE REPETITIVE FLOOD LOSSES			
		95	$11,988,043	533	$22,949
	Portsmouth (2015)	229	$10,009,951	631	$15,864
		SEVERE REPETITIVE FLOOD LOSSES			
		16	$2,070,120	86	$24,071

[2] The FEMA Hazard Mitigation Assistance Program defines RL as having incurred flood-related damage on 2 occasions, in which the cost of the repair, on the average, equaled or exceeded 25 percent of the market value of the structure at the time of each such flood event; and, at the time of the second incidence of flood-related damage, the contract for flood insurance contains increased cost of compliance coverage.

TABLE 5.5a: NFIP REPETITIVE LOSS PROPERTIES					
REGION	COMMUNITY	REPETITIVE FLOOD LOSSES			
		NUMBER OF PROPERTIES	VALUE OF LOSSES	NUMBER OF LOSSES	AVERAGE PAYMENT PER CLAIM
	Suffolk (2015)	17	$2,285,818	50	$45,716
	Virginia Beach (2015)	574	$34,205,856	1,768	$19,347
		SEVERE REPETITIVE FLOOD LOSSES			
		62	$8,673,919	361	$24,027
	Chesapeake (2015)	395	$19,611,525	1,214	$16,154
		SEVERE REPETITIVE FLOOD LOSSES			
		37	$3,523,288	199	$17,705
Western Tidewater	Isle of Wight County (2015)	23	$1,584,416	60	$26,407
	Smithfield (2015)	3	$71,418	7	$10,203
	Franklin (2015)	6	$686,165	12	$57,180
	Southampton County (2015)	9	$557,595	19	$29,347
	Surry County (2021)	5	$578,071	14	$41,291
		SEVERE REPETITIVE FLOOD LOSSES			
		2	$297,572	8	$34,947
Totals		4,832	$148,165,583	13,578	$626,186

** Williamsburg officials have conducted additional research into these data and contend the data do not represent a pattern of repetitive overland flooding.*

Sources: FEMA and NFIP

In May 2022, FEMA provided additional data regarding repetitive losses in the study area. These data are not reflected in the planning process or the repetitive loss area mapping below, but may prove useful for the region’s communities in future repetitive loss planning. The data are shown in **Table 5.5b**.

TABLE 5.5b: 2022 NFIP REPETITIVE FLOOD LOSSES			
SUBREGION	**COMMUNITY**	**REPETITIVE FLOOD LOSS PROPERTIES**	**SEVERE REPETITIVE FLOOD LOSS PROPERTIES**
Peninsula	Hampton	956	109
	Newport News	129	10
	Poquoson	983	50
	Williamsburg	3	0
	James City County	37	4
	York County	245	15
Southside	Norfolk	977	125
	Portsmouth	255	27
	Suffolk	24	3
	Virginia Beach	676	128
	Chesapeake	420	78
Western Tidewater	Isle of Wight County	23	5
	Smithfield	6	1
	Windsor	0	0
	Franklin	7	1
	Southampton County	8	2
	Boykins	0	0
	Branchville	0	0
	Capron	0	0
	Courtland	0	0
	Ivor	0	0
	Newsoms	0	0
	Surry County	6	2
	Claremont	4	3
	Dendron	0	0
Total		4,759	563

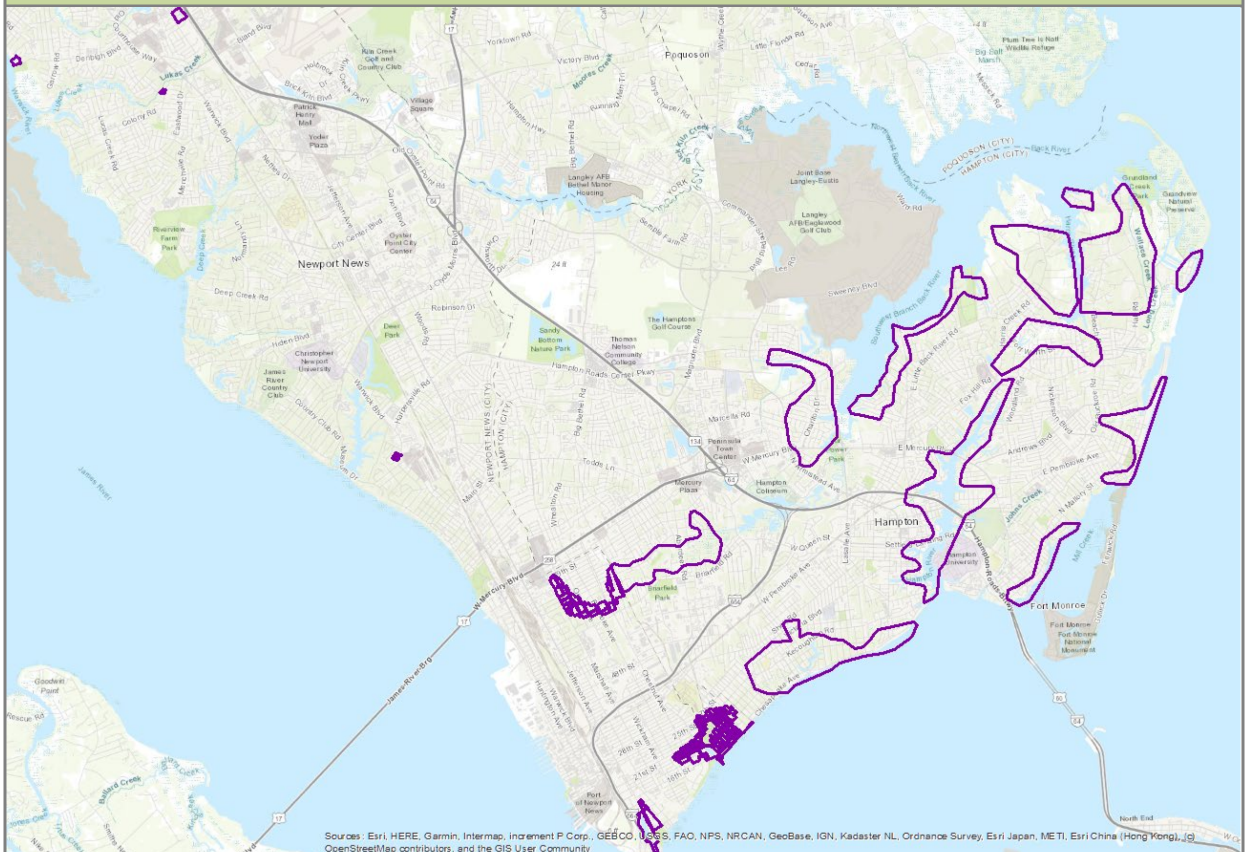
Figures 5.3 through 5.11 contain maps of the region's repetitive loss areas. Each designated area was identified by referencing maps of all historical NFIP flood claims, NFIP RL lists, the SRL list, a Digital Elevation Model (DEM)-based depth grid of the 100-year floodplain, and the HAZUS results regarding predicted flood damages from a 100-year flood for individual structures. As shown in Table 5.5, there are 4,514 properties on FEMA's repetitive loss list and an additional 55,179 parcels identified as being within those repetitive loss areas. Other structures near the ones listed by the NFIP may have been uninsured during the floods, may have had single flood insurance claims, or may have had multiple claims under different policies that the claims system did not recognize as being the same repetitively flooded address. **Table 5.6** provides additional detail regarding the repetitive loss areas identified for each community.

TABLE 5.6: REPETITIVE FLOOD LOSS AREA DETAILS

REGION	COMMUNITY	REPETITIVE FLOOD LOSS AREAS		
		NUMBER OF RL AREAS	NUMBER OF PROPERTIES OR BUILDINGS	SOURCES OF FLOODING
Peninsula	Hampton	12	7,736	Low-lying land along the banks of tidal rivers and creeks are regularly inundated by nor'easters and tropical storms. Newmarket Creek overflows banks during coastal storms and heavy rains. Wind driven storm tides drive water into smaller tributaries and flood low-lying areas. Along Chesapeake Bay, wind and wave velocity, coastal flooding and overwash during coastal storms causes damage.
	Newport News	8	1,662	Low-lying land along the banks of tidal rivers and creeks are regularly inundated by nor'easters and tropical storms. Newmarket Creek overflows banks during coastal storms and heavy rains. Wind driven storm tides drive water into smaller tributaries and flood low-lying areas. Along James River, wind and wave velocity, coastal flooding and overwash during coastal storms causes damage.
	Poquoson	1	4,810	Low-lying land along the banks of tidal rivers and creeks are regularly inundated by nor'easters and tropical storms.
	James City County	10	643	Low-lying land along the banks of tidal rivers and creeks are regularly inundated by nor'easters and tropical storms. Stormwater drainage from heavy rains cause flooding in some riverine watersheds.
	York County	20	1,681	Low-lying land along the banks of tidal rivers and creeks are regularly inundated by nor'easters and tropical storms.
Southside	Norfolk	114	8,764	Low-lying land along the banks of tidal rivers and creeks are regularly inundated by nor'easters and tropical storms. Stormwater drainage from heavy rains cause flooding in some riverine watersheds. Tidal inundation of stormwater system increases flooding in some neighborhoods.
	Portsmouth	25 maps	1,974	Low-lying land along the banks of tidal rivers and creeks are regularly inundated by nor'easters and tropical storms. Stormwater drainage from heavy rains cause flooding in some riverine watersheds. Tidal inundation of stormwater system increases flooding in some neighborhoods. Seawall damaged.
	Suffolk	12	81	Low-lying land along the banks of tidal rivers and creeks are regularly inundated by nor'easters and tropical storms.

TABLE 5.6: REPETITIVE FLOOD LOSS AREA DETAILS				
REGION	COMMUNITY	REPETITIVE FLOOD LOSS AREAS		
		NUMBER OF RL AREAS	NUMBER OF PROPERTIES OR BUILDINGS	SOURCES OF FLOODING
	Virginia Beach	156	3,888	Low-lying land along the banks of tidal rivers and creeks are regularly inundated by nor'easters and tropical storms. Stormwater drainage from heavy rains cause flooding in some riverine watersheds. Tidal inundation of stormwater system increases flooding in some neighborhoods.
	Chesapeake	62	3,869	Low-lying land along the banks of tidal rivers and creeks are regularly inundated by nor'easters and tropical storms. Flat terrain hinders stormwater
Western Tidewater	Isle of Wight County	13	151	Low-lying land along the banks of tidal rivers and creeks are regularly inundated by nor'easters and tropical storms.
	Smithfield	1	45	Low-lying land along the banks of tidal rivers and creeks are regularly inundated by nor'easters and tropical storms.
	Franklin	2	462	Blackwater River overflows its banks and tributary banks as a result of heavy rain in the upper parts of the watershed causing severe flooding in the downtown area.
	Southampton County	4	74	The Blackwater and Nottoway River systems overflow their banks as a result of heavy rain in the watershed, causing pockets of flooding especially where tributaries flow into main rivers.
	Surry County	4	89	Low-lying land along the banks of the James River cause much of the repetitive flooding near Pleasant Point and the Jamestown-Scotland Ferry Terminal. A low-lying area near Claremont is outside the SFHA, but experiences urban flooding when infrastructure cannot carry stormwater away from structures. Another area near Dendron experiences flooding within and beyond the SFHA of the nearby Cypress Swamp.
Totals		419	39,098	

FIGURE 5.3: NFIP REPETITIVE FLOOD LOSS AREAS, LOWER PENINSULA

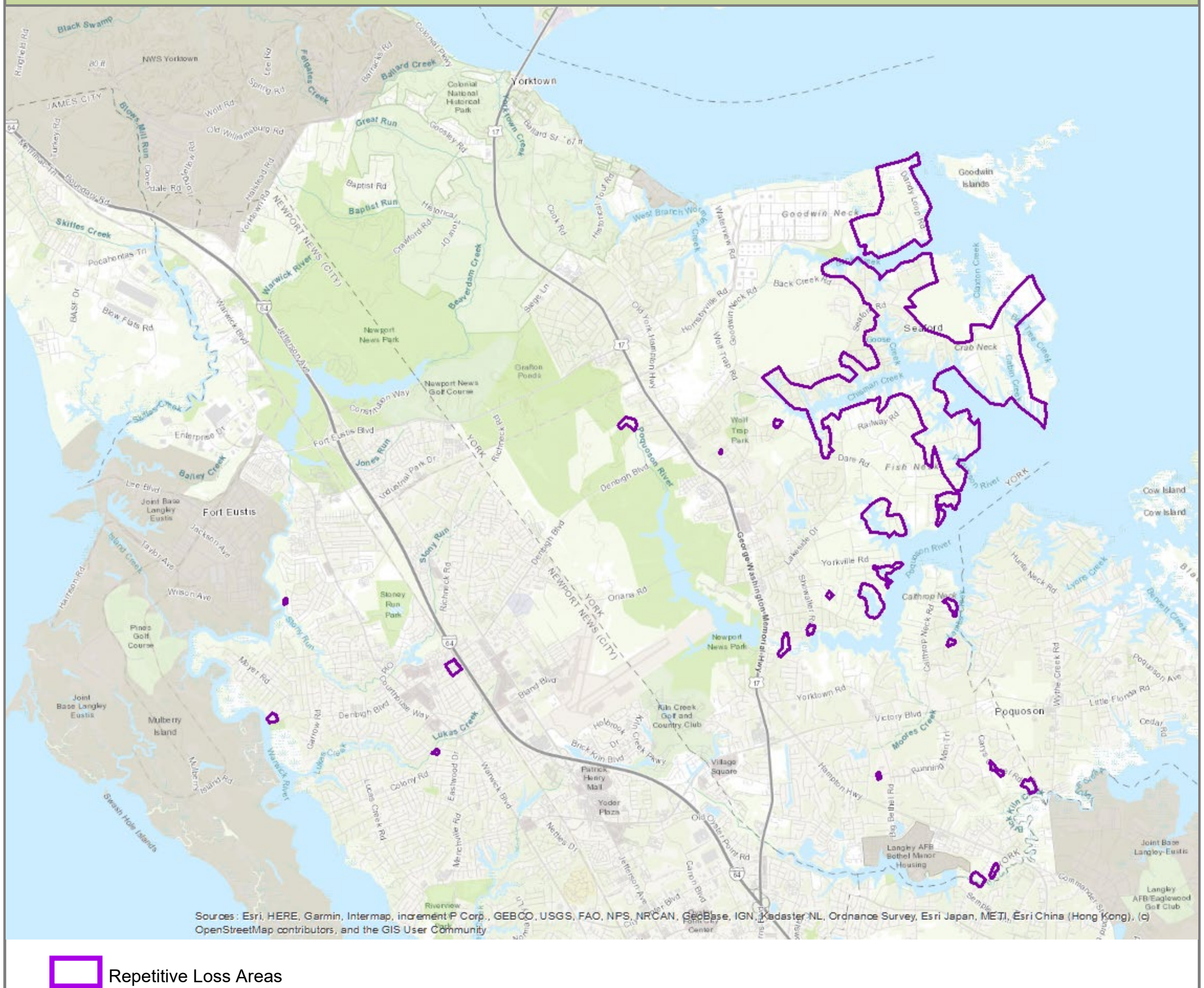


Repetitive Loss Areas

2021

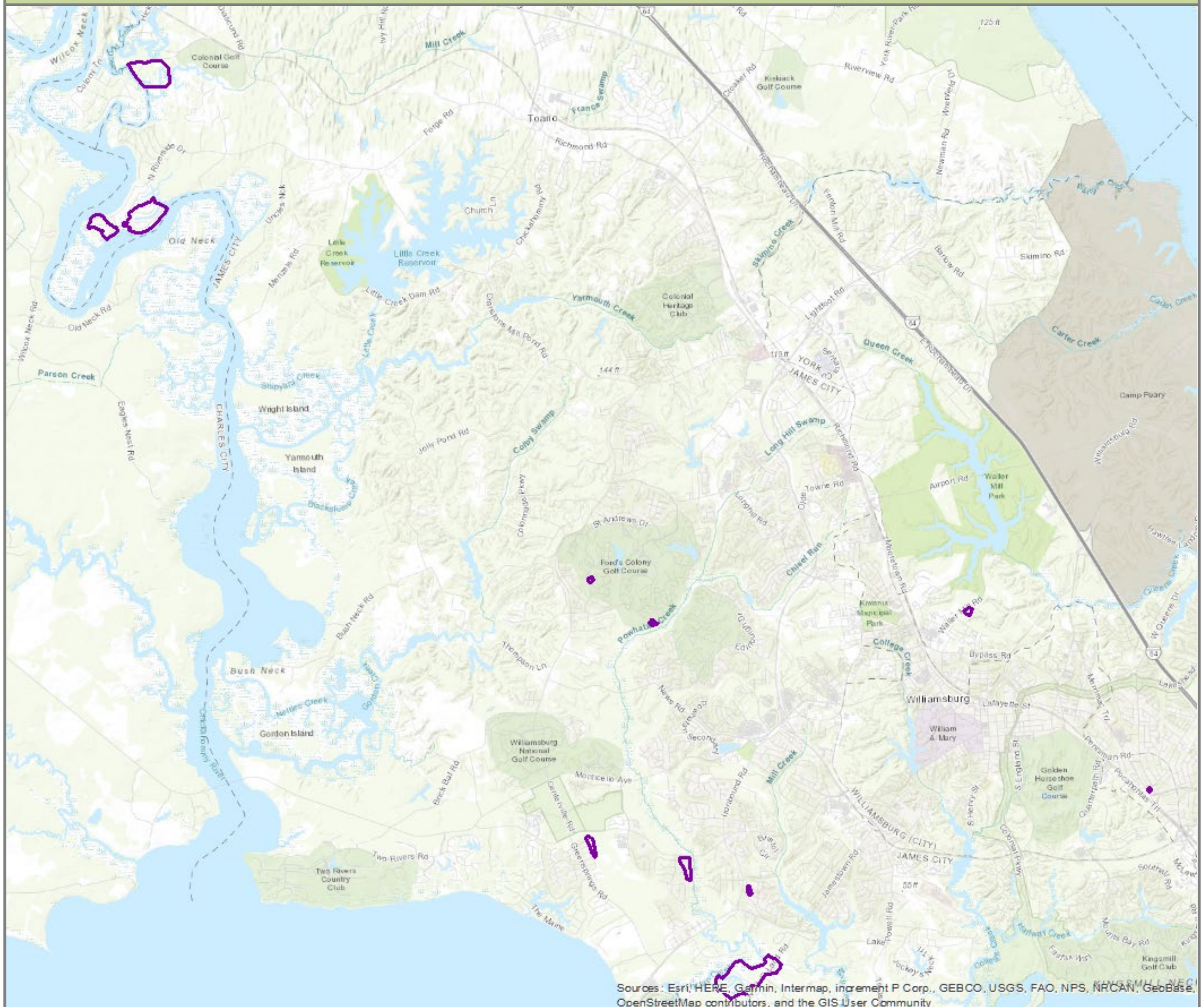
**Poquoson designated entire SFHA as repetitive loss area. See Figure 4.1.*

FIGURE 5.4: NFIP REPETITIVE FLOOD LOSS AREAS, MIDDLE PENINSULA



2021

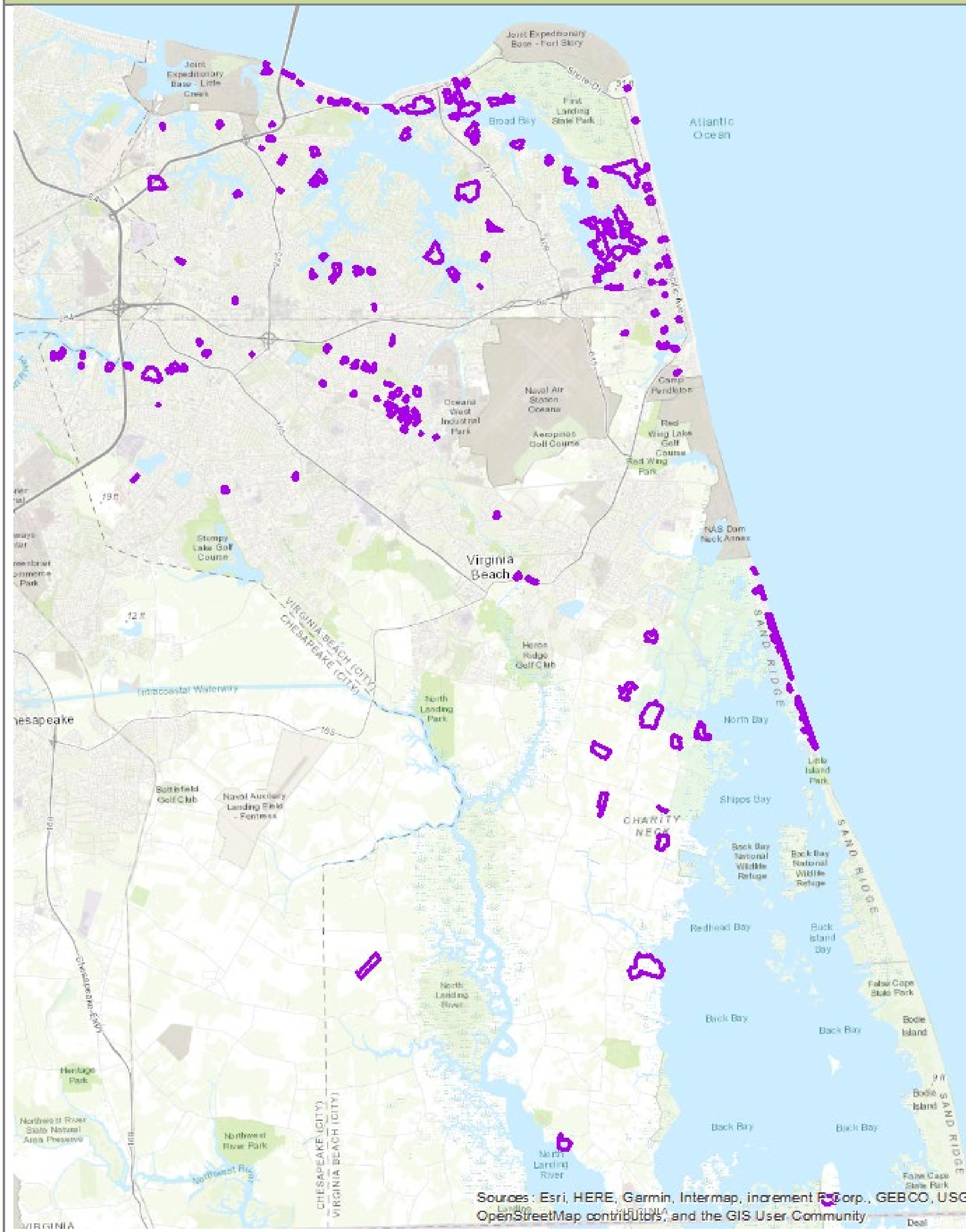
FIGURE 5.5: NFIP REPETITIVE FLOOD LOSS AREAS, UPPER PENINSULA



Repetitive Loss Areas

2021

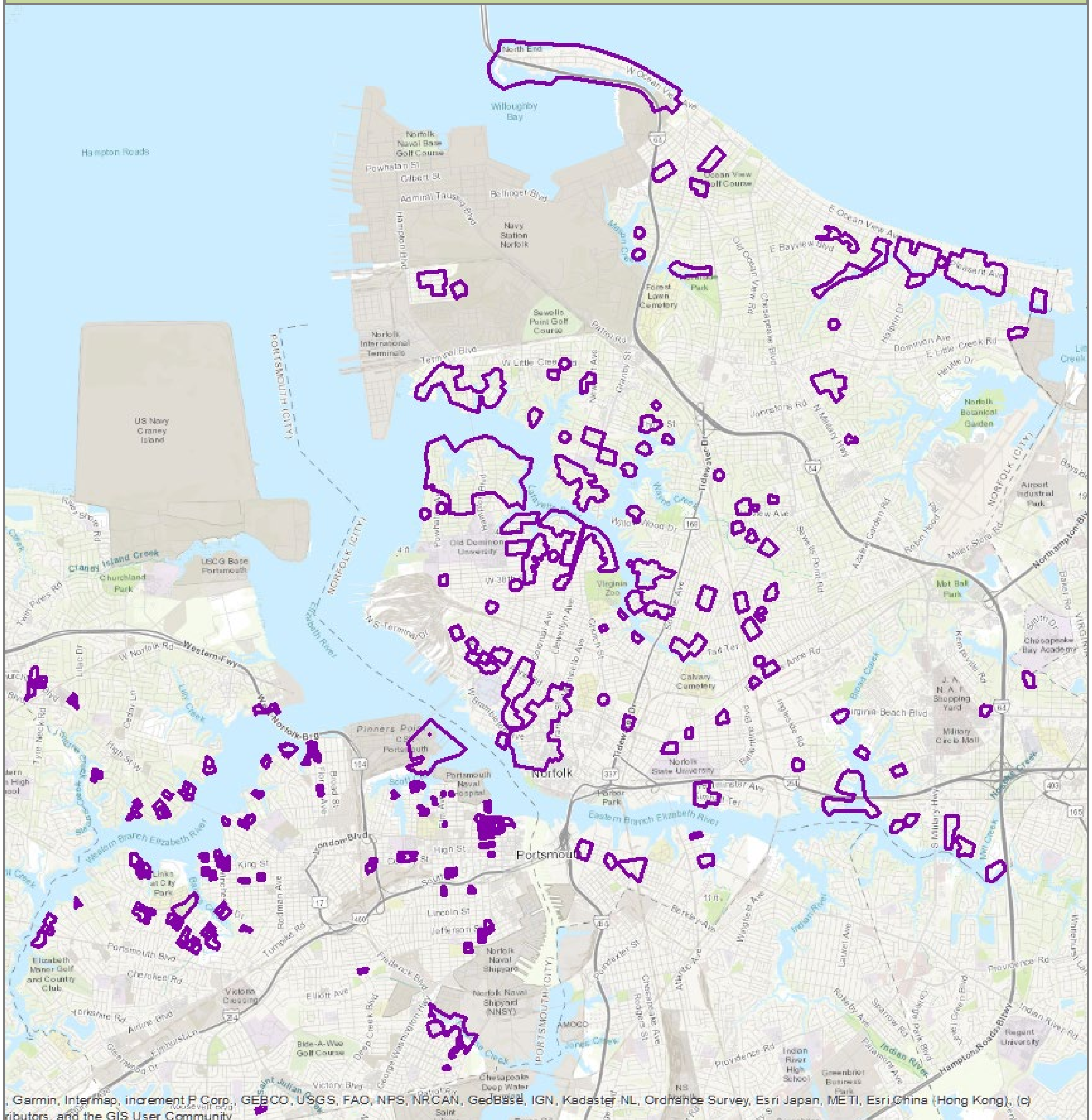
FIGURE 5.6: NFIP REPETITIVE FLOOD LOSS AREAS, VIRGINIA BEACH



Repetitive Loss Areas

2021

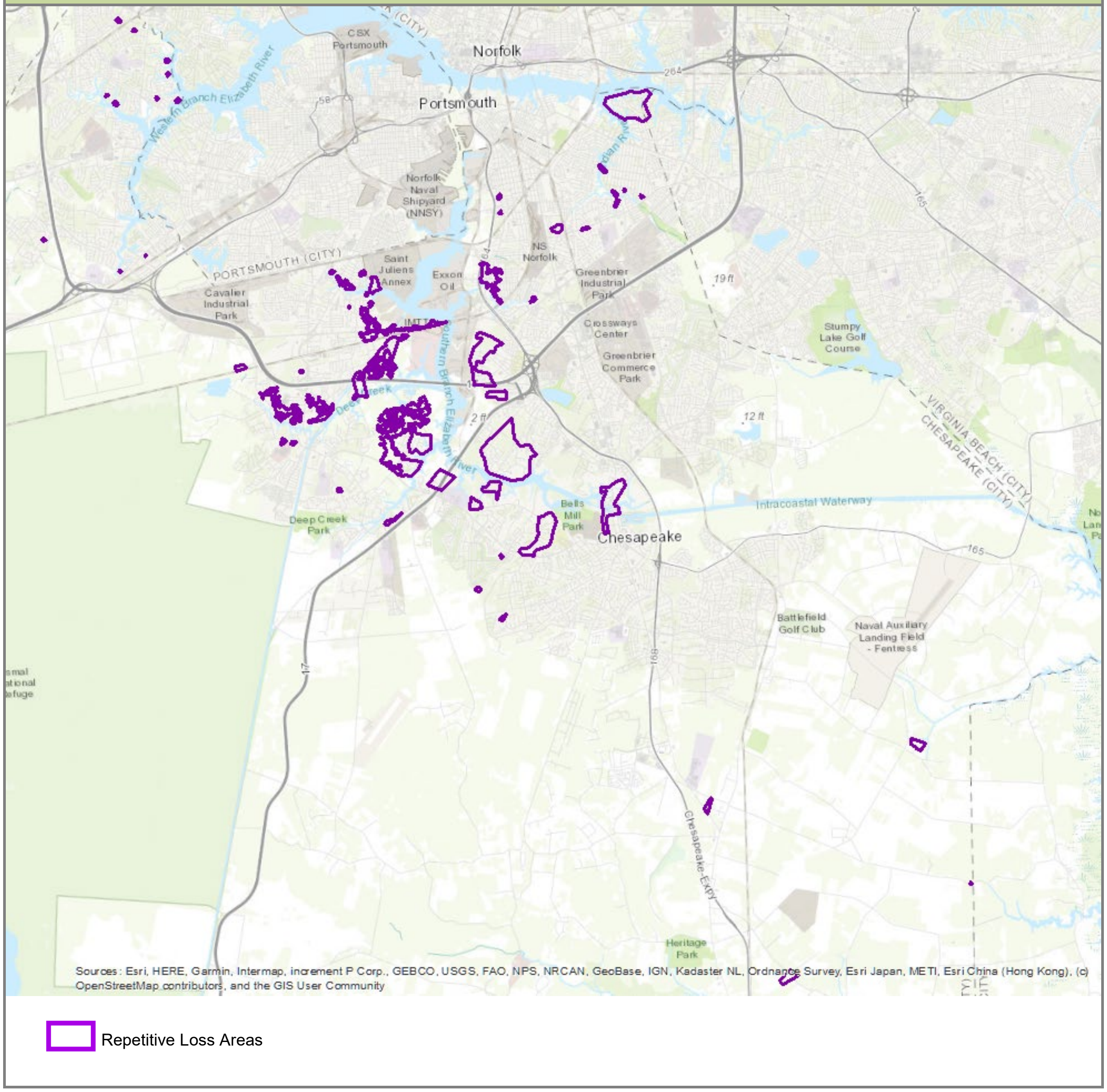
FIGURE 5.7: NFIP REPETITIVE FLOOD LOSS AREAS, NORFOLK, PORTSMOUTH



Repetitive Loss Areas

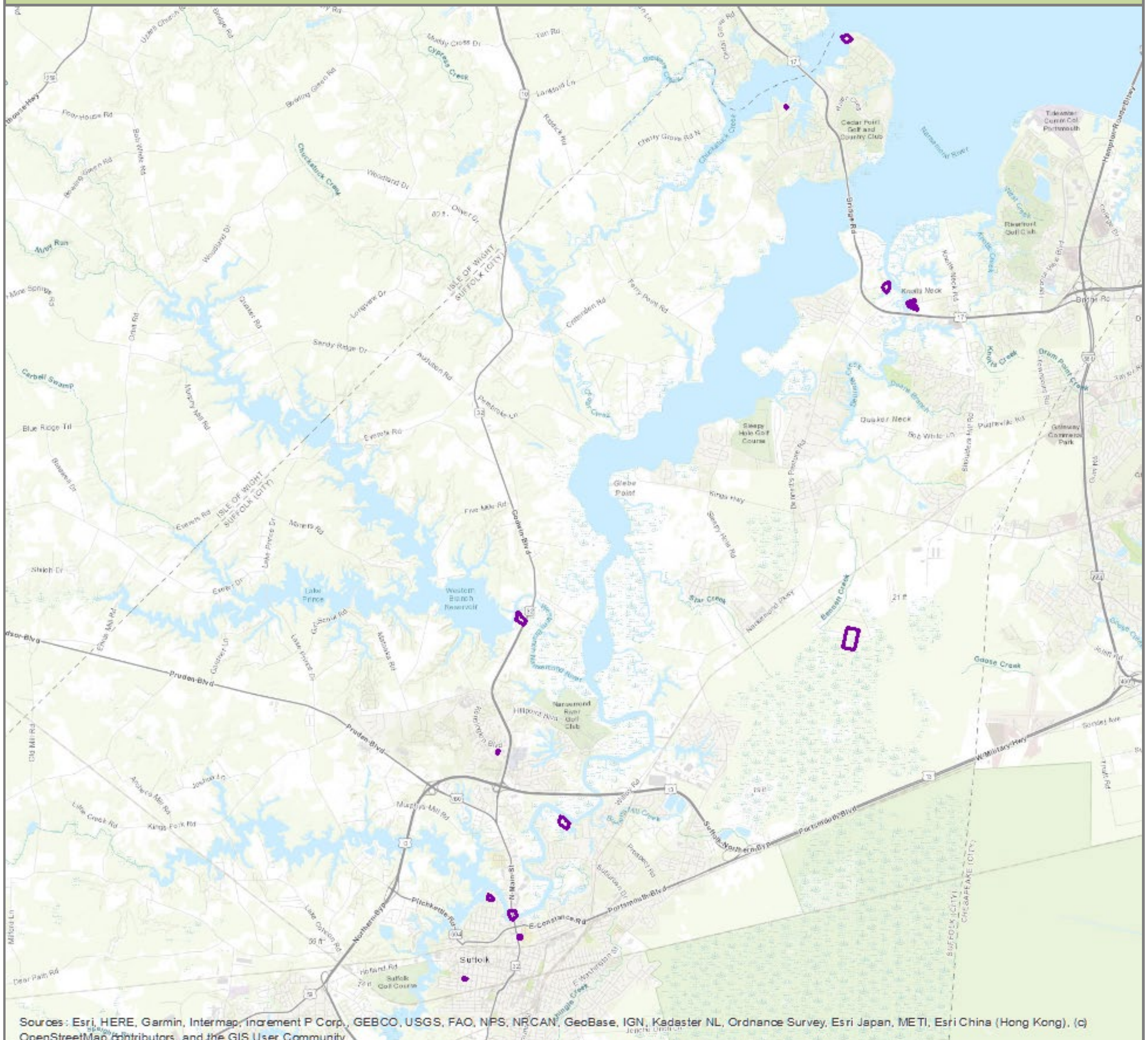
2021

FIGURE 5.8: NFIP REPETITIVE FLOOD LOSS AREAS, CHESAPEAKE



2021

FIGURE 5.9: NFIP REPETITIVE FLOOD LOSS AREAS, SUFFOLK

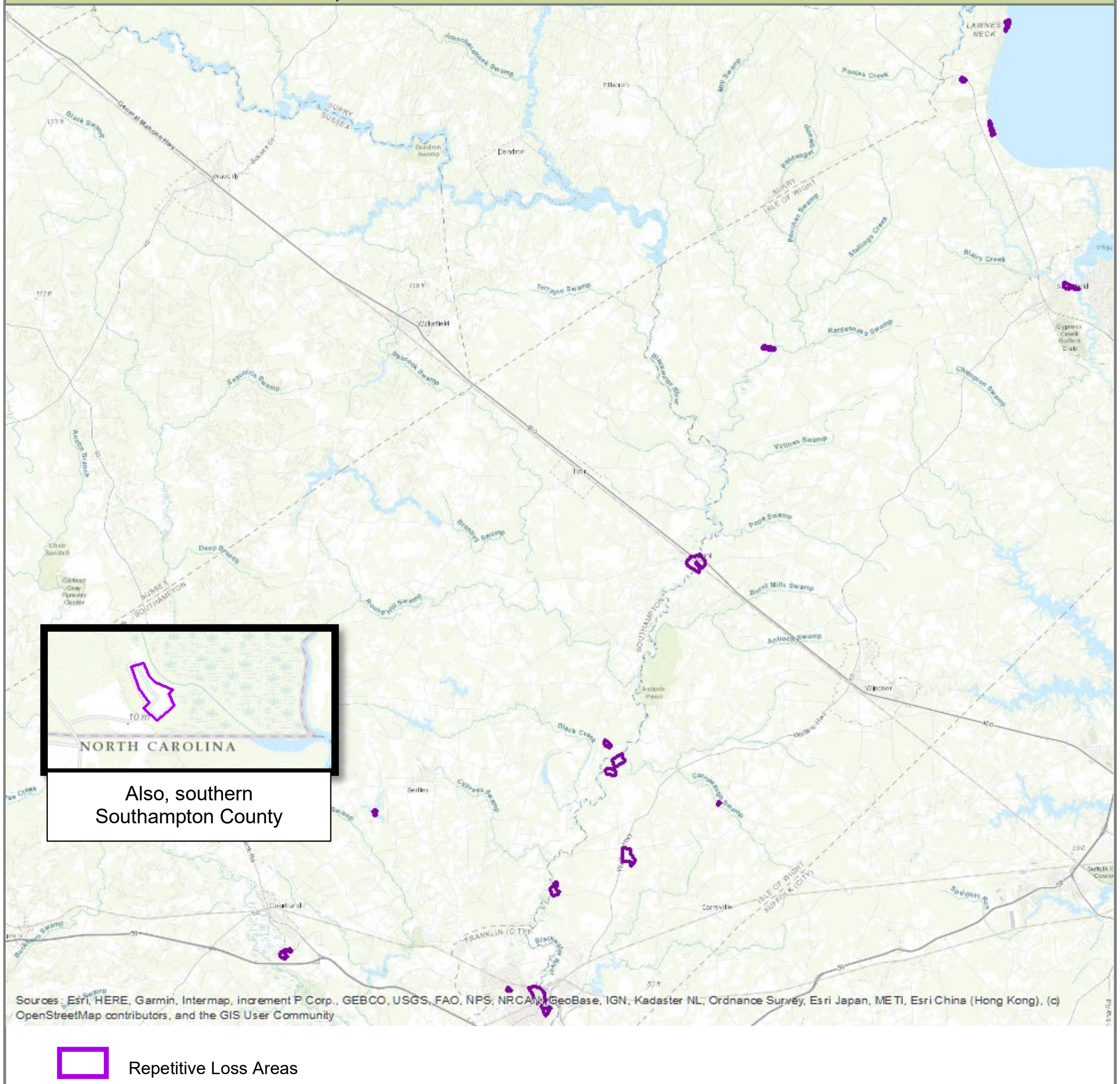


Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Repetitive Loss Areas

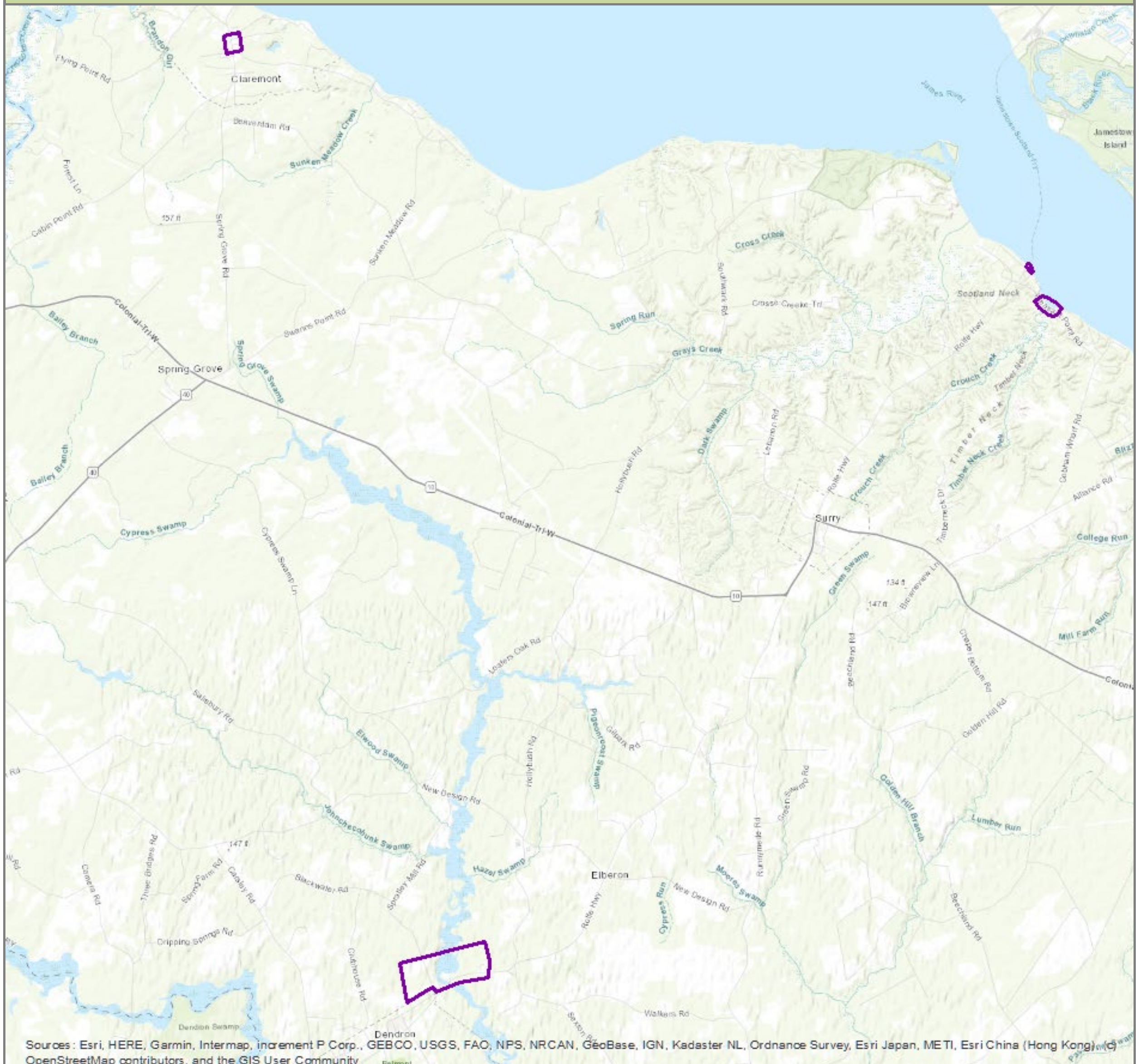
2021

FIGURE 5.10: NFIP REPETITIVE FLOOD LOSS AREAS, ISLE OF WIGHT, SMITHFIELD, SOUTHAMPTON COUNTY, FRANKLIN



2021

FIGURE 5.11: NFIP REPETITIVE FLOOD LOSS AREAS, SURRY COUNTY



Repetitive Loss Areas

2021

ESTIMATES OF POTENTIAL LOSSES

For the updated flood vulnerability analysis, participating communities were asked to share as much information as possible about individual structures in their communities, including:

- Elevation Certificate data or lowest floor elevation;
- address;
- year built;
- number of stories;
- building cost;
- content cost;
- building type;
- square footage;
- construction class;

- foundation type; and/or
- occupancy/use code.

A majority of the communities in this Plan had flood hazard vulnerability assessments performed at the individual structure level (Level 2 Hazus analysis) using flood depth raster data generated external to Hazus. Due to the nature of the FEMA FIRMs level of detail, Franklin and Southampton County were modeled using Hazus Flood Level 1 analysis, which generated flood depth rasters internal to Hazus making use of 30 meter digital elevation data from the USGS. Williamsburg was not modeled because previous studies had found no single family residential structures in the SFHA. For all of the other communities in the study area, an individual structure level analysis, also known as a User-Defined Facilities (UDF) analysis within Hazus Level 2, was performed for flood hazards as shown on the FIRM, including coastal and riverine flooding.

The following highlights the data source and processing methodology for each of the input datasets required by Hazus for the UDF analysis:

User Defined Facilities (Building Data, including First Floor Elevations)
HRPDC provided Hazus UDF building data for 11 of the 12 cities and counties where the UDF analysis was performed. These data were only for single family residential structures (RES1 specific occupancy type in Hazus), which typically make up 70-90% of all structures in the mapped floodplain. The City of Virginia Beach directly provided UDF building data for all structure types.

These UDF datasets had been previously developed based on approaches documented in the following three HRPDC reports:

Phase 1 Report: Developing First Floor Elevation Data for Coastal Resilience Planning in Hampton Roads, February 2019 (available at https://www.hrpdcva.gov/library/view/932/developing-first-floor-elevation-data-for-coastal-resilience-planning-in-hampton-roads)

Phase 2 Report: Applying First Floor Elevation Data to Flooding Vulnerability Assessments in Hampton Roads, February 2020 (available at https://www.hrpdcva.gov/library/view/1124/applying-first-floor-elevation-data-to-flooding-vulnerability-assessments-in-hampton-roads)

Phase 3 Report: A Regional Approach to Applying First Floor Elevation Data to Coastal Flooding Vulnerability Assessments in Hampton Roads, November 2020 (available at https://www.hrpdcva.gov/library/view/1386/a-regional-approach-to-applying-first-floor-elevation-data-to-coastal-flooding-vulnerability-assessments-in-hampton-roads)

These reports detail the data sources and approaches used to establish structure location and characteristic data, such as square footage and number of stories, from local assessor's parcel data. These reports also give a detailed description of how first floor elevations were derived for the structures, using a mix of actual surveyed first floor elevations from completed FEMA Elevation Certificates and modeling approaches to assign typical height above grade of first floors based on structure characteristics such as foundation types.

Flood Hazard Data and Depth Rasters
Geospatial analysts obtained the most recent effective Digital Flood Insurance Rate Map databases from the FEMA Map Service Center for the region. This included newly developed flood depth rasters (required inputs for Hazus flood UDF analysis) for the 100-year frequency flood event in all 12 cities and counties modeled using UDF analysis.

While this single flood depth raster allowed loss modeling for the 100-year event, HRPDC was interested in exploring ways to estimate average annual damages (AAD), as well. Estimating AAD requires having flood rasters for at least four additional flood frequency events (such as the 10-year, 25-year, 50-year, and 500-year events). The existing Flood Insurance Studies (FIS) in each of the communities includes multi-return period information that provides most or all of these additional return periods. Therefore, four additional flood depth rasters were derived for the 12 cities and counties modeled with UDF analysis using the following approach:

1. The flood profiles and transect tables of each city and county were reviewed and an “average” flood profile was selected for each jurisdiction, represented as a specific category of FEMA Probability of Elevation or PELV Curve values. PELV Curves for flood A zones range from A1 to A30 and flood V zones range from V1 to V30, where each curve represents a specific offset between the 10-year and 100-year elevation. For example, the A5 curve represents a flood profile with 2.5 feet between the 10-year and 100-year flood elevation. Each curve has a best-fit line to derive the relative flood elevation offsets to any other return periods, including the 25-year, 50-year, and 500-year required for the Hazus AAD calculations.
2. Once the PELV curve was established for each jurisdiction, new flood depth rasters were derived by subtracting the offset value for that return period from the official FEMA 100-year flood depth raster. For example, for a jurisdiction assigned the A5 PELV curve, the 10-year flood depth raster was estimated by subtracting 2.5 feet from each raster cell in the 100-year flood depth raster. This resulted in some raster cells with zero or negative values, which Hazus ignores in the flood UDF analysis.
3. The following shows the PELV Curve assumptions for the jurisdictions modeled using this approach:
   - Chesapeake, Norfolk, Portsmouth, Virginia Beach - A4 (2 foot offset between 10-year and 100-year)
   - Isle of Wight County, James City County, Newport News, Poquoson, Suffolk, Surry County - A5 (2.5 foot offset between 10-year and 100-year)
   - Hampton, York County - A7 (3.5 foot offset between 10-year and 100-year)

Using the five flood depth rasters and UDF building data listed above, a building level flood vulnerability analysis was conducted for each flood-prone community. Because of the large number of analyses that needed to be conducted (5 return periods for 12 jurisdictions), the newly developed Hazus FAST Tool was used. The FAST Tool uses a Python script-based approach to automate running a Hazus flood UDF analysis with the simple selection of an input UDF database and the selection of one or more flood depth rasters. The FAST tool outputs a text file with the analysis results for each structure determining the building and content damage percentage and dollar losses for each structure.

One final set of refinements was needed after running the FAST tool for the five return periods in each community. The HRPDC detailed structure data only included lowest floors and other characteristics for single-family residential structures. In order to estimate losses for all structure types, a companion Hazus Level 1 analysis was conducted for each of the 11 jurisdictions with only RES1 data using the 100-year FEMA flood depth raster as an input. The aggregated loss estimates from these Level 1 analyses were used to develop multiplication factors to apply to the building and contents losses in each community to account for non-residential structures. In addition, the final AAD value was derived using the standard Hazus calculation for the five return periods modeled.

Table 5.7a provides a detailed listing of the number of residential structures expected to be damaged by flooding (coastal storm surge and riverine flooding), and the total dollar losses predicted for all structures for the 100-year event, and Average Annual Damages.

TABLE 5.7A: HAZUS FLOOD DAMAGE VULNERABILITY RESULTS

SUBREGION	COMMUNITY	NUMBER OF SINGLE FAMILY RESIDENTIAL BUILDINGS DAMAGED (100-YR EVENT)	TOTAL ALL BUILDING TYPE LOSSES (100-YR EVENT)	TOTAL CONTENT LOSSES (100-YR EVENT)	TOTAL LOSSES (100-YR EVENT)	AVERAGE ANNUAL DAMAGES
Peninsula	Hampton	4,012	$93,763,321	$70,335,791	$164,099,112	$6,813,410
	Newport News	435	$6,045,697	$4,586,632	$10,632,329	$486,054
	Poquoson	1,405	$43,631,875	$31,715,660	$75,347,535	$3,715,393
	Williamsburg	Not modeled; there are no single family residential structures in mapped floodplain				
	James City County	64	$1,762,201	$1,000,658	$2,762,858	$156,374
	York County	266	$4,716,520	$3,376,412	$8,092,932	$687,866
Southside	Norfolk	2684	$163,342,598	$177,157,526	$340,500,124	$19,264,918
	Portsmouth	658	$8,197,586	$8,921,847	$17,119,433	$982,084
	Suffolk	40	$1,997,698	$1,421,059	$3,418,757	$190,613
	Virginia Beach	2322	$149,052,336	$65,543,442	$214,595,778	$9,524,586
	Chesapeake	1382	$17,411,115	$14,887,712	$32,298,827	$1,795,921
Western Tidewater	Isle of Wight County	47	$3,278,669	$2,844,448	$6,123,118	$410,568
	Franklin*	NA*	$109,000	$91,000	$200,000	$11,000
	Southampton County*	NA*	$854,000	$929,000	$1,783,000	$111,446
	Surry County	23	$1,052,801	$906,209	$1,959,011	$111,192
Totals		**13,338**	**$495,215,418**	**$383,717,396**	**$878,932,814**	**$44,261,424**

*Modeled using Hazus Level 1 Flood analysis
Source: Hazus

In an effort to ensure that this plan reflects the latest analyses available for the region, the planning team also examined the results of the *Virginia Coastal Resilience Master Plan – Phase One, December 2021.* Although this plan was released after the planning process for this plan was substantially complete, the team felt it was important to include the results of the later coastal study as a companion to the Hazus results for all flood types. Using a separate methodology as explained in detail in the new document's Appendix C, the *Virginia Coastal Resilience Master Plan – Phase One, December 2021*, showsaverage annual loss results that provide additional insights regarding the impacts of coastal flooding in Hampton Roads. The analysis in the *Coastal Resilience Master Plan* does not address riverine flooding not caused by storm surge.

TABLE 5.7B: COASTAL STORM SURGE IMPACTS, 2020						
SUBREGION	COMMUNITY	EXPOSED POPULATION	AAL RESIDENTIAL	AAL COMMERCIAL	AAL AGRICULTURAL	# PUBLIC STRUCTURES IMPACTED, 100-YEAR FLOOD
Peninsula	Hampton	6,849	$25,279,708	$6,750,368	$30,295	135
	Newport News	350	$1,551,702	$276,989	-	137
	Poquoson	1,114	$26,598,367	$1,259,621	–	25
	Williamsburg	-	-	-	-	-
	James City County	80	$2,001,233	$178,023	$17,550	1
	York County	868	$11,034,534	$1,051,836	$67,686	79
Southside	Norfolk	9,458	$89,208,351	$86,403,233	-	143
	Portsmouth	4,615	$9,336,570	$3,283,350	-	218
	Suffolk	194	$983,209	$605,126	$2,237	5
	Virginia Beach	10,906	$40,107,944	$20,975,453	$426,353	120
	Chesapeake	5,145	$24,316,555	$9,135,644	$55,650	209
Western Tidewater	Isle of Wight County	60	$ 637,785	$1,191,561	$6,791	-
	Franklin	-	-	-	-	-
	Southampton County	10	$38,625	$23,932	-	-
	Surry County	-	$1,550,375	$46,113	$32,335	-
Totals		39,649	$232,644,958	$131,181,249	$638,897	1,072

Source: Virginia Coastal Resilience Master Plan – Phase One, December 2021

Vulnerability to stormwater flooding caused by precipitation and/or stormwater management infrastructure issues was not directly evaluated due to insufficient and inconsistent data across the study area. Although some municipalities have made progress in evaluating this specific type of flooding and have started collecting data to reflect historic occurrences and future vulnerabilities, data are not available to express quantitative risk in a meaningful way for the whole region.

Clearly, much of the Hampton Roads region is susceptible to costly damage resulting from flood events and Figure 4.1 indicates where the flood risk is highest. The lower Peninsula (Hampton and Poquoson) and developed areas of Southside (Norfolk, Virginia Beach, Chesapeake and Portsmouth) have the highest numbers of repetitive losses and highest predicted number of structures expected to be damaged in a 100-year flood event based on the HAZUS data. Hampton, Poquoson, Norfolk and Chesapeake all have more than 1,000 structures that are highly vulnerable to the 100-year flood event, and these areas are likely the most vulnerable in the region. York County has fewer structures susceptible, but the value of those structures is higher, so the vulnerability is consequently higher. The repetitive flood loss areas shown in Figures 5.3 through 5.11 indicate where within each community the flood damage has historically been highest and can be expected to continue into the future without large-scale mitigation measures to reduce flood vulnerability.

FUTURE VULNERABILITY, LAND USE AND CLIMATE CHANGE IMPACTS

Future vulnerability will be determined, in part, by local officials. Flood hazard and SLOSH maps are available to indicate what areas of the region are most vulnerable to these hazards. These planning tools are used to help guide development away from hazardous areas. Local officials are responsible for enforcing local floodplain management regulations, flood damage prevention ordinances, and other forms of development policies that restrict new development in flood hazard areas. Additional discussion of actions these communities have taken to reduce future flood vulnerability is provided in Section 6, the Capability Assessment.

In its June 2021 report entitled *The Impact of Climate Change on Virginia's Coastal Areas*, the Virginia Academy of Science, Engineering, and Medicine (VASEM), laid out the consequences of climate change for Virginians. VASEM is a nonprofit organization consisting of members of the National Academies of Science, Engineering, and Medicine who reside or work in Virginia as well as other Virginians who are leaders in these fields. The most immediate consequence of climate change is sea level rise, caused primarily by melting ice and glaciers and thermal expansion. Additional consequences related to flooding include more recurrent flooding (higher frequency of occurrence for damaging floods), extreme rainfall and inundation of septic systems. The report projects that, particularly in urban areas, recurrent flooding will have a disproportional impact on racial and ethnic minorities, the poor, the elderly, renters, non-native English speakers, and those with mobility challenges. Exposure to a growing number of flood-prone facilities regulated for toxic and hazardous substances as sea levels rise is another concern, particularly on the James River, between Richmond and Hampton Roads. Impacts in rural areas are more likely to be centered around soil quality, such as water-logged soils in flood-prone areas, increased salinity due to saltwater intrusion and septic system failures that affect public health.[3]

Increased levels of precipitation from storm events sometimes overwhelm existing municipal stormwater management systems in the Hampton Roads region, which can result in roadway flooding, safety and access concerns, and issues with water quality and treatment capacity. As sea levels rise, the ability of the existing stormwater management systems to collect, convey, treat, and discharge flow will be further reduced by higher water levels at outfall locations.
The average annual number of days with heavy precipitation is expected to increase in the future as a result of climate change. This increased precipitation will have an impact on the frequency of regional flooding, especially riverine flooding, but may also impact coastal flooding unless municipal stormwater systems are redesigned. Heavy precipitation events can easily overwhelm existing infrastructure, causing failure of stormwater culverts, bridge scour, and overland flooding affecting areas and structures that do not normally flood. Increased heavy precipitation can impact dams and, over time, influence flood frequency curves that are used for a variety of insurance, building safety and planning purposes.

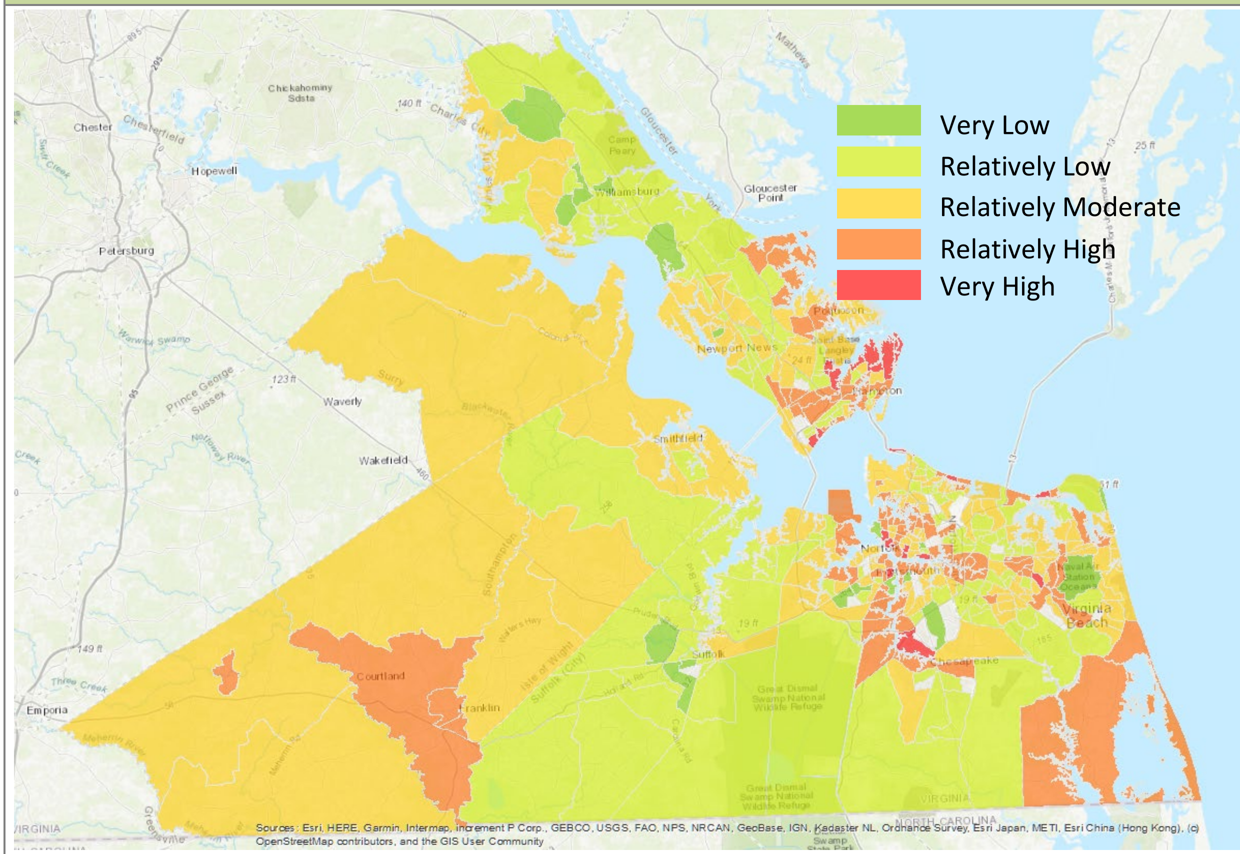
According to 2022 data from the Mid-Atlantic Regional Integrated Sciences and Assessments (MARISA)[4], under a moderate emissions scenario, Portsmouth can expect that for the period 2066 to 2095, the average number of days per year with rainfall greater than 1 inch will be 9.5 days, which is 20% more than in the period between 1976 and 2005. The same percentage increase is expected across the region. On the other hand, the number of days with rainfall greater than 3 inches is 0.4, 56% more than in 1976-2005 for Portsmouth. The predictions for days with this severe rainfall are not uniform across the region and range from a low of 35-percent increase in parts of Virginia Beach, to an 84-percent increase in western Isle of Wight County.

SOCIAL VULNERABILITY

Social vulnerability to both coastal and riverine flood (combined) for the Hampton Roads region is represented in **Figure 5.12**, categorized by Census tract. The map shows the NRI rating for flood risk is highest in the Franklin/Southampton County area, the lower Peninsula, Census tracts bordering the Elizabeth River in Portsmouth and Norfolk, and portions of central and southern Virginia Beach.

[3] *The Impact of Climate Change on Virginia's Coastal Areas*, the Virginia Academy of Science, Engineering, and Medicine, June 2021. Available online at: http://www.vasem.org/wp-content/uploads/2021/08/VASEM_VirginiasCoastalAreasReport_FINAL.pdf
[4] Mid-Atlantic Regional Integrated Sciences and Assessments: https://public.tableau.com/views/Climate_summary_rainfall_20181112_PUBS/3b?:embed=y&:toolbar=n&:embed_code_version=3&:loadOrderID=0&:display_count=y&:origin=viz_share_link

FIGURE 5.12: RIVERINE FLOODING, NRI RISK RATING



2021

Source: National Risk Index, 2021

FLOODING DUE TO IMPOUNDMENT FAILURE/HIGH HAZARD DAM

ESTIMATES OF POTENTIAL LOSSES

Table 4.4 summarizes possible impacts to downstream structures and infrastructure in the event of dam failure. In the downstream inundation areas for all of Hampton Roads high hazard potential dams, the following impacts are possible:

2,798 homes;
136 roadways;
8 businesses;
3 schools;
4 parks;
4 utilities;
6 railroad segments; and,
9 downstream dams.

Potential damages from inundation of these structures and infrastructure have not been further quantified, but is an area of expected future study in the region.

FUTURE VULNERABILITY, LAND USE AND CLIMATE CHANGE IMPACTS

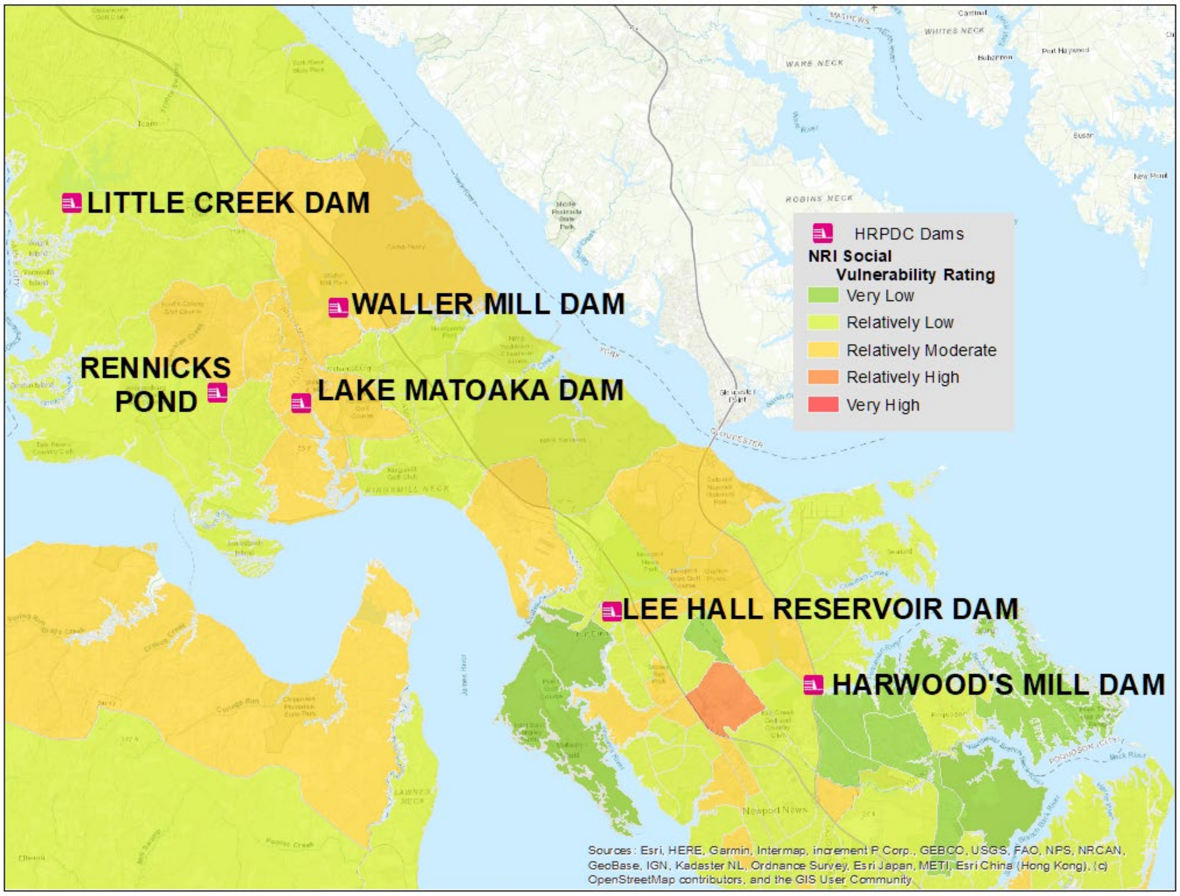
Based on historical experience and the fact that the dams in the study area are aging, precipitation patterns are increasingly more frequent and severe as a result of climate change, and the dams are categorized as High Hazard, there is a moderate probability of a future event involving a dam or levee failure in the study area. As climate change alters precipitation patterns, including frequency and quantity, the adequacy, safety and protection levels of all dams (not just high hazard potential dams) will need continuous evaluation.

SOCIAL VULNERABILITY

The locations of the study area high hazard potential dams were overlaid on the foundational social vulnerability map from the NRI. The analysis, as shown in **Figures 5.13 and 5.14**, indicates that 7 dams are located in areas of Relatively Moderate social vulnerability (no dams were in areas of Very High or Relatively High social vulnerability): Waller Mill Dam, Lake Matoaka Dam, Harwood's Mill Dam, B-1 Pond Dam, B-2 Pond Dam, ASB Pond Dam and C-Pond Dam. All other dams are in Relatively Low or Very Low areas of social vulnerability.

According to DCR, social vulnerability is a factor in assessing grant applications prepared by dam owners in Hampton Roads. Project engineers are also responsible for addressing impacts on historical and cultural impacts in accordance with state and federal regulations.

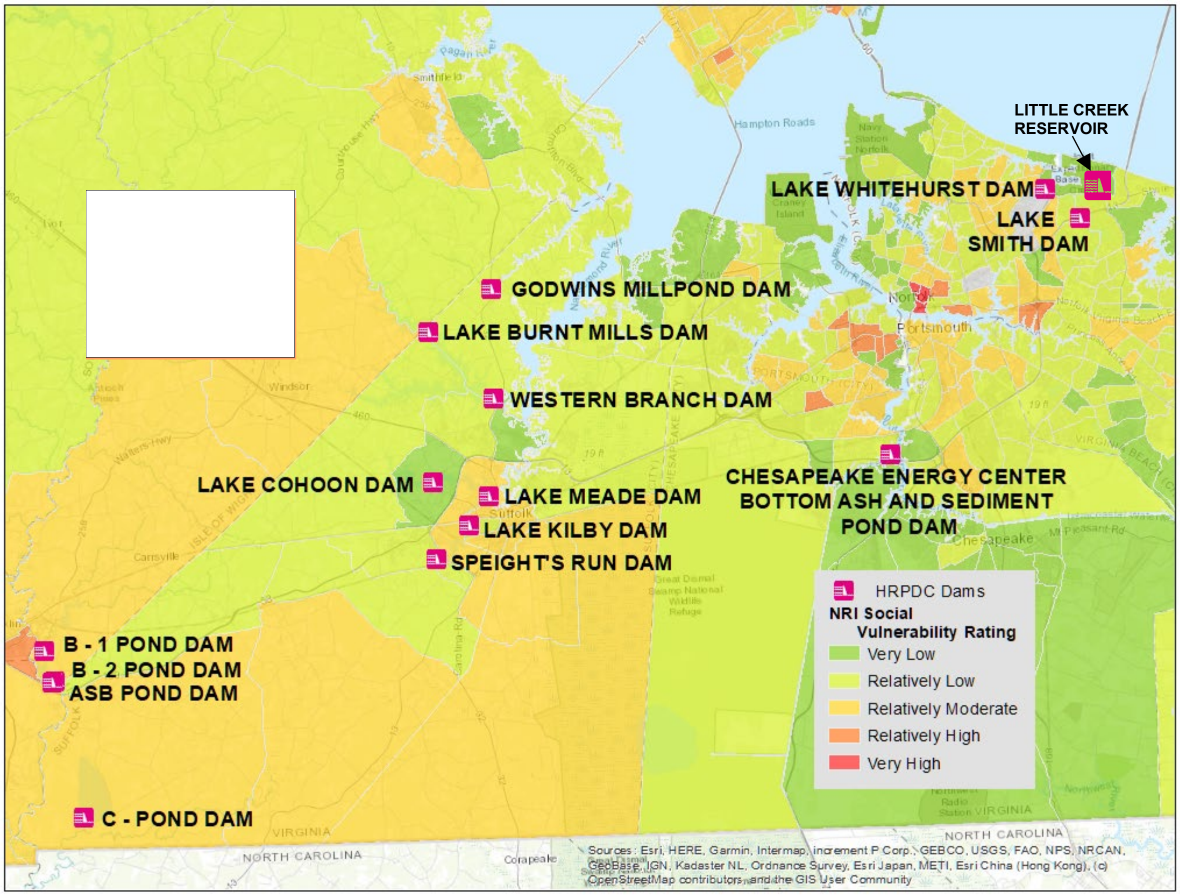
FIGURE 5.13: HIGH HAZARD POTENTIAL DAMS, PENINSULA



2021

Source: DCR, 2021

FIGURE 5.14: HIGH HAZARD POTENTIAL DAMS, SOUTHSIDE



2021

Source: DCR, 2021

SEA LEVEL RISE AND LAND SUBSIDENCE

Historical evidence shows that much of the Hampton Roads region is already experiencing some degree of sea level rise and land subsidence. As discussed in the *Hazard Identification and Analysis* section, data from Sewells Point at the Norfolk Naval Base indicate that sea level in the past 93 years has risen at a rate of approximately 4.73 millimeters per year and sea level rise at that rate is expected to continue and possibly accelerate. Vulnerability to sea level rise can be looked at in terms of economic losses resulting from future flood event damages, and by examining expectations for future land use and development patterns and highlighting what infrastructure and real estate will potentially be affected by rising tides. In both cases, this analysis assumes somewhat static conditions with regard to flood mitigation capabilities. A changing regulatory climate, development pressure, large-scale mitigation or resiliency projects, and changes in economic conditions or financial capabilities, for example, could dramatically affect the impact of sea level rise in the region. Additionally, HRSD's SWIFT program is an innovative water treatment project in eastern Virginia that is taking highly treated water that would otherwise be discharged into the region's waterways, and putting it through additional rounds of advanced water treatment. The SWIFT water is then added to the Potomac Aquifer and helping to slow or even revers the sinking of land due to groundwater withdrawals.

HRPDC has compiled a list of sea level rise viewing tools, some of which include data to help visualize the various types of risk posed by sea level rise and land subsidence:
Vulnerable Infrastructure - Buildings, roads, and critical facilities;
Societal Exposure - Demographic data summaries and socially vulnerable communities; or
Environmental Change - Marsh migration and shoreline condition.

ONLINE TOOLS	SEA LEVEL RISE SCENARIOS	INFRASTRUCTURE IMPACTS	SOCIETAL IMPACTS	ENVIRONMENTAL IMPACTS
ADAPT VIRGINIA INTERACTIVE MAP	Low, intermediate, and extreme scenarios for 2020-2100	✓	✓	✓
CCRFR SEA LEVEL RISE TOOL	NOAA Intermediate High Scenario for 2040, 2060, and 2080	✓	✗	✗
CLIMATE CENTRAL'S COASTAL RISK SCREENING TOOL	Map sea level rise by year (2030-2100) or water level.	✗	✗	✗
CLIMATE CENTRAL'S SURGING SEAS RISK FINDER	Map by water level for a specific city. Summary fact sheets and graphs available.	✓	✓	✗
NOAA COASTAL FLOOD EXPOSURE MAPPER	Map by water level. User can save and export maps.	✓	✓	✓
NOAA'S SEA LEVEL RISE VIEWER	Map by water level or local scenarios (2020-2100).	✗	✓	✓

[Adapt Virginia Interactive Map](#) (Virginia only)

CCRFR Sea Level Rise Tool (Virginia only)

Climate Central's Coastal Risk Screening Tool

Climate Central's Surging Seas Risk Finder

NOAA Coastal Flood Exposure Mapper

NOAA Sea Level Rise Viewer

ESTIMATES OF POTENTIAL LOSSES

Detailed economic loss estimates for long-term sea level rise and land subsidence are difficult to develop because the response of individual property owners and governmental entities to sea level rise is inherently unpredictable and variable over both time and space. Regional experience over the past 50 years indicates that shoreline protection measures will be reinforced to protect threatened structures, hindering the ability of wetlands and shorelines to adjust naturally as the water level rises. Therefore, models based on permanent inundation of developed areas, and which assume inundation means destruction of the built environment, can dramatically overstate losses.

In 2020, the City of Virginia Beach conducted a detailed analysis of annual average flood-related losses for current conditions, 1.5 feet of sea level rise in the 2040s, and 3 feet of sea level rise in the 2070s primarily using lowest floor elevations, HAZUS and depth-damage curves. Average annual losses today are estimated to be $26 million, and expected to be $77 million in the 2040s. In the 2070s, that loss estimate balloons to 12 times current conditions, at $329 million average annual losses.[5] Applying these ratios to Hampton Roads has some relevance due to similarities in the flood risks and growth patterns faced by the coastal communities, especially on the lower Peninsula and Southside areas. The current estimate of average annual flood losses in Hampton Roads as a result of this study is $44.2 million, which would translate into $130.8 million by the 2040s, and over $558.6 million annually by the 2070s. This is the average annual damage figure chosen as a basis for this plan analysis.

Different methodologies have produced additional predictions of the annualized flood damages in the future caused by sea level rise. The *Virginia Coastal Resilience Plan, Phase I, 2021*, estimates that statewide between 2020 and 2080, "the number of residential, public, and commercial buildings exposed to an extreme coastal flood is projected to increase by almost 150% from 140,000 to 340,000, while annualized flood damages increase by 1,300% from $0.4 to $5.1 billion."[6]

Another methodology for estimating average annual losses expected from sea level rise was supported by FEMA many years ago. The agency issued a report to Congress documenting the estimated impact of relative sea level rise on the Flood Insurance Rate Maps, *Projected Impact of Relative Sea Level Rise on the National Flood Insurance Program*, FEMA, October 1991, http://papers.risingsea.net/Flood-Insurance.html. The agency estimates that existing development in the coastal zone would experience a 36% to 58% increase in annual damages for a 1-foot rise in sea level by 2100, and a 102% to 200% increase resulting from a 3-foot rise by 2100. Applying these [albeit outdated] ratios to the current average annual flood losses, the result is $60-70 million from 1 foot sea level rise, increasing to $89-133 million with the expected 3-foot increase.

[5] *Coastal Flooding and Economic Loss Analysis: City of Virginia Beach, Virginia*. March 30, 2020. Available online at: https://www.vbgov.com/government/departments/public-works/comp-sea-level-rise/Documents/20200330_FloodRiskAnalysis_Final_(2).pdf
[6] *Virginia Coastal Resilience Master Plan, Phase One,* December 2021. Summary available online at: https://www.dcr.virginia.gov/crmp/plan.

The lack of detailed elevation information for the existing pre-FIRM and post-FIRM building inventory in much of Hampton Roads further hinders efforts to calculate detailed future average annual flood damages using increasing 100-year flood elevations, especially outside of the current SFHA. For example, calculations of sea level rise losses may be supported by the argument that areas below a certain elevation will be permanently inundated and evacuated. The FEMA study assumes that the current elevation distribution of post-FIRM construction relative to the 100-year flood elevation holds steady for future construction, when in fact many communities in the region have already implemented and are enforcing freeboard requirements, and many base flood elevations recently changed as a result of a restudy of coastal areas. The obsolescence of buildings is not accounted for in the FEMA predictions; presumably, the number of pre-FIRM and post-FIRM buildings built to outmoded floodplain management standards should decline with time. Replacement structures must be in compliance with NFIP regulations in effect at the time of their construction, and are thus better protected from flood (and wind) damage. Some communities, such as Hampton, are also adopting requirements for freeboard outside of the SFHA.

Recent research in other regions is estimating the negative impact from flooding and sea level rise on gross domestic product. In other words, this research is attempting to estimate overall impacts to the economy rather than just accumulating damage or losses to affected structures, families and businesses. There may be applications for this research in the Hampton Roads region in the future.

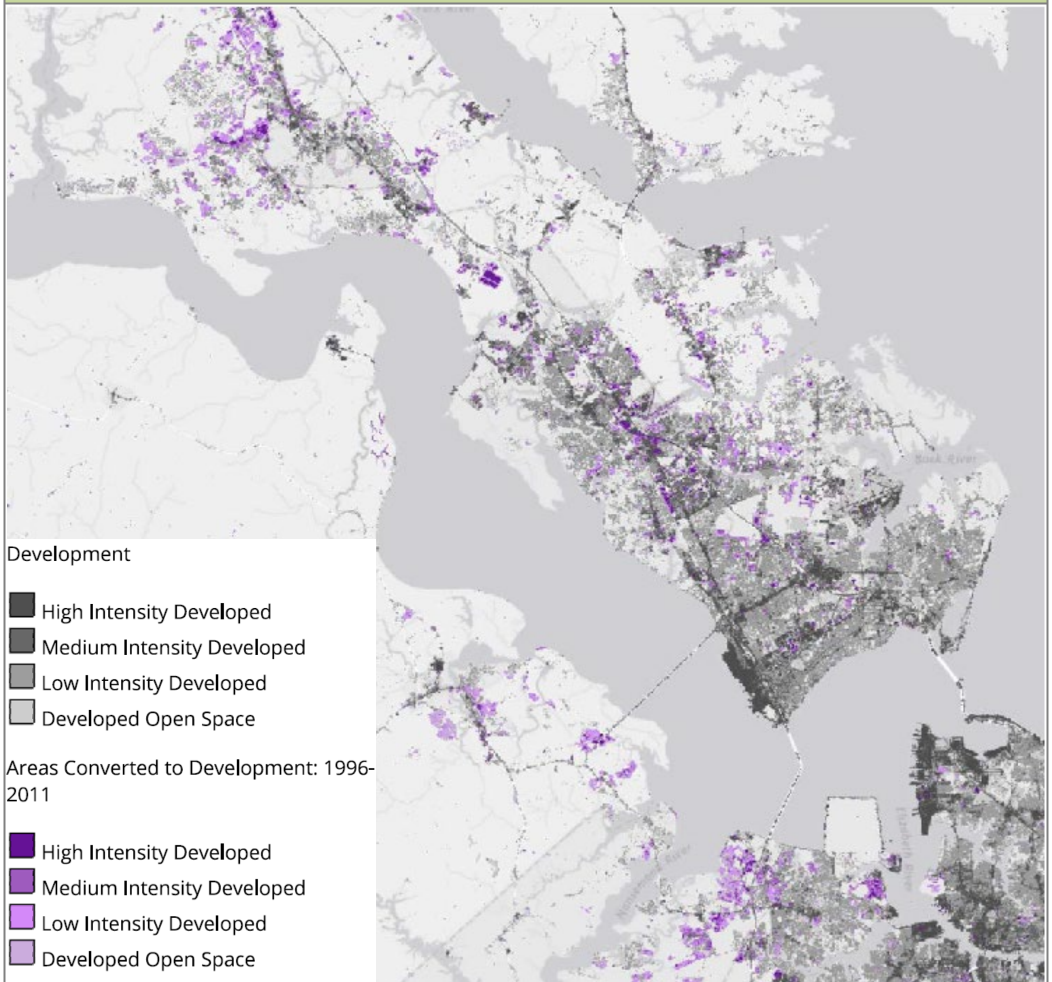
Communities in need of more detailed annualized estimates for the economic impacts of sea level rise in future scenarios, to include impacts to infrastructure and individual structures, must address three primary data needs:

1. Lowest floor elevations for all structures in and near the existing SFHA;
2. HAZUS Level 2 or Level 3 analysis for multi-frequency flood events and flood depths, with various scenarios for sea level rise, to provide sufficient results for annualization; and,
3. The functional, physical or economic obsolescence of existing development, and the variable requirements for flood-safe design for new construction.

FUTURE VULNERABILITY, LAND USE AND CLIMATE CHANGE IMPACTS

The NOAA Coastal Flood Exposure Mapper tool (http://www.coast.noaa.gov/floodexposure/#/map) uses recent land cover data to show where areas being developed may be impacted by varying levels of sea level rise. This tool can help provide planners with information needed to focus sea level rise mitigation efforts geographically. Summary maps are shown for each Hampton Roads subregion in **Figures 5.15 through 5.20**.

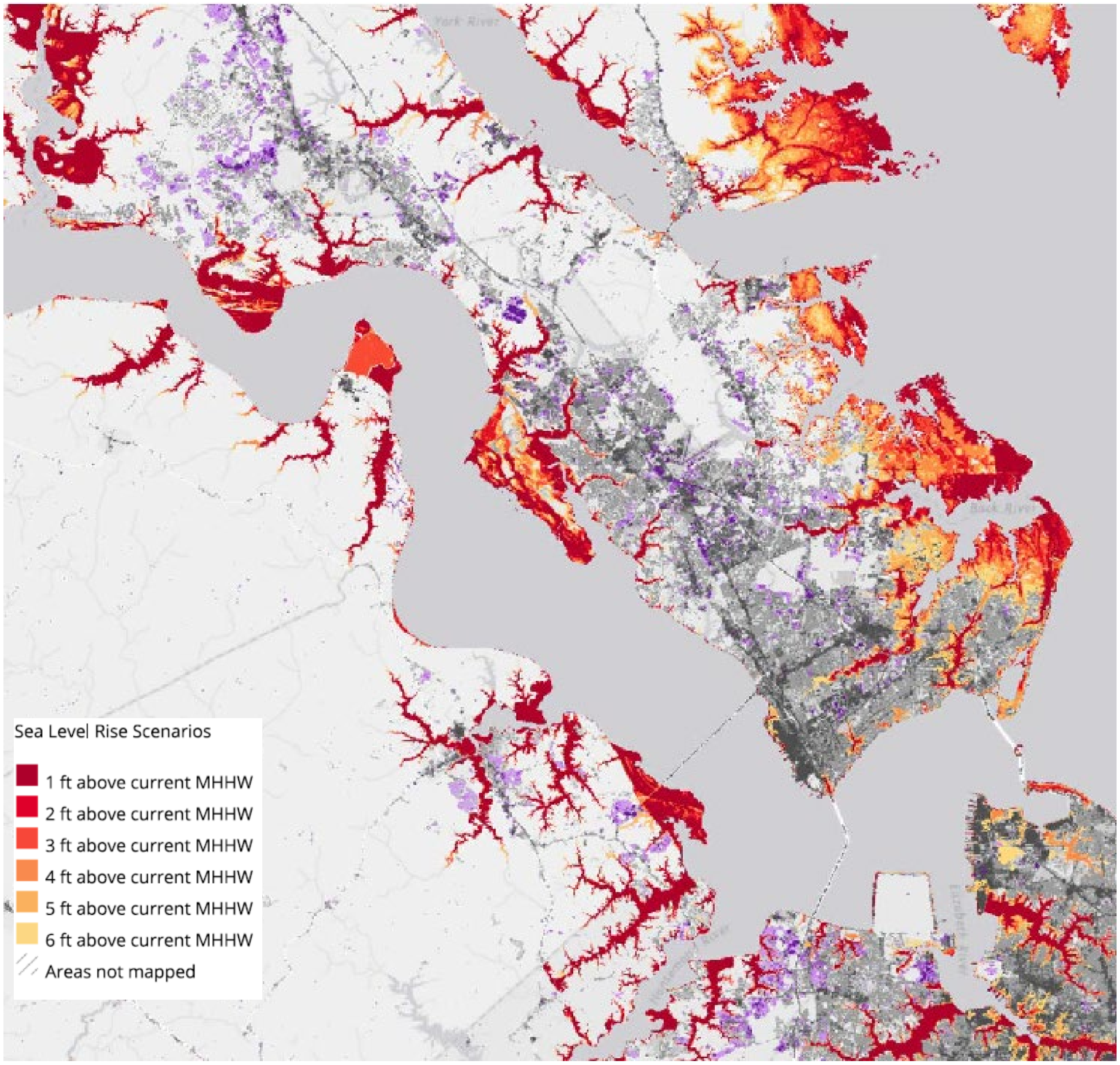
FIGURE 5.15: DEVELOPMENT PATTERNS, PENINSULA



2015

Source: NOAA Coastal Flood Exposure Mapper

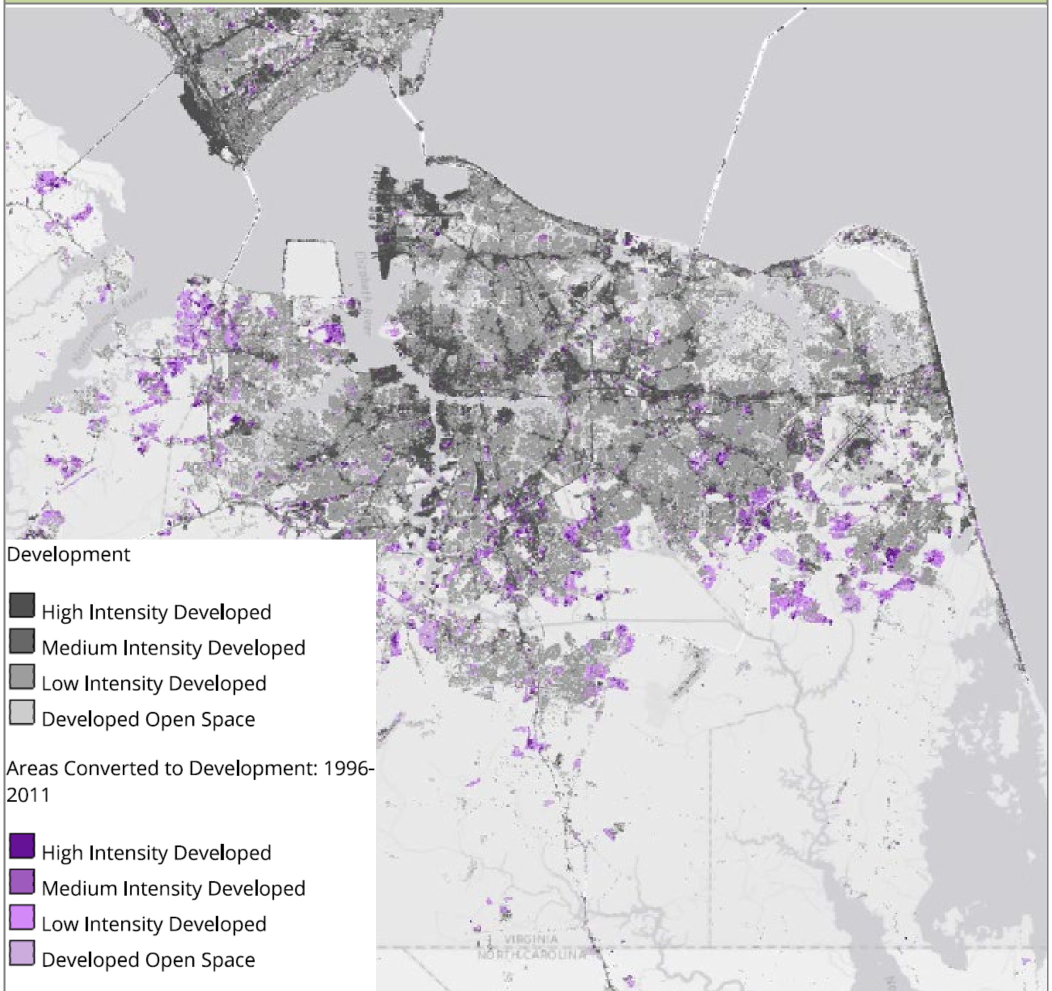
FIGURE 5.16: SEA LEVEL RISE SCENARIOS, PENINSULA



2015

Source: NOAA Coastal Flood Exposure Mapper

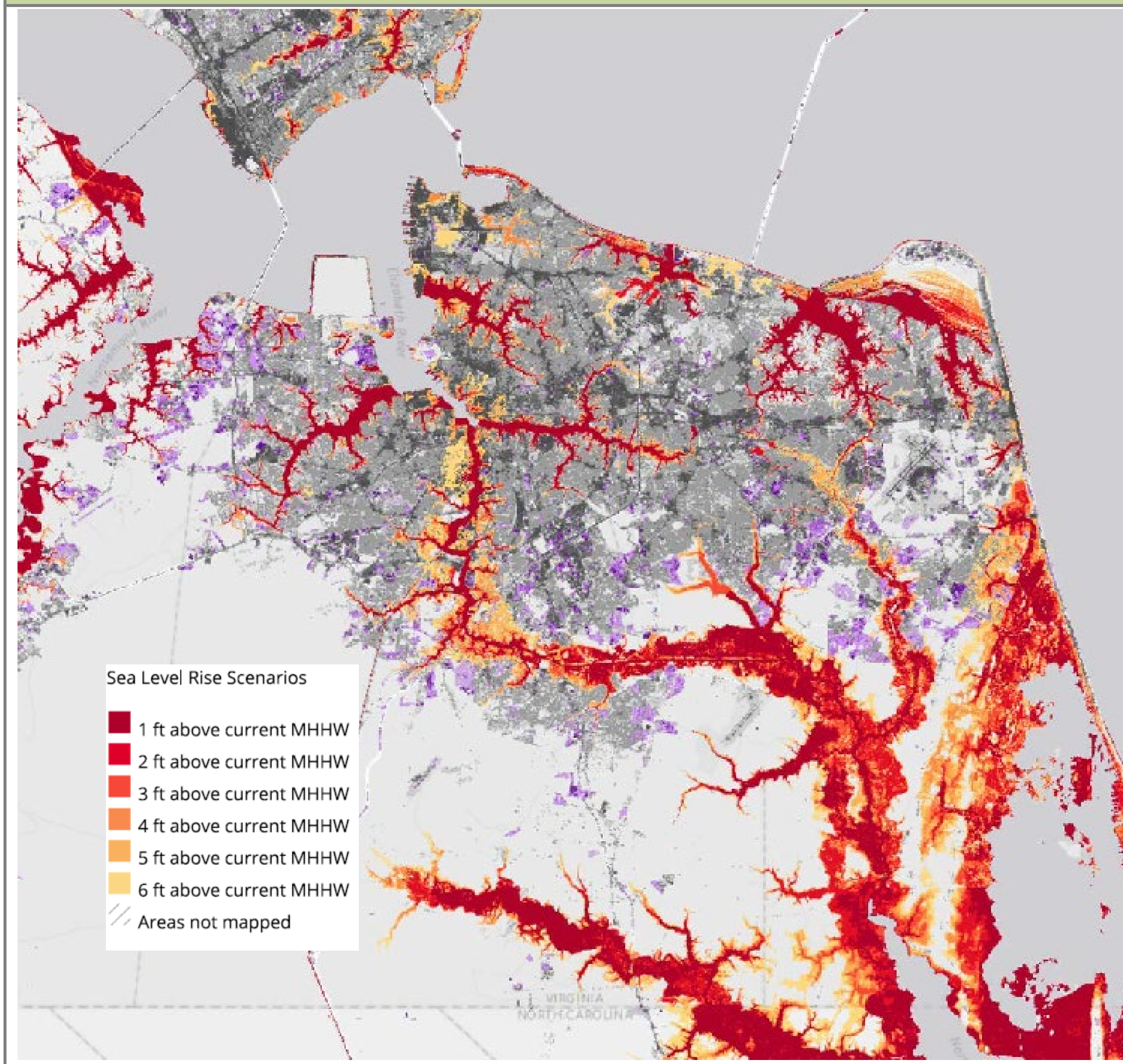
FIGURE 5.17: DEVELOPMENT PATTERNS, SOUTHSIDE



2015

Source: NOAA Coastal Flood Exposure Mapper

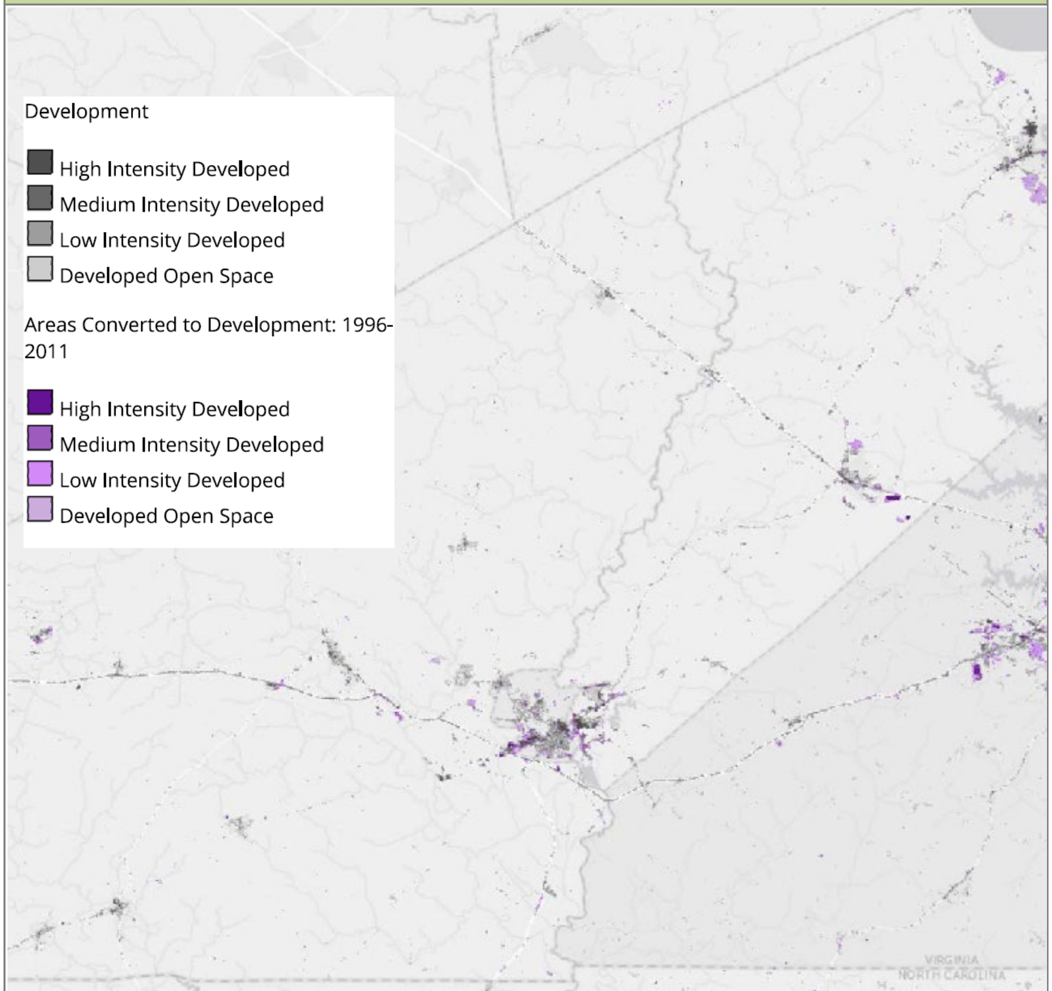
FIGURE 5.18: SEA LEVEL RISE SCENARIOS, SOUTHSIDE



2015

Source: NOAA Coastal Flood Exposure Mapper

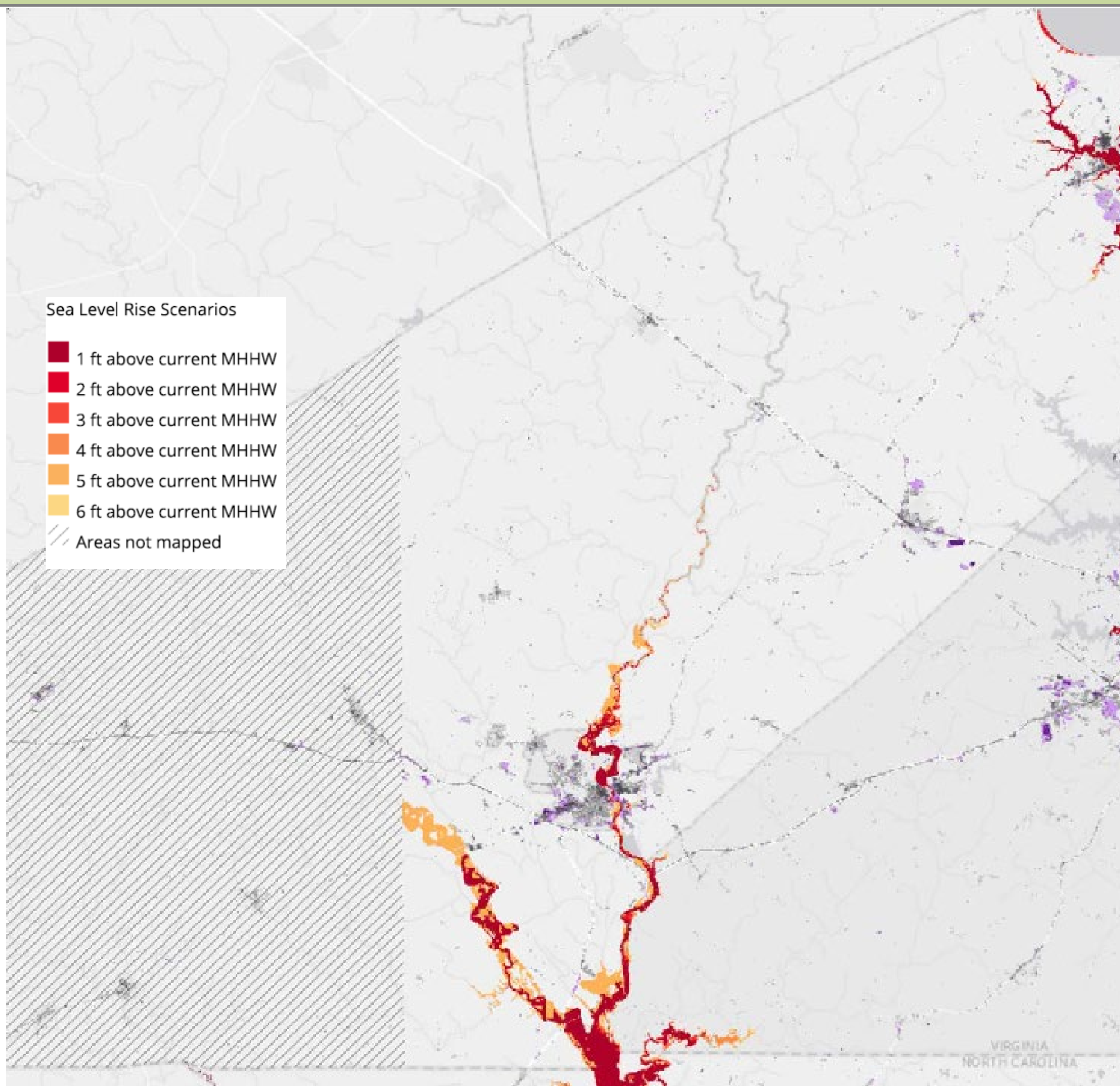
FIGURE 5.19: DEVELOPMENT PATTERNS, WESTERN TIDEWATER



2015

Source: NOAA Coastal Flood Exposure Mapper

FIGURE 5.20: SEA LEVEL RISE SCENARIOS, WESTERN TIDEWATER



2015

Source: NOAA Coastal Flood Exposure Mapper

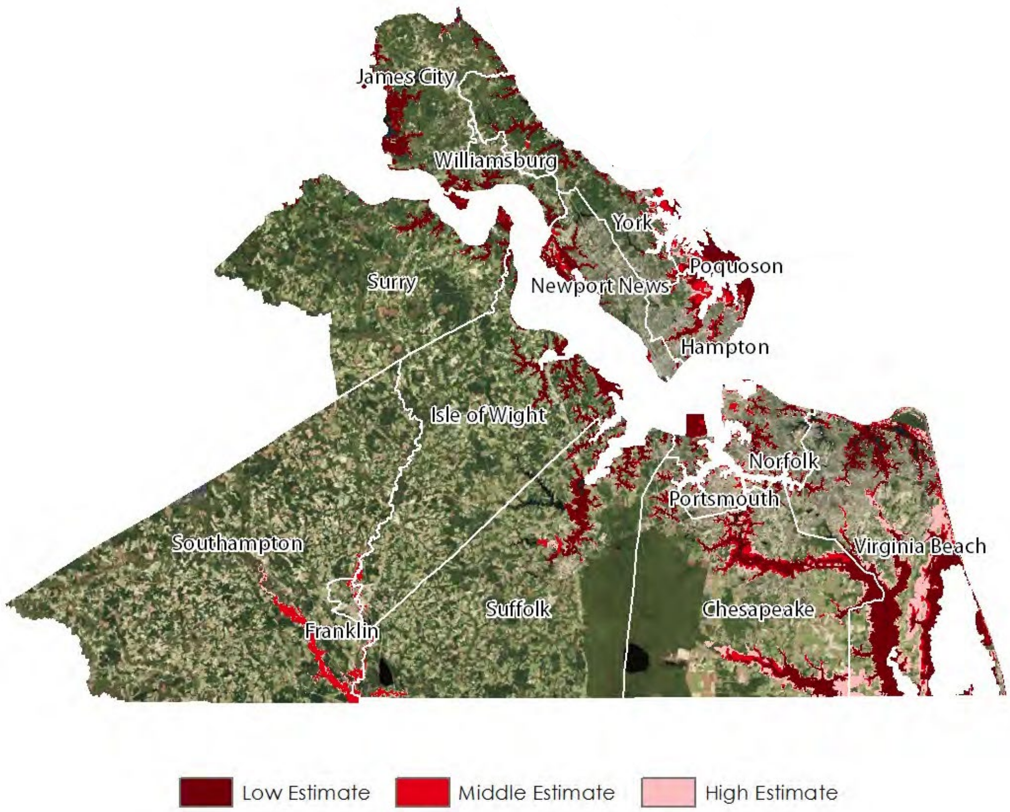
In a 2012 report entitled *Climate Change in Hampton Roads, Phase III: Sea Level Rise in Hampton Roads, Virginia,* HRPDC compiled maps and data to document those areas of the region that are exposed to one meter of sea level rise above spring high tide **(Figure 5.21)**. **Table 5.8** summarizes the report's findings, which highlight over $8.7 billion of vulnerability or exposure in the built environment. Norfolk, Virginia Beach and Chesapeake are the Hampton Roads communities with the highest population exposed to sea level rise. Hampton is fourth on the list and even has a larger number of housing units exposed than Chesapeake. Poquoson is a smaller community, but with a very high percentage of its land area and population exposed, the City must deal with the increasing vulnerability as frequency of damaging flooding increases. The exposure to sea level rise is lowest in the western part of the study area, including Southampton County and Franklin, where sea level rise may cause some moderate changes in river levels, but is not expected to have the dramatic impacts on homes, roads and businesses that it will in the eastern portion of the study area.

TABLE 5.8: EXPOSURE TO ONE METER SEA LEVEL RISE ABOVE SPRING HIGH TIDE (MIDDLE ESTIMATE)

SUBREGION	COMMUNITY	LAND AREA (square miles)	POPULATION	HOUSING UNITS	ROADS (total miles)	BUSINESSES
Peninsula	Hampton	12.6	14,066	6,011	97.0	263
	Newport News	9.5	4,321	1,896	8.3	28
	Poquoson	11.8	6,770	2,597	38.7	115
	Williamsburg	0.2	275	137	0.1	0
	James City County	14.9	1,796	835	4.5	12
	York County	11.0	5,483	2,195	34.6	64
Southside	Norfolk	6.5	24,715	8,955	75.5	532
	Portsmouth	7.0	4,655	2,089	17.5	127
	Suffolk	14.4	4,691	1,715	4.7	21
	Virginia Beach	58.0	21,160	10,051	66.9	389
	Chesapeake	32.4	15,983	5,731	65.2	380
Western Tidewater	Isle of Wight County	13.4	3,046	1,263	2.0	16
	Franklin	0.6	74	33	0.1	0
	Southampton County	7.8	149	64	2.0	1
	Surry County	5.4	107	59	1.3	0
TOTALS		**206**	**107,291**	**43,631**	**418**	**1,948**

Source: *Climate Change in Hampton Roads, Phase III: Sea Level Rise in Hampton Roads, Virginia.* HRPDC, July 2012.

FIGURE 5.21: AREAS EXPOSED TO ONE METER OF SEA LEVEL RISE ABOVE SPRING HIGH TIDE



Disclaimer: This map is for informational purposes only. Areas depicted as vulnerable are based on estimates only and should not be construed as being in imminent danger of inundation. The analysis depicted does not account for flood protection or control infrastructure. This map should not be used in place of official FEMA flood insurance rate maps. Users agree to hold harmless and blameless the Hampton Roads Planning District Commission and its representatives and its agents for any liability associated with the use of this map.

2012

Source: Climate Change in Hampton Roads, Phase III: Sea Level Rise in Hampton Roads, Virginia. HRPDC, July 2012.

SOCIAL VULNERABILITY

The National Risk Index does not include a risk or vulnerability analysis specific to sea level rise or land subsidence. In 2018, Virginia Beach conducted a very detailed analysis of socially vulnerable demographic groups using 2010 Census data, population projections, population distribution, as well as current and future 100-year floodplains, to more accurately assess the number of people at risk under current and future sea level rise scenarios. The conclusion was that the elderly population of Virginia Beach experiences a marginally disproportionate risk to coastal flood hazards, and that for every 1.5 feet of sea level rise, the percentage of people at risk to coastal flooding will double from present conditions. Currently, 6.5% of the population is at risk; with 1.5 feet of sea level rise, 12.5% of the population will be at risk; and with 3 feet of sea level rise, approximately 26-percent of the population will be at risk. Other demographic groups were not shown to have a disproportionate risk to coastal flood hazards.[7] The detailed study methodology used in Virginia Beach represents a possible methodology for additional study of social vulnerability to sea level

[7] *Demographic and Population Vulnerability Analysis: City of Virginia Beach, Virginia*, September 13, 2018. Accessed online at: https://www.vbgov.com/government/departments/public-works/comp-sea-level-rise/Documents/new%20PWCN-15-0014_WO12B_SocialVulnerability_Final_20180913.pdf

rise in all of Hampton Roads. Study of patterns of flood insurance coverage and other mitigation techniques could be incorporated into the analysis. The Virginia Beach results and conclusions may not necessarily apply broadly across the region due to variation in development patterns and population change; however, the disproportionate impact on the elderly compared to other vulnerable groups included in the analysis (people of color, children under five years old, institutionalized people, people with limited English proficiency, people with limited income, and people with disabilities) is noteworthy for mitigation planning purposes.

TROPICAL/COASTAL STORM

Historical evidence shows that Hampton Roads is vulnerable to damaging storm-force winds, whether associated with coastal storms like nor'easters, or tropical storms such as hurricanes. As discussed in detail in the *Hazard Identification and Analysis* section, 76 hurricanes and tropical storms have passed within 75 miles of the region since 1851. This equates to a 45-percent annual chance that a storm will similarly impact the region.

ESTIMATES OF POTENTIAL LOSSES

Detailed loss estimates for the wind damage associated with the tropical storm hazard were developed based on probabilistic scenarios using Hazus (Level 1 analysis). **Table 5.9** shows estimates of potential building damage for the 100-year return period, and annualized total losses. In summary, the region may be susceptible to an estimated total of approximately $1.65 billion in building damages from a 100-year wind event.

TABLE 5.9: ESTIMATES OF POTENTIAL BUILDING DAMAGE – WIND ONLY

SUBREGION	COMMUNITY	BUILDING DAMAGE	CONTENTS & INVENTORY DAMAGE	TOTAL*	ANNUALIZED TOTAL LOSSES
Peninsula	Hampton	$91,781,000	$42,021,000	$138,514,000	$7,265,000
	Newport News	$53,985,000	$10,663,000	$68,841,000	$5,035,000
	Poquoson	$9,575,000	$3,971,000	$13,874,000	$670,000
	Williamsburg	$1,366,000	$392,000	$1,766,000	$236,000
	James City County	$10,477,000	$3,944,000	$14,428,000	$1,841,000
	York County	$35,966,000	$18,024,000	$55,067,000	$2,997,000
Southside	Norfolk	$168,291,000	$28,515,000	$213,399,000	$10,494,000
	Portsmouth	$48,722,000	$8,960,000	$61,573,000	$3,824,000
	Suffolk	$23,969,000	$6,293,000	$31,191,000	$3,031,000
	Virginia Beach	$579,495,000	$190,242,000	$815,974,000	$37,078,000
	Chesapeake	$160,748,000	$55,549,000	$224,879,000	$12,459,000
Western Tidewater	Isle of Wight County	$8,008,000	$2,592,000	$10,789,000	$1,174,000
	Franklin	$381,000	$110,000	$491,000	$207,000
	Southampton County	$650,000	$268,000	$919,000	$437,000
	Surry County	$332,000	$142,000	$474,000	$165,000
Totals		**$1,193,746,000**	**$371,686,000**	**$1,652,179,000**	**$86,913,000**

* Also includes income losses from relocation, lost wages, and lost rental income.
Source: Hazus

Based on the data in Table 5.9, Virginia Beach, Chesapeake and Norfolk have the highest annualized total losses from wind associated with a 100-year wind event. These communities are also the most vulnerable for flood, so these 3 communities are considered the most vulnerable to the combined wind and flooding effects of Tropical Storms. Hampton and Newport News are also very vulnerable to wind effects from the 100-year wind event. Franklin, Williamsburg, Surry County and Southampton County are significantly further inland and are less likely to experience the devastating impacts of the remainder of Hampton Roads. Franklin has annualized wind-related damages of only $207,000; a small portion of the $37 million calculated for Virginia Beach.

Hazus was also used to produce building damage estimates based on percentage of damage (by damage state) for the 100-year return period (**Table 5.10**).

TABLE 5.10: NUMBER OF BUILDINGS DAMAGED, BY DAMAGE STATE[8], 100-YEAR WIND EVENT

OCCUPANCY TYPE	MINOR	MODERATE	SEVERE	DESTRUCTION
Residential	29,180	3,407	70	68
Commercial	1,214	204	20	0
Industrial	307	45	8	0
Other	287	36	5	1
TOTAL	**30,988**	**3,692**	**103**	**69**

Source: Hazus

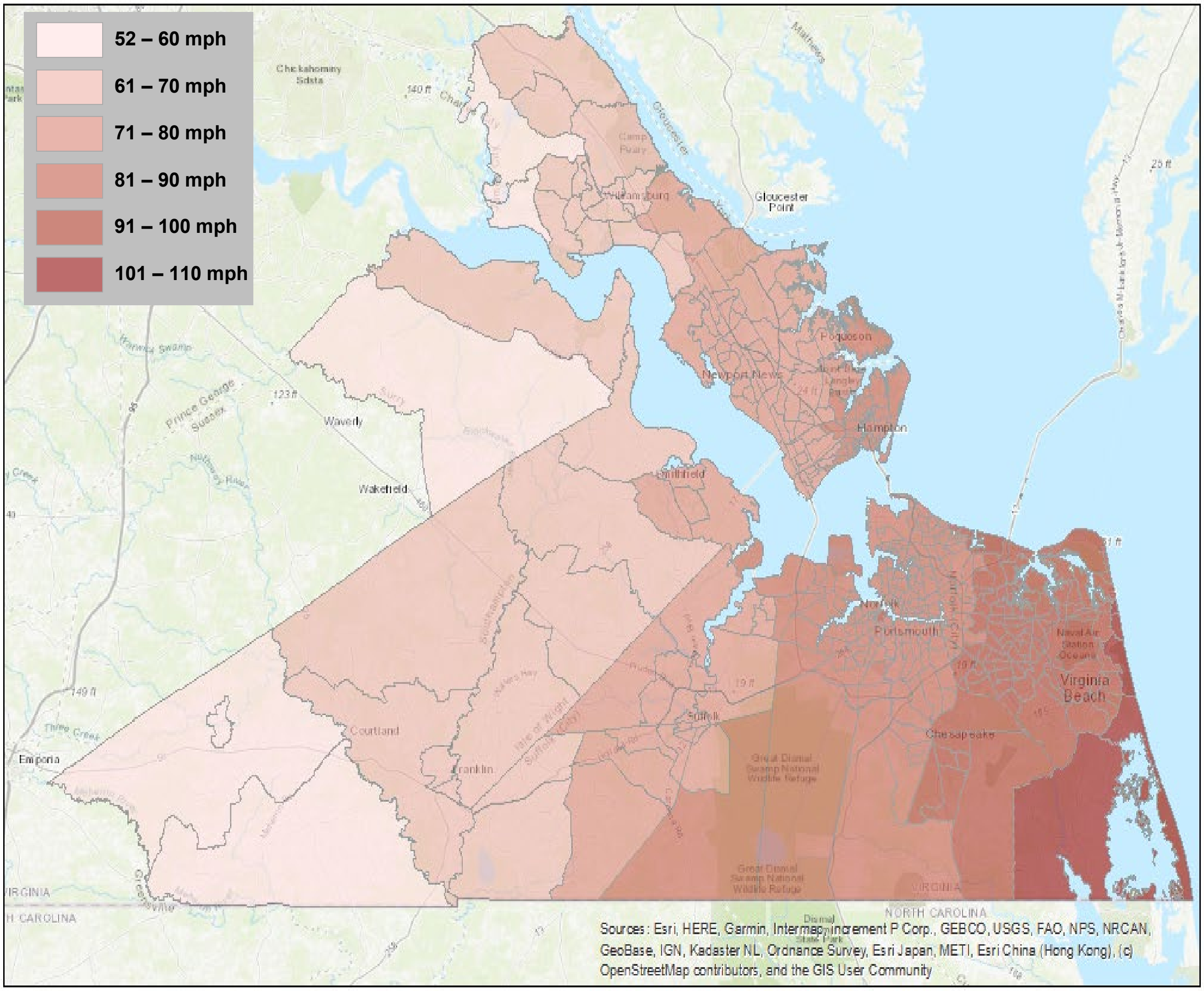
FUTURE VULNERABILITY, LAND USE AND CLIMATE CHANGE IMPACTS

The type of building construction has a significant impact on potential damages from high wind events in the future, as type of construction is also a key factor in determining the life of a structure. Basic building types in declining order of wind vulnerability are manufactured, non-engineered wood, non-engineered masonry, lightly engineered and fully engineered buildings. According to the HAZUS study, the primary construction type in the study area is wood framed (61 percent), varying from single story to multiple stories, although some masonry and steel properties are present as well. With the prevalence of non-engineered, wood-framed structures throughout the Hampton Roads region, a majority of structures in the area could be classified as having a high level of vulnerability to damages due to a high wind event in the future. Using HAZUS, an analysis of the damage caused by a 100-year frequency wind event indicates that 22,632 wood-framed structures would have minor, moderate, severe or destruction damage, while 10,346 masonry structures would have minor, moderate, severe or destruction damage.
All future structures built in the Hampton Roads region will likely be exposed to hurricane and tropical storm-force winds and may also experience damage not accounted for in the loss estimates presented in this section, with the highest vulnerability in structures near the Atlantic coast as shown in **Figure 5.22**, which show vulnerability to 100-year peak gusts by Census tract for the region. The State's Uniform Statewide Building Code continues to reduce vulnerability of newly constructed buildings to the wind hazard.

The VASEM 2021 report concludes that the research on climate change impacts in the study region is conflicted regarding increased frequency of Atlantic Coast hurricanes. However, the report indicates consensus among the researchers that there will be an increase in average cyclone intensity, precipitation rates, and the number of strong storms. Strong storms combined with sea level rise are particularly alarming for the eastern region of the study area. Even in rural areas in the western portion of the study area, increasing storm intensity can damage crops and soil in addition to vulnerable agricultural structures.

[8] For detailed definitions of the four damage states, please refer to the HAZUS-MH User Manual for the Hurricane Model.

FIGURE 5.22: 100-YEAR RETURN PERIOD PEAK GUST (MPH) BY CENSUS TRACT



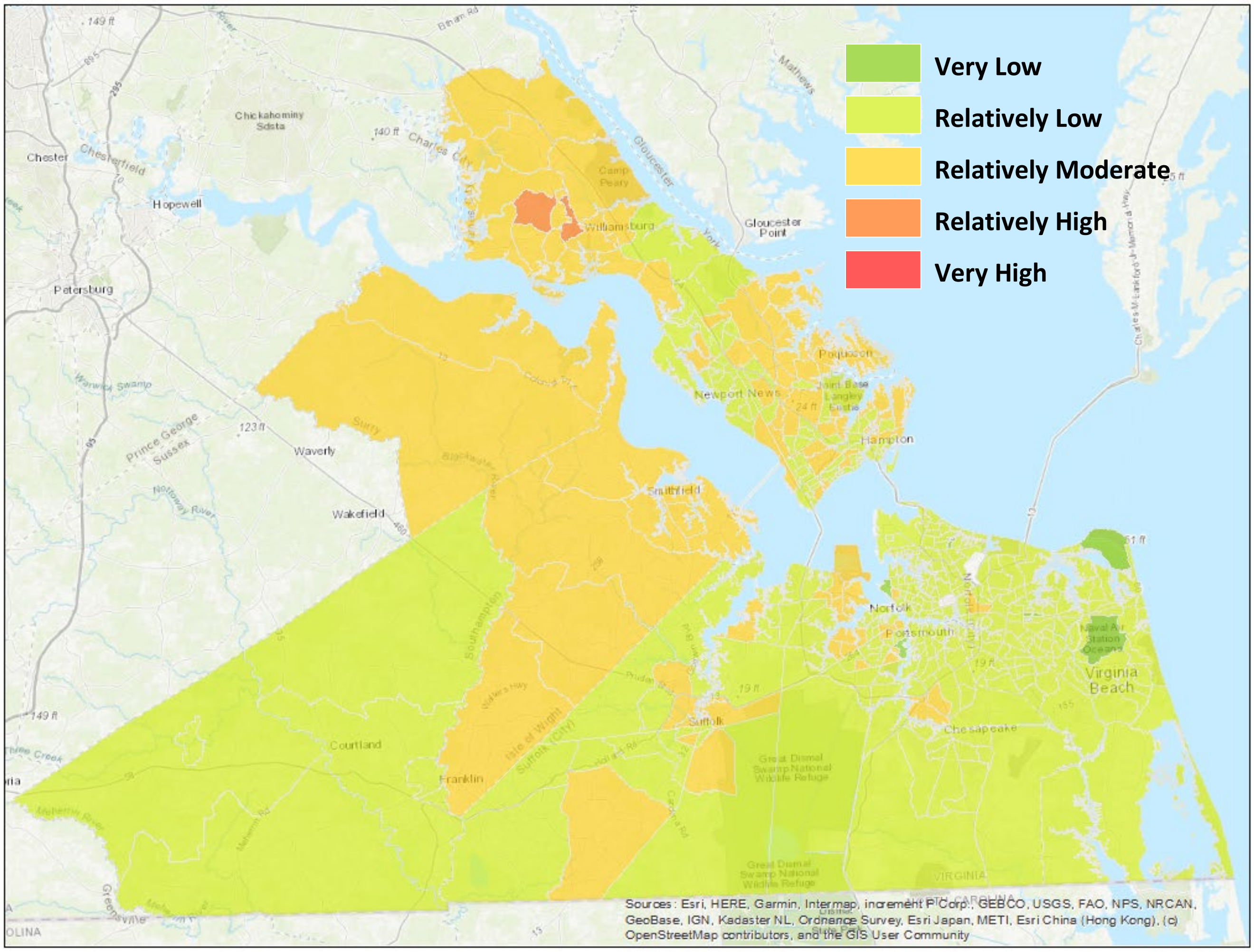
2021

Source: Hazus

SOCIAL VULNERABILITY

The NRI hurricane risk ratings by Census tract, which include a factor for social vulnerability, are shown in **Figure 5.23**. Most of the southern portion of the study area is shown as having low risk, while much of the Peninsula, Surry County and Isle of Wight County have relatively moderate risk. The Williamsburg area is shown as having relatively high social vulnerability to hurricane. This rating seems out of sync with local experience, and may be a result of the lower reported occurrences of hurricane damage in the NCEI database. When compared to the NRI hurricane risk ratings for North Carolina tracts just south of the state line, the Virginia ratings are remarkably lower.

FIGURE 5.23: NATIONAL RISK INDEX, HURRICANE RISK RATING



2021

Source: National Risk Index, 2021

LANDSLIDE/COASTAL EROSION

As documented in the *Hazard Identification and Analysis* section, the Hampton Roads region is vulnerable to the long term effects of both landslide and coastal erosion. Coastal erosion remains a significant hazard of concern that must continue to be addressed through sustained shoreline management practices. To date, existing strategies for shoreline hardening and the implementation of numerous replenishment projects have been successful in minimizing major coastal erosion losses within parts of the planning region.

ESTIMATES OF POTENTIAL LOSSES

It is difficult to determine the amount of property or the number of structures that are vulnerable to the erosion or landslide hazard. The jurisdictions in the region have demonstrated, through past projects such as the Virginia Beach Erosion Control and Hurricane Protection Project that they are willing to take on projects to protect coastal residences and commercial buildings in the hazard zone. Landslides are a much less frequent historical occurrence and are typically addressed by the landowner with little government involvement.

The Comprehensive Coastal Inventory Program (CCI) at VIMS has created a GIS shoreline database to develop revised Shoreline Situation Reports (SSR) for cities and counties in the region. SSRs were developed by VIMS in the 1970s, and are available online at: http://ccrm.vims.edu/gis_data_maps/index.html. These reports have been the foundation for shoreline management planning in the region for more than 30 years. CCI has developed new protocols for collecting, disseminating, and reporting data relevant to shoreline management issues today. New SSRs are currently available online at: http://ccrm.vims.edu/gis_data_maps/shoreline_inventories/. Southampton County and Franklin are not included in the Chesapeake Bay Shoreline Inventory project.

The data inventory developed for the new SSRs is based on a three-tiered shoreline assessment approach. In most cases this assessment characterizes conditions that can be observed from high resolution imagery. A small boat navigating along the shoreline was used to verify the remotely sensed data and collect features that could not be ascertained from the imagery. The three tiered shoreline assessment approach divides the shore zone into three regions: 1) the immediate riparian zone, evaluated for land use; 2) the bank, evaluated for height, stability, cover and natural protection; and 3) the shoreline, describing the presence of shoreline structures for shore protection and recreational purposes. Final prepared maps are available online at the site noted above. Although the maps alone do not indicate potential loss from erosion, they provide areas for future study and indicate where shoreline structure protection is currently in place to protect against coastal erosion.

Figure 5.24 provides a sample of the maps available in the SSR for the City of Hampton.

The Atlantic Ocean shorelines in Virginia Beach and Norfolk are the most vulnerable areas of Hampton Roads with regard to coastal erosion. The fetch for tropical storms and nor'easters is sufficient to create wind-driven waves that cause significant damage on a regular basis. The Chesapeake Bay shorelines of Hampton, Poquoson and Norfolk are also susceptible to wind-driven wave action that causes coastal shoreline erosion. The James River and York River are deep and wide enough to cause some shoreline erosion in Suffolk, Isle of Wight County, Newport News, York County, Surry County and James City County. Riverine erosion in Franklin and Southampton County, while not as dangerous to people and homes, creates limited vulnerability to infrastructure and the built environment.

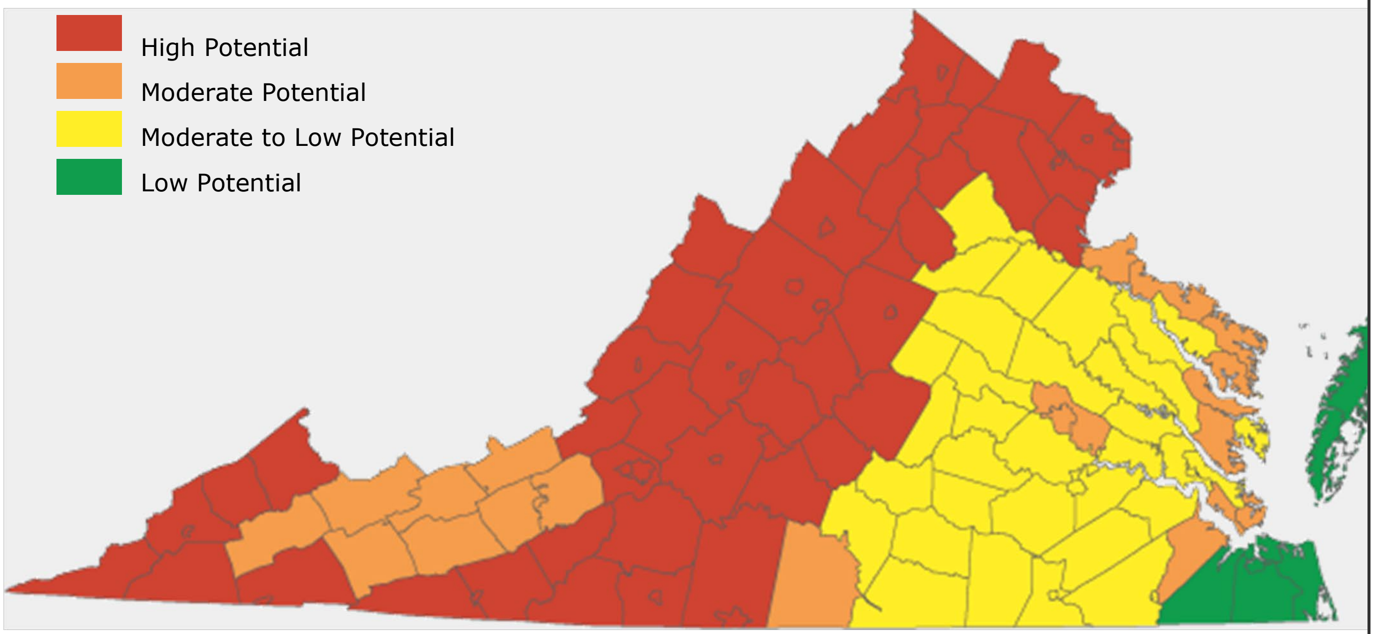
FIGURE 5.24: BANK CONDITIONS, HAMPTON RIVER

2021

Source: VIMS CCI

Landslide events in the region are considered a moderate- to low-probability event, with very localized impacts when and where they occur. Virginia Department of Energy provided the map in **Figure 5.25** that shows counties in Virginia and related susceptibility to landslides. Because damages are rarely quantified or are extremely limited in nature, average annual damages from landslides are not very useful. Occurrence intervals are similarly flawed because of the short period of record. Figure 5.25, however, indicates that the region’s highest relative vulnerability is in in Isle of Wight, Newport News, Hampton, and Poquoson, perhaps due to the unconsolidated soils in the area.

FIGURE 5.25: SUSCEPTIBILITY TO LANDSLIDES BY VIRGINIA COUNTY/CITY



Source: Virginia Department of Energy

FUTURE VULNERABILITY, LAND USE AND CLIMATE CHANGE IMPACTS

Generally speaking, future vulnerability to both landslide and coastal erosion will depend greatly on appropriate local site planning and permitting, as well as each community's approach to sea level rise and associated flooding problems. Planned mapping regarding landslide risk, if appropriately shared with local land use planners and incorporated into site planning and stormwater regulations, may reduce the incidence of landslides that affect structures in the future.

The Commonwealth's Stormwater Management program and enabling statutes help to manage future land use, and reduce stream channel erosion, water pollution, depletion of groundwater resources and more frequent localized flooding to protect property value and natural resources throughout the region. While waves are the primary force in determining the prevailing shoreline processes in the short-term of months or individual storms, sea level rise is the primary driver of shoreline change over the long-term. Documented sea level rise in the study area is expected to accelerate and will continue to impact shoreline morphology in the future.

Current building code requirements restrict fill materials used to fill a building site prior to new construction. But homes built on debris fill, or on oversteepened slopes (such as along a river bluff) may be more vulnerable to landslides in the future, especially on or near slopes near the contact between the Yorktown and Eastover convergence. The Virginia Department of Energy is interested in identifying at-risk areas in the region.

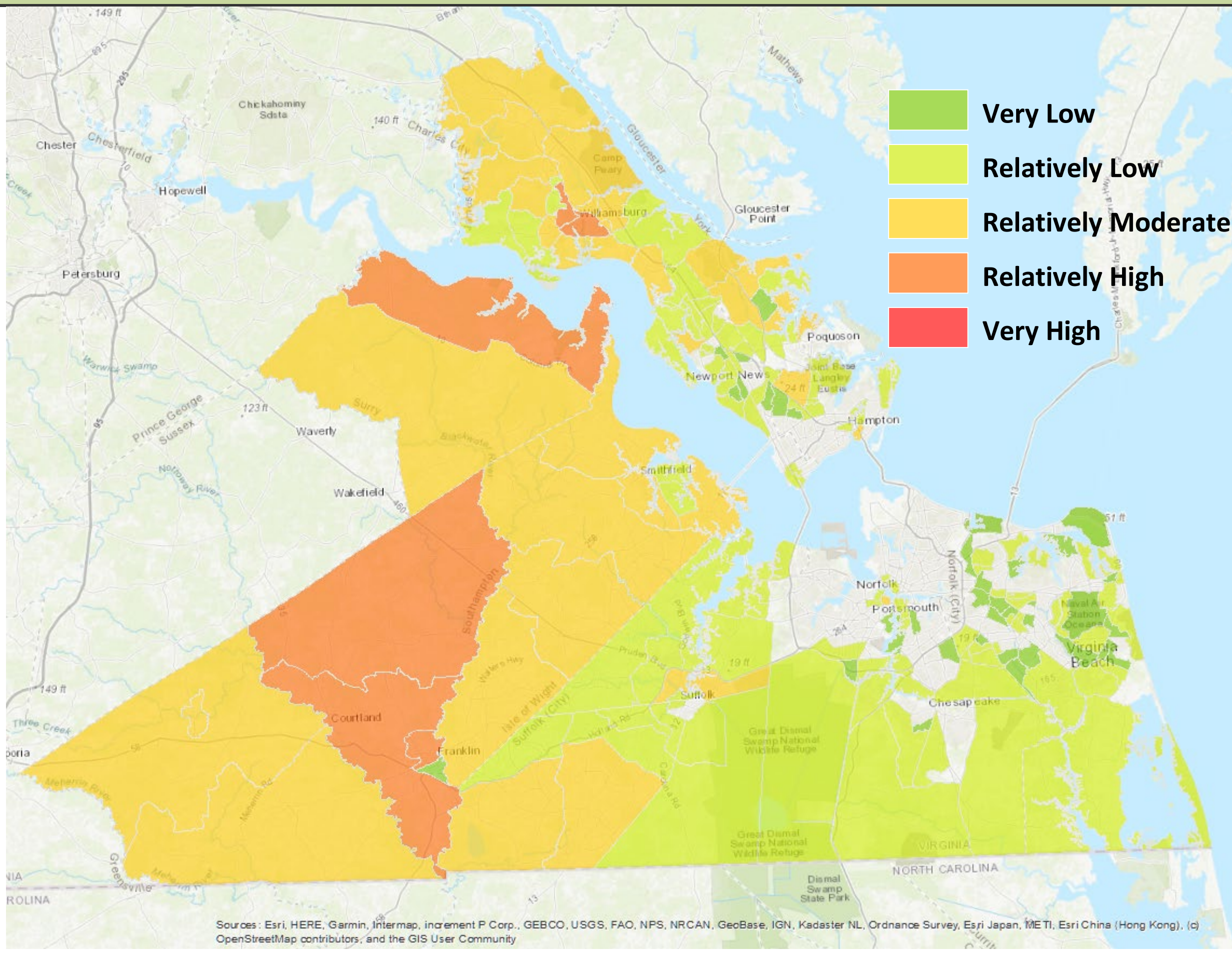
Climate change has the potential to worsen the risk associated with landslides in the study area. Precipitation patterns are expected to become more intense, prolonged and frequent as a result of a warming climate. There is a risk that these precipitation events could destabilize fragile slopes in the region, leading to more frequent and damaging landslides.

SOCIAL VULNERABILITY

Any measurement of social vulnerability to shoreline or coastal erosion requires considerably more knowledge about the location of vulnerable structures in each locality. Mitigation Action MH-4 in the *2018 Commonwealth of Virginia Hazard Mitigation Plan* proposes VDEM involvement in assisting localities, state agencies, and PDCs with identification of vulnerable structures and application for funding to implement soil stabilization projects to reduce risk to structures or infrastructure from erosion. Future revisions to the plan may be able to more precisely define socially vulnerable areas of the study region for shoreline or coastal erosion using information developed under this or a similar effort.

The region's NRI risk ratings for landslide are shown in **Figure 5.26**. The USGS Landslide Hazard Map was used as an input for hazard susceptibility, creating a raster that classified all of the conterminous United States as having either "some" or "negligible" landslide susceptibility based on slope and relief. This method may not adequately capture the unique geological conditions that are suspected as contributors to landslides in the study region. Nevertheless, the vulnerability shown in Figure 5.26 is a starting point for discussions regarding factors that could affect a household's vulnerability to landslide.

FIGURE 5.26: NATIONAL RISK INDEX RATING, LANDSLIDE



2021

Source: NRI, 2021

TORNADO

Historical evidence shows that the Hampton Roads region is vulnerable to tornado activity, which is often associated with other severe weather events such as thunderstorm or tropical cyclone activity.

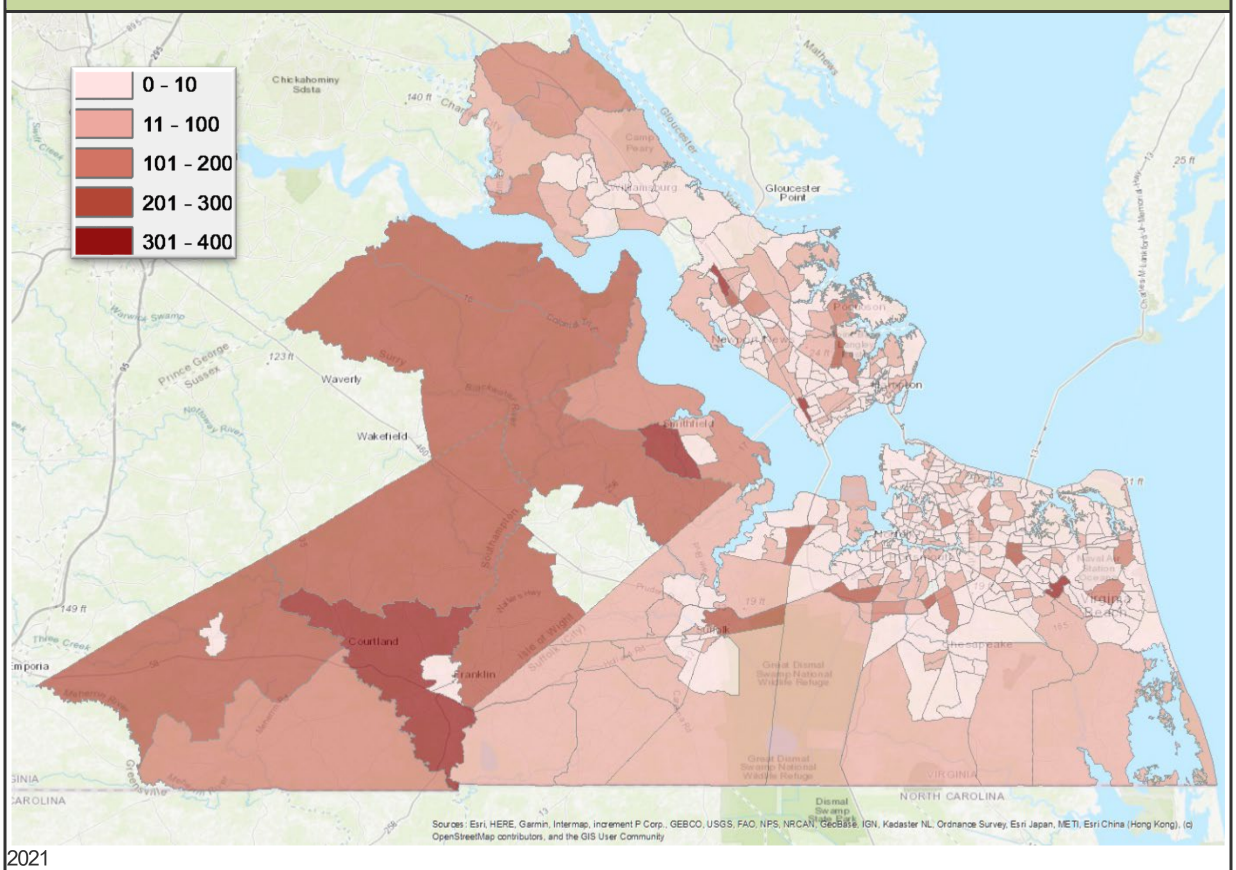
ESTIMATES OF POTENTIAL LOSSES

Because it cannot be predicted where a tornado may strike, it is not possible to map geographic boundaries for this hazard or produce detailed loss estimates. Therefore, the total dollar exposure figure of $204 billion for all buildings and contents within the region is considered to be exposed and could potentially be impacted on some level by the tornado hazard.

Low-intensity tornadoes may not completely destroy a well-constructed building, although even the most well-constructed buildings are vulnerable to the effects of a more intense (F2 or higher) tornado. The statewide building code provides a reasonable level of protection for newly constructed buildings, while structures built before the code went into effect are most vulnerable to damage.

Because manufactured homes are particularly vulnerable to damage from tornadoes, HAZUS was used to show geographic concentrations of manufactured homes in the study area. **Figure 5.27** is a map showing the number of manufactured homes by Census tract from the 2010 Census data generated by HAZUS.

FIGURE 5.27: NUMBER OF MANUFACTURED HOMES BY CENSUS TRACT



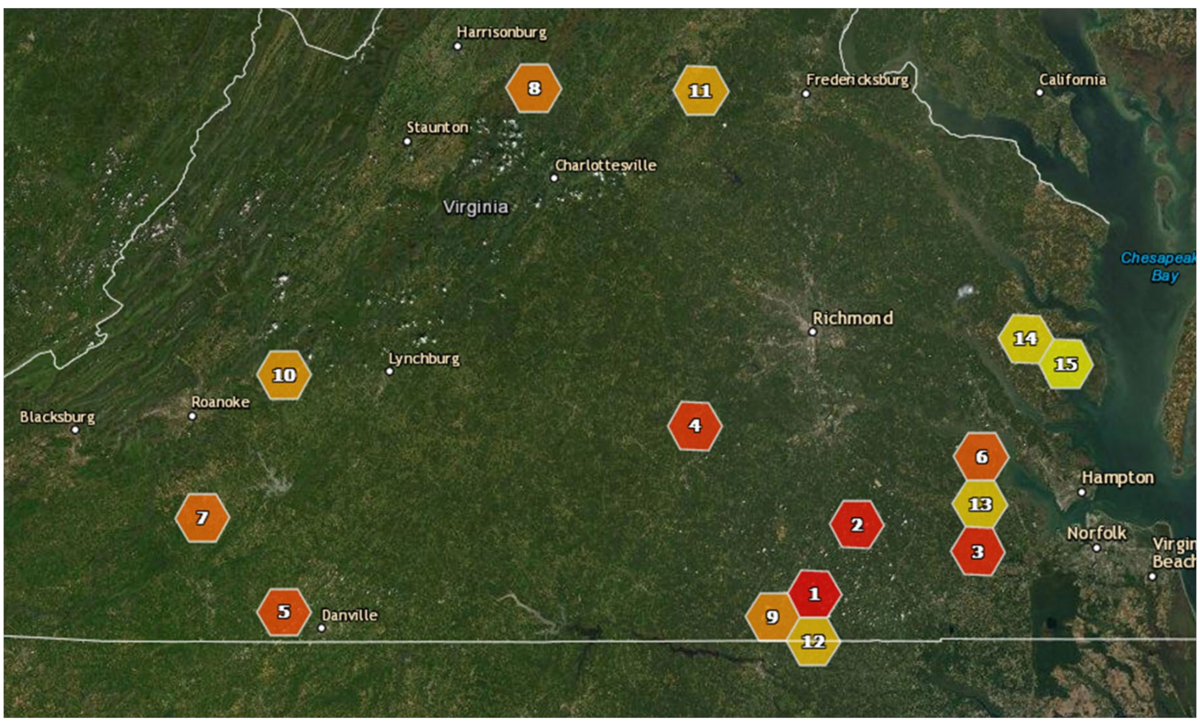
Source: Hazus and 2010 U.S. Census

Based on historic property damages for the 26-year period between 1995 and 2021 as shown in *Section 4, Hazard Identification and Risk Analysis*, there were 77 tornado events with an annualized loss estimate of $24.3 million and annual probability of 3.0% percent.

While Figure 4.18, Historical Tornado Hazard Frequency, and Figure 5.27, Number of Manufactured Homes by Census Tract, are useful for seeing where tornadoes have historically struck and where they could potentially damage a specific type of structure, the figures do not show measured differences in vulnerability among study area communities. Because tornadoes are driven by larger scale air masses and storm systems and these storm systems affect the Hampton Roads region uniformly, the region's vulnerability to tornadoes is quite uniform. The population concentrations in the urbanized areas of the Peninsula and Southside Hampton Roads may experience more damage as a result of a similar event in the more rural areas of Southampton County or Isle of Wight County, for example, but the vulnerability to tornado strike is uniform throughout the study area.

Researchers at Old Dominion University who have been researching spatial variability and trends in tornado occurrence in the Commonwealth, overlaid areas of increased tornado activity with the highest percentage of manufactured homes in the state, based on data from the 2014-2018 American Community Survey. Based on their analysis, there are several areas that have experienced an increased trend in number of tornadoes since 1950, and which have a high concentration of mobile homes, including specific areas in: Surry County and Isle of Wight County. **Figure 5.28** from the ODU study shows these areas in more detail.

FIGURE 5.28: VIRGINIA TORNADO MOBILE HOME RISK INDEX



Source: Old Dominion University web page, accessed online 2021 at: https://odu-gis.maps.arcgis.com/apps/Cascade/index.html?appid=723e660c2c09447fa8a57d3186dc8d2a

FUTURE VULNERABILITY, LAND USE AND CLIMATE CHANGE IMPACTS

All future structures built in Hampton Roads are likely to be exposed to the tornado hazard. The link between changing climate and tornado severity and frequency is currently unclear. One problem is that long-term trends are difficult to determine, as records only go back to the 1950s. Another issue is that as population centers have grown and shifted over time, the reporting of tornadoes has been inconsistent.

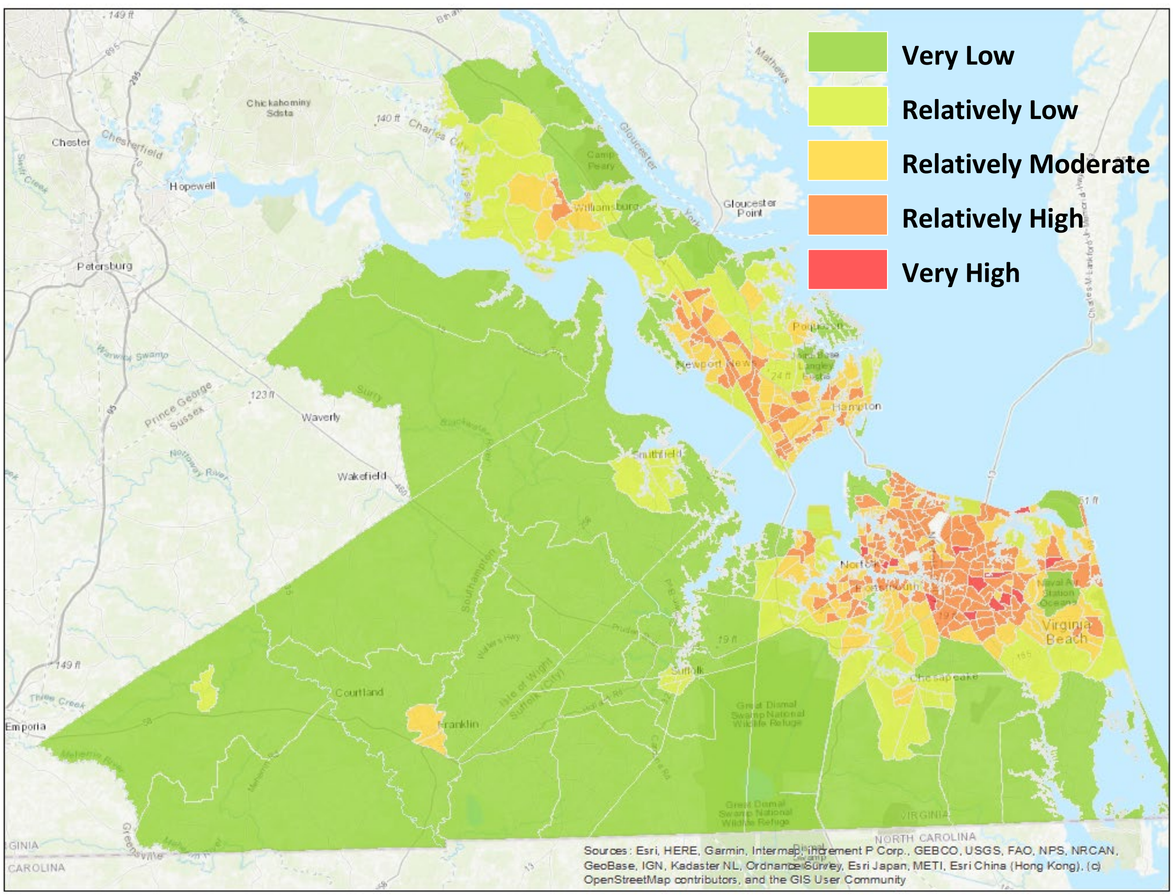
Also, improved observation technology (such a Doppler radar) allows for detection of events that was not possible in earlier years.

Researchers are working to better understand how the fundamental elements required for tornado formation – atmospheric instability and wind shear – interacts with changing climate conditions. Researchers expect that a warmer, wetter climate will allow for more frequent atmospheric instability. However, it is also possible that a warmer climate will dampen the probability of wind shear. Recent trends observed in the Midwest are inconclusive. A changing climate change could also shift the traditional timing or expected locations for tornadoes and have less impact on the total number of tornado occurrences.

SOCIAL VULNERABILITY

The NRI risk ratings for tornadoes are shown in **Figure 5.29** by Census tract. Despite the higher numbers of manufactured homes in the rural, southwestern portions of the study area, the damage history and built infrastructure exposure in the urbanized areas of the lower Peninsula and Southside are likely culprits in the rating disparity.

FIGURE 5.29: NATIONAL RISK INDEX RATING, TORNADO



2021

Source: National Risk Index, 2021

WINTER STORM

Historical evidence shows that the Hampton Roads region is vulnerable to winter storm activity and the wind-related impacts of nor'easters, including heavy snow, ice, extreme cold, freezing rain, and sleet.

ESTIMATES OF POTENTIAL LOSSES

Because winter storms typically affect large areas beyond county and municipal boundaries, it is not possible to map geographic locations at specific risk from this hazard or produce detailed loss estimates. Therefore, the total dollar exposure figure of $204 billion for all buildings and contents within the region is considered to be exposed and could potentially be impacted by the winter storm hazard. Based on historic property damages for the past 25 years (1996 to 2021), an annualized loss estimate of $805,800 and annual probability of 112% was generated for the winter storm hazard. Potential losses may be inflated by factors such as the costs associated with the removal of snow from roadways, debris clean-up, indirect losses from power outages, and the tendency of the NCEI data to combine metropolitan regional damages. Per the data in Table 4.13, no damages were reported for any of the NCEI database storms noted since the previous plan. Failure to report damages can significantly skew the data results.

Structures built prior to Virginia's statewide building code are somewhat more vulnerable to damage from severe winter storms where snow and ice may accumulate on rooftops, especially if snow loads were not accounted for in the original structure design. Because manufactured or mobile homes are also very susceptible to damage of roof collapse or additional damage due to their design features, HAZUS was used to show geographic concentrations of manufactured homes in the study area. **Figure 5.27** is a map showing manufactured homes by Census tract from the 2010 Census data generated by HAZUS.

Due to the consistency in the study area's basic geographic characteristics, winter storms can be expected to affect Hampton Roads' communities in a similar way. However, warm ocean currents offshore of Virginia Beach can occasionally diminish the effects of winter storms on the communities adjacent to larger bodies of water, including Virginia Beach, Norfolk, Hampton, and Poquoson. Temperature differences of a few degrees in these eastern communities can cause faster melting of snow and ice, and may result in a "snow line" that bisects the study area into areas of snow versus areas of rain associated with eastward moving systems. Such differences can result in dramatically different storm impacts in the study area.

FUTURE VULNERABILITY, LAND USE AND CLIMATE CHANGE IMPACTS

Winter storms remain a likely occurrence for the region. Because of the geographic location, all future structures built in Hampton Roads are likely to be exposed to the winter storm hazard and may experience damage. The *2018 Commonwealth of Virginia Hazard Mitigation Plan* suggests that the southern and southeastern portions of the state are likely to receive significant winter weather approximately once a decade. Local zoning and comprehensive plans are not focused on winter storm planning in the study area, although Emergency Operations Plans typically contain appropriate response actions.

As the earth's climate changes, heavy seasonal snow years have begun to occur with greater frequency. According to NCEI, the frequency of extreme snowstorms in the eastern US has increased over the past century, with approximately twice as many extreme snowstorms occurring in the last half of the 20th century as in the first half. Conditions that influence snowstorm severity including warmer ocean surface temperatures in the Atlantic. These increased temperatures can lead to exceptionally high amounts of moisture feeding into a storm and contribute to storm intensification.

Global ocean surface temperatures have increased at a rate of +.18 degrees Fahrenheit each decade since 1950. Natural variability can affect surface ocean temperatures, but as global surface temperatures increase, the temperature is higher at any time than it would have been if the climate were not changing.

Some research has shown that increasing ocean surface temperature and reductions in Arctic sea ice may produce atmospheric circulation patterns that are favorable for winter storm development in the eastern United States. Notably, a greater prevalence of high pressure blocking patterns over the North Atlantic that result in cold outbreaks in the eastern U.S., along with slow moving systems can further exacerbate the longevity and severity of a snowstorm.

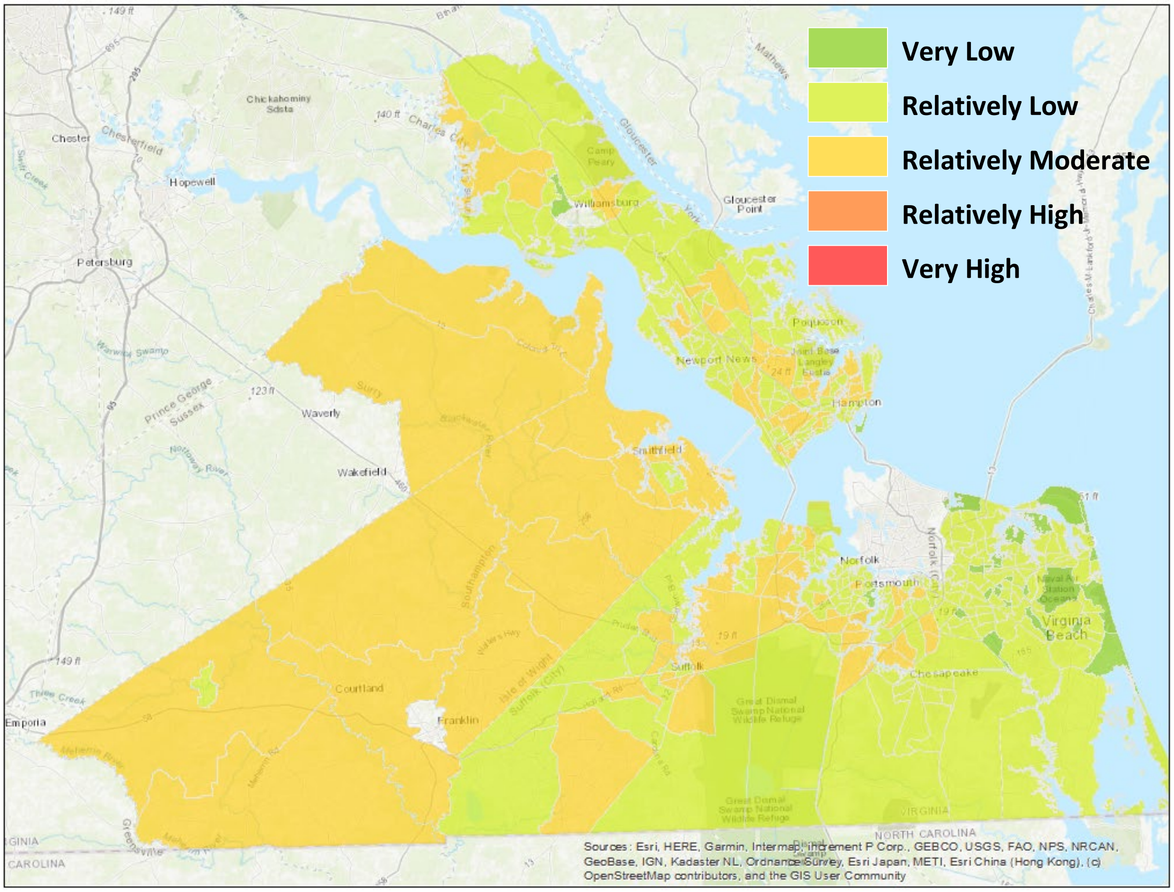
Studies have shown that natural variability associated with El Nino conditions has a strong relationship and influence on the incidence of severe snowstorms in the eastern U.S. An analysis of 100 storms in six regions east of the Rocky Mountains found that severe snowstorms are approximately twice as likely to occur in the eastern U.S. – north and south – during years when a moderate to strong El Nino is present as compared to years when more neutral conditions are present.

SOCIAL VULNERABILITY

The NRI risk ratings for winter weather are shown in **Figure 5.30** by Census tract. Most of the more populous regions of Hampton Roads are rated as Relatively Low, with some moderate areas found in Isle of Wight, Surry and Southampton counties, and portions of Suffolk. Technical documentation for the NRI indicates that the Iowa Environmental Mesonet data were used for tallying the number of historical occurrences; however, the historic loss ratios were derived from NCEI data which show relatively low dollar value losses for the region. Only four events in the past 25 years have associated damages in the NCEI database.

Severe winter weather can be problematic for socially vulnerable populations, especially people living in substandard housing or without alternative arrangements when power goes down. Transportation impacts are especially severe when vulnerable people rely on public transportation and those routes are interrupted by snow or ice accumulation. Populations with medical disabilities, many who require power to run oxygen supplies for example, are also vulnerable, as are elderly people who have less ability to adjust their living arrangements when winter storms affect the region.

FIGURE 5.30: NATIONAL RISK INDEX RATING, WINTER STORM



2021

Source: NRI 2021

EARTHQUAKE

The annual probability of an earthquake epicenter within 65 miles of Hampton Roads is estimated at less than 1% based on historical data. While the probability of an earthquake occurrence is relatively low, moderate losses, should a significant earthquake event occur, are possible.

ESTIMATES OF POTENTIAL LOSSES

Table 5.11 provides generalized building damage estimates by jurisdiction for the 1,000-year return period based on probabilistic scenarios using Hazus.

TABLE 5.11: ESTIMATES OF POTENTIAL BUILDING DAMAGE – EARTHQUAKE WITH 1,000-YEAR RETURN PERIOD

SUBREGION	COMMUNITY	BUILDING DAMAGE	NON-STRUCTURAL, CONTENTS & INVENTORY DAMAGE	TOTAL*
Peninsula	Hampton	$5,837,000	$14,560,000	$27,791,000
	Newport News	$7,525,000	$19,330,000	$37,344,000
	Poquoson	$643,000	$1,496,000	$2,695,000
	Williamsburg	$732,000	$2,019,000	$4,036,000
	James City County	$4,401,000	$11,077,000	$19,876,000
	York County	$3,446,000	$8,297,000	$15,185,000
Southside	Norfolk	$9,116,000	$21,526,000	$43,354,000
	Portsmouth	$2,851,000	$6,197,000	$13,391,000
	Suffolk	$3,451,000	$7,805,000	$14,954,000
	Virginia Beach	$16,885,000	$36,962,000	$73,951,000
	Chesapeake	$9,320,000	$20,815,000	$40,140,000
Western Tidewater	Isle of Wight County	$1,689,000	$3,932,000	$7,364,000
	Franklin	$325,000	$827,000	$1,701,000
	Southampton County	$825,000	$1,943,000	$3,676,000
	Surry County	$342,000	$843,000	$1,577,000
Totals		$**67,387,000**	$**15,7928,000**	**$307,034,000**

* Also includes income losses from relocation, lost wages, and lost rental income.
Source: Hazus

Hazus (Level 1 analysis) was also used to produce building damage estimates based on percentage of damage (by damage state) for the 1,000-year return period (**Table 5.12**). According to the Hazus model assumptions, there should be no building damage from the 100-year earthquake event.

TABLE 5.12: ESTIMATES OF POTENTIAL BUILDINGS DAMAGED BY DAMAGE STATE[9]– EARTHQUAKE WITH 1,000-YEAR RETURN PERIOD

SLIGHT	MODERATE	EXTENSIVE	COMPLETE
11,994	3,487	428	39

Source: Hazus

Due to the relative consistency in the topography, geographic characteristics and soils of the study area, earthquakes are expected to affect the Hampton Roads region communities in a similar manner, with damages proportional to the inventory of structures and infrastructure.

Average Annual Losses from earthquake in Hampton Roads total an estimated $1.1 million, with Norfolk and Virginia Beach having the highest annual loss estimates. Average annual losses are equal to or less than $10,000 per year in Poquoson, Franklin, and Surry County.

FUTURE VULNERABILITY, LAND USE AND CLIMATE CHANGE IMPACTS

All future structures built in Hampton Roads will be vulnerable to seismic events to a limited degree, and may also experience damage not accounted for in the estimated losses presented in this section.

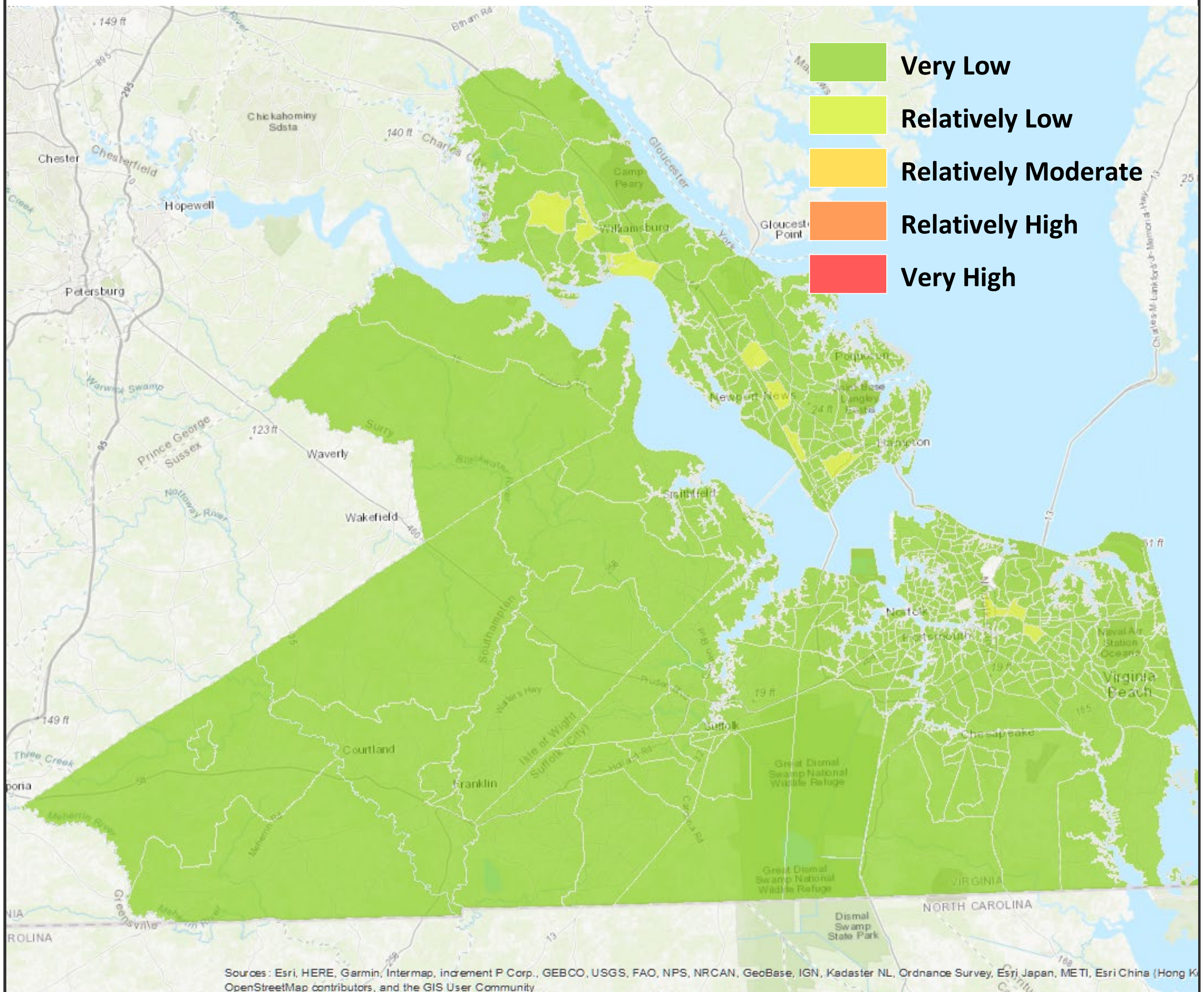
While scientists have observed some correlation between climate change on rising temperatures, melting glaciers and isostatic rebound, a causal connection to subsequent earthquakes is less documented, especially for the eastern United States. Earthquakes and weather have a few possible correlations that are still under investigation and should be considered more theoretical than scientific:
1. glacier melt and isostatic rebound causing earthquakes;
2. changing surface stress loads from increased surface water causing microseismicity or tiny earthquakes with magnitudes less than zero, and changes in water quantity stored in large dams inducing seismicity;
3. longer duration droughts and/or groundwater withdrawals that change stress loads on the Earth's crust causing earthquakes; and,
4. injection wells that lubricate faults and induce seismicity.[10]

SOCIAL VULNERABILITY

The NRI risk ratings for earthquake are shown in **Figure 5.31** by Census tract. The map reflects the history of earthquakes in Virginia, with few damages and very low risk throughout the Hampton Roads region.

[9] For more detailed description of the four damage states, please refer to the *HAZUS-MH User Manual* for the Earthquake Model.
[10] Buis, Alan. NASA: Global Climate Change: Vital Signs of the Planet. *Can Climate Affect Earthquakes, or are the Connections Shaky?* Feature dated October 29, 2019, accessed online at: https://climate.nasa.gov/news/2926/can-climate-affect-earthquakes-or-are-the-connections-shaky/

FIGURE 5.31: NATIONAL RISK INDEX RATING, EARTHQUAKE



2021

Source: NRI 2021

WILDFIRE

Historical data indicate that the Hampton Roads region of Virginia is vulnerable to wildfire, particularly in the western portion of the study area. Figure 4.24 provides a graphical overview of wildfire vulnerability in the region.

ESTIMATES OF POTENTIAL LOSSES

As shown in the *Hazard Identification and Analysis* section, VDOF documented an average of 24 wildfire events per year between 2002 and 2020, with total property damages of $663,550 reported for the 433 events between 2002 and 2020. Average losses for state-response wildfires in the region are, therefore, estimated to be $36,860 each year.

FUTURE VULNERABILITY, LAND USE AND CLIMATE CHANGE IMPACTS

In cities and counties throughout the U.S., population concentration increase has resulted in rapid development in the outlying metropolitan areas and in rural areas, both of which are areas already occupied by dense forests. Wildfire risk can increase when new developments are built in close proximity to large and dense stands of forest. Wildland Urban Interface (WUI) risk is not limited to new developments in large natural areas. Occasionally, forest and brushlands can grow up over time and engulf previously developed areas. Regardless of how the risk arises, the WUI creates an environment in which fire can move readily between structural and vegetative fuels. Expansion of the WUI over time has increased the likelihood that wildfires will threaten structures and people.

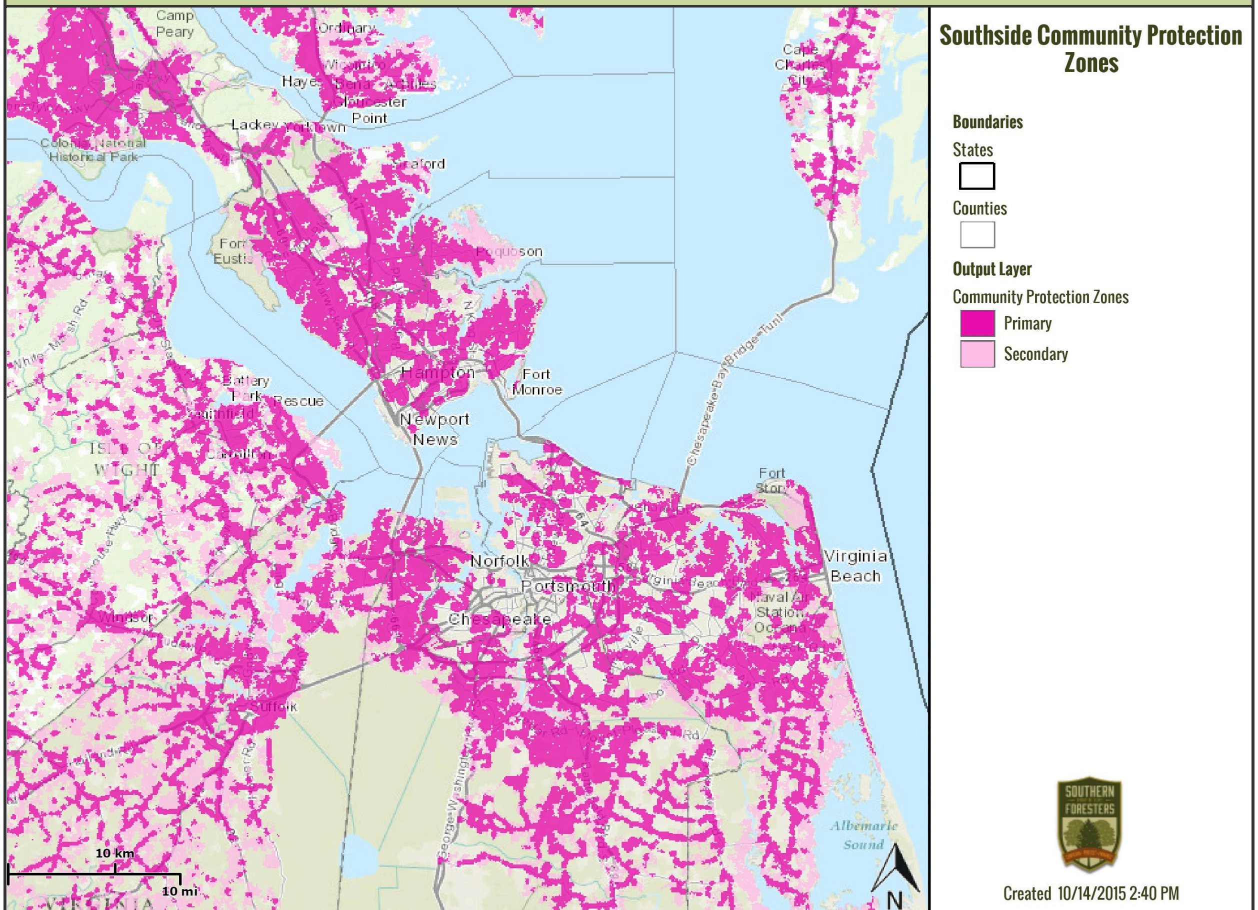
The Southern Group of State Foresters has created an online portal for wildfire risk assessment at http://www.southernwildfirerisk.com/map/index/public. The portal provides mapping to help determine future vulnerability to WUI fire in Hampton Roads and to provide planners a sense of where fire mitigation should be focused for the best reduction in vulnerability. Community Protection Zones (CPZs) with both primary and secondary levels of importance are depicted in **Figures 5.32 through 5.34**. The zones are based on an analysis of the "Where People Live" housing density data and surrounding fire behavior potential. Primary CPZs reflect areas with a predefined housing density appropriate to the region. Rate of Spread data is used to determine the areas of concern around populated areas that are within a 2-hour fire spread distance. This is referred to as the Secondary CPZ.

The online portal for wildfire risk assessment also allows users to highlight a neighborhood or street and determine the wildfire characteristics of that area, such as the Wildfire Urban Interface Risk Index, the wildfire ignition density and the fire intensity scale.

The CPZs in the Hampton Roads area, where wildfire vulnerability is highest, are clustered in the lower Peninsula (Hampton, Newport News and Poquoson), James City County, Suffolk, and north Chesapeake. There are sporadic pockets of vulnerability scattered through Surry County, eastern Isle of Wight County, parts of Virginia Beach, Norfolk and Portsmouth that make these areas perhaps slightly less vulnerable. The Great Dismal Swamp is not mapped as part of this effort as it is Federal land, but there is also high risk of wildfire in that region actively managed by the Great Dismal Swamp Fire Program.

The region is expected to continue to incur wildfires, particularly during extended periods of dry and windy weather. The region's zoning ordinances do not generally guide new development away from the Wildland Urban Interface, but the wildfire threat is not as severe as in the western United States.

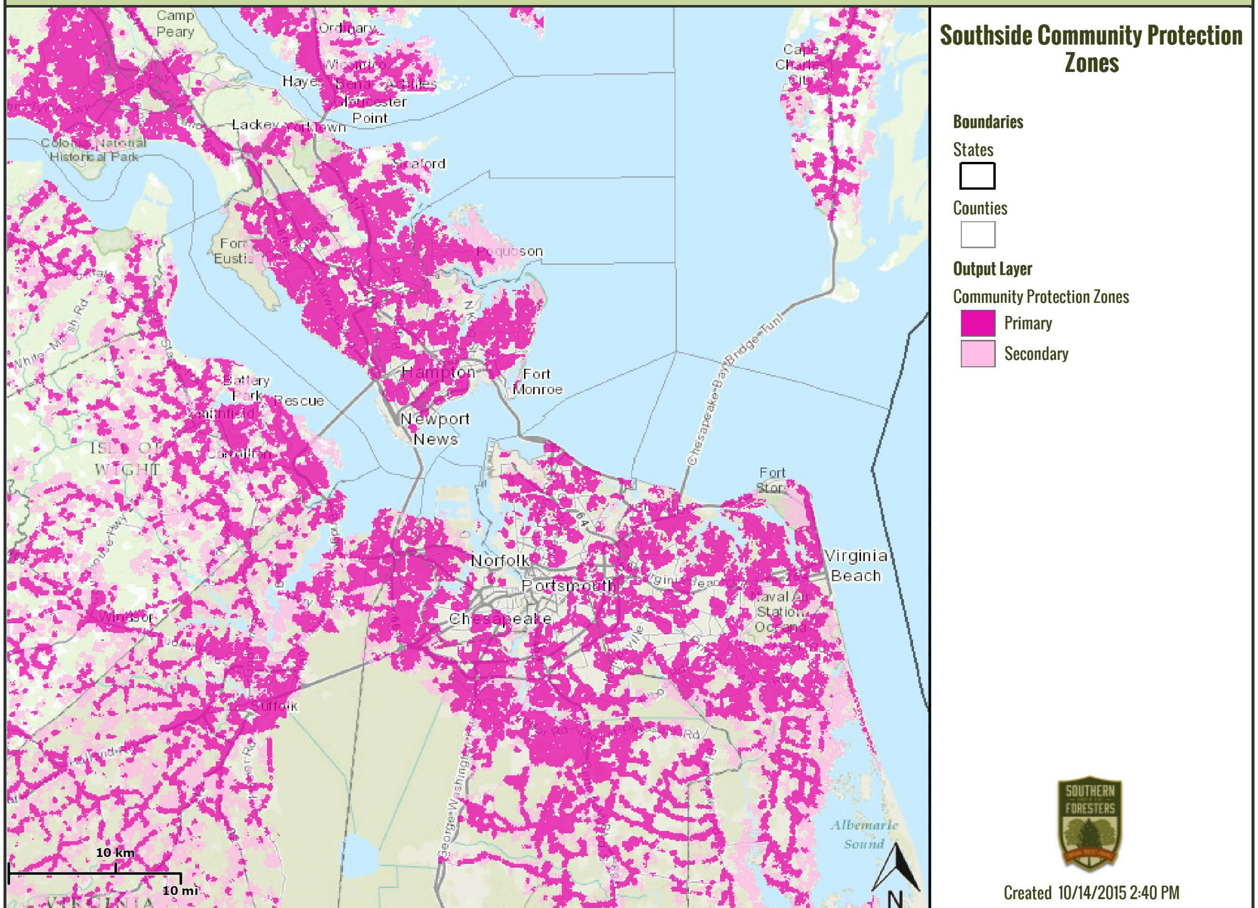
FIGURE 5.32: COMMUNITY PROTECTION ZONES FOR WILDFIRE, PENINSULA



2015

Source: Southern Group of State Foresters

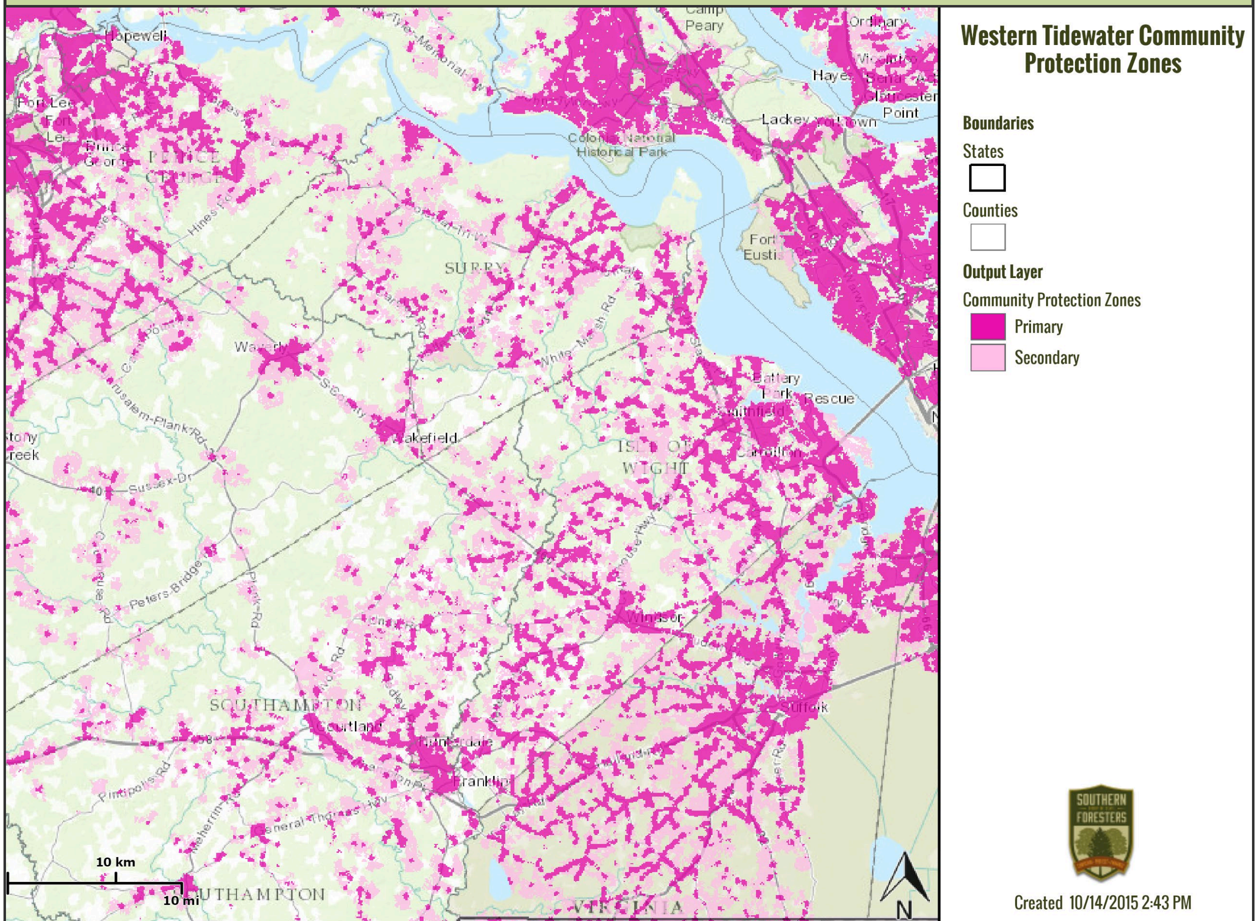
FIGURE 5.33: COMMUNITY PROTECTION ZONES FOR WILDFIRE, SOUTHSIDE



2015

Source: Southern Group of State Foresters

FIGURE 5.34: COMMUNITY PROTECTION ZONES FOR WILDFIRE, WESTERN TIDEWATER



2015

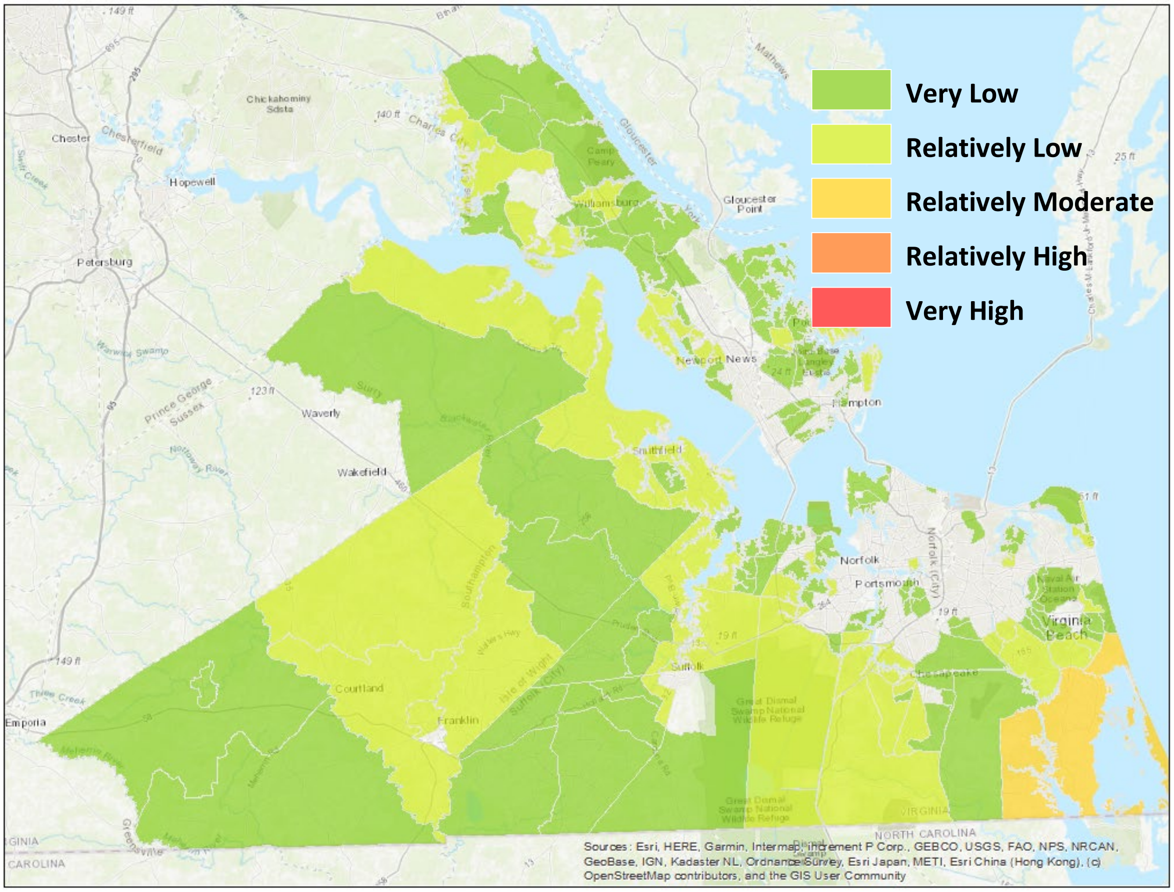
Source: Southern Group of State Foresters

Climate change increases the risk of the hot, dry weather that is likely to fuel wildfires. Also, because climate change is also a factor in higher intensity windstorms, there is a likelihood of increased fuel for wildfire when downed trees from storms are not removed. For site specific information on historic wildfire ignition density, property owners and planners can visit: www.southernwildfirerisk.com.

SOCIAL VULNERABILITY

The NRI risk ratings for wildfire are shown in **Figure 5.35**. The risk ratings are relative to the rest of the United States and the damage history upon which the ratings are built is simply not as substantial as many parts of the country. Although most of the region is rated low, there is one pocket of relatively moderate risk in the southeastern part of Virginia Beach.

FIGURE 5.35: NATIONAL RISK INDEX RATING, WILDFIRE



2021

Source: NRI 2021

DROUGHT

Droughts can impact natural systems and the ability of cities, towns and neighborhoods to function effectively. Specific impacts may include a reduction in the production of food grains and other crops, the size and quality of livestock and fish, available forage for livestock and wildlife, and the availability of water supplies needed by communities and industry. As evidenced by previous occurrences, the Hampton Roads region is vulnerable to the drought hazard.

ESTIMATES OF POTENTIAL LOSSES

While drought impacts agricultural, recreational, and manufacturing industries, estimating losses to the built environment is difficult because drought causes little documented physical damage to the built environment. In 2006, this plan included an annualized drought loss estimate of $2,215,839 for Isle of Wight County, Suffolk and Virginia Beach; however, the methodology regarding how this loss estimate was developed is not clear. Annualized damages appear to have been based on changes in total harvested cropland; however, losses in harvested cropland or the market value of crops cannot be attributed entirely to drought or other weather-related conditions, especially in rural parts of the planning area that are rapidly developing. Data on drought damages from the NCEI are incomplete and, when available, apply to a very large area including jurisdictions outside of the planning region. As a result, the estimation of annualized damages due to drought has been discontinued in plan updates.

Table 5.13 provides a time series of data regarding the total harvested cropland, irrigated land, market value of crops, and percent of non-irrigated land from 2002, 2007 and 2012. Due to a lack of agricultural information, data for many of the cities and towns are not provided.

TABLE 5.13: AGRICULTURAL DATA RELATED TO DROUGHT VULNERABILITY				
JURISDICTION	2002	2007	2012	2017
	TOTAL HARVESTED CROPLAND (acres)	TOTAL HARVESTED CROPLAND (acres)	TOTAL HARVESTED CROPLAND (acres)	TOTAL HARVESTED CROPLAND (acres)
James City County	5,258	2,367	2,698	318
York County	211	Withheld	Withheld	55
Suffolk	53,954	51,203	49,693	56,270
Virginia Beach	21,609	20,258	20,814	16,476
Chesapeake	53,188	41,391	36,269	31,592
Isle of Wight County	49,373	48,230	47,868	48,833
Southampton County	83,449	79,449	87,902	91,803
Surry County	35,265	26,526	30,238	23,844
TOTAL	**302,307**	**269,424**	**275,482**	**269,191**

Source: U.S. Department of Agriculture Census

The geography of the study area makes the Hampton Roads region uniformly vulnerable to the effects of drought. However, the impacts would vary across the region based on land use, with impacts to agriculture and the agricultural economy primarily in Surry and Southampton counties, as well as James City County, York County, Suffolk, Virginia Beach, Chesapeake, and Isle of Wight County. Social impacts to water utility customers in the cities of Hampton Roads would be more likely during a chronic, prolonged drought that results in water restrictions.

FUTURE VULNERABILITY, LAND USE AND CLIMATE CHANGE IMPACTS

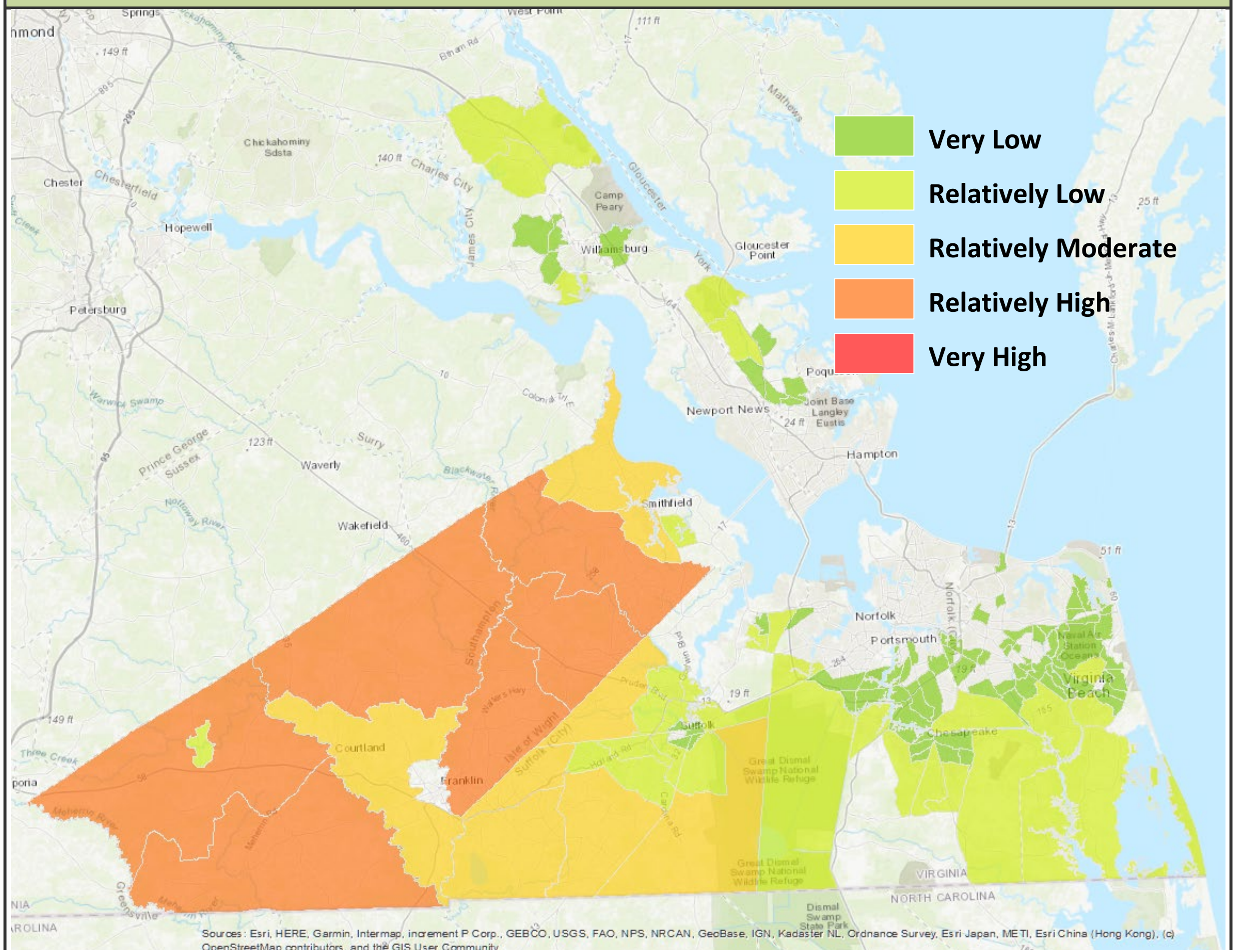
According to the USDA Agriculture Census data from 2002 through 2017, the total harvested cropland in Hampton Roads farming communities decreased 11-percent from 2002 to 2007, and then increased and held somewhat steady. This is consistent with the area's largest farming county, Southampton County, which experienced a decrease of 4-percent in the first period and an increase of 10-percent in the middle period, but has now increased to pre-2002 levels. These rates may be indicative of past and future changes in land use which may be peripherally related to long-term drought conditions, although the long period between data collection and relatively short period of record makes it difficult to draw useful conclusions.

The VASEM 2021 report predicts that as this century comes to a close, agriculture will be impacted by climate change with more intense precipitation and also longer periods of drought. The cumulative effect will particularly be bad for crops near the warm end of their geographic range.

SOCIAL VULNERABILITY

The NRI risk ratings for drought are shown in **Figure 5.36**. Historical occurrence data were taken from the University of Nebraska-Lincoln National Drought Mitigation Center, U.S. Drought Monitor. The period of record was January 2000 to December 2017. Large portions of Southampton County and Suffolk appear to be the most socially vulnerable to the impacts of drought.

FIGURE 5.36: NATIONAL RISK INDEX RATING, DROUGHT



2021

Source: NRI 2021

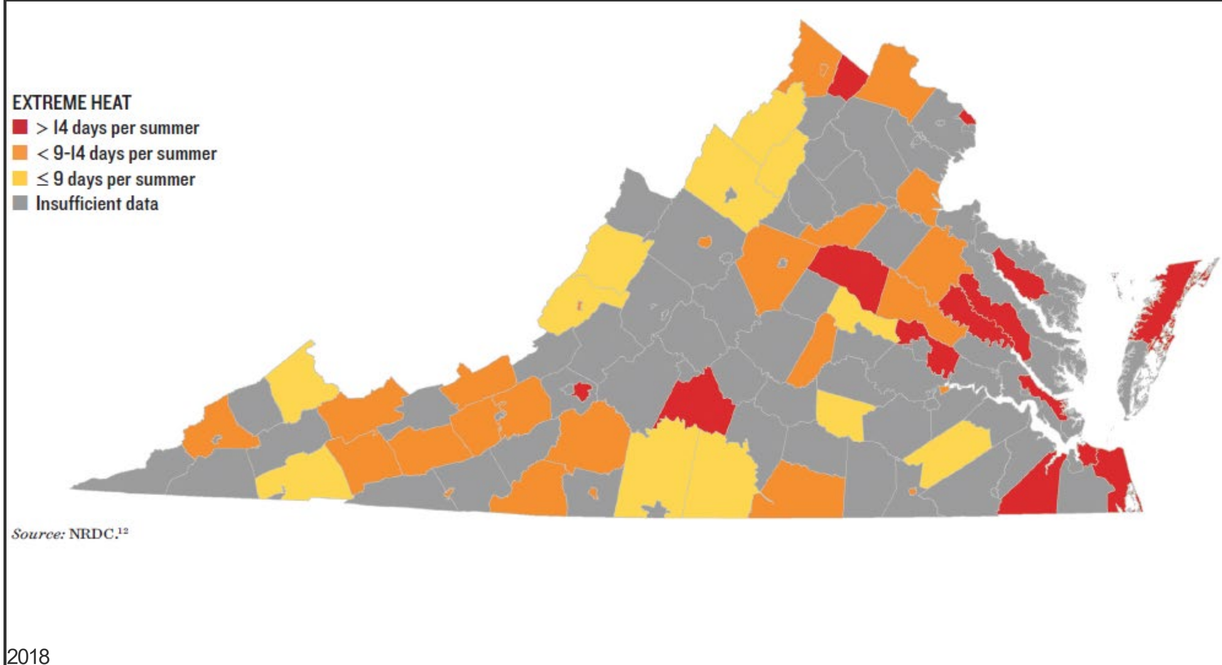
EXTREME HEAT

ESTIMATE OF POTENTIAL LOSSES

Based on the previous historical occurrences, annualized losses to the built environment are considered to be negligible (less than $1,000). Loss of human life or health impacts are a greater concern with extreme heat than is property damage, although extreme heat can exacerbate droughts, contribute to conditions that fuel wildfire, and cause road pavement to buckle.

An examination of vulnerability to extreme heat by jurisdiction necessitates the use of data other than NCEI data, which are incomplete. **Figure 5.37** shows the average number of extreme summer heat days per year in Virginia, by county, between 2007 and 2016, from an NRDC report on *Climate Change and Health in Virginia*. While the data are insufficient in much of the study area, a definite exposure to extreme heat for Virginia Beach, Suffolk and York County is evident.

FIGURE 5.37: AVERAGE NUMBER OF EXTREME SUMMER HEAT DAYS PER YEAR IN VIRGINIA

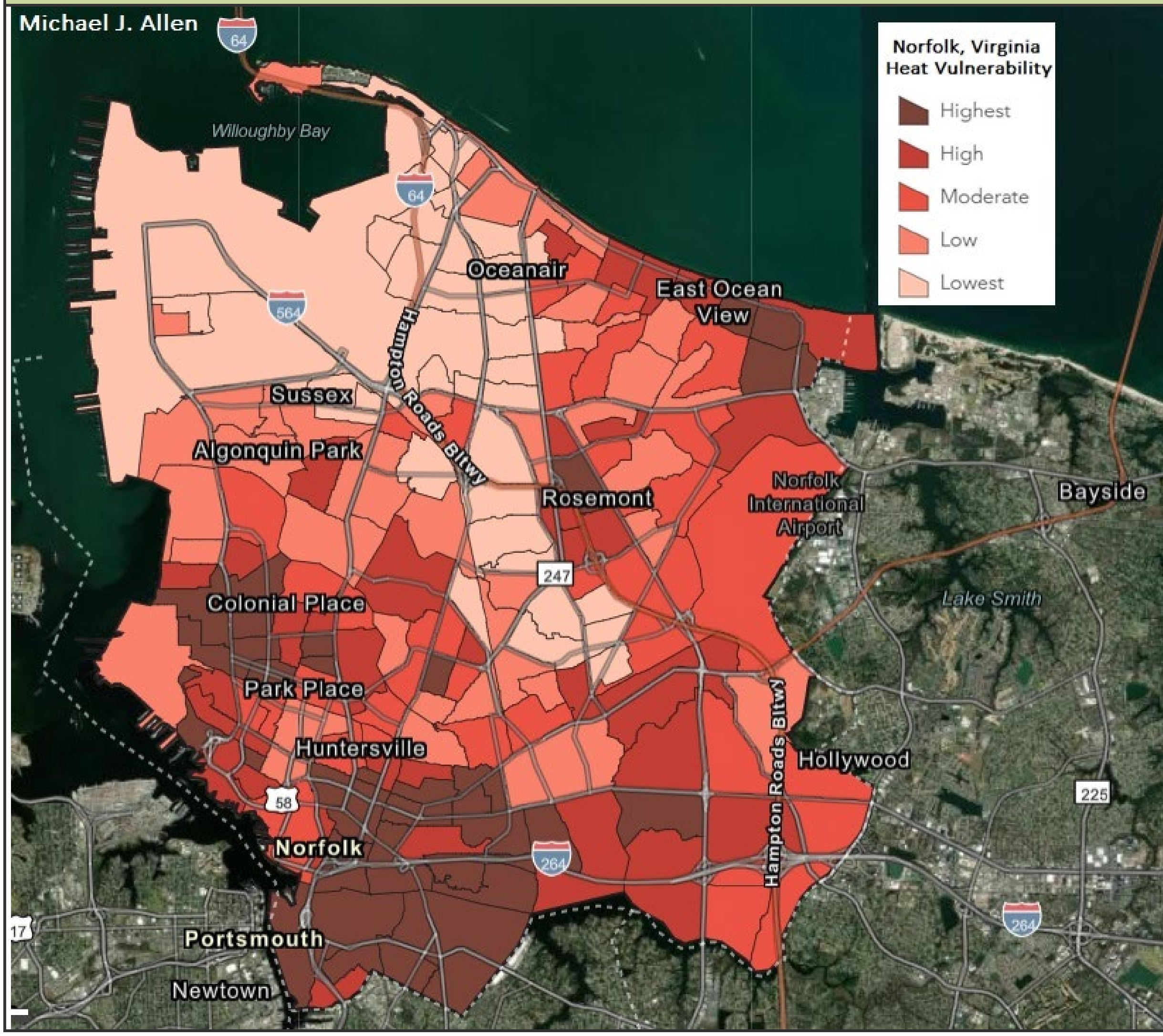


Source: NRDC: Climate Change and Health in Virginia, Issue Brief, April 2018. Accessed online: https://www.nrdc.org/sites/default/files/climate-change-health-impacts-virginia-ib.pdf

A heat mapping project in Norfolk in July, 2019, provides some insights to variability in risk to extreme heat for that particular city. By combining data on single day temperatures, land cover and poverty, researchers put together a far more detailed heat vulnerability map (**Figure 5.38**) that may be useful for future planning and research efforts on the geographic variability in risk to this hazard.[11] Land cover and tree cover at a neighborhood scale are important factors in determining vulnerability.

[11] Allen, Michael. *Norfolk Heat Vulnerability Story Map, 2021* accessed online at: https://storymaps.arcgis.com/stories/7cde13a422504a0682ec9c2deb18c4b6

FIGURE 5.38: NORFOLK HEAT VULNERABILITY



Source: Michael Allen, *Norfolk Heat Vulnerability Story Map* accessed 2021 online at: https://storymaps.arcgis.com/stories/7cde13a422504a0682ec9c2deb18c4b6

FUTURE VULNERABILITY, LAND USE AND CLIMATE CHANGE IMPACTS

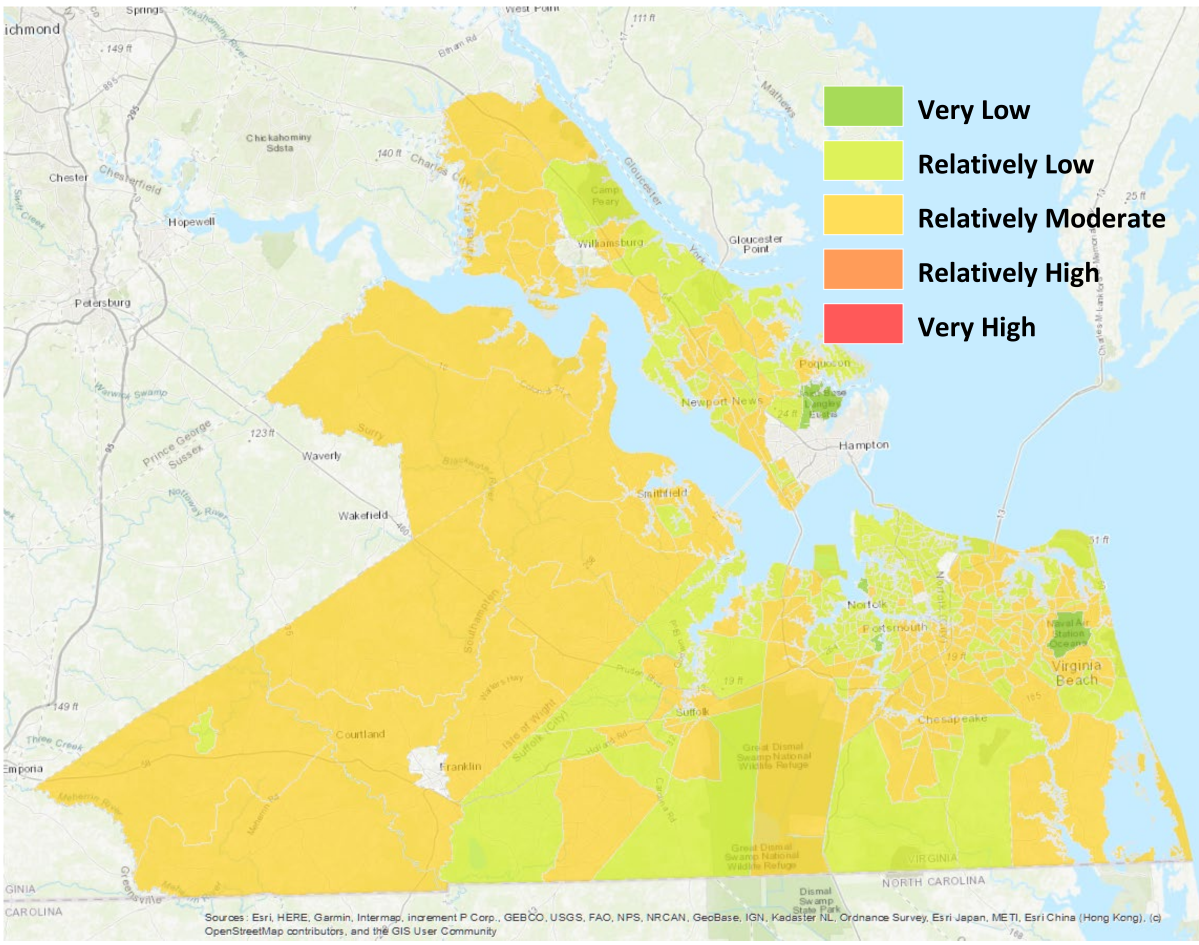
The risk of heat-related illnesses and deaths in Virginia will grow as climate change fuels more intense and frequent heat waves. While long-term trends at individual sites in Hampton Roads, such as airports, are useful for observing regional temperature change, students at Virginia Wesleyan in Virginia Beach are part of a statewide effort to more accurately map and distinguish urban heat islands and their evolving impact, similar to the Norfolk effort described above. On the hottest days of the year, students drive along predetermined routes at three different times of day to capture temperature and humidity data using sensors attached to car windows. The data will help link city planning decisions past and future, such as where trees and green spaces are required, to real results on the ground.

All future structures built in the Hampton Roads region will be exposed to extreme heat. Information gleaned from research such as the mapping in Norfolk and Virginia Beach will help inform future planning regulations and design guidelines, including passive cooling solutions for buildings and neighborhoods, that can improve energy efficiency, cooling and health outcomes from extreme heat events. Examples include cool roofs and reflective cool walls for buildings, cool corridors in neighborhoods where trees and concrete rather than asphalt prevent heat buildup, and positioning buildings to shade common pedestrian routes.

SOCIAL VULNERABILITY

The main concern in periods of extreme heat is the potential public health impact, such as heat exhaustion or heat stroke. Individuals of concern include those living in residences without air conditioning, or in areas where electric service is unavailable due to system-wide blackouts. The elderly, small children, the chronically ill, livestock and pets are most vulnerable to extreme heat. **Figure 5.39** shows the relative risk from heat waves based on the National Risk Index data.

FIGURE 5.39: NATIONAL RISK INDEX RATING, HEAT WAVE



2021

Source: NRI 2021

HAZARDOUS MATERIALS INCIDENTS

ESTIMATES OF POTENTIAL LOSSES

Based on information provided in the *Hazard Identification and Analysis* section, the Hampton Roads region experiences an average of 26 hazardous materials incidents per year with only minor damages (generally less than $10,000 per year) reported. **Table 5.14** shows hazardous materials incidents from 1998 to 2021 in Hampton Roads region (according to the U.S. Department of Transportation) that contribute to an annualized loss estimate of $67,500 from highway incidents.

TABLE 5.14: ANNUALIZED LOSSES FOR HAZARDOUS MATERIALS INCIDENTS

SUBREGION	COMMUNITY	NUMBER OF EVENTS	PROPERTY DAMAGE	AVERAGE ANNUAL NUMBER OF EVENTS	ANNUALIZED LOSS
Peninsula	Hampton	26	$9,454	1.13	$411
	Newport News	44	$5,058	1.91	$220
	Poquoson	0	$0	0.00	$0
	Williamsburg	3	$6,845	0.13	$298
	James City County	0	$0	0.00	$0
	York County	2	$0	0.09	$0
Southside	Norfolk	118	$425,847	5.13	$18,515
	Portsmouth	52	$148,234	2.26	$6,445
	Suffolk	15	$343,678	0.65	$14,943
	Virginia Beach	210	$78,807	9.13	$3,426
	Chesapeake	113	$292,360	4.91	$12,711
Western Tidewater	Isle of Wight County	0	$0	0.00	$0
	Franklin	8	$3,688	0.35	$160
	Southampton County	2	$10,706	0.09	$465
	Surry County	2	$7,550	0.09	$328

U.S. Department of Transportation, 2021

FUTURE VULNERABILITY, LAND USE AND CLIMATE CHANGE IMPACTS

Future land use and zoning of structural development as discussed in previous subsections are expected to have less impact on future vulnerability than mitigation. Protection of human life through administration of proper emergency notification and evacuation planning with regard to potential hazardous material incidents are critical elements in reducing real-time vulnerability before, during and after events.

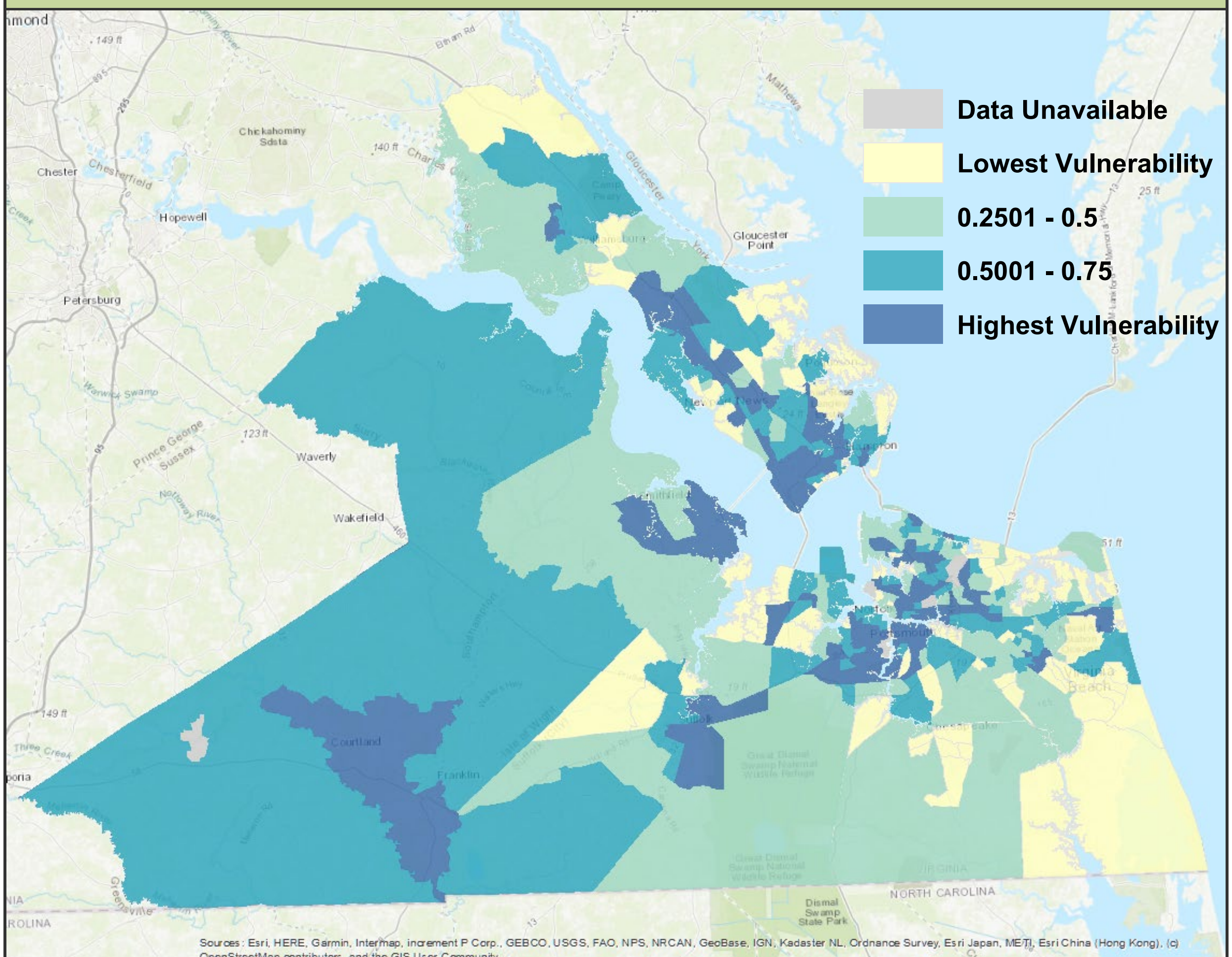
Climate change impacts are limited with hazardous materials incidents. Higher frequency of extreme weather events such as winter storms or tropical storms may increase the overall number of rail and highway accidents, which could naturally lead to an increase in events involving hazardous materials. Extreme heat and wildfire events brought about by higher temperatures could conceivably increase incidents involving flammable materials.

SOCIAL VULNERABILITY

The CDC Agency for Toxic Substances and Disease Registry (ATSDR) created a Social Vulnerability Index geared toward preparing for and responding to exposure to dangerous chemicals (and other natural hazards, as well). This index is better suited to examining the social vulnerability related to hazardous materials incidents, although many of the inputs are the same as the NRI. Overall vulnerability for this index is based on: socioeconomic status (below poverty, unemployed, income, no high school diploma); household composition and disability (aged 65 or older, aged 17 or younger, civilian with disability, single-parent households); minority status and language; and housing type and transportation (multi-unit structures, mobile homes, crowding, no vehicle, group quarters).

The ATSDR map provided in **Figure 5.40** shows the highest social vulnerability to hazardous materials incidents, is in the east end of Newport News, eastern Surry County, a corridor in Southampton County, and pockets in Suffolk, Chesapeake, Portsmouth, Norfolk and Virginia Beach.

FIGURE 5.40: CENTERS FOR DISEASE AND PREVENTION, SOCIAL VULNERABILITY INDEX



2021

Source: CDC/ATSDR Social Vulnerability Index 2018 Database, Virginia.

PANDEMIC FLU OR COMMUNICABLE DISEASE

ESTIMATES OF POTENTIAL LOSSES

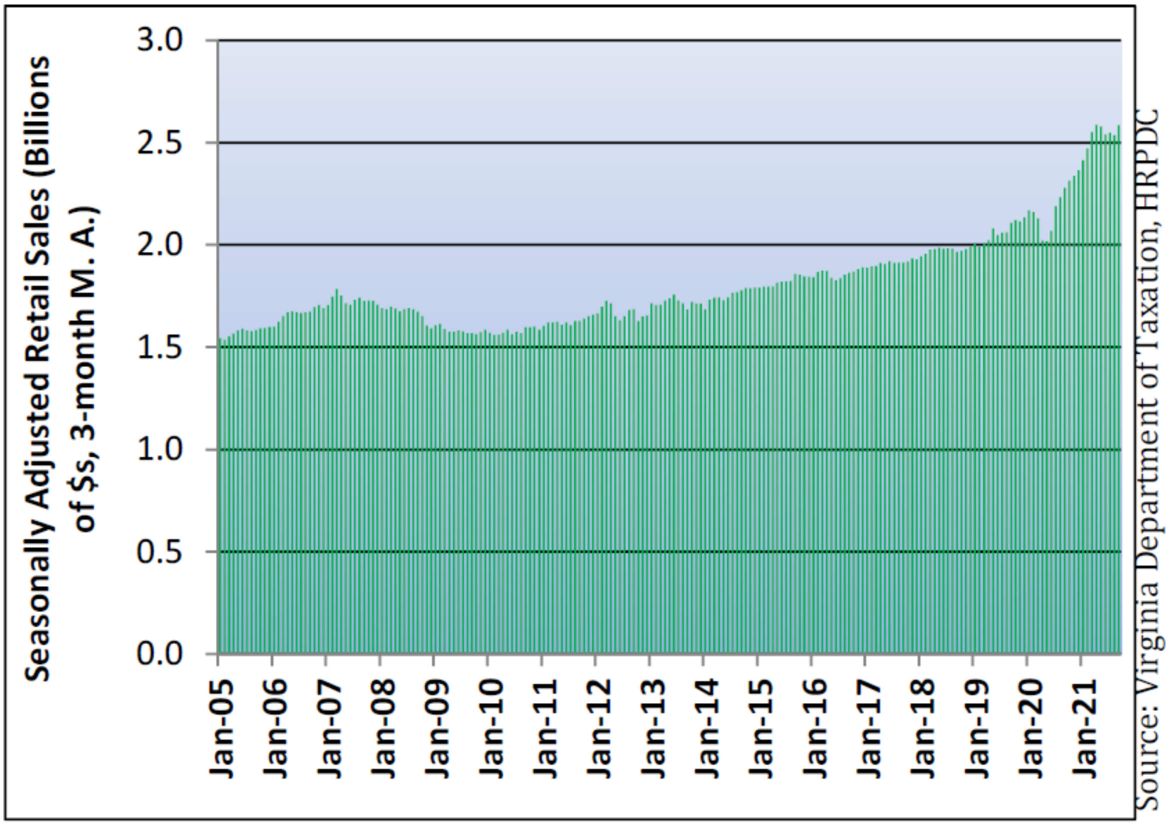
An outbreak of widespread disease burdens local medical facilities in terms of capacity for treatment, the region's health departments, emergency responders and other essential workers with additional staff responsibilities, but would not be expected to damage the built environment or community infrastructure in any significant way. Experience with COVID-19 has shown that economic impacts and job losses may affect almost every aspect of the economy, and the number of people remaining at home for work and schooling can dramatically impact the demand for childcare services and other support service industries. These impacts are expected to be temporary, unique to COVID-19, and may be further ameliorated by Federal stimulus dollars distributed as a result of a public health disaster, and eviction prohibitions issued at various government levels.

HRPDC has monitored how COVID-19 has impacted local transportation volume, employment, unemployment claims, retail sales, home prices and rent rates, and other economic indicators throughout the pandemic. A full writeup is prepared each month in the *Hampton Roads Economic Monthly*, gaging various metrics of the economy; these reports are available at: https://www.hrpdcva.gov/departments/economics. **Figures 5.41** through **5.43** graphically show the most recent impacts to Hampton Roads retail sales, unemployment rate and the number of homes sold, representing just a snapshot of the potential losses and the local recovery. Additional analysis once conditions return to a more normal, pre-pandemic status may be able to quantify the losses due to pandemic.

FIGURE 5.41: HAMPTON ROADS RETAIL SALES

Hampton Roads Retail Sales, Seasonally Adjusted

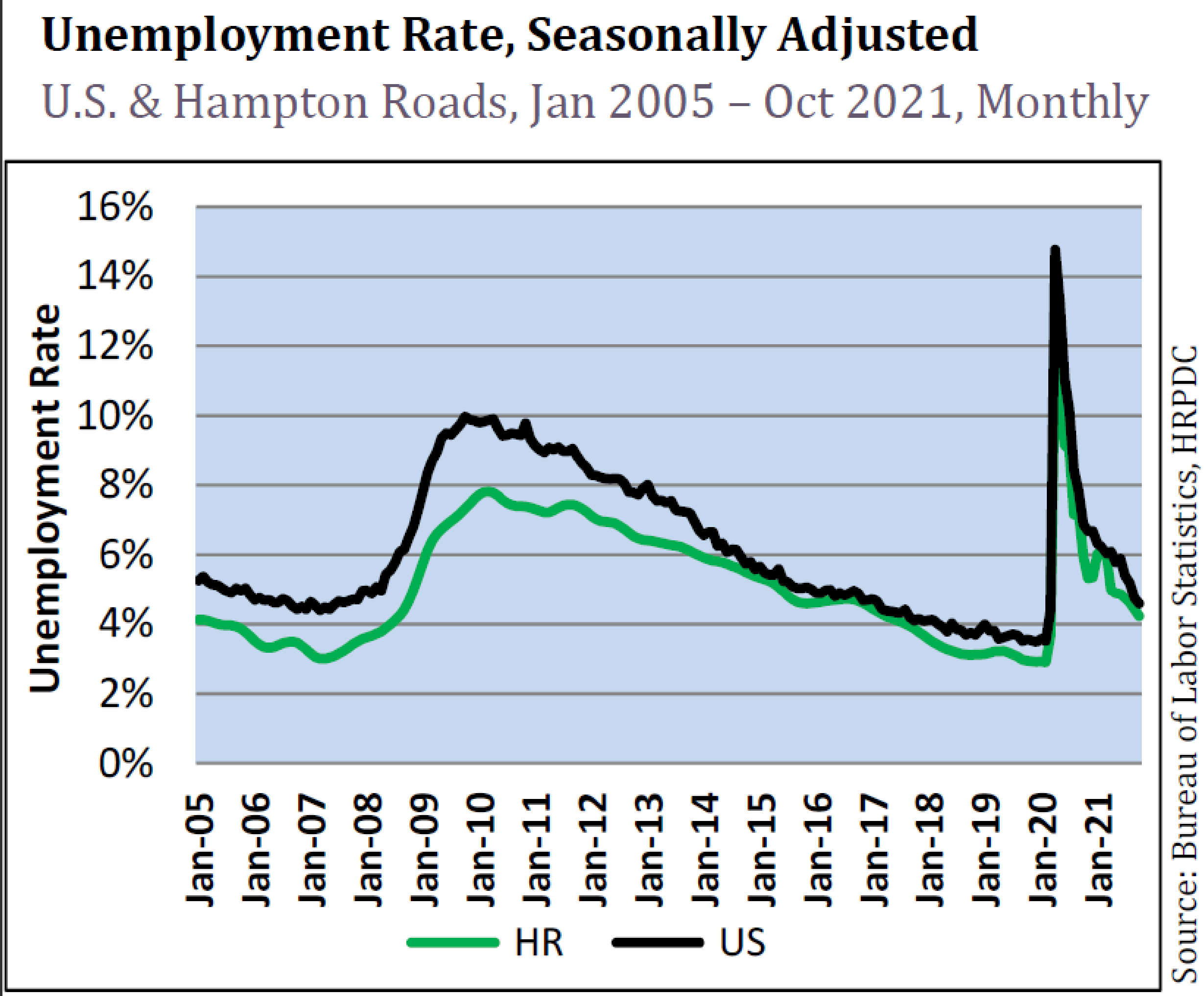
Hampton Roads, Jan 2005 – Sep 2021, Monthly



Retail Sales: Retail sales in Hampton Roads, as measured by the 1% local option sales tax, serve as an indicator for consumption in the region. When seasonally adjusted and averaged over 3 months, September shows an increase in retail sales after several months of declines. Unadjusted, Sept 2021 posted a 19% increase from September 2020 (when the rise in retail sales was in full swing after the initial shock of the pandemic wore off), and a nearly 30% increase from Sept 2019. In other words, retails sales are continuing to rise long-term as consumers are still spending more on goods than pre-pandemic.

Source: HRPDC

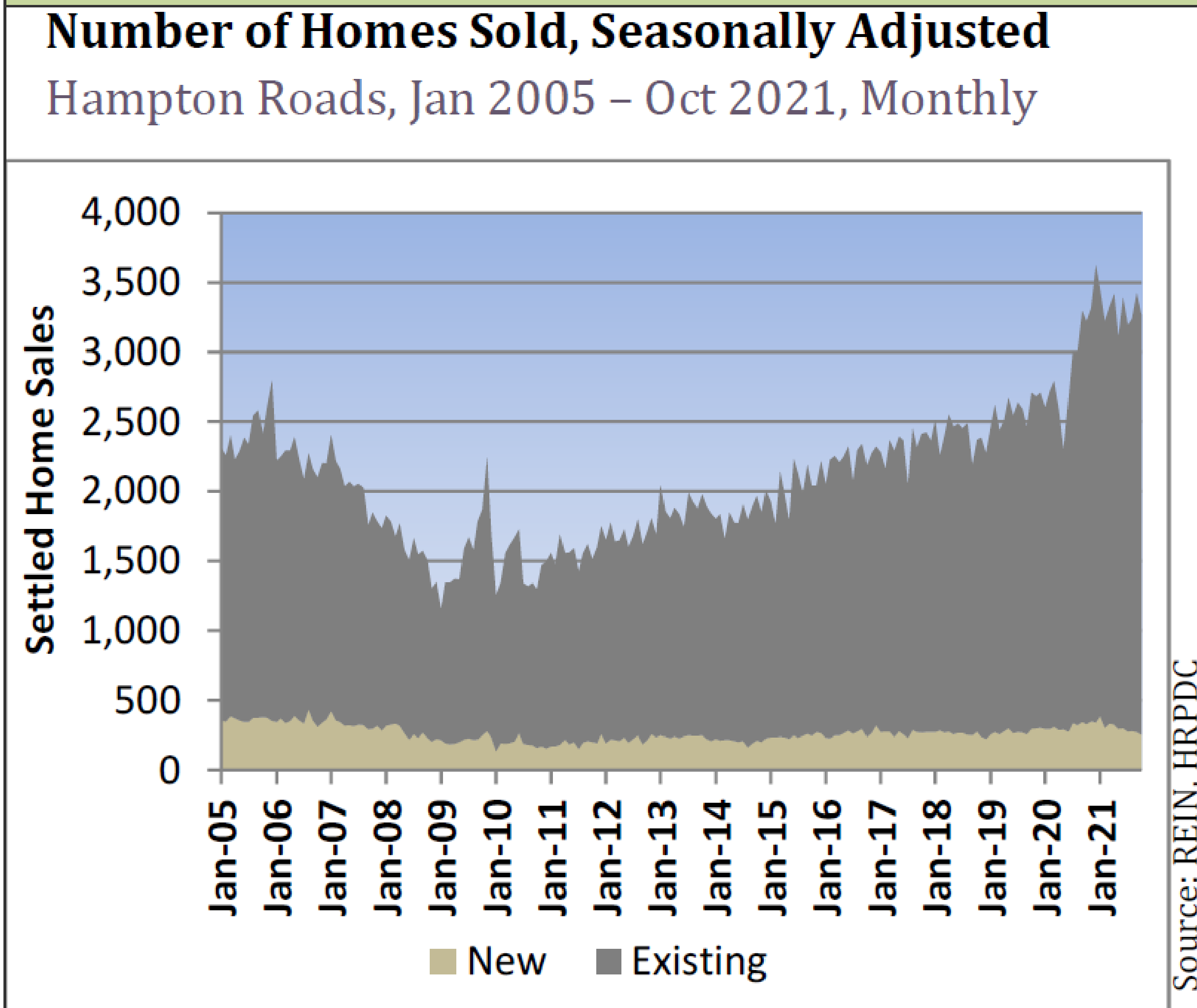
FIGURE 5.42: HAMPTON ROADS UNEMPLOYMENT RATE



Unemployment Rate: The unemployment rate is the percentage of the population actively seeking work but unable to obtain a position. Hampton Roads' unemployment rate decreased again to 4.24% in October 2021, reflected by an increase in the labor force, increase in employment, and a decrease in the number of unemployed persons (all seasonally adjusted). The unemployment rate in Hampton Roads continues to sit below the US rate, roughly 0.36 points lower.

Source: HRPDC

FIGURE 5.43: HAMPTON ROADS NUMBER OF HOMES SOLD



Home Sales: Settled home sales measure the level of transactions on the real estate market over time, and a healthy real estate market should have a consistent level of activity. Seasonally adjusted, existing home and total settled sales in October decreased slightly, remaining elevated with over 3,200 homes sold. Unadjusted, total home sales have been declining for a few months in a row, but are still elevated compared to 2019. The sales market appears to be reaching a plateau.

Source: HRPDC

FUTURE VULNERABILITY, LAND USE AND CLIMATE CHANGE IMPACTS

Future land use is expected to have less impact on future vulnerability to pandemic flu or communicable disease than the protection of public health through dissemination of proper individual protection measures, emergency notification with regard to flu or disease outbreak and effective vaccines.

Many causes of climate change also increase risk of pandemic, including deforestation, loss of habitat and loss of species. Warming temperatures and increasingly severe rainfall patterns make conditions better for Lyme disease, waterborne diseases and mosquito-borne diseases.

SOCIAL VULNERABILITY

Analysis of the impacts of COVID-19 on populations of varying economic, social and ethnic backgrounds is ongoing at the time of this study. Understanding how the virus spread requires examination of the specific geographic circumstances of where people are *required* to travel. Social isolation was quickly recognized as a critical element in managing the spread, but isolation is not an option for many essential workers who are critical to the healthcare system, food supply chain and transportation systems. There are clear divides in the region's communities regarding who can work from home and who is required to go out in public. COVID-19 clearly did not affect everyone equally. The Virginia Center for Inclusive Communities (https://inclusiveva.org/covid19/) noted the following disparities:

- older adults were more susceptible to the virus itself, leading to large numbers of socially isolated seniors;
- school closures led to food insecurity, disparities in technology and internet access, and a need for special services for students with disabilities and students learning English;
- persons with pre-existing conditions but less access to high quality, preventive healthcare were more susceptible to the virus;
- small businesses with existing banking relationships had better access to State and Federal financial assistance, especially during the early part of 2020;
- inequities related to transportation access impacted how the virus affected individuals;
- and violence against intimate partners, Asians, Islamics and others increased during the pandemic.

Fortunately, as of February 2021, at least seven different vaccines were being administered to the most vulnerable populations throughout the world. Three primary vaccines were being used in Virginia, and by January 31, 2022, over 6.7 million Virginians had received at least one dose, 5.87 million were fully vaccinated, and over 2.4 million had also received a third booster dose.[12]

As COVID-19 demonstrated, the nature and characteristics of a virus, such as how it is transmitted and who is most likely to suffer from severe symptoms, affects the populations most likely to be impacted. Social vulnerability can be influenced by financial health, physical health, mental health and other aspects of where and how a person lives. Similarly, access to virus testing, healthcare for those who contract the virus, and access to medications and vaccinations are all components in an assessment of social vulnerability to each virus and such assessment is difficult to manage while resources are committed to managing an ongoing virus. Communication and outreach to socially vulnerable groups is a key mitigation measure for lessening the impact of viruses that unequally impact demographic groups.

[12] Virginia Department of Health COVID-19 Vaccine Dashboard accessed online at: https://www.vdh.virginia.gov/coronavirus/covid-19-vaccine-summary/

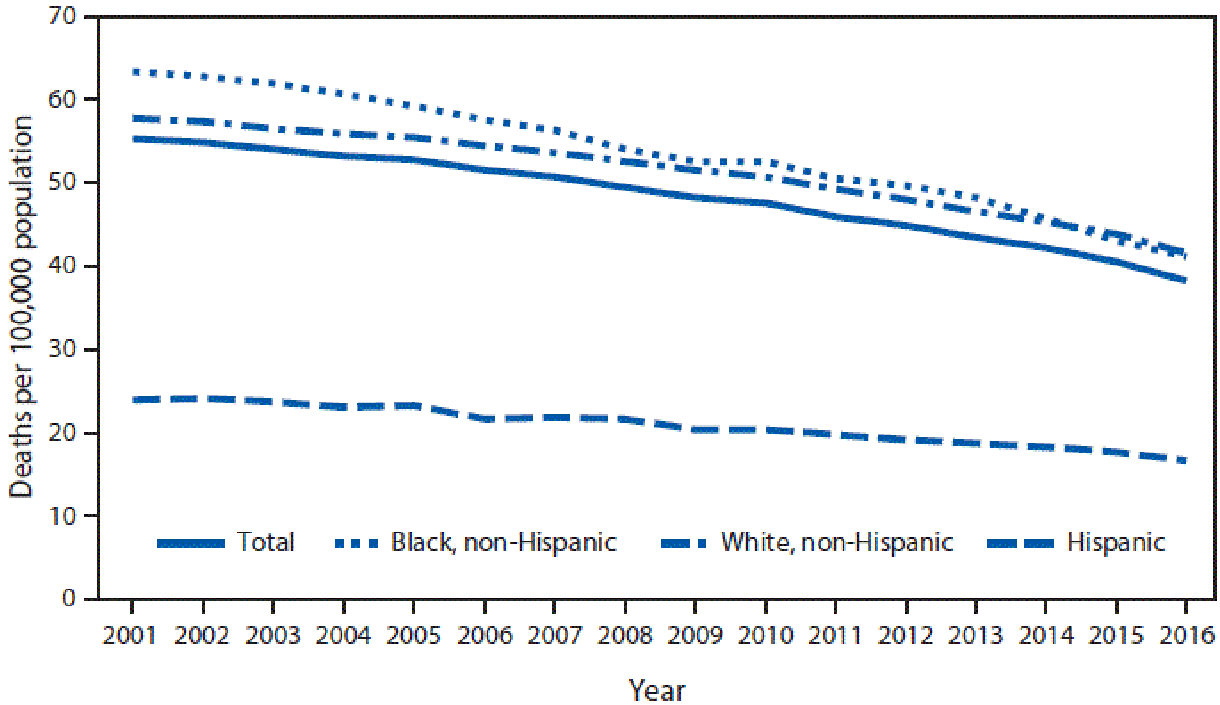
RADON EXPOSURE

ESTIMATES OF POTENTIAL LOSSES

Radon testing in Virginia has been sporadic and not necessarily reported to any single data repository. Thus, the only way to know if any structure or group of structures has a radon problem is to test. Testing of residential structures is easy and inexpensive. Low-cost test kits are available through the mail and at home improvement stores. Qualified testers can also do long-term residential testing and set up systems for testing larger non-residential buildings. Mitigation or treatment of structures with high radon concentrations is also possible, relatively inexpensive and can be very effective if done properly. Testing is most important for structures in the red or orange zones indicated in Figure 4.35, and especially important for structures in which inhabitants spend their time in parts of the structure below ground or in contact with the ground. Future updates to this plan may include identification of specific structure types, for example structures with basements, in any higher radon potential areas to further define vulnerability, especially if the EPA’s 1993 map of radon zones is updated based on more testing or other new scientific information.

Unlike many other hazards in this plan, structures are not physically damaged by radon exposure; instead, human lives are directly at risk. CDC QuickStats show that death rates from lung cancer declined between 2001 and 2016. While this stand-alone graph does not attribute the decline in lung cancer deaths to a specific cause, nor does it show the percentage of deaths attributed to radon exposure, the death rates by race/ethnicity provide evidence that there are racial/ethnic disparities in death from lung cancer (see **Figure 5.44**). During this period, the lung cancer death rates for the total population (deaths per 100,000 population) declined from 55.3 to 38.3, as well as for each racial/ethnic group shown. The death rate for the non-Hispanic Black population decreased from 63.3 to 41.2, for the non-Hispanic white population from 57.7 to 41.5, and for the Hispanic population from 23.9 to 16.6. Throughout this period, the Hispanic population had the lowest death rate.

FIGURE 5.44: AGE-ADJUSTED DEATH RATES FROM LUNG CANCER, BY RACE/ETHNICITY, UNITED STATES, 2001-2016



* Deaths per 100,000 population age-adjusted to the 2000 U.S. standard population.

Source: Centers for Disease Control and Prevention, accessed online 4/22/22 at: https://www.cdc.gov/mmwr/volumes/67/wr/mm6730a8.htm

FUTURE VULNERABILITY, LAND USE AND CLIMATE CHANGE IMPACTS

According to Memorial Sloan Kettering Cancer Center, major scientific organizations believe that radon contributes to approximately 12% of lung cancers annually in the United States. It is the second leading cause of lung cancer. With 5,820 new cases of lung and bronchus cancer expected in Virginia in 2021, this translates into approximately 700 of those new cases being caused by radon exposure.

Radon levels are very localized and additional testing is needed to verify EPA zones for the study area. There are no federal or state laws that require radon testing prior to a real estate transaction, but some contracts do include radon testing or mitigation contingency clauses, typically at the request of the buyer.

Virginia Code at Section 15.2-2280 gives all red zone (Zone 1) counties and cities the option of requiring passive radon resistant construction features; however, there are no Zone 1 communities in the study area for this plan.

In 1993 the Virginia General Assembly passed legislation that requires all schools in the Commonwealth to be tested for radon after July 1, 1994, and includes any new school buildings and additions built after that date. Each school is required to maintain files of their radon test results.

In the early 1990s the Virginia Department of Education purchased long-term radon test kits that were used to test all Virginia public school K-12 classrooms that were in contact with the ground at that time. Long-term tests are generally more accurate than short term tests because they sample anywhere from 90 to 365 days. Short term tests usually sample for only 2 to 7 days. Since radon levels can fluctuate over time, the longer the test duration, the more accurate the results will be. The EPA school testing protocol recommends testing during the heating season which runs roughly from late October through the end of March. A VDH review of the original testing data from the long-term tests done at that time indicated that some of these test results were not valid or usable due to:

- School classrooms not being identified on the test report;
- Testing periods that were outside of the preferred heating season; and
- Improper testing of unoccupied areas such as boiler and storage rooms.

In general, radon test results for the vast majority of school classrooms in Virginia are below the EPA action level of 4.0 pCi/L for indoor air. For the few classrooms that have shown elevated radon levels, the problem was usually solved by making adjustments to the school's HVAC system. However, in some cases the HVAC adjustments did not work and a radon mitigation system was installed to reduce the radon to acceptable levels. Future updates to this plan may include evaluation of school data for study area schools, as available. Calls to VDH regarding availability of the data for the purposes of this plan were not returned.

With regard to future climate change, changes in the environment and human behavior may alter the risks associated with radon for individual buildings. According to the EPA, the primary factors that influence radon entry into buildings include: 1) radon content of the soil; 2) pressure differential between the interior of a structure and the soil; 3) air exchange rate for the building; 4) moisture content surrounding the structure; and 5) presence and size of entry pathways. Climate change can affect these same factors and, therefore, may cause direct or indirect changes in indoor air quality within a structure. In addition, certain changing human behavioral factors driven by climate change may further impact air quality. Examples of how climate change may impact indoor air quality include:

- Increased Air Conditioning and Decreased Fan Usage: air conditioning used as a result of rising temperatures contributes to "closed house conditions" and reduced stratification of radon between floors;

- Activity Patterns and Spatial Radon Variation: rising outdoor temperatures may result in increased use of basements where radon concentrations are generally higher;

- Weatherization and Energy Efficiency: although undetermined, tightening structures for energy efficiency may increase radon concentrations for structures with indoor radon sources;

- Weather-Related Influences: increased wind can change pressure differentials between structure levels and the outside, and increased precipitation rates or totals may change hydrologic conditions causing a rise in the water table and force vapors from the vadose zone, or unsaturated zone, into a less dense media, such as a basement.

- High Density Housing: concrete construction used in high density housing (constructed to reduce greenhouse emissions) may be an increasing source of elevated radon exposure for some occupants.

SOCIAL VULNERABILITY

The CDC ATSDR created a Social Vulnerability Index geared toward preparing for and responding to exposure to dangerous chemicals (and other natural hazards, as well). This index is better suited to examining the social vulnerability related to hazardous materials incidents, although many of the inputs are the same as the NRI. Overall vulnerability for this index is based on: socioeconomic status (below poverty, unemployed, income, no high school diploma); household composition and disability (aged 65 or older, aged 17 or younger, civilian with disability, single-parent households); minority status and language; and housing type and transportation (multi-unit structures, mobile homes, crowding, no vehicle, group quarters).

The ATSDR map provided above in **Figure 5.40** shows the highest social vulnerability to radon exposure, is in the east end of Newport News, eastern Surry County, a corridor in Southampton County, and pockets in Suffolk, Chesapeake, Portsmouth, Norfolk and Virginia Beach. Perhaps once more information is collected regarding the underlying geology of the region and the relationship to radon, this map can be further refined in the future to more accurately isolate the social vulnerability to radon. Structure-specific data regarding age and existence of basements could also be incorporated to further enhance the analysis.

CONCLUSIONS ON HAZARD RISK

The risk and vulnerability assessment performed for the Hampton Roads region provides significant findings that allow committee members to prioritize hazard risks and proposed hazard mitigation strategies and actions. Prior to assigning conclusive risk levels for each hazard, the committee reviewed the results of the assessments shown in the following tables.

Damages and frequency information from the risk and vulnerability assessments are summarized in **Table 5.15**. This table provides a quantitative assessment of existing data for the hazards, recognizing that some hazards are not readily assessed, nor are the assessments truly comparable.

TABLE 5.15: SUMMARY OF QUANTITATIVE ASSESSMENT

HAZARD	AVERAGE ANNUAL ESTIMATED LOSSES
Sea Level Rise and Land Subsidence	$130.8 million by 2040
Tropical/Coastal Storm	$86,913,000
Flooding	$44,261,400
Tornado	$24,265,000
Earthquake	$1,119,000
Winter Storm	$805,000
Hazardous Materials Incident	$67,500
Wildfire	$36,900
Extreme Heat	Negligible*
Flooding Due to Impoundment/High Hazard Dam	Not quantified
Landslide/Coastal Erosion	Not quantified
Radon Exposure	Not quantified
Pandemic Flu or Communicable Disease	Not quantified
Drought	Not quantified

*Extreme heat event impacts are believed underreported by NCEI data.

Risk level ranking was based on historical and anecdotal data, as well as input from committee members. This ranking was done collaboratively in Workshop #1 for each hazard, using the matrix shown in **Figure 5.45**. Each hazard was discussed and analyzed based on the participants' knowledge about consequences and likelihood. This risk scoring approach is a simplified method for estimating risk that is easy to understand, based on a method developed for the Australian Institute for Disaster Resilience (AIDR)[13]. Scores from likelihood and consequence are then multiplied to provide a risk score, as shown in **Table 5.16**. Flooding and Impoundment Failure/High Hazard Dam were grouped for simplicity's sake.

[13] AIDR. (2015). *Handbook 10: National Emergency Risk Assessment Guidelines*. 2nd Edition. Australian Institute for Disaster Resilience, Australian Government Attorney-General's Department.

FIGURE 5.45: AIDR RISK RANKING FOR EACH HAZARD

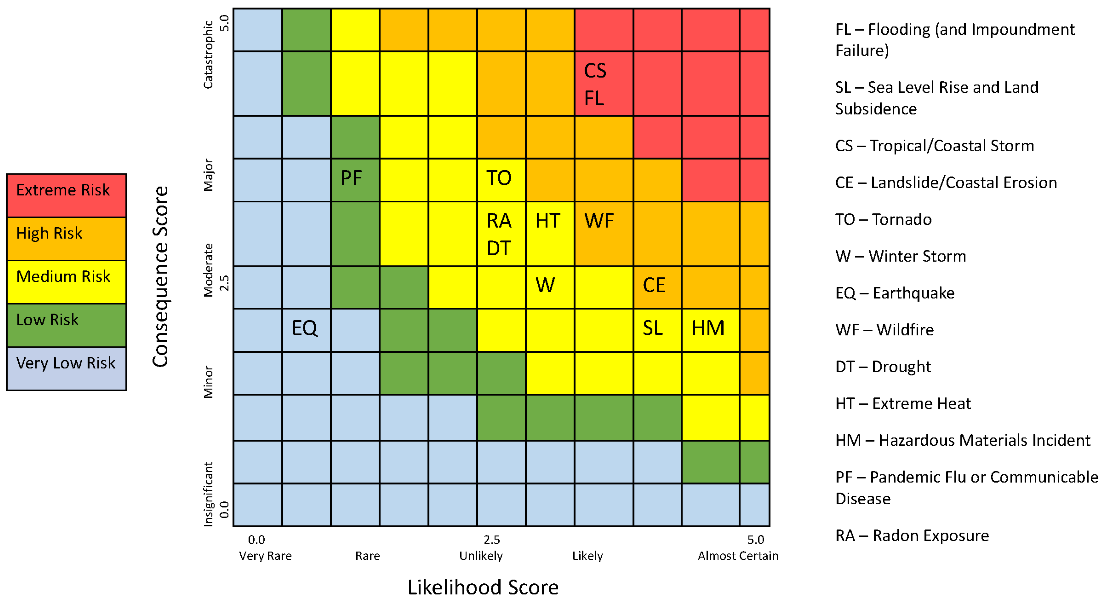


TABLE 5.16: AIDR RISK SCORES FOR EACH HAZARD

Hazard	Risk Score	Risk Description
Flooding	15.75	Extreme
Coastal/Tropical Storm	15.75	Extreme
Wildfire	10.5	High
Landslide/Coastal Erosion	10	High
Hazardous Materials Incident	9	Medium
Tornado	8.75	Medium
Extreme Heat	9	Medium
Sea Level Rise	8	Medium
Radon Exposure	7.5	Medium
Drought	7.5	Medium
Winter Storm	7.5	Medium
Pandemic Flu or Communicable Disease	3.5	Low
Earthquake	1	Very Low

The conclusions drawn from the assessments, combined with an examination of the rankings in the 2017 plan, as well as final determinations and discussion with committee members, were inserted into three categories for a final summary of hazard risk for the region based on High, Moderate, Low, or Negligible designations (**Table 5.17**). Although some hazards are classified as posing Low or Negligible risk and the impacts to infrastructure are limited, their occurrence and damages are still possible in the region.

TABLE 5.17: CONCLUSIONS ON HAZARD RISK FOR HAMPTON ROADS	
CRITICAL HAZARD - HIGH RISK	FLOODING TROPICAL/COASTAL STORM SEA LEVEL RISE AND LAND SUBSIDENCE
CRITICAL HAZARD - MODERATE RISK	WINTER STORM TORNADO HAZARDOUS MATERIALS INCIDENT
NONCRITICAL HAZARD - LOW RISK	EARTHQUAKE WILDFIRE FLOODING DUE TO IMPOUNDMENT FAILURE/HIGH HAZARD DAM PANDEMIC FLU/COMMUNICABLE DISEASE RADON EXPOSURE
NEGLIGIBLE	EXTREME HEAT LANDSLIDE/SHORELINE EROSION DROUGHT

CAPABILITY ASSESSMENT

Contents

2022 UPDATE

Section 6 was updated to combine capabilities of all communities based on the existing plans and updated information collected from interviews, phone calls, and committee work during the update process. The following major changes were incorporated:

1) All tables were updated to reflect new information;
2) Mitigation actions completed by communities and their methods of integrating hazard mitigation principles across plans and departments was updated and summarized;
3) Surry County and towns were appended to the section where necessary, and,
4) A brief section detailing regional capabilities and the Commonwealth's resiliency efforts was updated.

INTRODUCTION

This section of the Plan discusses the capability of Hampton Roads communities with regard to hazard mitigation activities, and consists of the following four subsections:

- WHAT IS A CAPABILITY ASSESSMENT?
- CONDUCTING THE CAPABILITY ASSESSMENT
- CAPABILITY ASSESSMENT FINDINGS
- INTEGRATING MITIGATION INTO COMMUNITY LIFE

WHAT IS A CAPABILITY ASSESSMENT?

The purpose of conducting a capability assessment is to confirm that the community's resulting mitigation strategy is based on the principles found in (or missing from) existing authorities, policies, programs, and resources, and based on the community's ability to expand and improve these existing tools. This planning process strives to establish goals, objectives, and actions that are feasible, based on an understanding of the organizational capacity of the departments tasked with their implementation. A capability assessment helps to determine which mitigation actions are practical and likely to be implemented over time given a local government's planning and regulatory framework, level of administrative and technical support, level of fiscal resources, and current political climate.

Careful examination of local capabilities helps detect existing gaps, shortfalls, or weaknesses within ongoing government activities that could hinder proposed mitigation activities or exacerbate hazard vulnerability. A capability assessment highlights positive mitigation measures already in place or being implemented at the local and regional levels, which should continue to be supported and enhanced through future mitigation efforts.

CONDUCTING THE CAPABILITY ASSESSMENT

In order to inventory and analyze Hampton Roads' community capabilities, the planning committee and consultant requested information on a variety of "capability indicators" such as existing local plans, policies, programs, or ordinances that may reduce, or in some circumstances, increase the community's hazard vulnerability. The matrix of capability indicators has been built by the consultant over several years of gathering capability information, and on review of numerous documents relating to factors that impact community capability. Other indicators included information related to each community's fiscal, administrative and technical capabilities such as access to local budgetary and personnel resources necessary to implement mitigation measures. Identified gaps, weaknesses, or conflicts can be recast as opportunities to implement specific mitigation actions.

For the 2022 update, the planning committee was asked to review and provide feedback on: the existing plan's capability assessment, and a presentation at the second meeting of the planning subcommittee. The presentation included information on possible new mitigation actions, and other relevant regional and state capabilities. This section has been updated based on feedback from these reviews and discussions during the Committee meetings as well as in person meetings conducted with many of the communities toward the end of the planning process.

CAPABILITY ASSESSMENT FINDINGS

PLANNING AND REGULATORY CAPABILITY

Planning and regulatory capability is based on the implementation of plans, ordinances and programs that demonstrate each local jurisdiction's commitment to guiding and managing growth, including reconstruction following a disaster. Examples include emergency response, mitigation and recovery planning, comprehensive land use planning, transportation planning, and capital improvements planning. Additional examples include the enforcement of zoning or subdivision ordinances and building codes. These planning initiatives present significant opportunities to integrate hazard mitigation principles and practices into the local decision making process.

This assessment is designed to provide a general overview of the key planning and regulatory tools in place or under development in Hampton Roads, along with their potential effect on hazard loss reduction. This information will help identify opportunities to address existing gaps, weaknesses or conflicts in the hazard mitigation strategy.

Table 6.1 provides a summary of the relevant local plans, ordinances, and programs already in place or under development. A checkmark (✓) indicates that the item is currently in place and being implemented. A "C" indicates that the item is in place for a town but is maintained and administered by the County.

TABLE 6.1: RELEVANT PLANS, ORDINANCES, AND PROGRAMS

COMMUNITY	Hazard Mitigation Plan	Comprehensive Land Use Plan	Floodplain Management Plan	Open Space Management Plan	Stormwater Management Program	Emergency Operations Plan	SARA Title III Plan	Radiological Emergency Plan	Continuity of Operations Plan	Evacuation Plan	Disaster Recovery Plan	Capital Improvements Plan	Economic Development Program	Historic Preservation Plan	Flood Damage Prevention Ordinance (feet freeboard)	Zoning Ordinance	Subdivision Ordinance	Unified Development Ordinance	Post-disaster Redevelopment Plan	Building and Fire Code	NFIP	NFIP Community Rating System
PENINSULA																						
Hampton	✓	✓			✓	✓	✓	✓		✓	✓	✓	✓		✓(3)	✓	✓			✓	✓	✓
Newport News	✓	✓		✓	✓	✓	✓	✓		✓		✓	✓	✓	✓(2)	✓	✓			✓	✓	✓
Poquoson	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓			✓(3)	✓	✓			✓	✓	✓
Williamsburg	✓	✓			✓	✓	✓	✓		✓	✓	✓	✓		✓	✓	✓			✓	✓	
James City County	✓	✓			✓	✓	✓	✓	✓	✓		✓			✓(2)	✓	✓			✓	✓	✓
York County	✓	✓			✓	✓	✓	✓	✓	✓		✓			✓(3)	✓	✓			✓	✓	✓
SOUTHSIDE																						
Norfolk	✓	✓			✓	✓	✓	✓		✓		✓		✓	✓(3)	✓	✓			✓	✓	✓
Portsmouth	✓	✓	✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓(3)	✓	✓			✓	✓	✓
Suffolk	✓	✓		✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓	✓			✓	✓	
Virginia Beach	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓(2)	✓	✓			✓	✓	✓
Chesapeake	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓(1.5)	✓	✓			✓	✓	✓
WESTERN TIDEWATER																						
Isle of Wight County	✓	✓			✓	✓	✓	✓	✓	✓		✓	✓	✓	✓(1.5)	✓	✓			✓	✓	
Smithfield	✓	✓			✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	
Windsor	✓	✓			✓		✓	✓		✓		✓			✓	✓	✓			✓	✓	
Franklin	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓(2)	✓	✓		✓	✓	✓	✓
Southampton County	✓	✓		✓	✓	✓	✓	✓	✓	✓		✓			✓(1.5)	✓	✓			✓	✓	
Boykins	✓	✓			✓	C	C	C	C	✓			✓		✓	✓	✓			✓	✓	
Branchville	✓	✓			✓	C	C	C	C	✓			✓		✓	✓	✓			✓	✓	
Capron	✓	✓			✓	C	C	C	C	✓			✓			✓	✓			✓		
Courtland	✓	✓			✓	C	C	C	C	✓			✓		✓	✓	✓			✓	✓	
Ivor	✓	✓			✓	C	C	C	C	✓			✓		✓	✓	✓			✓	✓	
Newsoms	✓	✓			✓	C	C	C	C	✓			✓			✓	✓			✓		
Surry County	✓	✓			✓	✓		✓		✓		✓	✓	✓	✓	✓	✓			✓	✓	
Claremont	✓	✓			✓	C		C		✓					✓	✓	✓			✓	✓	
Dendron	✓	✓			✓	C		C		✓						✓	✓			✓		

Emergency Management

Hazard mitigation is one of four primary phases of emergency management. The three other phases include preparedness, response, and recovery. Each phase is interconnected with hazard mitigation as **Figure 6.1** suggests. Opportunities to reduce potential losses through mitigation practices are ideally implemented before a disaster strikes. Examples include the acquisition or elevation of flood-prone structures or the enforcement of regulatory policies that limit or prevent construction in known hazard areas. The post-disaster environment provides an important "window of opportunity" to implement hazard mitigation projects and policies. During this time period, federal disaster assistance, such as the Hazard Mitigation Grant Program (HMGP), may be available. In addition, elected officials and disaster victims may be more willing to implement mitigation measures in order to avoid similar events in the future.

FIGURE 6.1: FOUR PHASES OF EMERGENCY MANAGEMENT

Source: Federal Emergency Management Agency

Planning for each phase is a critical part of a comprehensive emergency management program and key to the successful implementation of hazard mitigation actions.

Hazard Mitigation Plan: A hazard mitigation plan represents a community's blueprint for how it intends to reduce the impact of natural and human-caused hazards on people and the built environment. The essential elements of a hazard mitigation plan include a risk assessment, capability assessment and mitigation strategy.

Disaster Recovery Plan: A disaster recovery plan guides the physical, social, environmental, and economic recovery and reconstruction process following a disaster. In many instances, hazard mitigation principles and practices are incorporated into local disaster recovery plans with the intent of capitalizing on opportunities to break the cycle of repetitive disaster losses. Disaster recovery plans can also lead to the preparation of disaster redevelopment policies and ordinances to be enacted following a hazard event.

Emergency Operations Plan: An emergency operations plan outlines responsibilities and the means by which resources are deployed during and following an emergency or disaster.

- Virginia Department of Emergency Management (VDEM) assists local governments with plan development and revisions by offering the following services:
  - Issuing update notification at both 1 year and 6 months;
  - Conducting a plan review, as requested;
  - Facilitating plan review meetings; and,
  - Developing plan templates through collaboration with local partners.
- In December 2015, VDEM released *2015 Report on the Status of Emergency Response Plans and Preparedness Efforts in the Commonwealth*. According to the report, 98-percent of Virginia localities have current local emergency operations plans. Virginia was accredited for the third time in a row by the Emergency Management Assessment Program. Recommendations from the report included implementing statewide disaster planning software to digitize all EOPs to increase efficiency and coordination between agencies and localities and using common operating picture tools to provide situational awareness to state leaders in real-time.
- Emergency Managers for each city and county were included in preparation of the MAP because their knowledge of their jurisdiction's EOP and its strengths and weaknesses is a valuable component of this planning process.

Continuity of Operations Plan (COOP): A continuity of operations plan establishes a clear chain of command, line of succession, and plans for backup or alternate emergency facilities in case of an extreme emergency or disaster. Many Emergency Managers in communities without comprehensive COOPs for all internal agencies were interested in supplementing their existing EOP or existing COOP with additional planning and this insight was included in the MAP planning process.

Radiological Emergency Plan: A radiological emergency plan delineates roles and responsibilities for assigned personnel and the means to deploy resources in the event of a radiological accident.

- The Virginia plan for radiological emergencies is available online at: https://www.nrc.gov/docs/ML0834/ML083470907.pdf.

SARA Title III Emergency Response Plan: A SARA Title III Emergency Response Plan outlines the procedures to be followed in the event of a chemical emergency such as the accidental release of toxic substances. These plans are required by federal law under Title III of the Superfund Amendments and Re-authorization Act (SARA), and the Emergency Planning and Community Right-to-Know Act (EPCRA).

General Planning

The implementation of hazard mitigation activities involves departments and individuals in a broad range of professions. Stakeholders may include local planners, public works officials, economic development specialists, and others. Concurrent local planning efforts can complement hazard mitigation goals even though they are not designed as such.

Comprehensive Land Use Plan: A comprehensive land use plan establishes the overall vision for what a community wants to be and serves as a guide to future governmental decision making. Typically, a comprehensive plan is comprised of demographic conditions, land use patterns, transportation elements and proposed community facilities. Given the broad nature of the plan and its regulatory standing in many communities, the integration of hazard mitigation measures into the comprehensive plan can serve as a far reaching, long-term risk reduction tool.

- Virginia law requires that all communities have a comprehensive land use plan and that it be updated every five years.
- As indicated in Sections 2 and 3, the comprehensive plans for each of the counties and cities involved in this planning process were relied upon for three planning stages: 1) updating the community profile; 2) comprehensive plan goals and objectives were reviewed during the updating of this plan’s goals and objectives; and 3) each comprehensive plan was reviewed by the consultant prior to the in-person meetings to identify mitigation plan conflicts or areas of potential integration/coordination. This process helps make sure that the comprehensive plans and the hazard mitigation plan are in parallel.

Capital Improvements Plan (CIP): A capital improvements plan guides the scheduling of spending on public improvements. A capital improvements plan can serve as an important mechanism to guide future development away from identified hazard areas, or to fix infrastructure problems that contribute to hazard-related damage. Limiting public investment in hazardous areas is one of the most effective long-term mitigation actions available to local governments. Jurisdictions with CIPs were able to pull projects from the CIP that reflect the goals and objectives of mitigation planning, and vice versa. CIPs often include more detail on projects costs, allowing the hazard mitigation plan actions to be described in more detail. In this way, the community CIPs and hazard mitigation plan share similar projects.

Historic Preservation Plan: A historic preservation plan is intended to preserve historic structures or districts within a community. An often overlooked aspect of the historic preservation plan is the assessment of buildings and sites located in areas subject to natural hazards to include the identification of the most effective way to reduce future damages. This may involve retrofitting or relocation techniques that account for the need to protect buildings that do not meet current building standards or are within a historic district that cannot be easily relocated out of harm’s way.

Zoning Ordinances: Zoning represents the primary means by which land use is controlled by local governments. As part of a community’s police power, zoning is used to protect the public health, safety and welfare. Since zoning regulations enable municipal governments to limit the type and density of development, it can serve as a powerful tool when applied in identified hazard areas.

- The Virginia General Assembly enacted the Chesapeake Bay Preservation Act in 1988, requiring local governments statewide to include water quality protection measures in their zoning and subdivision ordinances and in their comprehensive plans. Although the Act was developed with the intent of improving water quality throughout Virginia, the regulations have the additional benefit of controlling or restricting development in floodplain areas. The CBPA Overlay District consists of three components: Resource Protection Area (RPA) that includes a 100 foot RPA buffer, a Resource Management Area (RMA), and the Intensely Developed Areas (IDA). The lands that make up Chesapeake Bay Preservation Areas are those that have the potential to impact floodplains and water quality most directly. Generally, there are two main types of land features: those that protect and benefit water quality (RPAs); and those that, without proper management, have the potential to damage water quality (RMAs). Areas with intensive waterfront industrial land uses and activities are categorized as IDAs.
- Floodplain management ordinances in Virginia communities are commonly administered as zoning overlay districts in the community zoning ordinance.
- Zoning ordinance floodplain management overlay district regulations were reviewed by the consultant prior to in person meetings with the jurisdictions. The review helped identify areas of potential improvement to the ordinances.

Subdivision Ordinances: A subdivision ordinance regulates development of housing, commercial, industrial or other uses, including associated public infrastructure, as land is subdivided into buildable lots. Subdivision design that accounts for natural hazards can dramatically reduce the exposure of future development. For the 2017 update to this plan, the consultant reviewed subdivision ordinances and recommended potential areas of improvement related to hazard mitigation.

Building Codes, Permitting and Inspections: Building codes regulate design and construction standards. Permits are issued and work is inspected on new construction and building alterations. Permitting and inspection processes both before and after a disaster can affect the level of hazard risk faced by a community.

- Under Virginia Law the Department of Housing and Community Development (DHCD) has authority to promulgate building regulations and a regulatory process for development and adoption of a statewide mandatory mini/maxi construction code that all 167 units of local government (counties and incorporated cities) must adopt and implement. The Virginia Uniform Statewide Building Code (USBC) is administered by the Virginia Board of Housing and Community Development and regulates construction and maintenance of buildings and structures. Effective July 1, 2021, Virginia adopted the 2018 I-codes as referenced in the Virginia Construction Code Part 1, the 2018 Statewide Fire Prevention Code; and the 2017 National Electrical Code. Implementation for state colleges and universities is the responsibility of the Virginia General Services Department. The State Fire Marshal within DHCD is responsible for statewide implementation of the Fire Code unless localities elect to adopt this code at the local level. Localities can and do adopt the Property Maintenance Code, which is within the scope of the statewide code. Enforcement of the USBC is the responsibility of the local government's building inspections department. Many of the towns in the study area rely upon the county building department for code-related functions.
- The consultant for this plan update reviewed Appendix F of the International Codes related to radon control. This appendix was discussed with the communities for this update to determine if any communities were interested in enforcing Appendix F in view of the HIRA information regarding Radon Exposure risk.

Resiliency Planning: In 2021, the Commonwealth worked with 2,000 stakeholders to build the *Coastal Resilience Master Plan*. This plan documents which land is exposed to coastal flooding hazards now and into the future, as well as the impacts of future flooding scenarios on coastal Virginia's community resources and manmade and natural infrastructure.

The Master Plan concluded that between 2020 and 2080:

- the number of residents living in homes exposed to extreme coastal flooding is projected to grow from approximately 360,000 to 943,000, an increase of 160%;
- the number of residential, public, and commercial buildings exposed to an extreme coastal flood is projected to increase by almost 150%, from 140,000 to 340,000, while annualized flood damages increase by 1,300% from $0.4 to $5.1 billion;
- the number of miles of roadways exposed to chronic coastal flooding is projected to increase from 1,000 to nearly 3,800 miles, an increase of nearly 280%; and
- an estimated 170,000 acres, or 89%, of existing tidal wetlands and 3,800 acres, or 38%, of existing dunes and beaches may be permanently inundated, effectively lost to open water.

The Commonwealth intends to develop successive updates of the Master Plan on at least a five-year cycle, managed by the Department of Conservation and Recreation in consultation with the Chief Resilience Officer, the Special Assistant to the Governor for Coastal Adaptation and Protection, and the Technical Advisory Committee.

The next phase of the Master Plan anticipated by 2024, will aim to address recommendations of the Technical Advisory Committee to broaden the analysis of natural hazards by including rainfall-driven, riverine, and compound flooding, expand and improve the inventory of resilience projects by continuing to add efforts and working with project owners to better understand the benefits of projects, and extend this critical work beyond the coastal region to encompass statewide resilience needs.

Projects identified in the Master Plan must go through a specified resiliency planning process to be funded through the Community Flood Preparedness Fund (CFPF), also launched in 2021. Many communities in Hampton Roads have begun the planning process, and consequently, those communities were able to incorporate many of their projects into the hazard mitigation plan, as well. CFPF is a statewide program maintained by the Department of Conservation and Recreation that fills pressing needs by prioritizing low-income communities and provides a permanent funding stream to finance flooding resilience projects, studies, and capacity building initiatives. The Regional Greenhouse Gas Initiative (RGGI) is an initiative made up of eleven states that aims to reduce greenhouse gas emissions. RGGI holds carbon dioxide auctions, which will fund the Virginia CFPF.

Radon Exposure Remediation:
The Code of Virginia requires that Radon testers and mitigators be currently certified by either the National Radon Proficiency Program or the National Radon Safety Board. The program is administered by Virginia Department of Health, Office of Radiological Health, Indoor Radon Program.

- In 1993 the Virginia General Assembly passed legislation that requires all schools in the Commonwealth to be tested for radon after July 1, 1994, and also any new school buildings or additions built after that date. Each school is required to maintain files of their radon test results.
- Upon request, the Department's Radon Coordinator can present a course on radon for real estate transactions in Virginia. This information was reviewed and incorporated into the HIRA and the public meeting presentations on radon provided during this update process.
- The department has a limited supply of radon test devices that are distributed annually, free upon request.

Floodplain Management

The NFIP contains specific regulatory measures that enable government officials to determine where and how growth occurs relative to flood hazards. Participation in the NFIP is voluntary but is promoted by FEMA as a crucial means to implement and sustain an effective hazard mitigation program.

In order to join the NFIP, a community must adopt flood damage prevention ordinance development standards in the floodplain. These standards require that all new buildings and substantial improvements to existing buildings be protected from damage by the 100-year flood, and that new floodplain development does not aggravate existing flood problems or increase damage to other properties.

Another key service provided by the NFIP is the identification of flood hazard areas. FIRMs are used to assess flood hazard risk, regulate construction practices, and set flood insurance rates. FIRMs are an important source of information to educate residents, government officials, and the private sector about the likelihood of flooding in their community.

Detailed information on each community's NFIP participation history and current map status is provided in Sections 5 and 6; **Table 5.3** summarizes NFIP participation for Hampton Roads communities, along with general NFIP policy data, while **Tables 5.4** and **5.5** provide the repetitive flood losses; and **Table 6.1** provides information on freeboard requirements. Each of the communities that participates in the NFIP has designated a floodplain manager in their floodplain management ordinance and each community in the NFIP has created a very specific Mitigation Action in the Mitigation Action Plan in Section 7 that addresses actions they will consider in the near-term to address their commitment to continuing their participation in the NFIP. Noteworthy accomplishments in floodplain management are also found at the end of this section, broken out by community. **Table 6.2** provides additional summary information on how the NFIP is managed in each of the participating communities in Hampton Roads and notes specific actions or programs of interest in each community, especially with regard to their flood ordinances.

Effective January 1, 2022, a new flood disclosure requirement of Virginia Code Section 55.1-708.2, requires that an owner of residential real property who knows that the dwelling unit is a repetitive risk loss structure must disclose such fact to the purchaser. A "repetitive risk loss structure" is defined as a property for which two or more claims of more than $1,000 were paid by the National Flood Insurance Program within any rolling 10-year period since 1978. The law further requires that the owner of a property subject to the disclosure requirement must provide notification to the purchaser of any disclosure before the ratification of a contract.

TABLE 6.2: NFIP MANAGEMENT IN PARTICIPATING COMMUNITIES				
SUBREGION	**COMMUNITY**	**Designated Floodplain Manager/Agency**	**CFM on Staff?**	**Notes on Floodplain Management Ordinance and Administration**
Peninsula	Hampton	Zoning Administrator	Yes	The city last updated their ordinance in 2016 and included 3 feet of freeboard in the SFHA and 1.5 feet of freeboard outside the SFHA. Most ordinance administration is by Community Development or Public Works. ECs are maintained in digital format.
	Newport News	City Manager	Yes	Ordinance was updated in 2014 and requires 2 feet freeboard. Codes Compliance maintains ECs and performs inspections of floodplain construction. City recently joined the CRS.
	Poquoson	Building Official	Yes	Last updated in 2014, the city's ordinance has many higher standards, including coastal A Zone, and freeboard of 3 feet. The ordinance is administered by the Building Official within the Permit Office.
	Williamsburg	Zoning Administrator	No	The city last updated their ordinance in 2015, adopting the State's model ordinance, with 2 feet of freeboard for nonresidential structures and 18 inches for residential structures. The narrow floodplains of Williamsburg do not lend themselves to development pressure.
	James City County	Zoning Administrator	Yes	The ordinance was last updated in 2018 and includes 2 feet of freeboard, and many prohibited uses in the SFHA. It also has higher standards for fill. Community Development office administers the ordinance. Ordinance addresses accessory structures.
	York County	Chief of Stormwater Programs	Yes	The ordinance requires 3 feet of freeboard for residential structures and an additional foot of freeboard for structures in the Coastal A Zone.
Southside	Norfolk	Floodplain Administrator (Planning)	Yes	Revisions to ordinance approved 2020 with several higher standards, including 3 feet freeboard, and coastal A zone regulation to V Zone standards. City has robust flood mitigation program, CRS program and ordinance administration system through city Planning, Building Safety and the Development Services Center.
	Portsmouth	Environmental Manager	Yes	Last updated in 2015, the ordinance requires 3 feet freeboard and V Zones requirements for Coastal A Zone structures. Zoning-related inquiries and information regarding floodplains is handled by the Department of Neighborhood Advancement. The city has a robust flood mitigation program and CRS program.
	Suffolk	Director of Planning and Community Development	No	The floodplain management ordinance was updated in 2015. Flood damage is tied to the assessor's record for properties. High water mark data are collected along the Nansemond River at North Main Street. The city does not maintain ECs digitally.
	Virginia Beach	Public Works Director	Yes	The city ordinance requires 2 feet of freeboard. The ordinance was last updated in 2020. A

TABLE 6.2: NFIP MANAGEMENT IN PARTICIPATING COMMUNITIES				
SUBREGION	**COMMUNITY**	**Designated Floodplain Manager/Agency**	**CFM on Staff?**	**Notes on Floodplain Management Ordinance and Administration**
				major rewrite in 2013 had several higher standards, including compensatory fill in specified areas, and no new residential structures on lots created after October 23, 2001. 38% of the SFHA is protected as open space. Lowest floor data for new structures is recorded in online permit record and EC are attached to Certificate of Occupancy. City has a Southern Rivers watershed buffer and the CBPA buffers which help protect natural and beneficial functions of floodplains.
	Chesapeake	Director of Development and Permits	Yes	Ordinance was updated in 2014 and includes 1.5 feet of freeboard. The city maintains ECs digitally.
Western Tidewater	Isle of Wight County	Director of Planning and Zoning	Yes	The County has freeboard of 1.5 feet required in their 2015 ordinance, has no freeboard outside the SFHA.
	Smithfield	Planning & Zoning Administrator	No	2015 ordinance has 1.5 feet freeboard and is administered by Planning, Engineering & Public Works.
	Windsor	Planning and Zoning	No	Ordinance does not require freeboard and is administered by Planning and Zoning Department.
	Franklin	Zoning Administrator	Yes	The city updated ordinance in 2016; requires freeboard of 2 feet. City routinely considers higher standards and the impact when updating ordinance. The Comprehensive Plan promotes a greenway along the Blackwater River and zoning protects open space along the river. The city recently joined the CRS. Online maintenance of ECs is under development. The Downtown area has an older Flood Recovery Plan.
	Southampton County	Director of Community Development	Yes	The County adopted State Model Floodplain Ordinance and included 1.5 feet of freeboard. Residential structures are required to have large, front-yard-type, setbacks along waterfront, rather than smaller rear yard setbacks. Comprehensive Plan encourages conservation easements/ag and forestal districts and reforestation of clear-cut properties plus environmental goals to protect waterways and wetlands. Nottoway and Blackwater Rivers are part of State Scenic River program, limiting development that visually impacts rivers, thereby helping limit development in the floodplain.
	Boykins	Mayor	No	Ordinance requirements administered by town staff, as required.
	Branchville	Unknown	No	Ordinance requirements administered by town staff, as required.
	Courtland	Mayor	No	Ordinance requirements administered by town staff, as required.

TABLE 6.2: NFIP MANAGEMENT IN PARTICIPATING COMMUNITIES				
SUBREGION	COMMUNITY	Designated Floodplain Manager/Agency	CFM on Staff?	Notes on Floodplain Management Ordinance and Administration
	Ivor	Clerk	No	Ordinance requirements administered by town staff, as required.
	Surry County	Planning & Community Development Director	No	Ordinance was updated in 2015. Unclear on freeboard as ordinance contains template language: "recommend for > 1 foot".
	Claremont	Information not provided	No	Ordinance not available online and not provided by Town.

An additional indicator of floodplain management capability is participation in the CRS. The CRS is an incentive program that encourages communities to undertake defined flood mitigation activities that go above and beyond the minimum requirements of the NFIP, adding extra local measures to provide protection from flooding. The creditable CRS mitigation activities are assigned a range of point values. As points are accumulated and identified thresholds are reached, communities can apply for an improved CRS class rating. Class ratings, which run from 10 to 1, are tied to flood insurance premium reductions as shown in **Table 6.3**. As class ratings improve (decrease), the percent reduction in flood insurance premiums for NFIP policy holders in that community increases. Every 500 points accumulated is equal to a 5% reduction in flood insurance premiums in the SFHA; premium discounts are typically limited to 5% outside the SFHA.

TABLE 6.3: CRS PREMIUM DISCOUNTS, BY CLASS	
CRS CLASS	PREMIUM REDUCTION
1	45 percent
2	40 percent
3	35 percent
4	30 percent
5	25 percent
6	20 percent
7	15 percent
8	10 percent
9	5 percent
10	0 percent

Source: Federal Emergency Management Agency

Community participation in the CRS is voluntary. Any community that is in full compliance with the rules and regulations of the NFIP may apply to FEMA for a CRS classification better than class 10.

- As of January 2022, there were ten communities in the study area participating in the Community Rating System: Hampton (Class 7); Newport News (Class 7); James City County (Class 5); Norfolk (Class 5); Poquoson (Class 8); Portsmouth (Class 7); Chesapeake (Class 7); York County (Class 7); Virginia Beach (Class 7); and Franklin (Class 9). Successful participation in the CRS shows continued compliance with the NFIP on the part of these communities. Newport News and Franklin are the most recent communities to join CRS and their premium discounts will begin in Spring 2021. Virginia Beach joined in 2019.

Floodplain Management Plan: A floodplain management plan (or a flood mitigation plan) provides a framework for the identification and implementation of corrective and preventative measures specifically designed to reduce the impacts of floods.

- The City of Portsmouth is the only community in the study area that has adopted a separate floodplain management plan, but the community has decided to use the hazard mitigation planning process to develop and enact flood mitigation activities in the future rather than maintaining both documents separately.

Open Space Management Plan: An open space management plan is designed to preserve, protect and restore largely undeveloped lands, and to expand or connect areas in the public domain, including parks, greenways and other outdoor recreation areas. Open space management practices are consistent with the goals of reducing hazard losses, such as the preservation of wetlands or other flood-prone areas in their natural state.

Stormwater Management Plan: A stormwater management plan is designed to address flooding associated with stormwater runoff. The stormwater management plan is typically focused on design and construction measures that are intended to reduce the impact of frequent urban nuisance flooding.

- Virginia Department of Environmental Quality (VDEQ) is the lead agency for developing and implementing statewide stormwater management and nonpoint source pollution control programs to protect the Commonwealth's water quality and quantity. Currently, three laws apply to land disturbance activity in Virginia: the Stormwater Management Act (§ 62.1-44.15:24 et seq.), Erosion and Sediment Control Law (§ 62.1-44.15:51 et seq.), and Chesapeake Bay Preservation Act (§ 62.1-44.15:67 et seq.). These laws evolved at different times, have been administered by different agencies throughout the years, and created three distinct regulatory programs with varying requirements. At the request of the Chairs of the Virginia House and Senate Natural Resources committees, DEQ pulled together a group of stakeholders to consider ways to streamline and possibly combine these programs. The goal is to make the requirements clearer, more consistent and more "user-friendly", while continuing to ensure the protection of the Commonwealth's water quality. The Department asked representatives of all affected constituencies to take part in this important effort – including local governments, the development community, environmental organizations, agriculture, and others.
- Local governments in Virginia are required to administer the stormwater management and erosion and sediment control laws and regulations promulgated by the State through local ordinances. Surry County's program is administered directly by DEQ.
- As part of this update, the contractor reviewed the City of Virginia Beach's Stormwater ordinance to understand the higher standards that the City has incorporated above and beyond the State minimum requirements.

Administrative and Technical Capability

The ability of a local government to develop and implement mitigation projects, policies, and programs is directly tied to its ability to direct staff time and resources for that purpose. Administrative capability is evaluated by determining how mitigation-related activities are assigned to local departments and if there are adequate personnel resources to complete these activities. The degree of intergovernmental coordination among departments will also affect administrative capability associated with the implementation and success of proposed mitigation activities. Technical capability is evaluated by assessing the level of knowledge and technical expertise of local government employees, such as personnel skilled in using GIS to assess community hazard vulnerability.

Staff interviews were used to capture information on administrative and technical capability through the identification of available staff, and available personnel resources, whether through consultants or collaborators with community government. **Table 6.4** provides a summary of the results. A checkmark (✓) indicates that local staff members are tasked with the services listed.

TABLE 6.4: RELEVANT STAFF / PERSONNEL RESOURCES

COMMUNITY	Planners with knowledge of land development and land management practices	Engineers or professionals trained in construction practices related to buildings and/or infrastructure	Planners or engineers with an understanding of natural and/or human-caused hazards	Emergency manager	Floodplain manager	Land surveyors	Scientist familiar with the hazards of the community	Staff with education or expertise to assess the community vulnerability to hazards	Personnel skilled in Geographic Information Systems and/or HAZUS	Resource development staff or grant writers
PENINSULA										
Hampton	✓	✓	✓	✓	✓			✓	✓	✓
Newport News	✓	✓	✓	✓	✓			✓	✓	✓
Poquoson	✓	✓	✓	✓	✓		✓			✓
Williamsburg	✓	✓	✓	✓	✓			✓	✓	✓
James City County	✓	✓	✓	✓	✓			✓	✓	
York County	✓	✓	✓	✓	✓				✓	
SOUTHSIDE										
Norfolk	✓	✓	✓	✓	✓				✓	✓
Portsmouth	✓	✓	✓	✓	✓	✓		✓	✓	✓
Suffolk	✓	✓	✓	✓				✓	✓	✓
Virginia Beach	✓	✓	✓	✓	✓	✓		✓	✓	
Chesapeake	✓	✓	✓	✓	✓	✓			✓	✓
Franklin	✓	✓	✓	✓	✓			✓	✓	

TABLE 6.4: RELEVANT STAFF / PERSONNEL RESOURCES										
COMMUNITY	Planners with knowledge of land development and land management practices	Engineers or professionals trained in construction practices related to buildings and/or infrastructure	Planners or engineers with an understanding of natural and/or human-caused hazards	Emergency manager	Floodplain manager	Land surveyors	Scientist familiar with the hazards of the community	Staff with education or expertise to assess the community vulnerability to hazards	Personnel skilled in Geographic Information Systems and/or HAZUS	Resource development staff or grant writers
WESTERN TIDEWATER										
Isle of Wight County	✓	✓	✓	✓					✓	
Smithfield	✓	✓	✓	✓					✓	
Windsor										
Southampton County	✓	✓	✓	✓	✓			✓	✓	✓
Boykins		✓								
Branchville										
Capron										
Courtland	✓	✓								
Ivor										
Newsoms										
Surry County	✓	✓	✓	✓	✓		✓	✓	✓	✓
Claremont					✓					
Dendron										

Fiscal Capability

The ability of a local government to take action is often closely associated with the amount of money available to implement policies and projects. This may take the form of grant funding or locally-based revenue and financing. The costs associated with mitigation policy and project implementation vary widely. In some cases, policies are tied to staff time or administrative costs associated with the creation and monitoring of a given program. In other cases, direct expenses are linked to an actual project such as the acquisition of flood-prone homes, which can require a substantial commitment from local, state and federal funding sources.

Staff interviews were used to capture information on fiscal capability through the identification of locally available financial resources. **Table 6.5** provides a summary of the results. A checkmark (✓) indicates that the listed fiscal resource is locally available for hazard mitigation purposes.

TABLE 6.5: FISCAL CAPABILITY

COMMUNITY	Capital Improvement Programming	Community Development Block Grants	Special Purpose Taxes	Gas / Electric Utility Fees	Water / Sewer Fees	Stormwater Utility Fees	Development Impact Fees	General Obligation Bonds	Partnering Arrangements or Intergovernmental Agreements
PENINSULA									
Hampton	✓	✓	✓	✓		✓		✓	✓
Newport News	✓	✓			✓	✓			✓
Poquoson	✓	✓				✓		✓	✓
Williamsburg	✓	✓		✓	✓			✓	✓
James City County	✓	✓							✓
York County	✓	✓							✓
SOUTHSIDE									
Norfolk	✓	✓		✓	✓	✓			✓
Portsmouth	✓	✓			✓	✓		✓	✓
Suffolk	✓	✓	✓	✓	✓		✓	✓	✓
Virginia Beach	✓	✓	✓		✓	✓	✓	✓	✓
Chesapeake	✓	✓			✓	✓	✓	✓	✓
WESTERN TIDEWATER									
Isle of Wight County	✓	✓		✓	✓			✓	✓
Smithfield	✓	✓			✓		✓		✓
Windsor	✓	✓					✓		✓
Franklin	✓	✓	✓	✓	✓				✓
Southampton County	✓	✓		✓	✓			✓	✓
Boykins		✓						✓	✓
Branchville		✓						✓	✓
Capron		✓			✓			✓	✓
Courtland		✓			✓			✓	✓
Ivor		✓			✓			✓	✓
Newsoms		✓						✓	✓
Surry County	✓	✓			✓				✓
Claremont		✓			✓				✓
Dendron		✓							✓

Political Capability

One of the most difficult capabilities to evaluate involves the political will of a jurisdiction to enact meaningful policies and projects designed to reduce the impact of hazards. The adoption of hazard mitigation measures may be seen as an impediment to growth and economic development, which may adversely impact other hazard-related initiatives. Mitigation may not generate the same level of interest among local officials when compared with competing priorities.

Self-Assessment of Capabilities

In addition to the inventory and analysis of specific local capabilities, communities should self-assess their capability to implement hazard mitigation activities. Officials were encouraged to consider the barriers to implementing proposed mitigation strategies in addition to the mechanisms that could enhance or further such strategies. The committee classified each of the capabilities as either "limited," "moderate" or "high."

Table 6.6 summarizes the results of the self-assessment process. An "L" indicates limited capability; an "M" indicates moderate capability; and an "H" indicates high capability.

TABLE 6.6: SELF ASSESSMENT OF LOCAL CAPABILITY					
COMMUNITY	Planning and Regulatory Capability	Administrative and Technical Capability	Fiscal Capability	Political Capability	Overall Capability
PENINSULA					
Hampton	H	H	M	M	M
Newport News	H	H	M	H	H
Poquoson	H	H	M	M	H
Williamsburg	H	H	H	H	H
James City County	H	H	M	H	H
York County	H	H	M	H	H
SOUTHSIDE					
Norfolk	M	H	M	H	M
Portsmouth	M	M	L	M	M
Suffolk	M	H	M	L	M
Virginia Beach	M	H	M	L	M
Chesapeake	H	H	M	M	H
WESTERN TIDEWATER					
Isle of Wight County	H	M	M	M	M
Smithfield	L	L	L	M	L
Windsor	L	L	L	L	L
Franklin	M	M	L	M	M
Southampton County	M	M	L	M	M
Boykins	L	L	L	M	L
Branchville	L	L	L	M	L
Capron	L	L	L	M	L
Courtland	M	M	L	M	M
Ivor	L	L	L	M	L
Newsoms	L	L	L	M	L
Surry County	M	M	M	M	M
Claremont	L	L	L	L	L
Dendron	L	L	L	L	L

INTEGRATING MITIGATION MEASURES INTO COMMUNITY LIFE

The success of future mitigation efforts in a community can be gauged to some extent by its past efforts. Previously implemented mitigation measures indicate that there is and continues to be a desire to reduce the effects of natural hazards in the region. The success of these projects can be influential in building local government support for new mitigation efforts. Additional capability toward realizing mitigation goals is built through the integration of mitigation strategies into other local planning and administrative tasks.

While the notes below are not an exhaustive list of all mitigation actions taken in the region, they do provide a summary of very recent mitigation measures undertaken by communities in Hampton Roads and in part describe how many of the communities have integrated their mitigation strategies into other planning mechanisms. Additionally, as called for in the *National Mitigation Framework*, the aspects of leadership, collaboration, partnership building, and education/skill building have been shown in the following summary notes whenever possible.

Regional Activities

- In 2015, HRPDC prepared grant application for hazard mitigation plan update that combined 7 existing plans into 1 large regional plan. Updated plan streamlined the list of hazards to align more closely with the State Hazard Mitigation Plan. The PDC also conducted two Joint Land Use Studies described below for each participating city, in partnership with the U.S. Navy, Portsmouth, Chesapeake, Norfolk and Virginia Beach.
- The All-Hazards Advisory Committee (AHAC) was formed in 2015 to bring together mitigation practitioners from each of the HRPDC communities. This group is helping the PDC administer the mitigation planning contract among other tasks.
- Coastal Virginia CRS Users' Group meets every other month to review best practices of other communities and stay up to date on floodplain management and CRS issues. Consulting hazard mitigation planners for the HRPDC updated the group on how to create and update mitigation capability analyses at spring 2015 meeting.
- Each community's comprehensive plan, local and state resilience plans, and the State Hazard Mitigation Plan were used and will continue to be used to carefully update the goals and objectives in the HMP to align with existing plan goals at the State and regional levels.
- Most communities in the region include mitigation planning committee members who are also involved in the comprehensive planning process. This helps ensure consistency across planning documents. Since there are 15 comprehensive plans to consider during this HMP update, it is expected that common themes can be found that will help focus the HMP goals and objectives.
- VDEM procured Crisis Track for each of Virginia's counties and independent cities in 2017. The primary objective was to provide all localities with the capability to quickly complete, document, and report the outcomes of local damage assessments in a manner that allowed VDEM to see real-time data of the disaster consequences. This real-time data will help VDEM to be better prepared to support any unmet needs and assist VDEM in more quickly processing requests for Federal Assistance when needed. Crisis Track uses local government GIS data, such as address points and tax parcel layers, to locate and valuate every structure in the Commonwealth. When an incident occurs, local emergency managers use Crisis Track to identify all infrastructure in an area of concern and send pre-populated damage assessment forms to each damage assessment team's mobile device. As teams complete the damage assessment forms, Crisis Track calculates damage costs using tax assessment values and summarizes results for each county. Most of the communities in the study area have pre-populated and tested Crisis Track, and several have already implemented the software for incident assessment.
- HRPDC developed a regional Elevation Certificate database with information from 10 Hampton Roads local governments, to include over 2000 data points. The data from Hampton and Chesapeake were then used to evaluate statistical approaches for estimating building first floor

elevations regionally in support of local and regional vulnerability assessments under various flooding scenarios.[1]

City of Hampton

- The city's Fire Department Public Educator has added more hazards to their 4th grade fire presentation.
- The 2011 Hazard Mitigation Plan, especially HIRA information, was integrated into city's 2014 Emergency Operations Plan update.
- Hampton and Newport News applied for and received a hazard mitigation grant to add a generator to Hines Middle School, which is one of the shelters in the city's MOU with Newport News.
- Hampton received a State Homeland Security Grant in 2014 to add specialized items for sheltering children, such as highchairs and pack and plays.
- As a result of a previous HMP action to evaluate/review options for more effective public warning systems to upgrading/replace existing reverse 911 system, in 2013 Hampton switched to Everbridge which provides more options for alerting the public. This system is also integrated with the system being used by VDEM.
- HMP action to educate elected officials and residents on the importance of the NFIP has resulted in a multi-agency effort to provide flood insurance brochures at all outreach events. The importance of flood insurance is in the city's general presentation that is given to the public on emergency management.
- A high priority action in the HMP was to support mitigation of priority flood-prone structures through promotion of acquisition/demolition, elevation and flood proofing of non-residential projects where feasible using FEMA hazard mitigation grant programs where appropriate. The city has hired new staff to implement grants and has completed several home elevation projects.
- The city has implemented a revolving loan fund for residential elevation projects. The revolving loan program is up and running. It is the only program of its kind, in Virginia, for residents to apply for low-interest loans to help with qualifying mitigation projects. This project is supported by the Office of Emergency Management, Hampton Redevelopment and Housing Authority, and Old Point National Bank.
- Mitigation action to provide NOAA weather radios to high risk populations was funded and completed with weather radios provided to residents that live in mobile homes in Hampton in April 2015.
- HMP mitigation action to evaluate the relocation of Hampton City Schools Maintenance Building was implemented by chance when the building was destroyed by a tornado that hit Hampton on January 11, 2014. The building was not rebuilt.
- The city plans to improve CRS Class 7 rating to a Class 6 using inputs and capabilities across many city departments.
- City currently has a Newmarket Creek mitigation project in design phase with the USACE, in addition to other projects in design phase: North Armistead Avenue Road Raining, Oakland-Old Point Area Drainage Improvements, Phoebus Area Drainage Improvements at Hygeia, North and Sherwood Street. These projects rely on CIP funding and stormwater fee funds.
- The city announced in December 2021 that they will receive more than $9 million in grants to deal with sea level rise and extreme weather as part of an ongoing statewide effort by the Virginia CFPF. The grants, announced last week by Gov. Ralph Northam, will be directed at four specific projects in Hampton: $3,841,555 for Lake Hampton and North Armistead Avenue; $3,008,500 for the Big Bethel Blueway (Albany Drive at Big Bethel Road); $2,022,143 for the Sunset Creek Urban Channel Naturalization Project; and $291,850 for the Billy Woods Canal. The four Hampton grants were among 30 applications from 22 local government organizations to receive grants made possible with funding from the RGGI.

[1] *Developing First Floor Elevation Data for Coastal Resilience Planning in Hampton Roads*, February 2019. Available online at: https://www.hrpdcva.gov/library/view/932/wr19_01-developing-first-floor-elevation-data-for-coastal-resilience-planning-in-hampton-roads.

- As part of the city's Resilient Hampton initiative, the city hired a Resiliency Officer and has worked in multiple phases to implement the living with water approach across the city. Throughout this effort, the Initiative has approached the work at multiple scales, from looking at policy and process changes that influence resiliency across the city, to supporting plans and projects designed to create benefits for a whole neighborhood, to identifying opportunities to support individual homeowners to increase their resilience. The city issued a General Obligation Bond in 2019 and an Environmental Impact Bond in 2020 to help fund identified projects. Phase I (citywide) planning is complete, while Phase II (watershed level) plans are underway.

City of Newport News

- The Comprehensive Plan update process during the summer of 2015 examined goals, objectives, and actions from the previous HMP. This hazard mitigation planning effort drew mitigation actions from the latest comprehensive plan. Many of the same planning team members are continually involved in both plan updates.
- The emphasis on floodplain management through ordinance administration in the HMP resulted in flood ordinance changes in 2014 that included adoption of freeboard.
- Certified Floodplain Managers, a professional certification program administered by the Association of State Floodplain Managers, increased in number across at least 2 departments and they participate in hazard mitigation planning on a regular basis.
- The City Watch program was expanded to include post-disaster messages as a result of a careful capability analysis.
- The city formed a Generator Committee to address needs in the city identified during hazard mitigation capability review.
- A mitigation action in a previous hazard mitigation plan recommended developing a natural hazards school curriculum. Existing Fire Department programs were expanded to address this need.
- The previous HMP identified City Line apartments as a high hazard area and some retrofits were made to the complex's HVAC system. Additional flood protection measures for this and an adjacent housing complex are being pursued in conjunction with the City of Hampton, U.S. Department of Housing and Urban Development and other State and Federal agency partners.
- Six mitigation actions from the 2017 plan were removed because they have been completed. Projects used a combination of state, Federal and CIP funds.
- The city currently has a Class 7 CRS rating but plans to use the capabilities across several city departments to improve their rating. The city is negotiating a contract that will provide master planning services for water resources, including CRS, stormwater management, floodplain management and resilience planning by a single contractor over the next few years.
- The city's Flood Assistance Program has had measurable benefits using primarily acquisition to mitigate an average of 2 structures per year since 1999. Eighty properties comprising 15.2 acres have been purchased. In some cases, the Newport News Green Foundation gets involved in preserving, transforming and promoting the resultant green spaces created as a result of mitigation projects.
- Many of the city's new and ongoing mitigation actions are tied closely to projects already approved for CIP funding or the Stormwater Fund.

City of Poquoson

- In partnership with Hampton, the two cities hired a shared grants administrator specifically to pursue funding for mitigation actions identified for sea level rise and flood mitigation.
- The city continues to elevate repetitively flooded structures using Federal funding mechanisms, and plans to pursue CFPF funding, as well.
- Many projects to protect critical infrastructure are completed or ongoing. Poquoson has protected almost every pump station, fire station, and several schools over the past decade through demo/rebuild, elevation, generator-installation and other retrofits.
- The city continues to use various measures to collect existing Elevation Certificates from property owners and is investigating methods for putting that information online for public accessibility.

- Poquoson has ongoing partnerships with nearby NASA for drone data collection and with Langley Motor Speedway for car storage prior to predicted flood events.
- The Wythe Creek Road to Hampton elevation project will begin construction in spring 2022. The Victoria Boulevard widening project is still in the planning stages. Cooperation with adjacent York County and Hampton remains critical to getting these projects to completion. City has agreement with York County for road clearance to aid evacuation of Poquoson and York County residents.
- Poquoson does not have a large staff of city employees, but representatives from various departments, including Finance and the City Manager's office, are always deeply involved in mitigation planning meetings and document reviews, which results in bringing flood mitigation to the forefront of other planning efforts such as the comprehensive plan and capital planning.
- City coordinates with Virginia Marine Resources Commission for help enforcing the "No Wake Zones" instituted to help protect flooded structures from further flooding when floodwaters remain high.

City of Williamsburg

- The city has and maintains StormReady designation.
- City staff coordinate mitigation planning and emergency preparedness efforts with both Colonial Williamsburg and the College of William and Mary to ensure coordinated response to a variety of hazard incidents. This high level coordination has led to inclusion of mitigation actions in this plan regarding the high hazard potential dam on campus, the tree maintenance program Colonial Williamsburg uses to protect visitors and historic resources and the development of elements for the Continuity of Operations Plan for the city. The team is also assessing large assembly planning and coordinating command and control efforts especially if a secondary hazard event impacts a large assembly and evacuation is needed.
- The stormwater program has started a series of inter-departmental training sessions to help other city staff who are out in neighborhoods to recognize problems associated with drainage maintenance, including waste dumping, improper use of drains and proper notification of problems. Drainage system maintenance is a medium priority action in the HMP and this innovative method for addressing maintenance problems has been well-received in by the Fire Department.
- Shelter generator maintenance program called for in previous HMPs has been implemented through the CIP, with a regular maintenance budget and real-time monitoring software included.
- Strengthening the GIS capability was a medium priority in the last two HMPs. The city has now hired GIS staff and hazard-related GIS data gathering has been accomplished, including verification of hydrant locations and identification/mapping of critical structures and infrastructure.
- Several hazards are identified and addressed through recommendations in the city's comprehensive plan. Those data and recommendations were reviewed to identify potential mitigation actions for this planning effort.
- The city has a development review process for circulating proposed developments that includes hazard-related reviews by various departments.
- Williamsburg is working with the Local Emergency Planning Committee on the Peninsula to obtain a grant for a commodity flow study in light of the railroad that traverses the city.
- During the pandemic, city officials partnered with the school system, the Health Department, Colonial Williamsburg, William & Mary, James City County and York County regarding clinics for testing, vaccination and supply distribution.

James City County

- Repetitive flood loss data is reviewed annually as part of the County's participation in the CRS, or when the data is made available. This action is included in the Hazard Mitigation Plan but is also part of the County's plan to address flood mitigation through the CRS. The county has maintained a Class 5 CRS rating for several years, which requires inputs across many departments and stakeholders.
- Both the County and Busch Gardens, a theme park in the county, received StormReady designation through NOAA.

- The county is considering expanding their existing pre-disaster debris management plan across several departments and beyond public properties. Public outreach elements are being considered, as well.
- The County is participating in the regional "Flood Fluent" initiative.
- Several mitigation actions in this version of the plan are derived from the "Environment" section of the county's most recent comprehensive plan. This practice reinforces the importance of mitigation planning and spreads the responsibility for implementation across various departments, with funding considered through capital spending.

York County

- A mitigation action in the Hazard Mitigation Plan suggests evaluating sustainability and safety of critical facilities. The county's ongoing plan for generator replacement is now tied to the CIP. The county's new Sheriff's Office incorporated resilient design measures such as a generator.
- York County, Newport News and Newport News Waterworks work jointly on forest management at the Waterworks-owned property. Fire trails are regularly maintained.
- Part of staff responsibilities include making information/speakers available to business for contingency planning as needed, or as requested. This is a mitigation action identified in the Hazard Mitigation Plan and reflected in day-to-day operations.
- The County adopted 3 feet of freeboard for structures built or substantially improved in flood hazard areas. Freeboard was recommended as an action in the hazard mitigation plan.
- Comprehensive Plan adopted in 2013 echoes several of the hazards included in the previous hazard mitigation plan and proposes Implementation Strategies to address them in great detail. The shoreline erosion strategies will continue to be referenced, or included directly, in the 2017 update to the Hazard Mitigation Plan.

City of Norfolk

- Updated Comprehensive Plan was adopted March 26, 2013 and was recognized as an example of content and metrics to include in a comprehensive plan. The plan was also recognized for its inclusion of sea level rise, flooding and mitigation actions as part of the metrics.
- As a result of a previous mitigation action plan strategy to expand existing notification systems, several city departments have come together to expand the city's ability to notify the public. Sources include real-time updates the web page, email distribution lists, Facebook and Twitter.
- The city continues to update the flooding awareness webpage, accessible from the homepage. A cross-departmental Flood Awareness Committee was formed, and also provides quarterly updates to citizens as well as to the professional community regarding the city's progress on flood mitigation as well as providing an opportunity for dialogue for all interested stakeholders. The city has a Coastal Resiliency Manager dedicated to managing resilience projects, coordinating the CRS participation, coordinating grants and emergency managers, and presenting information to public and private boards and commissions across the spectrum of city government and civic organizations.
- The city is part of the Rockefeller Foundation RE.invest Initiative which explores ways the private sector can be engaged to enhance flood protection in some older areas of Norfolk with a history of flooding.
- The city is recognized as part of the initial cohort of the 100 Resilient Cities. Also funded by the Rockefeller Foundation, the program provides access to a worldwide network and knowledge base that will be able to identify additional strategies to help the city be more resilient to physical, social, and economic threats.
- As a result of a previous mitigation action plan strategy, Norfolk and Norfolk Public Schools have funded and are in the design phase of multiple school replacements throughout Norfolk. These new facilities will replace older facilities that do not meet current requirements for stormwater management and, in some cases, elevation for flood protection. New structures will meet these requirements and provide safer emergency shelters in times of need.
- Public Works has completed improvements to Brambleton Avenue that provide better access and egress to Sentara Norfolk General Hospital and Eastern Virginia Medical College during storm and flooding events.

- After a storm or flooding event occurs, properties that have received damage are mapped using GIS as part of the damage assessment reporting. Damage assessment training is provided each spring for staff that inspect properties after events.
- RISE, a Norfolk-based nonprofit funded through the Virginia Department of Housing and Community Development, accelerates innovation and business growth around solutions to coastal communities' critical resilience challenges. RISE and FloodMapp launched a novel (and award-winning) forecast flooding technology with Waze, the navigation app. FloodMapp's innovative solution allows Waze to be the only traffic app to offer drivers real-time, street level alerts about flooded roads. FloodMapp is piloting the program in the City of Norfolk where Waze users will be the first in the world to test the new feature. FloodMapp's groundbreaking forecast technology mixes tidal, riverine and rainfall data to create a rapid, real-time flood inundation model. The information is automatically layered with Norfolk's citywide road network and sent to Waze in real time. Drivers receive pop-up icons and audio alerts to warn them about flooded streets along their route and help them avoid property and life-threatening hazards. Drivers can confirm flooding in the app, which helps validate FloodMapp's technology and makes future Waze alerts more accurate. The information will also be used for an automatic rerouting feature, which is now under development.
- Revisions to the Zoning Ordinance were approved and implemented on January 1, 2014. These revisions allow for development to be more resilient to flood damage. Changes helped lower the city's CRS classification and further reduce flood insurance premiums for property owners in the city. The city now has a Class 5 CRS rating thanks to participation across several city departments.
- The city has acquired Everbridge, calling it Norfolk Alert, to alert property owners in flood-prone areas of need for evacuation or other short-term actions ahead of, during or after events.
- The city's GIS department development a tool termed the Tidal Inundation Tracking Application for Norfolk (TITAN) that shows potential flooding based on current tide projections or other hypothetical scenarios.
- HRPDC and the U.S. Navy worked together with City of Virginia Beach and City of Norfolk on an intergovernmental Joint Land Use Study presented to the public in 2019. More frequent flooding is affecting military operations and access to military facilities. This study focused on identifying specific conditions, including recurrent flooding, coastal storms, and erosion, outside of the military footprint that have the potential to impact Navy operations in Hampton Roads. Two recommendations that stand out for local planners are the wastewater treatment plant vulnerability assessment, and Terminal Boulevard rail and roadway grade separation project.
- Norfolk was awarded a $112 million federal grant from the National Disaster Resilience Competition for the Ohio Creek Watershed Project. Goals were multi-objective and show how flood hazard mitigation can feed into creating economic opportunity, advancing community interconnectivity, and deconcentrating poverty. Expected completion in 2023. Project addressed flooding in two residential, predominantly African American neighborhoods with civic leagues and a strong community identity: Historic Chesterfield Heights with over 400 houses on the Historic National Register; and Grandy Village, which includes a public housing community with more than 300 units.

City of Portsmouth

- In addition to HMP, Portsmouth has the 2015 Floodplain Management Plan. Plans are slightly redundant but serve different purposes.
- Flood Information Pamphlets are distributed by several city departments, including recently to all rental units as inspections are completed, and at the public counters in Planning and Inspections. Originally developed for CRS and repetitive loss mailings, pamphlets have an expanded purpose and audience in recent years.
- Staff created a "flood speakers bureau" for Civic Leagues and has attended several civic/neighborhood meetings to speak.
- Floodplain Management function was transferred to the Department of Neighborhood Advancement in August 2013. New web page was created in 2014.

- Staff training on the NFIP is a priority in the HMP. Staff provided training to City Council and Planning Commission on Biggert-Waters 2012 and other NFIP legislative changes to increase knowledge and allow integration of NFIP information in city planning strategies.
- Identifying and funding drainage improvements and protecting water/sewer infrastructure from flooding is a high priority in the HMP and FMP. Work has been coordinated between several departments and an outside engineering firm and funded through capital improvements planning. New stormwater lines are being replaced with larger lines and outfalls are getting flood gates. New and retrofitted pump stations can be quickly connected to generators or auxiliary pump connections. The city's seawall has also been substantially replaced, a high priority item in both the HMP and the FMP.
- GIS is being used to map flood-prone properties that store hazardous materials as identified by the Fire Department. This inter-departmental use of funds was a priority in the FMP. This action increases the city's ability to identify capability gaps with regard to fire and flood as compounding hazards.
- While not complete, an interdepartmental effort to help homes for persons with disabilities develop emergency operations plans is underway. This priority of the FMP will tie together several existing plans for flood, emergency operations and outreach/warning.
- HRPDC and the U.S. Navy worked together with City of Chesapeake and City of Portsmouth on an intergovernmental Joint Land Use Study (JLUS) presented to the public in 2021. Navy facilities in Portsmouth and Chesapeake face several impacts from the surrounding communities, including transportation impacts (such as congestion, existing and planned capital improvements, facility access, gate security, and rail operations), stormwater management, waterway management, land use conflicts, and residential, commercial, and industrial encroachment impacts. Nuisance and storm surge flooding can have major impacts on Navy operations by obstructing access and damaging local infrastructure on which military facilities rely. This study identifies specific conditions and develops mutually beneficial recommendations to address these issues. The JLUS effectively implemented Mitigation Action 16 from the 2017 HMP by "creating dialog between governmental and nongovernmental stakeholders to encourage incorporation of mitigation strategies into projects and policies".
- Portsmouth has rewritten their Zoning Ordinance to capture recommendations of the Comprehensive Plan, which contains hazard-related elements regarding CRS, CIP-funded drainage improvement projects, geographic information on flood exposure, development of a COOP, and a long list of resilience recommendations such as adding a Resilience Officer (completed), transfer/purchase of development rights in floodprone areas, developing a guide for resilient building retrofits, and positioning cool buildings/shelters for access by socially vulnerable populations.

City of Suffolk

- Information from the 2011 HMP was incorporated into the 2015 Revision of the City of Suffolk Emergency Operations Plan and into the 2015 revision to the City of Suffolk Hazardous Materials Response Plan.
- Flood hazard risk and vulnerability information was considered for the city's 2035 Comprehensive Plan and the recent FIRM updates.
- As a result of a previous mitigation action plan strategy, a FIRM viewer and a Hurricane Surge Viewer are in place on the city's Emergency Management website in the "Flooding" tab. A PDF document also resides there for users who are not comfortable with mapping programs.
- Suffolk OEM answers email and phone requests for address-specific flood data. Personalized maps can either be generated in the office or during community outreach events.
- Hurricane/tropical storm/flood safety talks are delivered upon request to church, civic and community groups.
- Hurricane/flooding preparedness brochures are placed at local libraries, the visitor's center and other public buildings around the city.
- Many of the hazard mitigation plan recommended actions will be incorporated into the city's resilience planning effort related to CFPF grants.

City of Virginia Beach

- The 2015 Comprehensive Plan update references the hazard mitigation plan update process; new upcoming rewrite will incorporate city's resiliency initiatives. The Sustainability Plan references the Hazard Mitigation Plan content in the appendices, echoes the goals and objectives of the Hazard Mitigation Plan, and contains a flood component to address the interrelationship of flood mitigation and sustainability.
- The ComIT Data Center relocation mitigation action is near completion using city funds.
- The city changed floodplain management ordinance to adopt two feet of freeboard for structures built or substantially improved in flood hazard areas.
- City is aggressively tackling enforcement issues in floodplains.
- City is integrating floodplain management more widely into other community actions such as the preliminary development review process which includes flood mitigation recommendations early in the process and formation of the City Manager's Sea Level Rise/Flooding Work Group.
- Although the Hazard Mitigation Plan is not referenced per se in the annual CIP, projects are included that reflect mitigation actions from the plan on a regular basis. One example was the relocation and rebuilding of the city's Animal Control Facility. Another example is the complete replacement of the public safety communication hardware and the 6-year spending/replacement plan that is reflected in each CIP.
- Public information, particularly regarding floodplain management, has been redesigned on the city's web site and the site references and includes information from the HIRA in the Hazard Mitigation Plan.
- CERT curriculum was revised to include damage assessment and storm preparation advice as a result of mitigation actions and hazard information included in the Hazard Mitigation Plan.
- The city's Urban Forestry Management Plan, a component of the Comprehensive Plan, was published in 2014 and includes strategies for better management of dunes and landscaping in V Zones. The plan is expressly tied to the Sustainability Plan, the city's stormwater management regulations, the Strategic Growth Area Plans, and the Outdoors Plan, and includes a reference to Sea Level Rise as a threat to tree cover in the city.
- HRPDC and the U.S. Navy worked together with City of Virginia Beach and City of Norfolk on an intergovernmental Joint Land Use Study presented to the public in 2019. More frequent flooding is affecting military operations and access to military facilities. This study focused on identifying specific conditions, including recurrent flooding, coastal storms, and erosion, outside of the military footprint that have the potential to impact Navy operations in Hampton Roads.
- The city is implementing a long-term comprehensive program for addressing rising sea levels and recurrent flooding risk entitled *Sea Level Wise*. The strategy has four phases: Impact Assessment, Adaptation Research, Strategy Development and Implementation. The *Sea Level Wise* program has been key in identifying projects and planning efforts related to state funding through CFPF. Similar to the HMP mitigation action categories, adaptation for Virginia Beach involves a series of natural mitigations (nature based solutions), engineered defenses (structural flood protection measures), adapted structures (siting/design/retrofit measures), and prepared communities (educational services and financial planning tools). The program also includes a series of watershed-based strategies for precisely targeting flood-related challenges and suggesting opportunities. Data gathering for this effort included collection of lowest floor elevations of many of the city's flood-prone existing structures; data that were used for the Hazus modeling summarized in Section 5 of this plan.
- City passed a bond referendum in 2021 to speed up funding of flood prevention infrastructure in the CIP. Money is administered by Department of Public Works.
- A High Priority mitigation action in the 2017 HMP was to join the CRS. That initiative has been successful thanks to the participation of numerous departments. Virginia Beach currently has 11 certified floodplain managers across numerous departments, in recognition of the role that flood vulnerability plays in everyday administration of city business.
- In summer 2020, the city revised and strengthened stormwater management requirements for new site plans to include calculation of future conditions (precipitation, flooding and sea level rise). Public Works promulgated design standards for residential structures as well as nonresidential.

- The city's new Historic Resources Plan is currently being finalized. This effort has guidance for structure modifications, including guidance for flood-prone historic structures.
- Amazon Web Services awarded Virginia Beach the 2017 City on a Cloud Innovation Challenge for StormSense. This program, in partnership with VIMS, enhances the capability of the city and neighboring communities to predict coastal flooding in ways that are replicable, scalable, and measurable. The project applies data science and artificial intelligence to: create historic, current and future data analysis platforms; address flood-related issues caused by coastal storms; and empower citizens to better manage their real-time and future flood risk. Available online at: https://stormsensedev.vbgov.com/

City of Chesapeake

- Chesapeake recently attained a Class 7 rating in the CRS program (improved from Class 8), qualifying most Chesapeake SFHA property owners for a 15 percent discount in flood insurance premiums, due to its continued vigilance in floodplain management, hazard mitigation planning, open space policies, public outreach in flood issues, and acquisition, demolition and elevation of severe repetitive flood loss properties through various grant programs.
- The city has expanded its ability to notify the public of potential flood hazards by using Everbridge, which is a part of Chesapeake Alert. Additionally, Emergency Management has coordinated with Public Information offices and Public Works to provide the public with real-time updates via its city webpage, Facebook and Twitter.
- Chesapeake provides continued information on flood-related issues, including the NFIP, via the city's home web page and the Emergency Management web page.
- Chesapeake has obtained and continues to apply for FEMA grants for acquiring repetitive flood loss homes and has committed CIP funds to mitigate flooding. City has acquired at least $7,515,092.00 in FMA grant funds over the past twelve years to acquire and demolish 25 and elevate five severe repetitive loss structures. Five of 7 applications are in the process of being processed from a 2018 FMA Grant. Two applications were submitted for houses in 2019 and 3 applications were submitted for houses in 2020. Additionally, stormwater flood protection reduction projects are scheduled for numerous subdivisions in the SFHA.
- Chesapeake begins its hazard mitigation planning through the Natural Event Mitigation Advisory Committee (NEMAC). NEMAC is a citizen/city staff advisory committee appointed by City Council to advise it on all hazards and report yearly on progress in mitigation and resiliency. NEMAC's 8 citizens (who form the quorum) is supported by 9 city department representatives, with each department representing a part of mitigation problems and solutions. NEMAC normally meets 6 times a year to plan for hazards, to make recommendations for improvements in the hazard mitigation plan to increase resiliency, and to provide oversight on accomplishing the actions recommended therein. One particular resiliency improvement overseen by the NEMAC was providing guidance to include sea level rise and land subsidence in the city's standalone 2014 hazard mitigation plan as a critical hazard.
- In 2022, the city will begin a resiliency planning project for the industrial waterfront, a mitigation action that will help protect valuable waterfront businesses for the long-term.
- City built new Public Safety building that serves as the city's EOC. The building can withstand a Category 3 hurricane, a magnitude 4 earthquake as it's the only systematically safe non-DOD building on the East Coast and has multiple redundancy infrastructure built into the building. City Jail project to install a generator to run the HVAC and Kitchen of the building is in current CIP. The city has applied for a grant to outfit the city's Community Centers with generators using FEMA Pre-Disaster Mitigation funds. Chesapeake has applied for PDM funds for mitigation purposes to install generators at Public Utilities Pump Stations. These generators will ensure there is not flooding due to lack of power to pump water.
- City uses CIP funds to outfit all community centers and the conference center with generators and completed the work on two new Fire Stations. Sta #10 in Bowers Hill & Sta #7 in Southern Chesapeake are now open. Sta #10 serves both as a Fire Station and Logics Center for the department, increasing the city's ability to prepare, respond and mitigate following a disaster. Sta #7 is dual use facility, as a Fire Station and a newly added Police Precinct.

- The city will implement planning measures to pursue CFPF funding in the coming planning period. Mitigation projects will align with priorities set by the NEMAC in the hazard mitigation plan.
- HRPDC and the U.S. Navy worked together with City of Chesapeake and City of Portsmouth on an intergovernmental Joint Land Use Study presented to the public in 2021. Navy facilities in Portsmouth and Chesapeake face several impacts from the surrounding communities, including transportation impacts (such as congestion, existing and planned capital improvements, facility access, gate security, and rail operations), stormwater management, waterway management, land use conflicts, and residential, commercial, and industrial encroachment impacts. Nuisance and storm surge flooding can have major impacts on Navy operations by obstructing access and damaging local infrastructure on which military facilities rely. This study identifies specific conditions and develops mutually beneficial recommendations to address these issues.

Isle of Wight County

- Comprehensive Plan updates in the region have included resource conservation areas. Sea level rise continues to be a consideration for future planning efforts. Previous plan mitigation action related to development of a sea level rise adaptation strategy has been reevaluated and removed as a mitigation action because county officials felt that existing zoning measure adequately address new development and vulnerable lands.
- Stormwater drainage in floodprone areas has been identified as a local hazard and related action to implement a drainage plan is being acted upon through implementation of a stormwater master plan in development.
- Flooding of access roads identified as a problem in the HIRA. VDOT owns and maintains all roadways in the county. County has recently added a transportation planner/VDOT liaison to staff to help with coordination of issues like this. Similarly, an extra fueling station for county vehicles was needed and has been installed in conjunction with the new volunteer rescue squad building. The most recent comprehensive plan includes a section devoted to transportation planning.
- The County has increased GIS capabilities in recent years, which will benefit various land use and hazard-planning efforts.
- Several new mitigation actions in this 2022 updated plan reflect similar strategies identified in the most recent comprehensive plan, such as preparation of a green infrastructure network plan.

City of Franklin

- City has successfully enrolled in the CRS as recommended in the 2017 hazard mitigation plan. Planners aspire to improve their rating and increase savings to policyholders.
- Having made Elevation Certificates widely available in the community, city planners see the next logical step to be installing high water marks in downtown buildings to visually remind owners and visitors of the flood risk.
- City is reviewing and considering updates to the Flood Recovery Plan identified in previous versions of this plan.
- The city's 2015 Comprehensive Plan included recommendations regarding HMGP funding for flood proofing nonresidential buildings downtown and elevating floodprone residential buildings downtown.
- American Rescue Plan Act (ARPA) funding made available following the COVID-19 pandemic has been used to address other flood hazard vulnerabilities in the city and radio system and citywide wireless network upgrades. They are working with Dominion to raise electrical panels and other equipment, possibly including the substation.
- The city uses Virginia Department of Forestry materials to distribute to the public to help reduce the prevalence of hazardous trees, as recommended in the 2017 hazard mitigation plan.

Southampton County

- The County has implemented the necessary shelter retrofits and improvements to Southampton County High School, including a new roof and a generator at the substation dedicated to the high school. Emergency operations will be amended accordingly.
- One additional staff member is working to become CFMs in calendar year 2022.

- The County's Comprehensive Plan is undergoing revision one chapter at a time. The new document will include hazard-related impacts.
- The County is helping Newsoms implement their drainage area plan, as called for in the 2017 hazard mitigation plan.
- County Courthouse renovations are underway with considerable flood protection measures included.
- Tree preservation and landscaping requirements are included in a proposed solar ordinance that the County is considering in winter 2021, as called for in previous mitigation plan.
- County has considered participation in the CRS, but after reviewing location of most insured structures in the County, has determined that the program is likely not cost effective.
- The County has implemented many of the ordinance revisions called for in the previous comprehensive plan, which also relate to hazard mitigation, such as smart growth principles such as clustering, and building streets to State standards.
- County has implemented a comprehensive plan recommendation calling for removal and disposal of junk vehicles, dilapidated structures, litter, hazardous materials and debris.

Town of Boykins

- An acquisition project on Spring Garden Street is complete with the exception of 1 vacant home. Boykins Volunteer Fire Department acquired and cleared the remaining structures.
- Identified as a problem flooding area in the HIRA, the town has done what they can to clean out Tarrara Creek. Private property owners have removed beaver dams and other impediments.
- The mayor is going to put a flyer on each door in town reminding people to sign up for the county's reverse 911. He'll mention it at town council meetings and put it on the town's updated website, which he will ask the county to link to from the county site.
- The town has a new web site and Boykins Fire-Rescue has a Facebook page to post hazard-related warnings for community members, such as that shown in **Figure 6.2**.

FIGURE 6.2: BOYKINS FIRE-RESCUE FACEBOOK WARNING, WINTER STORM

Source: Boykins Facebook page, 2022

Town of Newsoms

- Drainage improvements to eliminate standing water in yards and drainage ditches as identified in a 2011 stormwater study were targeted as a high priority in the previous HMP. Town procured a grant in 2012 to evaluate storm drainage and recommend improvements. Preliminary engineering report was completed. Town applied for Community Development Block Grant (CDBG) and, as part of the application, also completed a preliminary housing assessment in 2013. The grant was denied, but the Town has sought additional funding sources and has a Virginia Department of Housing and Community Development grant underway that includes stormwater improvements and other initiatives.

Surry County

- The County's Director of Planning is considering putting together an official administrative design review committee for all development to include hazard review.
- County has a Post-Disaster Debris Management Plan.
- The County recently updated their Radiological Emergency Plan in August 2021. Regular exercises with VDEM maintain currency of the plan, which is especially important given the location of Surry Power Station with the county.

- Surry County Department of Economic Development regularly connects businesses to various agencies and tools that provide business resilience planning assistance.
- Public Information Officer regularly uses social media and the county's web site to disseminate hazard- and mitigation-related information.
- The County's Economic Development Plan is contained within the Comprehensive Plan. Both documents were reviewed for potential mitigation actions under this planning effort.

In summary, much of the work of integrating hazard mitigation into other planning mechanisms has already happened since the adoption of the first hazard mitigation plans. The process is ongoing in Hampton Roads communities as leaders identify new ways to incorporate hazard mitigation priorities into the life of their community. Table 6.7 summarizes how individual communities expect to continue integrating hazard mitigation actions into other planning tools, regulations and activities beyond those activities listed above. Check marks indicate which planning mechanisms are targeted for existing or future coordination and integration with that community's mitigation action plan. None of the communities participating in the NFIP are considering a change in status at this time.

TABLE 6.7: INTEGRATION OF HAZARD MITIGATION ACTIONS INTO OTHER PLANNING MECHANISMS

COMMUNITY	Regulations	Administrative & Technical Procedures	Fiscal Planning (CIP, grants, budgeting)	Land Use Planning (comprehensive, resilience, transportation)	Other (public information, activities, etc)
PENINSULA					
Hampton	✓	✓	✓	✓	✓
Newport News	✓	✓	✓	✓	✓
Poquoson	✓	✓	✓	✓	✓
Williamsburg	✓	✓	✓	✓	✓
James City County	✓	✓	✓	✓	✓
York County	✓	✓	✓	✓	✓
SOUTHSIDE					
Norfolk	✓	✓	✓	✓	✓
Portsmouth	✓	✓	✓	✓	✓
Suffolk	✓	✓	✓	✓	✓
Virginia Beach	✓	✓	✓	✓	✓
Chesapeake	✓	✓	✓	✓	✓
WESTERN TIDEWATER					
Isle of Wight County	✓	✓	✓	✓	✓
Smithfield	✓	✓	✓	✓	✓
Windsor	✓	✓			
Franklin	✓	✓	✓	✓	✓
Southampton County	✓	✓	✓	✓	✓
Boykins	✓	✓	✓	✓	

TABLE 6.7: INTEGRATION OF HAZARD MITIGATION ACTIONS INTO OTHER PLANNING MECHANISMS					
COMMUNITY	Regulations	Administrative & Technical Procedures	Fiscal Planning (CIP, grants, budgeting)	Land Use Planning (comprehensive, resilience, transportation)	Other (public information, activities, etc)
Branchville	✓	✓	✓	✓	
Capron	✓			✓	
Courtland	✓	✓	✓	✓	
Ivor	✓	✓	✓	✓	
Newsoms	✓		✓	✓	
Surry County	✓	✓	✓	✓	✓
Claremont	✓	✓	✓	✓	
Dendron	✓			✓	

Regional Capabilities

The communities of Southside Hampton Roads are part of HRPDC, one of 21 Planning District Commissions in the Commonwealth of Virginia. HRPDC is a regional organization representing the area's sixteen local governments. Planning District Commissions are voluntary associations and were created in 1969 pursuant to the Virginia Area Development Act and a regionally executed Charter Agreement. The HRPDC was formed in 1990 by the merger of the Southeastern Virginia Planning District Commission and the Peninsula Planning District Commission.

The purpose of planning district commissions, as set out in the Code of Virginia, Section 15.2-4207, is "…to encourage and facilitate local government cooperation and state-local cooperation in addressing on a regional basis, problems of greater than local significance." The HRPDC mission is to:

- Serve as a forum for local and elected officials and chief administrators to deliberate and decide issues of regional importance;

- Provide the local governments and citizens of Hampton Roads credible and timely planning, research and analysis on matters of mutual concern; and

- Provide leadership and offer strategies and support services to other public and private, local and regional agencies, in their efforts to improve the region's quality of life.

The HRPDC serves as a resource of technical expertise to its member local governments. It provides assistance on local and regional issues pertaining to Economics, Physical and Environmental Planning, Emergency Management, and Transportation. For example, the commission staff is currently working on cataloging GIS data for the region and improving compatibility of the data on a regional basis.

Additional regional capabilities exist with regard to the management of coastal zone resources in the Commonwealth. A permit must be obtained from the Virginia Marine Resources Commission (VMRC) to build, dump or otherwise trespass upon or over, encroach upon, take or use any material from the beds of the bays, ocean, rivers, streams or creeks within the jurisdiction of Virginia. The permitting process is designed to reduce the unnecessary filling of submerged land, to minimize obstructions or hazards to navigation and to avoid conflicts with other uses of state-owned submerged lands or state waters.

In addition, the VMRC is responsible for managing and regulating the use of Virginia's tidal wetlands in conjunction with Virginia's local wetlands boards. Under Virginia law, tidal wetlands include both vegetated and non-vegetated intertidal areas. Vegetated wetlands include all the land lying between and contiguous to mean low water and an elevation above mean low water equal to a factor 1.5 times the mean tidal range at the site and upon which is growing at least one of the botanical species specified in the Virginia Wetlands Act. Non-vegetated wetlands include all the land lying contiguous to mean low water and between mean low water and mean high water at the site.

Technical assistance and advice on dredging and filling operations that involve subaqueous bottoms and wetlands, all aspects of the marine environment, marine science and marine affairs is available from the VIMS. The institute provides technical assistance, often at no cost, to businesses whose development plans have impacts on marine resources.

The Virginia Coastal Zone Management Program (CZM Program) was established in 1986 to protect and manage Virginia's "coastal zone." The CZM Program is part of a national coastal zone management program, a voluntary partnership between the National Oceanic and Atmospheric Administration, National Ocean Service Office of Ocean and Coastal Resource Management, and U.S. coastal states and territories authorized by the federal Coastal Zone Management Act. The Virginia program was established through an Executive Order, which is renewed by each new governor. The program is not a single centralized agency or entity, but a network of state agencies and local governments which administer the following enforceable laws, regulations and policies that protect our coastal resources:

- Tidal and Nontidal Wetlands;
- Fisheries;
- Subaqueous Lands;
- Dunes and Beaches;
- Point Source Air Pollution;
- Point Source Water Pollution;
- Nonpoint Source Water Pollution;
- Shoreline Sanitation; and
- Coastal Lands.

The geographic areas of particular concern for the CZM Program include:
- spawning/nursery/feeding grounds;
- coastal primary sand dunes;
- barrier islands;
- significant wildlife habitat areas;
- significant public recreation areas;
- significant sand and gravel resource deposits;
- underwater historic resources;
- highly erodible/high hazard areas; and
- waterfront development areas.

Currently, some of the projects that the CZM Program is pursuing that have applications with regard to hazard capabilities include: adapting to climate change, special area management planning, coastal land conservation, shoreline management, and public access.

A local nonprofit organization and mitigation planning stakeholder, Wetlands Watch, has provided regional (and statewide) leadership in the natural resource management arena, especially with regard to sea level rise and related threats to tidal wetlands, wildlife and fish habitats, and the economy of coastal Virginia. Wetlands Watch works to raise awareness, engage and educate all stakeholders and decision-makers about existing and potential sea level rise impacts, incorporate this threat into regional and local land-use plans and decisions, and develop and implement sea level rise adaptation plans. The group's impact can be seen through the number of new CRS communities in the region, an initiative they promote by creating useful tools and forums for interested communities, and through the evolution of the *Coastal Resilience Master Plan,* among other things.

MITIGATION STRATEGY

Contents

2022 UPDATE

Section 7 was updated to reflect the Committee's work to update the Goals and Objectives. The following major changes were incorporated:

1) All tables were added or updated to reflect new information, including the new goals and objectives;
2) Mitigation actions were reviewed, completed actions were deleted; and, new mitigation actions were revised and added as directed by Committee members; and
3) Mitigation actions were modified to include a ranking for social vulnerability.

INTRODUCTION

This section of the Plan provides the "blueprint" for Hampton Roads to become less vulnerable to natural hazards. It is based on the general consensus of the Committee along with the findings and conclusions of the Capability Assessment and Risk Assessment. The Mitigation Strategy section consists of the following four subsections:

- MITIGATION GOALS
- IDENTIFICATION AND ANALYSIS OF MITIGATION TECHNIQUES
- SELECTION OF MITIGATION TECHNIQUES
- MITIGATION ACTION PLAN

The intent of the Mitigation Strategy is to provide participating communities with the goals that will serve as the guiding principles for future mitigation policy and project administration, along with a list of proposed actions available to meet those goals and reduce the impact of natural hazards. It is designed to be comprehensive and strategic in nature.

The development of the strategy included a thorough review of all natural hazards and identified policies and projects intended to not only reduce the future impacts of hazards, but also to assist the region in achieving compatible economic, environmental, and social goals. The development of this section is also intended to be strategic, in that all policies and projects are linked to established priorities assigned to specific departments responsible for their implementation and assigned target completion deadlines. Funding sources are identified when possible, that can be used to assist in project implementation.

The first step in designing the Mitigation Strategy includes the identification of mitigation goals. Mitigation goals represent broad statements that are achieved through the implementation of more specific, action-oriented tasks listed in the Mitigation Action Plan. These actions include both hazard mitigation policies (such as the regulation of land in known hazard areas), and hazard mitigation projects that seek to address specifically targeted at-risk properties (such as the acquisition and relocation of flood-prone structures). Additional mitigation measures are then considered over time as new mitigation opportunities are identified, new data become available, technology improves, and mitigation funding becomes available.

The last step in designing the Mitigation Strategy is the creation of a set of jurisdictionally specific Mitigation Action Plans (MAPs). The MAPs represent the key outcome of the mitigation planning process. MAPs include a prioritized list of proposed hazard mitigation actions (policies and projects), including accompanying information such as those agencies or individuals assigned responsibility for their implementation, potential funding sources, and an estimated target date for completion. The MAPs provide those individuals or agencies responsible for implementing mitigation actions with a clear roadmap that also serves as an important tool for monitoring progress over time. The collection of actions listed in the MAP also serves as a synopsis of activities for local decision makers.

In preparing the Mitigation Action Plans, committee members considered their overall hazard risk and capability to mitigate natural hazards, in addition to the mitigation goals. The prioritization of mitigation actions was based on the following five factors: (1) effect on overall risk to life and property; (2) ease of implementation; (3) political and community support; (4) a general economic cost/benefit review; and (5) funding availability. A separate ranking for impact on socially vulnerable populations is also included. This High, Moderate or Low impact rating is based on the NRI vulnerability information provided in Section 5. Where projects were identified in a specific location and/or tied to reducing vulnerability from a single hazard, the hazard-specific ranking for that Census tract or hazard was used. Projects geared toward reducing risk community-wide, such as general outreach, were ranked based on the relative NRI social vulnerability of that community versus the percent of counties/cities with lower social vulnerability in Virginia (Low - less than 40% of other counties/cities have lower social vulnerability; Moderate – 41-75%; High –75-100%). In cases where an action was specifically geared toward socially vulnerable populations within a community, the impact was rated High.

MITIGATION GOALS

The goals of the Hampton Roads Hazard Mitigation Plan were crafted as part of Workshop #3, a facilitated discussion and brainstorming session with committee members (see Section 2: *Planning Process*). As part of the 2022 update, the planning consultant reviewed the goals and objectives of the previous plan as well as pertinent goals and objectives from Virginia Beach's *Sea Level Wise: Adaptation Strategy*, Norfolk's *Coastal Resilience Strategy Report*, Hampton's *Living with Water Hampton: A Holistic Approach to Addressing Sea Level Rise and Resiliency*, Virginia's *Coastal Resilience Master Planning Framework,* and the 2018 *Commonwealth of Virginia Hazard Mitigation Plan.* In this way, the committee was able to incorporate some important regional resilience goals and work to find common ground in statewide, regional and local mitigation programming.

The groups reassessed each goal word for word, reprioritized the list, and edited overall for brevity. The original document ("2017 Plan Goals and Objectives") and updated ("2022 Goals and Objectives") goals with strikethrough and underline are provided in **Table 7.1** below, with notes about the discussion leading to the changes. Each of the following goal statements represent a broad target to achieve through implementation of specific *Mitigation Action Plans*.

TABLE 7.1: UPDATED GOALS AND OBJECTIVES	
2017 PLAN GOALS AND OBJECTIVES	**2022 GOALS AND OBJECTIVES**
Goal 1: Increase community resiliency by reducing vulnerability to hazards. *Objective 1.1: Reduce damage to repetitively flooded properties* *Objective 1.2: Protect existing and future development* *Objective 1.3: Protect critical facilities/infrastructure* *Objective 1.4: Maintain government services throughout hazard events* *Objective 1.5: Reduce hazard-related impacts on daily routines* *Objective 1.6: Preserve and enhance benefits of natural areas*	**Goal 1: Increase community resiliency by reducing vulnerability to hazards.** *Objective 1.1: Reduce damage to all repetitively flooded properties, not just NFIP-insured structures* *Objective 1.2: Protect existing and future development* *Objective 1.3: Protect critical facilities/infrastructure, including High Hazard Potential Dams* *Objective 1.4: Maintain diverse, equitable and inclusive government functions and services throughout the duration of hazard events* *Objective 1.5: Reduce hazard-related impacts on daily routines* *Objective 1.6: Preserve and enhance benefits of natural areas* **Why the Change?** High Hazard Potential Dams were added to clarify that a high priority goal and objective of the plan is to reduce long-term vulnerabilities from eligible high hazard potential dams that pose an unacceptable risk to the public. Changes to Objective 1.4 express the explicit focus communities are making to ensure that the functions of government touch *all* citizens before, during and after hazard events.
Goal 2: Educate the public about hazard vulnerabilities and ways to reduce risk *Objective 2.1: Encourage property owners to assume responsibility for reducing vulnerability*	**Goal 2: Educate the public about hazard vulnerabilities and ways to reduce risk** *Objective 2.1: Encourage citizens and businesses ~~property owners~~ to assume responsibility for reducing vulnerability* *Objective 2.2: Ensure that information and hazard education opportunities are available to all elements of the communities* *Objective 2.3: Pursue public/private partnerships that help facilitate access to hazard-related educational opportunities and gather feedback from citizens* **Why the Change?** The committee felt Objective 2.1 should be expanded to include all citizens, not just property owners. Renters, for example, need hazard education to protect their personal property and businesses, as well. Objective 2.2 was added to document community goals to work toward a whole-community effort with regard to hazard education. Objective 2.3 focuses on the importance of involving other stakeholders in hazard outreach.
Goal 3: Strengthen and develop partnerships for mitigating hazard impacts *Objective 3.1: Integrate mitigation concepts into local and regional government plans, policies and actions* *Objective 3.2: Improve and standardize hazard data collection and mapping* *Objective 3.3: Leverage shared resources in pursuit of funding for hazard mitigation projects* *Objective 3.4: Develop partnerships among local, regional, national, and international organizations*	**Goal 3: Strengthen and develop partnerships for mitigating hazard impacts** *Objective 3.1: Integrate mitigation concepts into local and regional government plans, policies and actions* *Objective 3.2: Improve and standardize hazard data collection and mapping* *Objective 3.3: Leverage shared resources in pursuit of funding for hazard mitigation projects* *Objective 3.4: Develop partnerships among private, local, regional, national, and international organizations* **Why the Change?** Objective 3.4 was changed to emphasize the importance of private funding sources – a change that has come about in the past 5 years.

IDENTIFICATION AND ANALYSIS OF MITIGATION TECHNIQUES

44 CFR Requirement
Part 201.6(c)(3)(ii): The mitigation strategy shall include a section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effect of each hazard, with particular emphasis on new and existing buildings and infrastructure.

In formulating Hampton Roads' *Mitigation Strategy*, a wide range of activities was considered in order to help achieve the goals and address specific hazard concerns. At the third workshop, committee members considered six broad categories of mitigation techniques. Committee discussions regarding each category are summarized beneath each category, including notes on the appropriateness and applicability of each as it applies to Hampton Roads.

1. Prevention
Preventative activities are intended to reduce the impact of future hazard events, and are typically administered through government programs or regulatory actions that influence the way land is developed and buildings are constructed. They are particularly effective in reducing a community's future vulnerability, especially in areas where development has not occurred or capital improvements have not been substantial. Examples of preventative activities include:

- Planning and zoning
- Building codes
- Open space preservation
- Floodplain regulations
- Stormwater management regulations
- Drainage system maintenance
- Capital improvements programming
- Shoreline/riverine setbacks

Committee Discussion: Prevention activities have been implemented in the past in Hampton Roads, are ongoing, and will continue to be included in this and future mitigation action plans. Many communities will mitigate flood damage through planning and zoning actions, such as amendments to their floodplain management ordinances which are viewed as very effective mitigation tools locally. Most communities in the region are continually updating zoning ordinances, especially for flood zones. The statewide building code is viewed as a rather static mitigation tool; it has components that mitigate especially for wind and flood, but is not a product that local governments exert a great deal of influence upon regularly. Appendix F of the building code could be adopted by communities concerned about protecting future construction from the impacts of radon exposure.

Open space preservation strategies are contained in most of the regional comprehensive plans, including Newport News. In York County and several other communities, open space preservation is also addressed in subdivision regulations. Franklin has taken action to promote cluster development outside of flood hazard areas and create conservation and recreation districts along riverbanks. Several communities, including Hampton, Newport News and Southampton County, have integrated information from their existing hazard mitigation plans into Comprehensive Plan revisions.

Stormwater management regulations and drainage system maintenance rules promulgated at the state level are viewed as quite robust and not in need of additional local action at this time, although Virginia Beach has adopted more stringent regulations to require use of future precipitation levels; in addition, VDOT performs much of the drainage system maintenance in the Wester Tidewater region. Similarly, the state's Chesapeake Bay Act regulations governing shoreline setbacks are enforced locally. Capital improvements programming is seen as a useful tool in the implementation of high priority mitigation activities across the participating communities.

2. Property Protection

Property protection measures involve the modification of existing buildings and structures or the removal of the structures from hazardous locations. Examples include:

- Acquisition
- Relocation
- Building elevation
- Critical facilities protection
- Retrofitting (i.e., windproofing, floodproofing, seismic design)
- Safe rooms, shutters, shatter-resistant glass
- Insurance

Committee Discussion: Property protection measures have been implemented in the past in the region and across the state, and are ongoing primarily through HMGP projects. These measures will continue to be included in this and future mitigation action plans. Acquisition is preferred over elevation for Isle of Wight County. Relocation of flood-prone structures is not a high priority in the Western Tidewater region, and is not a preferred alternative in the more built-out municipalities on the Peninsula and Southside. Building elevation projects, critical facilities protection, and floodproofing/retrofitting are popular alternatives with the region's emergency managers, and many communities continually seek ways to increase insurance coverage for vulnerable property owners.

The Community Rating System and related activities encompass and highlight several property protection measures ongoing in the participating communities. The committee decided to continue acquisition, relocation, and elevation measures for repetitively flooded properties, including critical facilities retrofits, in the Mitigation Action Plan, but did not act on any measures specifically for safe rooms or shatter-resistant glass as tornadoes are not a high risk critical hazard. Some communities in Western Tidewater have had discussions about providing safe rooms in designated areas, but no action was taken for this plan.

Existing building code requirements are seen as sufficient with regard to wind and tornado protection; however, hurricane shutters and shatter-resistant glass may be an option for critical facility or emergency shelter retrofits as necessary. Lobbying to ensure critical infrastructure partners are required to have generator power backup, as well as wind protection design elements, was brought up as both a preventive and property protection measure. Many of the study area communities have installed or are considering installation of back-up generators for specific critical facilities, and this will be reflected in the MAP.

With regard to insurance, some communities in Western Tidewater have produced community flyers regarding the importance of having insurance coverage on structures, and the counties participate in the Virginia Association of Counties Group Self-Insurance Risk Pool, a member-owned program that provides equitable rates with stable prices for long-term budgeting purposes. The City of Norfolk recently completed a detailed Program for Public Information and Flood Insurance Coverage Improvement Plan to address areas of the City that are under-insured for flood.

3. Natural Resource Protection

Natural resource protection activities reduce the impact of natural hazards by preserving or restoring natural areas and their protective functions. Natural areas could include floodplains, wetlands, steep slopes, barrier islands and sand dunes. Parks, recreation or conservation agencies and organizations often implement these measures. Examples include:

- Land acquisition
- Floodplain protection
- Watershed management

- Beach and dune preservation
- Riparian buffers
- Forest and vegetation management (i.e., fire resistant landscaping, fuel breaks)
- Erosion and sediment control
- Wetland preservation and restoration
- Habitat preservation
- Slope stabilization
- Historic properties and archaeological site preservation

Committee Discussion: Natural resource protection measures remain commonly-used throughout the coastal Virginia region. Many state programs discussed in Section 6, such as the Chesapeake Bay Act, are established natural resource protection measures that are not expected to be weakened in the near- or long-term. The most important of these measures in relation to Hampton Road's critical hazards are floodplain protection, erosion and sediment control, wetland preservation, and watershed management. Several communities in Western Tidewater discussed the fact that they did a lot of land acquisition after Isabel and Floyd and feel like that measure is no longer a high priority under consideration, and others indicated the cost of flood-prone land acquisition is often prohibitive for their local governments.

Several rivers in the study area are designated scenic rivers and that designation has positively impacted watershed management efforts. Forest and vegetation management were discussed and determined to be low priority items at this time, although changes in risk or vulnerability for wildfire may change this thinking in the future. Beach and dune preservation is another state-promulgated program that requires permitting for impacts.

Several communities decided to continue floodplain protection measures and land acquisition in the Mitigation Action Plan, but did not act specifically on other natural resource protection measures as those are considered to be sufficiently addressed through state regulations. Invasive species control is an important habitat preservation technique used, especially in Isle of Wight County within a 200-acre park containing both wetlands and floodplains. York County has a rare and endangered species overlay in the zoning ordinance, as well as an overlay zone for protection of historic or significant archaeological sites. Slope stabilization is not seen as a particularly high priority need in the study area, although individual projects have been implemented in the past, such as a bridge replacement in Franklin and cliff stabilization at a park along the James River at Fort Boykins. Smithfield recently spent $3 million on historic property preservation on the Pagan River to protect a valuable historic asset; additional projects may be under consideration but were not believed to be tied to hazard mitigation at this time.

4. Structural Projects

Structural mitigation projects are intended to lessen the impact of a hazard by modifying the hazard itself through construction. These projects are usually designed by engineers and managed or maintained by public works staff. Examples include:

- Reservoirs
- Dams/levees/dikes/floodwalls/seawalls
- Diversions/detention/retention
- Channel modification
- Beach nourishment
- Storm sewers

Committee Discussion: New large-scale reservoirs are not under consideration at this time in the region. Dam regulations at the state level are considered sufficient and communities are not considering additional regulation; however, physical upgrades to existing dams are necessary and some are currently underway, including raising and strengthening of the Newport News Waterworks reservoir. Virginia DCR provided input on additional dam maintenance, retrofit and repair projects that are necessary in the region in the coming years. "Dutch Dialogues", or conversations with Dutch engineers regarding successful flood mitigation techniques overseas, including structures, have resonated with several Hampton Roads communities as they explore ways to protect their built environment from sea level rise. Examples under consideration include green streets and other infrastructure that help manage stormwater so that rising seas and stormwater can be managed effectively. In Newport News, Norfolk and Portsmouth, deteriorating seawalls are under consideration for replacement with increased levels of protection. Virginia Beach, Norfolk and Hampton have ongoing beach nourishment programs to provide flood protection and recreation amenities, and this will be reflected in MAP actions for those communities.

Other structural protection measures are in place and must be maintained by the communities or private owners. Channel modifications, diversions, and detention/retention, such as tide gates, backflow preventers and stream restoration, have been effective in reducing flood hazards in some areas of the region and will remain viable mitigation actions in the future, especially for reducing the compounding effects of increased precipitation, floods and sea level rise. Stream restoration was recently included as a BMP in the State's BMP clearinghouse and some committee members believe that this may result in this method being considered and possibly used more in the future.

Isle of Wight County is implementing some watershed management measures through installation of larger BMPs. Dry hydrants, and smoke testing of sanitary sewers, and the stormwater management preventive maintenance schedule are potential structural projects, with dry hydrants particularly important in wildfire control in the western parts of the study area. High value structural projects are being considered for some study area communities.

5. Emergency Services

Although not typically considered a "mitigation" technique, emergency services can minimize the impacts of a hazard event on people and property. These actions are often taken prior to, during, or in response to an emergency or disaster. Examples include:

- Warning systems
- Evacuation planning and management
- Emergency response training and exercises
- Sandbagging for flood protection
- Installing temporary shutters for wind protection

Committee Discussion: Traditional riverine warning systems are inappropriate for some of the region's flood hazards, but a system of citizen and institutional tidal gauge monitoring provides limited input to community emergency planners for specific watersheds in the region. Hampton and Newport News have flood gauges with alerts along Newmarket Creek. Flood warning systems in Southampton County and Franklin are implemented and effective and Isle of Wight County has switched to a more robust system. Several communities have recently implemented Everbridge unified critical communications software to deliver messages to targeted audiences, and most communities have some form of reverse 911. Leveraging the various communities' flood warning systems to create a more regional approach would aid the citizens who live and commute through multiple jurisdictions. Regional cooperation on this front could benefit citizens and visitors to the region and may result in savings to communities by reducing the need to invest in so many systems.

Evacuation planning is aided at the regional and state levels, but local planners use many tools to continually manage and improve the program; several are now considering more use of sheltering in place, the use of central evacuation locations or evacuating more targeted groups rather than automatically going to mass evacuations. Evacuation and sheltering plans for vulnerable populations are a high priority for the region's emergency planners at this time, and Western Tidewater planners continue to work with NC officials regarding Outer Banks evacuation routes that traverse the region.

Sandbagging for flood protection is generally considered helpful, but local governments are not involved in helping property owners sandbag, with the exception of Franklin and Virginia Beach. In Franklin, a new rule allows downtown business owners to get sand and bags from the City. Virginia Beach does provide sandbagging opportunities when necessitated based on storm impacts. Sandbagging is not provided for any and every storm in Virginia Beach, but is most likely available in response to a hurricane. Individual property owners may decide to sandbag for protection, but this is not an action committee members want to include in the MAP, as longer-term retrofit protection methods are deemed preferable. Adding generator electrical circuits to support jail operations during power outages was discussed and included in the MAP for Chesapeake. This activity is both an Emergency Services action and a Property Protection measure. Some communities, such as Poquoson, Newport News, and York County, have installed shutters for wind protection on Emergency Operations Centers; Hampton is building a new EOC outside the SFHA. Committee members in Western Tidewater discussed battery backups for stoplights, but indicated that in their region, such a measure would require assistance and cooperation with VDOT to implement.

6. Public Education and Awareness

Public education and awareness activities are used to advise residents, elected officials, business owners, potential property buyers, and visitors about hazards, hazardous areas, and mitigation techniques they can use to protect themselves and their property. Examples of measures used to educate and inform the public include:

- Outreach projects
- Speaker series/demonstration events
- Hazard mapping
- Real estate disclosure
- Library materials
- School children educational programs
- Hazard expositions
- Inter-governmental coordination

Committee Discussion: Public education and outreach activities are a particular focus of emergency planners in the region and are ongoing, particularly through existing web sites and several CRS-related activities. Speaker series and demonstration events, such as hurricane awareness events, are supported by several of the local governments throughout the year, but may not rise to the importance of being included in the MAP for each of these communities. For example, Hampton participates in the Home Expo and Emergency Preparedness Day annually, and York County has a Safety Town Program each summer. Norfolk has a speaker series on stormwater concepts for schoolchildren. The groups considered ways to improve upon these programs in the MAP moving forward, including working with the State Department of Education to integrate mitigation lessons in the Virginia Standards of Learning. This is potentially a mitigation action for future State Hazard Mitigation Plan updates.

FEMA, working with the U.S. Army Corps of Engineers, has revised many of the Flood Insurance Rate Maps for the region as ongoing coastal studies are completed. Additional hazard mapping was discussed and some communities have worked with HRPDC to gather more structure lowest floor elevations in flood prone areas. Real estate disclosure, particularly for flood risk and radon risk, is guided by current State regulations and not influenced by local government. Library materials, school programs, and open houses are included in the MAP for many communities.

Committee members discussed train-the-trainer opportunities in conjunction with the City's Community Emergency Response Team (CERT) and the Tidewater Builders Association and several decided to add this as an action or to append it to existing actions despite the altered functions of CERTs during the COVID-19 disaster. The HRPDC supports several efforts at inter-governmental coordination, including the Hampton Roads All Hazards Advisory Committee (AHAC) and HR Green. There is also a local CRS User's Group that is very active among CRS and CRS-interested communities in the study area.

SELECTION OF MITIGATION TECHNIQUES

In order to determine the most appropriate mitigation techniques, committee members reviewed and considered the findings of the *Capability Assessment* and *Risk Assessment*. Other considerations included each mitigation action's effect on overall risk reduction, its ease of implementation, its degree of political and community support, its general cost-effectiveness and funding availability.

FEMA guidance for meeting the planning requirements of the Disaster Mitigation Act of 2000 also specifies that local governments should prioritize their mitigation actions based on the level of risk a hazard poses to the lives and property of a given jurisdiction. A Mitigation Technique Matrix (**Table 7.2**) shows that those hazards posing the greatest threat are addressed by the updated MAP.

The matrix provides the committee with the opportunity to cross-reference each of the priority hazards (as determined through the *Risk Assessment*) with the comprehensive range of available mitigation techniques, including prevention, property protection, natural resource protection, structural projects, emergency services, and public education and awareness. The *Mitigation Action Plan* includes an array of actions targeting multiple hazards, not just those classified as either high or moderate risk.

As part of the 2022 update, the committee reviewed several documents to assist with the development of new mitigation actions and the assessment of existing actions. Review documents included: 1) a spreadsheet of each community's capabilities and any mitigation program gaps subsequently identified; 2) each community's Comprehensive Plan and Resilience Plans (if available), specifically components that may be compatible with mitigation goals, or that may be appropriate as mitigation actions; 3) contractor review of local floodplain management regulations; 4) the mitigation action items from the existing plans with 2022 status information; and 5) several recommended publications, including FEMA Publication *Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards*, January 2013, FEMA's *Mitigation Best Practices* and *Mitigation Action Portfolio* web site, and resilience design guidelines for Miami Beach, Boston and New York City.

TABLE 7.2: MITIGATION TECHNIQUE MATRIX

MITIGATION TECHNIQUE	HIGH RISK HAZARDS			MODERATE RISK HAZARDS		
	Flooding	Tropical/Coastal Storm	Sea Level Rise and Land Subsidence	Winter Storm	Tornado	Hazardous Materials Incident
PREVENTION	✓	✓	✓	✓	✓	✓
PROPERTY PROTECTION	✓	✓	✓	✓	✓	
NATURAL RESOURCE PROTECTION	✓		✓			✓
STRUCTURAL PROJECTS	✓	✓	✓	✓	✓	
EMERGENCY SERVICES	✓	✓		✓	✓	✓
PUBLIC EDUCATION AND AWARENESS	✓	✓	✓	✓	✓	✓

MITIGATION ACTION PLAN

The mitigation actions proposed for local adoption are listed in the MAP on the pages that follow. They will be implemented according to the plan maintenance procedures established for the *Hampton Roads Hazard Mitigation Plan* (see Section 8: Plan Maintenance Procedures). The action items have been designed to achieve the mitigation goals and priorities established by the committee.

Each proposed mitigation action has been identified as an effective measure to reduce hazard risk in Hampton Roads. Each action is described with available background information such as the location of the project and general cost benefit information.

Other information provided includes data on cost estimates and potential funding sources to implement the action should funding be required (not all proposed actions are contingent upon funding). Most importantly, implementation mechanisms are provided for each action, including the designation of a lead agency or department responsible for carrying the action out, as well as a timeframe for its completion. These implementation mechanisms ensure that the *Hampton Roads Hazard Mitigation Plan* remains a functional document that can be monitored for progress over time. Proposed actions are not listed in exact priority order though each has been assigned a priority level of “high,” “moderate” or “low” as described in the previous section.

Table 7.3 describes the key elements of the Mitigation Action Plan, and **Table 7.4** lists the additional considerations that were evaluated for each proposed action once selected for inclusion in the Mitigation Action Plan. This includes social, technical, administrative, political, legal, economic, and environmental considerations collectively known as "STAPLEE" evaluation criteria.

As part of the plan update process, the committee reviewed the list of recommended actions included in their respective existing plans to determine if the actions should be deleted because they are completed, deferred, cancelled, or continued, and made recommendations regarding modified and new actions. Summary results of this review are included in **Appendix F**.

TABLE 7.3: KEY ELEMENTS OF THE MITIGATION ACTION PLAN	
Proposed Action	Identifies a specific action that, if accomplished, will reduce vulnerability and risk in the impact area. Actions may be in the form of local policies (i.e., regulatory or incentive-based measures), programs or structural mitigation projects and should be consistent with any pre-identified mitigation goals and objectives.
Site and Location	Provides details with regard to the physical location or geographic extent of the proposed action, such as the location of a specific structure to be mitigated, whether a program will be Citywide, countywide or regional, etc.
Cost Benefit	Provides a brief synopsis of how the proposed action will reduce damages for one or more hazards.
Hazard(s) Addressed	Lists the hazard(s) the proposed action is designed to mitigate for.
Goal(s) Addressed	Indicates the Plan's established mitigation goal(s) the proposed action is designed to help achieve.
Priority	Indicates whether the action is a "high" priority, "moderate" priority, or "low" priority based on the established prioritization criteria.
Impact on Socially Vulnerable Populations	Indicates whether the action has a "high" impact, "moderate" impact , or "low" impact based on the established ranking criteria.
Estimated Cost	Indicates what the total cost will be to accomplish this action. This amount will be an estimate until actual final dollar amounts can be determined.
Potential Funding Sources	If applicable, indicates how the cost to complete the action will be funded. For example, funds may be provided from existing operating budgets or general funds, a previously established contingency fund, or a cost-sharing federal or state grant program.
Lead Agency/Department Responsible	Identifies the local agency, department or organization that is best suited to implement the proposed action.
Implementation Schedule	Indicates when the action will begin and when it is estimated to be completed. Some actions will require only a minimal amount of time, while others may require a long-term or continuous effort.

TABLE 7.4: ADDITIONAL CONSIDERATIONS (STAPLEE EVALUATION)	
Socially Acceptable	Is the proposed action socially acceptable to the community? Is the action compatible with present and future community values? Are there equity issues involved that would mean that one segment of the community is adversely affected?
Technically Feasible	Will the proposed action serve as a long term solution? Will it create any negative secondary impacts? Are there any foreseeable problems or technical constraints that could limit its effectiveness?
Administratively Possible	Does the community have the capability to implement the proposed action? Is there someone available to coordinate and sustain the effort?
Politically Acceptable	Is there political support to implement the proposed action? Is there enough public support to ensure the success of the action?
Legal	Is the community authorized to implement the proposed action? Is there a clear legal basis or precedent for the action? Are there any potential legal consequences of the action?
Economically Sound	What are the costs and benefits of the proposed action? Does the cost seem reasonable for the size of the problem and the estimated benefits? Are there funding sources available to help offset costs of the action? Is the action compatible with other economic goals of the community?
Environmentally Sound	How will the action impact the environment? Will the action require any environmental regulatory approvals? Is the action consistent with other environmental goals of the community?

The following is a list of current funding sources and their acronyms as may be indicated in the mitigation actions. Additional acronyms used throughout this plan are interpreted in Appendix G. The pool of potential funding mechanisms is changing very rapidly as a result of COVID and other Federal and state legislative priorities at the time of this update.

Key to Potential Funding Source Acronyms:

DHS U.S. Department of Homeland Security
- **BRIC –** Building Resilient Infrastructure and Communities
- **HMGP –** Hazard Mitigation Grant Program
- **FMA –** Flood Mitigation Assistance Program
- **HHPD –** Rehabilitation of High Hazard Potential Dams (HHPD) grant program

ARPA American Rescue Plan Act

USACE U.S. Army Corps of Engineers
- **SFCP** – Small Flood Control Projects
- **FPMS** – Flood Plain Management Services Program
- **CAP** – Continuing Authorities Program

DOI U.S. Department of the Interior
- **LWCF –** Land and Water Conservation Fund Grants

EDA U.S. Economic Development Administration
- **DMTA –** Disaster Mitigation and Technical Assistance Grants

EPA U.S. Environmental Protection Agency
- **CWA –** Clean Water Act Section 319 Grants

HUD U.S. Department of Housing and Urban Development
- **CDBG –** Community Development Block Grant Program

USDA U.S. Department of Agriculture
- **EWP –** Emergency Watershed Protection
- **WPFP –** Watershed Protection and Flood Prevention
- **WSP –** Watershed Surveys and Planning

Virginia
- **CFPF – Virginia Community Flood Preparedness Fund**

Table 7.5 provides a matrix indicating that each critical and noncritical hazard affecting communities is addressed in the Mitigation Action Plan.

TABLE 7.5: MITIGATION ACTIONS FOR CRITICAL AND NON-CRITICAL HAZARDS

	Flooding	Tropical/Coastal Storm	Sea Level Rise and Land Subsidence	Tornado	Winter Storm	Hazardous Materials Incident	Landslide/Coastal Erosion	Earthquake	Wildfire	Radon Exposure	Flooding Due to Impoundment Failure	Pandemic Flu or Communicable Disease
Regional Actions	M*	2, 3	M	2	2	2	2	2, 3	2	2,4	2	2
Hampton	M	M	M	M	M	M	M	M	M	M	M	M
Newport News	M	M	M	3	3	3	M	3, 5	3, 8	3	3, 10	3
Poquoson	M	M	M	M	M	M	M	M	M	4	n/a	4, 10
Williamsburg	M	M	M	M	M	M	M	M	M	M	M	M
James City County	M	M	M	M	M	M	6, 9	M	M	1,7	M	1,7
York County	M	M	M	M	M	M	M	M	M	M	M	M
Norfolk	M	M	M	M	M	3	M	M	3	3,5	M	3,5
Portsmouth	M	M	M	M	M	M	M	M	M	M	n/a	M
Suffolk	M	M	M	M	M	M	2,4	M	M	2	2,8	2
Virginia Beach	M	M	M	M	M	M	M	M	M	6,20	M	M
Chesapeake	M	M	M	M	M	M	M	M	M	M	M	M
Isle of Wight County	M	M	M	M	M	M	M	M	M	5,8	5,8	5,8
Smithfield	M	M	M	M	M	8	M	M	6, 8	8	n/a	8
Windsor	M	3	1	3	3	3	1	3	3	3	n/a	3
Franklin	M	M	M	M	M	M	5,11	M	M	12, 13	n/a	12
Southampton County	M	M	17	M	M	M	M	M	M	M	n/a	10,11
Boykins	M	2,4	3,4	3,4	2,4	3,4	3,4	3,4	M	3,4	n/a	3,4
Branchville	M	M	M	M	M	M	1,3	M	M	1,3	n/a	1,3
Capron	1	1	1	1	1	1	1	1	1	1	n/a	1
Courtland	M	M	M	M	M	M	1,4	3,4	M	2,4	n/a	2,4
Ivor	4,3	3	3,4	3	3,4	3	3	3	M	3	n/a	3
Newsoms	M	1	M	1,2	1,5	1,2	1	1	1,2	1,2	n/a	1,2
Surry County	M	M	M	M	M	M	M	M	M	M	n/a	M
Claremont	M	M	M	M	M	2,5	M	M	M	M	n/a	2,5
Dendron	1	1	1	1	1	1	1	1	1	1	n/a	1

**M = 3 or more actions address this hazard*

REGIONAL STRATEGIES

REGIONAL MITIGATION ACTION 1	
Use existing or create new Elevation Certificates to collect lowest floor elevation data for flood-prone structures in the region, focusing initially on repetitive loss areas in each community.	
BACKGROUND INFORMATION	
Site and Location:	Hampton Roads region, particularly repetitive flood loss areas as identified in Section 5 of this plan
Cost Benefit:	Lowest floor elevation data for pre-FIRM structures are critical information for developing robust cost-benefit analyses of mitigation options for flood-prone structures. The data are necessary in order to prioritize and fund mitigation projects, especially through Federal and state grant processes.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2; Goal 3, Objectives 3.2, 3.3, 3.4
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate/Low; Hampton, Newport News, Norfolk and Portsmouth have Moderate NRI flood risk – all other communities have Low
Estimated Cost:	Estimated $30/structure, based on similar project in eastern North Carolina
Potential Funding Sources:	USACE: FPMS; DHS: BRIC and HMGP; Virginia CFPF
Lead Agency/Department Responsible:	AHAC
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
Significant progress made in recent years by gathering archived Elevation Certificates from building records.	

REGIONAL MITIGATION ACTION 2	
Use AHAC structure and HRPDC resources to develop additional regional mitigation strategies and initiate annual workshop on mitigation project funding.	
BACKGROUND INFORMATION	
Site and Location:	Throughout Hampton Roads study area
Cost Benefit:	Through AHAC organizational structure, VDEM and HRPDC can provide no-cost assistance to the communities to help satisfy reporting requirements, make progress on mitigation actions, and apply for mitigation grant funding.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All Hazards
Goal(s) Addressed:	Goal 3, Objectives 3.3, 3.4
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	Travel costs and staff time
Potential Funding Sources:	Existing budgets
Lead Agency/Department Responsible:	AHAC/HRPDC, partner with Wetlands Watch, HR Green
Implementation Schedule:	Annually
ADDITIONAL COMMENTS	
Proposed workshop agenda: 1. HRPDC and VDEM to provide update on funds available, details on how to apply, and what projects are eligible; 2. HRPDC update on regional mitigation actions and progress; 3. Break into community-based work groups to provide report on status of each mitigation action (modified, complete, not started and why).	

REGIONAL MITIGATION ACTION 3	
Analyze and update the platform, availability, and accuracy of HAZUS input data and output results for the purposes of conducting future, more detailed vulnerability analyses.	
BACKGROUND INFORMATION	
Site and Location:	Throughout Hampton Roads study area
Cost Benefit:	Some of the data used to update HAZUS in this study were not intended for the purposes of flood vulnerability analyses. Particularly, the assessor databases from communities are for tax purposes and the data are incomplete.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Flooding Due to Impoundment Failure/High Hazard Dam, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm and Earthquake
Goal(s) Addressed:	Goal 1, Goal 3; Objective 3.2, 3.3
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate/Low; Hampton, Newport News, Norfolk and Portsmouth have Moderate NRI flood risk – all other communities have Low
Estimated Cost:	$60,000
Potential Funding Sources:	USACE, HMGP, HMGP 5% Initiative, BRIC
Lead Agency/Department Responsible:	HRPDC
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
The PDC has established a platform, but as data and computing needs change, platforms requires ongoing analysis. Some progress has been made and the PDC continues to investigate workshare arrangements with VDEM, CRS Task Force, VFMA/ASFPM and the Silver Jackets.	

REGIONAL MITIGATION ACTION 4	
Use commercially available radon test kits to determine radon levels in structures. Evaluate radon data against known geological formations in the region to determine geographic variability in vulnerability. End product will be a refined map of radon zones.	
BACKGROUND INFORMATION	
Site and Location:	Hampton Roads, particularly areas of suspected high radon concentration over the western extent of the Yorktown Formation.
Cost Benefit:	Radon exposure has a high cost; it is a known cause of lung cancer, especially in smokers. Radon tests are inexpensive (<$50) and structural mitigation is inexpensive. The results of additional testing and map refinement will provide local and state officials with additional tools to advise homeowners when testing is advised, resulting in mitigation of lung cancer. Leaders at the local, regional and State level will gain valuable information to determine if a change in capabilities is warranted (*e.g.*, building code requirements, real estate transaction disclosures).
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Radon Exposure
Goal(s) Addressed:	Goal 1, Objective 1.2, 1.3, 1.5; Goal 2, Objective 2.1, 2.2, 2.3
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate – Franklin has very high NRI social vulnerability; Hampton, Newport News, Portsmouth and Williamsburg have relatively moderate social vulnerability; all other communities have low or relatively low
Estimated Cost:	Estimated $30/structure, plus mapping costs
Potential Funding Sources:	EPA, DHS: HMGP, BRIC
Lead Agency/Department Responsible:	HRPDC, College of William & Mary
Implementation Schedule:	Begin project within 2 years of plan adoption; project may extend beyond 2027 planning horizon
ADDITIONAL COMMENTS	

REGIONAL MITIGATION ACTION 5	
Partner with VDEM to review repetitive flood loss data from FEMA on a regular basis, update repetitive flood loss area polygons and shapefiles, and analyze data for patterns, errors and mitigation opportunities.	
BACKGROUND INFORMATION	
Site and Location:	Throughout HRPDC jurisdictions
Cost Benefit:	Implementing this action at the State level would reduce the burden on communities by centralizing the process. Using state GIS capabilities would ensure consistency across the Commonwealth and help make this data available beyond just CRS participating communities.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Goal 3
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	Staff time
Potential Funding Sources:	DHS; Virginia CFPF
Lead Agency/Department Responsible:	VDEM, HRPDC, all Hampton Roads flood-prone communities, particularly those participating in the CRS
Implementation Schedule:	Within 2 years
ADDITIONAL COMMENTS	
VDEM GIS staff can assist with ranking RL polygons by more detailed social vulnerability measure than NRI.	

REGIONAL MITIGATION ACTION 6	
Address high and significant hazard dam safety in the region, to include: • **Investigate and conduct risk assessments on dams using risk prioritization methodology;** • **Conduct alternatives analyses to identify preferred plans for dam rehabilitations and the estimated costs for design and construction;** • **Repair, removal, or any other structural or nonstructural measures to rehabilitate an eligible high hazard potential dam, including development of conceptual, preliminary, and final design plans;** • **Conduct additional inundation studies, and use dam inundation data and flood depths to determine if retrofits to affected critical facilities may be necessary.**	
BACKGROUND INFORMATION	
Site and Location:	Throughout HRPDC jurisdictions. Harwood's Mill Dam in York County, Little Creek Dam in James City County and Godwin's Millpond Dam in Suffolk are of particular concern because they are high hazard dams in poor condition. See Figures 5.13 and 5.14 for dam locations.
Cost Benefit:	Local engineering expertise and regional knowledge may prove effective in supplementing existing, limited state resources for inspecting and rating dams. Dam inundation planning is similarly impacted.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Flooding Due to Impoundment Failure/High Hazard Dam, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Objectives 1.3; Goal 3, Objective 3.2, 3.3, 3.4
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low/Moderate
Estimated Cost:	TBD
Potential Funding Sources:	FEMA: HHPD; ARPA; Virginia CFPF
Lead Agency/Department Responsible:	Virginia DCR, HRPDC, affected communities
Implementation Schedule:	Continuously over next 5 years

ADDITIONAL COMMENTS
HRPDC and its localities work to act as local sponsors of HHPD projects and determine whether specific structural or non-structural measures are needed to meet state standards. In more complex situations, dam owners are advised to undertake alternatives analysis to ensure a cost effective solution is implemented that also meets state and federal environmental requirements.

REGIONAL MITIGATION ACTION 7	
Provide regional leadership regarding the new NFIP's new Risk Rating 2.0 system and renewal policy planning, to include assistance with: **1) Evaluation of rating accuracy and "minus-rated" policies;** **2) Messaging and outreach to homeowners;** **3) Elevation Certificate correction; and** **4) Mitigation assistance for property protection.**	
BACKGROUND INFORMATION	
Site and Location:	Throughout HRPDC jurisdictions
Cost Benefit:	The PDC has contacts and the ability to assemble and then disseminate information at a more cost-effective price point than if each locality on its own.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 2
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	TBD
Potential Funding Sources:	FEMA: HMGP, BRIC
Lead Agency/Department Responsible:	HRPDC AHAC, Virginia DCR
Implementation Schedule:	Over the next 2 years
ADDITIONAL COMMENTS	

REGIONAL MITIGATION ACTION 8	
Strengthen existing and create new regional transportation networks and hubs for evacuation and sheltering. The purposes and needs for evacuation and sheltering are evolving, and communities are moving away from traditional, large shelters to house large populations toward a more targeted approach that tries to anticipate disaster-related needs more specifically. Educating the public about these changes is an important component to this type of regional planning.	
BACKGROUND INFORMATION	
Site and Location:	Throughout HRPDC jurisdictions
Cost Benefit:	Evacuation and sheltering costs, in particular, can be impacted by how many people are evacuated and how they are moved to shelters. The services available at shelters is impacted, as well. Regional approaches to evacuation can save valuable time and money.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All hazards
Goal(s) Addressed:	Goal 1: Objectives 1.4, 1.5; Goal 2; Goal 3
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High – evacuation of socially vulnerable populations will be a focus of the planning effort
Estimated Cost:	TBD
Potential Funding Sources:	FEMA
Lead Agency/Department Responsible:	HRPDC AHAC; Stakeholders (e.g., hospital systems, universities, military bases, American Red Cross, social service agencies, transportation partners)
Implementation Schedule:	Immediately upon adoption
ADDITIONAL COMMENTS	

REGIONAL MITIGATION ACTION 9	
Work with private companies to advance continuity of operations, including but not limited to power, gas, and water service restoration. Mitigation actions may include implementation of system redundancies, mutual aid agreements or other partnerships to address critical capability gaps. Physical retrofits may increase resilience of critical infrastructure, such as burying power lines and provision of dependable backup power to water and wastewater treatment facilities.	
BACKGROUND INFORMATION	
Site and Location:	Throughout HRPDC jurisdictions
Cost Benefit:	Damages are reduced when critical lifelines are returned to service promptly after a disaster. By creating partnerships between private utility providers, the region can expect a faster return to full operations, thereby reducing losses to business and property owners.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All hazards
Goal(s) Addressed:	Goal 1, Goal 3
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	TBD
Potential Funding Sources:	ARPA, FEMA
Lead Agency/Department Responsible:	Dominion, HRPDC AHAC
Implementation Schedule:	Within 4 years of plan adoption
ADDITIONAL COMMENTS	

HAMPTON

HAMPTON MITIGATION ACTION 1	
Maintain participation in National Flood Insurance Program and Community Rating System, with goal of obtaining Class 6 CRS rating. Continue enforcement of standards in existing ordinance that meet and exceed NFIP minimum requirements.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	The NFIP and related flood mapping and development regulations have proven benefits nationwide. CRS benefits accrue through increased insurance coverage, improved hazard awareness and reduced flood insurance premiums; a Class 6 rating equates to a 20% flood insurance premium savings for most flood-prone property owners. New construction and future development are protected from current flood conditions through existing standards that meet or exceed NFIP minimum requirements.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, and Tropical/Coastal Storm
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.5
Priority (High, Moderate, Low):	High
Estimated Cost:	Staff time
Impact on Socially Vulnerable Populations:	High – All 13 repetitive flood loss areas contain areas of very high or relatively high NRI flood risk, which includes analysis of social vulnerability
Potential Funding Sources:	Existing budgets
Lead Agency/Department Responsible:	Emergency Management, Public Works and Community Development
Implementation Schedule:	Annually
ADDITIONAL COMMENTS	

HAMPTON MITIGATION ACTION 2	
Acquire, elevate, relocate, retrofit or floodproof structures in flood prone areas. This action includes acquisition/demolition of repetitive and severe repetitive losses from trustee sales/tax sales.	
BACKGROUND INFORMATION	
Site and Location:	Flood prone areas Citywide
Cost Benefit:	Retrofit measures that address flooded structures, particularly those designated as repetitive loss or severe repetitive loss by the NFIP, have quantifiable benefits. The City has collected elevation data and will continue collection as part of this action in order to more easily make cost-benefit analyses of at risk structures. City acquisition of repetitively flooded trustee sales is a cost-effective way to remove severely flood-prone structures from the real estate market and prevent resale without mitigation. These properties can be purchased inexpensively. Treasurer's Office can provide list of tax sales on regular basis.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, and Tropical/Coastal Storm
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.5, 1.6
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High – All 13 repetitive flood loss areas contain areas of very high or relatively high NRI flood risk, which includes analysis of social vulnerability
Estimated Cost:	Cost will be based on specific flood protection measures chosen. Under new guidance, FEMA will now fund hazard mitigation projects that include sea level rise estimates.
Potential Funding Sources:	DHS: BRIC, HMGP, HMGP 5% Initiative, FMA, RFC; USACE: SFCP, FPMS; HUD: CDBG; USDA: WPFP; Virginia CFPF
Lead Agency/Department Responsible:	Emergency Management, Community Development, Treasurer's Office
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
Locally funded projects may be creditable under the Community Rating System.	

HAMPTON MITIGATION ACTION 3		
Provide flood, wind and heat protection and dry access/egress for critical facilities and infrastructure. Retrofits may include, but are not limited to: elevate and harden communication sites, provide generator backup or prewire evacuation shelters for quick hook-ups, and upgrade sewer pump stations.		
BACKGROUND INFORMATION		
Site and Location:	Critical facilities Citywide	
Cost Benefit:	Benefits of mitigating damage to critical facilities are realized by all citizens through the city's ability to maintain the highest operational capabilities post-disaster. Benefits are based on reduced response times, and longevity of critical infrastructure.	
MITIGATION ACTION DETAILS		
Hazard(s) Addressed:		Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Extreme Heat
Goal(s) Addressed:		Goal 1, Objectives 1.3, 1.4, 1.5
Priority (High, Moderate, Low):		High
Impact on Socially Vulnerable Populations:		Moderate
Estimated Cost:		Cost will be based on specific protection measures chosen for each facility. Under new guidance, FEMA will now fund hazard mitigation projects that include sea level rise estimates.
Potential Funding Sources:		DHS: BRIC, HMGP, HMGP 5% Initiative, FMA, RFC; Stafford Act Section 406 - post-disaster mitigation funds under Public Assistance for damaged public facilities
Lead Agency/Department Responsible:		Emergency Management, Public Works, Hampton City Schools
Implementation Schedule:		Ongoing
ADDITIONAL COMMENTS		
New 911/EOC is nearing construction out of the SFHA, on Big Bethel Road.		

HAMPTON MITIGATION ACTION 4	
Adopt and implement holistic water plans to mitigate flooding on a watershed level.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Identify and prioritize impactful and implementable projects, policies, and programs to reduce flooding impacts, spur flood-safe redevelopment and add value to affected neighborhoods.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Sea Level Rise and Land Subsidence, Flooding, Tropical/Coastal Storm, Landslide/Coastal Erosion
Goal(s) Addressed:	Goal 1; Goal 3, Objectives 3.1, 3.3, 3.4
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	Approximately $250,000 per water plan, or $1 million in total for remaining plans
Potential Funding Sources:	DHS: BRIC, HMGP, HMGP 5% Initiative; Virginia CFPF
Lead Agency/Department Responsible:	Community Development, Public Works
Implementation Schedule:	Ongoing; planning complete in approximately 5 years
ADDITIONAL COMMENTS	
Planning is led by the Resilient Hampton Initiative, and is based on the idea of living with water. The focus is on flood mitigation, economic growth, mobility and access, green infrastructure, natural resources, and revitalization of flood-prone areas. Plans aim to coordinate a variety of goals while mitigating flooding impacts, working together with the community to identify assets, approaches, and projects.	

HAMPTON MITIGATION ACTION 5	
Maximize use of social media before, during and after hazard events.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Minimal cost to reach larger audience more effectively
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Tornado, Winter Storm, Earthquake, Wildfire, Drought, Extreme Heat, Hazardous Materials Incident
Goal(s) Addressed:	Goal 2; Objective 2.1
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	$200,000 annually, including staff time
Potential Funding Sources:	n/a
Lead Agency/Department Responsible:	Marketing Department, Emergency Management
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
The prominence of social media points to a need to refine activity on Twitter, Facebook, Instagram and other programs. Need to be pro-active and targeted in messages. Identify specific messages, links. Other information that we will need to spread and the most effective methods, may include short videos, maps, links, photos, and infographics. In 2021, Hampton won an award for Top 10 Digital City for its size range. Efforts to reach a broad group of citizens are working and should continue.	

HAMPTON MITIGATION ACTION 6	
Develop a Resilient Hampton Education Plan, which may include a CRS Plan for Public Information. **Prepare public outreach materials and conduct outreach to educate elected officials and residents on methods of mitigating flood damage, the importance of maintaining flood insurance coverage, the City's floodplain management efforts, and the benefits of the City's CRS participation.** **Expand capacity building and training for various groups and neighborhood-serving organizations to include communication about mitigation, building code requirements, and response.**	
BACKGROUND INFORMATION	
Site and Location:	Citywide, with particular emphasis on vulnerable neighborhoods with less access to social or broadcast media
Cost Benefit:	Local residents are better able to address and then communicate the needs of their specific neighborhoods. Using community members to transmit information to neighbors can expand capacity of City staff to communicate, mitigate and respond more effectively.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Extreme Heat
Goal(s) Addressed:	Goal 2, Objective 2.1; Goal 3, Objectives 3.1, 3.4
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High
Estimated Cost:	$5,000 to $50,000
Potential Funding Sources:	General Fund – Neighborhood Education Programs; HMGP 5% Initiative
Lead Agency/Department Responsible:	Emergency Management, Community Development, Marketing, Public Works
Implementation Schedule:	Ongoing; incorporate into upcoming Resilient Hampton education plan
ADDITIONAL COMMENTS	
Also considering partnerships with neighboring localities to share training opportunities for interested citizens. Make sure homeowners have flood insurance coverage. Flood insurance coverage has been shown to reduce response needs and help Hampton's citizens return to normalcy more quickly after flooding.	

HAMPTON MITIGATION ACTION 7	
Improve stormwater management capacity of existing system, to include improving drainage system maintenance using increased sediment and debris clearance, and ongoing analysis of the current system's status of functionality.	
BACKGROUND INFORMATION	
Site and Location:	Drainageways citywide. Engineering studies have specifically identified Mill Creek Terrace, Mary Peake and Riverdale as particular areas of concern.
Cost Benefit:	The City's network of structures, channels and underground pipes that carry stormwater help reduce flooding, especially during high frequency events. Maintenance and retrofits are required to keep the system functioning effectively, especially as sea level rises.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Landslide/Coastal Erosion
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.4, 1.5, 1.6
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	$22.1 million (see additional information below)
Potential Funding Sources:	Stormwater Utility Fee; Bond Funding; ARPA; IIJA
Lead Agency/Department Responsible:	Public Works Engineering
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
Hampton's MS4 permit has requirements for this activity and the city is required to increase debris and sediment removal for each 5-year permit. Pochin Place was completed December 2020, cost $762,183, the total cost for the remaining mitigation efforts in the Mill Creek Watershed are $2,361,000, Mary Peake Watershed $10,561,699 and the Riverdale Watershed is $10,561,699. The total cost is estimated at $22,120,109.	

HAMPTON MITIGATION ACTION 8	
Coordinate with owners of post-FIRM structures that are NFIP "minus-rated" to help property owners determine reason for rating and implementing solutions. Identify funding sources to help identify and fund retrofits.	
BACKGROUND INFORMATION	
Site and Location:	Flood-prone locations citywide
Cost Benefit:	Minus-ratings are typically related to flood vents and are straightforward, low cost retrofits. Assistance from City staff and/or private insurers could help owners reduce flood insurance premiums while gaining flood resilience.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.5; Goal 2, Objective 2.1, 2.3; Goal 3, Objective 3.4
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	Staff time. Some private companies that offer flood insurance often provide this service to homeowners free of charge.
Potential Funding Sources:	HMGP 5% Initiative; Hampton's flood mitigation fund provides low-cost loans for mitigation
Lead Agency/Department Responsible:	Community Development, Emergency Management, Public Works
Implementation Schedule:	Within 2 years of plan adoption
ADDITIONAL COMMENTS	

HAMPTON MITIGATION ACTION 9	
Conduct repetitive loss area analyses of repetitive flood loss areas, partnering with HRPDC and VDEM where relevant. Include outreach to homeowners regarding potential mitigation options.	
BACKGROUND INFORMATION	
Site and Location:	Repetitive flood loss areas Citywide (see Section 5 for maps)
Cost Benefit:	Analyses benefit property owners by identifying potential mitigation actions, making the repetitively flooded areas better known to elected officials and the public, and possibly garnering CRS points to contribute to reducing flood insurance premiums.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm
Goal(s) Addressed:	Goal 1, Objective 1.1, 1.2, 1.5
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High – All 13 repetitive flood loss areas contain areas of very high or relatively high NRI flood risk, which includes analysis of social vulnerability
Estimated Cost:	$100,000
Potential Funding Sources:	Grant funding through Emergency Management; see also Regional Action #5
Lead Agency/Department Responsible:	Community Development, Public Works/Engineering and Emergency Management
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

HAMPTON MITIGATION ACTION 10	
Continue to build resiliency into the city's approach to social, economic and physical challenges. Incorporate resilience strategies into City plans (community plan, capital improvement plan, master plans, etc.). Develop a tool to evaluate how City decisions align with resiliency goals.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	As the historic patterns of natural hazards shift with the impacts of climate change, addressing hazards and their impacts on citizens is increasingly the work of all City departments. Disseminating responsibility for addressing resilience to relevant staff through education and training, and updating guidelines and creating tools, is more cost effective than hiring additional resources to address hazards. Approaching resiliency from a whole-community standpoint in plans helps to reduce counterproductive measures, conflicting projects, and redundancy in operation, thus saving taxpayer funds in the long-term.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 1; Goal 3, Objectives 3.1, 3.3 and 3.4
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	Staff time
Potential Funding Sources:	CIP
Lead Agency/Department Responsible:	City Manager's Office and Community Development Resiliency Officer
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

HAMPTON MITIGATION ACTION 11	
Maintain storm-resistant public beaches.	
BACKGROUND INFORMATION	
Site and Location:	Atlantic Ocean/Chesapeake Bay shoreline
Cost Benefit:	Maintaining the existing beach profile provides flood protection and wave protection to waterfront structures.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Landslide/Coastal Erosion
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.6
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	$7,000,000 as proposed for 2022
Potential Funding Sources:	ARPA
Lead Agency/Department Responsible:	Public Works
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

HAMPTON MITIGATION ACTION 12	
Ensure safe ramp access is provided for rapid extraction of City-owned boats prior to Tropical/Coastal storm.	
BACKGROUND INFORMATION	
Site and Location:	Hampton River and Back River
Cost Benefit:	Emergency Services has invested considerable resources in rescue boats. The ability to extract these boats protects assets from storm damage or loss.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Landslide/Coastal Erosion, Winter Storm
Goal(s) Addressed:	Goal 1, Objectives 1.3, 1.5
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	Undetermined
Potential Funding Sources:	
Lead Agency/Department Responsible:	Public Safety and Community Development
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
As various City departments examined options for redevelopment at the Sunset Boat Ramp in 2021, Emergency Management highlighted the importance of the public ramp for this purpose.	

HAMPTON MITIGATION ACTION 13	
Develop, finalize and implement Disaster Recovery Plan.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	A plan for disaster recovery minimizes the negative impacts of hazard events on City functions, citizens and businesses, and may even identify opportunities for safer redevelopment.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 1, Goal 3
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	Staff time
Potential Funding Sources:	DHS, VDEM
Lead Agency/Department Responsible:	Emergency Management, Community Development
Implementation Schedule:	Ongoing, with plan expected to be finalized in 2022 or 2023.
ADDITIONAL COMMENTS	
Disaster recovery can be short-term or long-term depending on the nature of the event itself. The City is developing a Disaster Recovery Plan to set out expectations for managing multiple hazard events and the related recovery processes, to include setting up a Storm Response Center, assigning roles and responsibilities to the recovery team members, collecting and backing up data, restoring/continuing City and private utility operations, and testing and maintaining critical facilities. Major disasters may also require longer-term recovery plans that address Community Development and resiliency issues to minimize hazardous redevelopment practices.	

HAMPTON MITIGATION ACTION 14	
Develop a plan to collect surveyed high water mark data following flood events.	
BACKGROUND INFORMATION	
Site and Location:	Citywide floodplains
Cost Benefit:	Collection of high water mark data allows better calculation of a storm's frequency, thus improving cost benefit analyses for future mitigation projects.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Landslide/Coastal Erosion
Goal(s) Addressed:	Goal 3, Objective 3.2
Priority (High, Moderate, Low):	Low
Impact on Socially Vulnerable Populations:	High – All 13 repetitive flood loss areas contain areas of very high or relatively high NRI flood risk, which includes analysis of social vulnerability
Estimated Cost:	Staff time, Post-disaster surveys could be used to collect high water mark elevations at approximately $500/structure (for a large number of surveys at once)
Potential Funding Sources:	USACE: FPMS; VDEM: HMGP, HMGP 5% Initiative, USGS
Lead Agency/Department Responsible:	Public Works, Emergency Management
Implementation Schedule:	Set up any necessary post-disaster contracts within 2 years of plan adoption
ADDITIONAL COMMENTS	
Structural inventories with elevations, high water marks, and flood frequency data help prepare accurate cost-benefit analyses for a large number of structures rapidly, which is especially useful in a post-disaster scenario.	

HAMPTON MITIGATION ACTION 15	
Provide business resiliency planning services to the City's business owners, particularly Virginia Department of Minority Business Enterprise (DMBE)-certified SWaM businesses that may have access to fewer resources than larger establishments. Workshops and outreach would identify businesses interested in further planning, with more detailed assistance then provided to assist businesses with details regarding risk and vulnerability assessment, preparedness, continuity of operations planning and adaptation/recovery. Help businesses identify specific mitigation projects and sources of funding to reduce vulnerability and increase resiliency.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Businesses that are prepared for disasters unique to their location are more likely to remain operational or to resume operations quickly post-disaster, thus making the business' services available to residents more quickly. Pre-disaster planning costs reduce post-disaster damages for the business, the customers, and the City.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.4, 1.5; Goal 2, Objectives 2.1, 2.2, 2.3; Goal 3, Objectives 3.1, 3.3, 3.4
Priority (High, Moderate, Low):	Medium
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	To be determined based on business community interest
Potential Funding Sources:	DHS: BRIC, HMGP; Virginia CFPF; EDA DMTA; Commonwealth Center for Recurrent Flooding Resiliency (CCRFR)
Lead Agency/Department Responsible:	Economic Development, CCRFR
Implementation Schedule:	Within 3 years of plan adoption
ADDITIONAL COMMENTS	
The CCRFR has prepared the Coastal Virginia Small Business Self-Assessment and Guide available at: https://www.floodingresiliency.org/coastal-virginia-small-business-resilience-self-assessment-and-guide/ which could be useful for beginning this action.	

HAMPTON MITIGATION ACTION 16	
Implement structural and nature-based flood control projects in flood prone areas, such as tide gates, berms, constructed wetlands, roadway elevations, etc. This action includes projects identified by the *Resilient Hampton* Initiative plans.	
BACKGROUND INFORMATION	
Site and Location:	Flood prone areas Citywide
Cost Benefit:	Multi-objective projects have benefits across the spectrum, including flood protection benefits, and benefits that accrue from natural and beneficial functions of floodplains and wetlands.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, and Tropical/Coastal Storm
Goal(s) Addressed:	Goal 1
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	Cost will be based on specific flood protection measures chosen.
Potential Funding Sources:	DHS: BRIC, HMGP, HMGP 5% Initiative, FMA, RFC; USACE: SFCP, FPMS; HUD: CDBG; USDA: WPFP; Virginia CFPF
Lead Agency/Department Responsible:	Emergency Management, Community Development, Treasurer's Office
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

NEWPORT NEWS

NEWPORT NEWS MITIGATION ACTION 1	
Maintain participation in National Flood Insurance Program. Continue enforcement of standards in existing ordinance that meet and exceed NFIP minimum requirements. Improve floodplain management program and CRS rating.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	The NFIP and related flood mapping and development regulations have proven benefits nationwide. CRS benefits accrue through increased insurance coverage, improved hazard awareness and reduced flood insurance premiums. New construction and future development are protected from floods through existing standards that meet or exceed NFIP minimum requirements.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, and Tropical/Coastal Storm
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	Staff time
Potential Funding Sources:	Existing budgets
Lead Agency/Department Responsible:	Emergency Management/Engineering
Implementation Schedule:	Annually
ADDITIONAL COMMENTS	
The city is currently a class 7 in the CRS program.	

NEWPORT NEWS MITIGATION ACTION 2	
Acquire, elevate, relocate, retrofit or floodproof structures in flood prone areas. Flood protection may include small structural flood control projects, such as tide gates, or backflow preventers. This action includes Mitigation Reconstruction projects.	
BACKGROUND INFORMATION	
Site and Location:	Flood loss areas Citywide
Cost Benefit:	Retrofit measures that address flooded structures, particularly those designated as repetitive loss or severe repetitive loss by the NFIP, have quantifiable benefits. The City's Flood Assistance Program has had measurable benefits using primarily acquisition to mitigate an estimated 2 structures per year since 1999. FEMA will now fund hazard mitigation projects that include sea level rise estimates.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, and Tropical/Coastal Storm
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2 and Goal 3
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High – Salter's Creek and Newmarket Creek repetitive flood loss areas contain areas of very high or relatively high NRI flood risk, which includes analysis of social vulnerability. The other 6 repetitive flood loss areas affect moderate to low risk areas.
Estimated Cost:	Estimated $750,000 per year through various channels and sources
Potential Funding Sources:	CIP; DHS: BRIC, HMGP, HMGP 5% Initiative, FMA, RFC; USACE: SFCP, FPMS; HUD: CDBG; USDA: WPFP; Virginia CFPF. Flood Assistance Program has primarily used City funds.
Lead Agency/Department Responsible:	Engineering
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
80 properties comprising 15.2 acres have been purchased.	

NEWPORT NEWS MITIGATION ACTION 3	
Protect critical facilities and infrastructure, including access/egress. Retrofits may include, but are not limited to: upgrades or relocation of the 911/EOC/311 facilities and wind vulnerability of building, components and equipment; floodproofing or elevating pump stations; retrofitting remaining pump stations with generators or quick-connect hookups.	
BACKGROUND INFORMATION	
Site and Location:	Critical facilities Citywide. Pump stations #2, #53 and #99 have been identified as high priority locations for non-structural mitigation measures.
Cost Benefit:	Benefits of mitigating flood damage to critical facilities are realized by all citizens through the city's ability to maintain the highest operational capabilities post-disaster. Benefits are based on reduced response times, and longevity of critical infrastructure. FEMA will now fund hazard mitigation projects that include sea level rise estimates.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 1, Objectives 1.2, 1.3, 1.4s
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	Cost will be based on specific flood protection measures chosen for each building.
Potential Funding Sources:	DHS: BRIC, HMGP, HMGP 5% Initiative, FMA, RFC; Stafford Act Section 406 - post-disaster mitigation funds under Public Assistance for damaged public facilities
Lead Agency/Department Responsible:	Emergency Management, Facilities Engineering
Implementation Schedule:	Long-term, 3 to 7 years
ADDITIONAL COMMENTS	
Wind retrofits should ensure EOC is protected with winds up to 120mph.	

NEWPORT NEWS MITIGATION ACTION 4	
Construct new access road to Pump Station 49 on Warwick Boulevard.	
BACKGROUND INFORMATION	
Site and Location:	Pump Station 49, Warwick Blvd – new access road from Old Courthouse Way
Cost Benefit:	Existing access drive is below the 100-year flood elevation and has been flooded by the adjacent Stoney Run Creek during significant storm events. This flooding prevents access to the station including the delivery of fuel needed to run the station emergency power generator. Finished floor elevation of the station is above the 100-year flood elevation and it is not considered susceptible to flooding. Under new guidance, FEMA will now fund hazard mitigation projects that include sea level rise estimates.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm
Goal(s) Addressed:	Goal 1, Objectives 1.3, 1.4
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	$300,000, includes acquisition of undeveloped commercial property
Potential Funding Sources:	DHS: HMGP, BRIC; Virginia CFPF
Lead Agency/Department Responsible:	Engineering
Implementation Schedule:	Within 5 to 7 years
ADDITIONAL COMMENTS	
Other alternatives considered but rejected include: 1) raise existing service road (would require undesirable impacts to Stoney Run); and 2) new access road from Warwick Blvd (steep grade issues would limit access).	

NEWPORT NEWS MITIGATION ACTION 5	
Drainage improvements on Chelsea Place, to include increased flow through the drainage outfall from the apartments and diversion of some of the flow from Edgemoor Drive to a new outfall.	
BACKGROUND INFORMATION	
Site and Location:	Chelsea Place Apartments, Warwick Blvd
Cost Benefit:	Existing drainage system drains to a channel along the CSX right-of-way, then through a small culvert to a drainage channel along Warwick Blvd. The culvert under the railroad is undersized and causes flooding in the parking lot of the apartments. The flooding enters at least 15 ground floor apartments rendering them unrentable and has resulted in the loss of multiple vehicles.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm
Goal(s) Addressed:	Goal 1, Objectives 1,1, 1,2, 1.3, 1.4, 1.5
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	$750,000
Potential Funding Sources:	Stormwater Management Fund
Lead Agency/Department Responsible:	Engineering
Implementation Schedule:	Construction estimated to begin late 2022
ADDITIONAL COMMENTS	
Project delayed by CSX close to agreement for crossing. Design is being updated.	

NEWPORT NEWS MITIGATION ACTION 6	
Provide various watershed and flood warning improvements to reduce danger to lives and property from flooding along Newmarket Creek. This action may include Mitigation Reconstruction projects.	
BACKGROUND INFORMATION	
Site and Location:	Newmarket Creek watershed
Cost Benefit:	Several alternatives considered. Combination of computer modeling improvements, early warning/detection systems and drainage improvements considered most beneficial for multi-objective management of the watershed. Benefits include: 1) upgrades to current watershed models to pinpoint drainage improvements; 2) detection systems to alert City officials to pre-determined water levels in drainage system to initiate procedures for warning/evacuating residents; 3) drainage improvements (quality and quantity controls) to improve lifespan of the system, reduce nuisance flooding, and provide credit for pollutant reduction; 4) measures may provide sufficient flood mitigation/protection to result in removal of repetitive flood loss properties from the City's inventory and may provide points under CRS.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.4, 1.5; Goal 3, Objectives 3.3, 3.4
Impact on Socially Vulnerable Populations:	High – Newmarket Creek repetitive flood loss area contains areas of relatively high NRI flood risk, which includes analysis of social vulnerability.
Priority (High, Moderate, Low):	High
Estimated Cost:	Computer model upgrade = $152,000 Projects pending watershed model & analysis in 2023 Early Warning/Detection systems = $200,000 Drainage Improvements – pipe installations= $7,350,000 Drainage Improvements – channel upgrades = $3,725,000 Drainage Improvements – BMP installations = $6,683,000
Potential Funding Sources:	DHS: FMA, HMGP, HMGP 5% Initiative
Lead Agency/Department Responsible:	
Implementation Schedule:	5 to 10 years; sensors have been installed
ADDITIONAL COMMENTS	
Other alternatives considered include: raise elevation of all houses within 100-year floodplain; purchase properties and relocate residents in 100-year floodplain; build structures (levees, floodwalls, gates/pumps) to protect properties; provide detection systems within watershed to alert to high water levels within major drainage channels; modify current City programs to streamline application process for homeowners; assist in redeveloping areas of the watershed (commercial/businesses, recreational areas, and residential neighborhoods).	

NEWPORT NEWS MITIGATION ACTION 7	
Improve drainage system maintenance, including increased sediment and debris clearance.	
BACKGROUND INFORMATION	
Site and Location:	Drainageways citywide.
Cost Benefit:	The City's network of structures, channels and underground pipes that carry stormwater help reduce flooding, especially during high frequency events. Maintenance is required to keep the system functioning effectively.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Landslide/Coastal Erosion
Goal(s) Addressed:	Goal 1, Objectives 1.3, 1.4
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	$2,275,500
Potential Funding Sources:	Stormwater User Fee, Capital Improvement Program
Lead Agency/Department Responsible:	Public Works
Implementation Schedule:	Ongoing as part of 5-year CIP updated annually. New projects continually identified.
ADDITIONAL COMMENTS	

NEWPORT NEWS MITIGATION ACTION 8	
Continue Forest Management Program to mitigate wildfire hazards and promote forest health.	
BACKGROUND INFORMATION	
Site and Location:	Program is primarily focused on Waterworks land holdings near the utility's reservoirs.
Cost Benefit:	This ongoing program reduces the number of fires, and works to control pine beetle infestations. Forest thinning is a primary control mechanism. This is one of many programs the utility implements related to hazard mitigation.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Wildfire, Drought
Goal(s) Addressed:	Goal 1
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	Net cost is low because costs are offset by selling the timber
Potential Funding Sources:	Waterworks Enterprise Fund
Lead Agency/Department Responsible:	Newport News Waterworks
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

NEWPORT NEWS MITIGATION ACTION 9	
Prepare public outreach materials. Educate elected officials and residents on the importance of the NFIP and the City's floodplain management efforts, maintaining flood insurance coverage, and methods for mitigating flood damage. City's comprehensive master floodplain management planning will include developing educational, outreach and more accessible materials and tools.	
BACKGROUND INFORMATION	
Site and Location:	Flood-prone areas Citywide
Cost Benefit:	Making sure homeowners have flood insurance coverage has been shown to reduce response needs and help Newport News' citizens return to normalcy more quickly after flooding.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Landslide/Coastal Erosion
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.5; Goal 2, Objective 2.1
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High – Salter's Creek and Newmarket Creek repetitive flood loss areas contain areas of very high or relatively high NRI flood risk, which includes analysis of social vulnerability. The other 6 repetitive flood loss areas affect moderate to low risk areas.
Estimated Cost:	<$5,000 per year
Potential Funding Sources:	Existing budgets; DHS: HMGP 5% Initiative
Lead Agency/Department Responsible:	Emergency Management
Implementation Schedule:	Continuous
ADDITIONAL COMMENTS	
While this action is ongoing, it is important to retain in the hazard mitigation plan to ensure continued funding is secured annually.	

NEWPORT NEWS MITIGATION ACTION 10	
Rehabilitation and improvement of Harwood's Mill Dam which impounds Harwood's Mill Reservoir to provide water for Harwood's Mill Water Treatment Plant. The planned improvement project consists of the demolition of the existing outlet works and principal spillway chute and construction of a new principal spillway floor slab, training walls, intake structure and flume, access bridge, concrete crest wall and the rehabilitation of the existing spillway weir.	
BACKGROUND INFORMATION	
Site and Location:	Yorktown, Virginia – Route 17
Cost Benefit:	Repairs are needed to bring project into compliant with State regulations. Project avoids damages which could result from a compromised spillway.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding Due to Impoundment Failure/High Hazard Dam
Goal(s) Addressed:	Goal 1: Objectives 1.2, 1.3, 1.5
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate/High – Downstream of the dam are areas of relatively moderate to relatively high NRI flood risk, which includes analysis of social vulnerability.
Estimated Cost:	$12,800,000
Potential Funding Sources:	CIP
Lead Agency/Department Responsible:	Facilities Engineering
Implementation Schedule:	February 2022 – December 2023
ADDITIONAL COMMENTS	

NEWPORT NEWS MITIGATION ACTION 11	
Stormwater Master Planning: the City will develop three separate, yet inter-dependent master plans for citywide stormwater management, floodplain management, and resilience & climate change management.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	The City's current Stormwater and Floodplain management plans are out of date and no longer viable for addressing current or future flooding problems. Last year the state issued new requirements for addressing climate change.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm
Goal(s) Addressed:	Goal 1; Goal 2
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	$5,500,000
Potential Funding Sources:	Capital Improvement Plan, CFPF
Lead Agency/Department Responsible:	Engineering
Implementation Schedule:	Planning to begin 2022 and will last 3 years
ADDITIONAL COMMENTS	
Newport News does not have a comprehensive City specific plan for addressing climate change and resilience. The combined master planning will include an assessment of the existing state of several components of the City’s stormwater management; public engagement; general inventory, documentation, and evaluation of infrastructure; analysis of ordinances and design manuals; greenway corridor planning and conceptual plan development with capital planning, cost estimating, and financial planning. Planning will also provide data on where structures lie in the City with regard to future flooding and sea level rise so that regulations governing future development can based on more detailed vulnerability.	

NEWPORT NEWS MITIGATION ACTION 12	
Improve the Lions Bridge Dam which impounds Mariners' Lake to bring the dam into compliance with current state dam safety standards.	
BACKGROUND INFORMATION	
Site and Location:	100 Museum Drive
Cost Benefit:	The current Lions Bridge Dam was built in 1937 before dam safety regulations. The current dam is considered a significant hazard dam because greater than 400 vehicles per day travel on the roadway across the dam. The dam will be armored to safely withstand overtopping during the half probable maximum flood.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm
Goal(s) Addressed:	Goal 1, Objectives 1.2, 1.3, 1.5, 1.6
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	$11,000,000
Potential Funding Sources:	Capital Improvement Plan, Lake Maury Fund
Lead Agency/Department Responsible:	Engineering
Implementation Schedule:	Design will be completed Spring 2022, construction will begin late 2022
ADDITIONAL COMMENTS	

NEWPORT NEWS MITIGATION ACTION 13	
Nicewood Area Drainage Improvements. Evaluation of existing storm system and implementation of recommended improvements to address flooding.	
BACKGROUND INFORMATION	
Site and Location:	Area around the intersection of Malden Lane and Maryle Court to Nicewood Park in the Runnymeade Subdivision
Cost Benefit:	Citizens within the area of the intersection of Malden Lane and Maryle Court and the outfalling storm system to Nicewood Park experience frequent flooding during significant rain events. The existing storm drainage system is inadequate. The project will reduce the risk of flooding and damages to approximately 70 homes and approximately 2200 linear feet of roadway.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise, Tropical/Coastal Storm
Goal(s) Addressed:	Goal 1
Priority (High, Moderate, Low):	Low
Impact on Socially Vulnerable Populations:	Low – the area has very low NRI flood risk, which includes analysis of social vulnerability.
Estimated Cost:	$2,100,000
Potential Funding Sources:	Stormwater user Fee, Capital Improvement Program
Lead Agency/Department Responsible:	Engineering
Implementation Schedule:	Design will begin 2022
ADDITIONAL COMMENTS	
The project includes funding for a detailed model of the storm system to determine what improvements are required, along with funds for the design and construction of a new system once improvements are identified.	

NEWPORT NEWS MITIGATION ACTION 14	
Marshall Ridley. Redevelopment of a large area of outdated apartments with no existing stormwater management system in place. The new development will include multiple BMPs and a regional stormwater management facility.	
BACKGROUND INFORMATION	
Site and Location:	Between Jefferson Avenue and Ivy Avenue, between 12th Street and 18th Street
Cost Benefit:	The area currently does not have any stormwater management, so all stormwater outfalls directly into Seafood Industrial Park Small Boat Harbor without detention or water quality treatment. The new development will provide treatment and serve as a regional BMP for approximately 30 acres. Provide improved drainage on public right-of-way to alleviate nuisance flooding; upgrade to City's drainage system for another 50 years, reduce maintenance costs for repairs, and provide a new storm system that meets current design standards.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm
Goal(s) Addressed:	Goal 1
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High – the area has very high or relatively high NRI flood risk, which includes analysis of social vulnerability.
Estimated Cost:	$6,000,000
Potential Funding Sources:	Stormwater user Fee, Capital Improvement Program
Lead Agency/Department Responsible:	Engineering
Implementation Schedule:	Design 2021, Construction 2022
ADDITIONAL COMMENTS	

NEWPORT NEWS MITIGATION ACTION 15	
Governors Drive Stream Restoration & BMP, including restoration of Flaxmill Creek to alleviate erosion and protect a major HRSD force main.	
BACKGROUND INFORMATION	
Site and Location:	Flaxmill Creek between Governors Drive and Riverview Farm Park.
Cost Benefit:	The existing drainage channel at the rear of residential properties is experiencing erosion and has deteriorated to a point where it is unstable.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm; Landslide/Coastal Erosion
Goal(s) Addressed:	Goal 1
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	$2,000,000
Potential Funding Sources:	Stormwater Fees, Capital Improvement Plan, & State Local Assistance Fund (SLAF)
Lead Agency/Department Responsible:	Engineering
Implementation Schedule:	Design 2022, Construction 2024
ADDITIONAL COMMENTS	
The project will include providing a stable and constant cross-section with applicable natural and stone armaments for conducting stormwater runoff from a 10-year storm event. This channel conducts stormwater runoff from several public right-of-ways such as Lucas Creek Rd, Menchville Rd, and roads within Denbigh Plantation.	

NEWPORT NEWS MITIGATION ACTION 16	
Analyze and improve drainage/stormwater system along Stoney Run.	
BACKGROUND INFORMATION	
Site and Location:	Northern portion of the Stoney Run Watershed
Cost Benefit:	Several neighborhoods (Colony Pines, Windsor Great Park, and surrounding areas), totaling approximately 900 acres, within the northern portion of the Stoney Run watershed experience repeated issues frequent flooding during high intensity storm events. Most of the storm system was designed and constructed under a 5-year design storm requirement, and current regulations require storm systems be designed to handle a 10-year storm event. A detailed analysis will determine potential modifications and additions to the stormwater system, including the stormwater management facilities. Funding is included to design and implement identified modifications and additions necessary to improve the drainage system and maintain the efficient conveyance of runoff while meeting regulatory requirements for water quantity and quality.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise, Tropical/Coastal Storm
Goal(s) Addressed:	Goal 1
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	$8,500,000
Potential Funding Sources:	Stormwater Fees, Capital Improvement Plan, SLAF, CFPF
Lead Agency/Department Responsible:	Engineering
Implementation Schedule:	Computer Model Analysis 2021, Construction within 5 – 10 years
ADDITIONAL COMMENTS	

NEWPORT NEWS MITIGATION ACTION 17	
Salters Creek Analysis and Drainage Improvements. Develop computer model analysis and implement identified drainage projects. Reduce flooding throughout the Salters Creek watershed by improving the capacity of the existing drainage system, providing additional storage, and ensuring compliance with stormwater regulations.	
BACKGROUND INFORMATION	
Site and Location:	Salters Creek Watershed
Cost Benefit:	The Salters Creek watershed in the Southeast Community is approximately 1,236 acres and is extremely low-lying. As a result, the surrounding area experiences issues with drainage and frequent flooding from storms and high tides. A detailed computer model analysis will be performed to determine potential modifications and additions to the stormwater system. Funding is also included for the design and construction of identified improvements. The project will result in implementing improvements necessary to maintain the efficient conveyance of runoff during storm and high tidal events.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise, Tropical/Coastal Storm
Goal(s) Addressed:	Goal 1
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	High – Salter's Creek repetitive flood loss area contains areas of very high or relatively high flood risk, which includes analysis of social vulnerability.
Estimated Cost:	$7,200,000
Potential Funding Sources:	Stormwater Fees, Capital Improvement Plan, SLAF, CFPF
Lead Agency/Department Responsible:	Engineering
Implementation Schedule:	Design 2021, Construction 3-7 years
ADDITIONAL COMMENTS	

NEWPORT NEWS MITIGATION ACTION 18	
James River Shoreline Stabilization. Stabilize 720 linear feet of shoreline on the James River to address severe erosion and failure of the steep slope along River Rd, and protect existing utilities and the road.	
BACKGROUND INFORMATION	
Site and Location:	James River along River Rd from 9304 to 9508 River Road
Cost Benefit:	The project provides restoration and stabilization of 720 feet of shoreline adjacent to River Road to reduce erosion of the existing embankments, prevent loss of shoreline, and protect the City's roadway and underground utilities. The improvements will be a combination of stone riprap sills and a vegetative slope along with a living shoreline.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Landslide/Coastal Erosion, Flooding, Sea Level Rise, Tropical/Coastal Storm
Goal(s) Addressed:	Goal 1
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	$3,400,000
Potential Funding Sources:	CAP funding, Stormwater Fees, CIP
Lead Agency/Department Responsible:	Engineering
Implementation Schedule:	Design 2022
ADDITIONAL COMMENTS	

NEWPORT NEWS MITIGATION ACTION 19	
Christopher Shores Drainage Improvements. Address repeated flooding in the Christopher Shores subdivision by installing larger storm pipes and additional pipes and inlets to alleviate flooding during tidal events.	
BACKGROUND INFORMATION	
Site and Location:	Christopher Shores subdivision
Cost Benefit:	The project consists of construction of a new storm drain system and outfalls to replace an existing system that is outdated and does not conform to present City standards. This project will alleviate ongoing flooding issues caused by rainfall events, storm surges, and tidal action of Hampton Roads within the existing closed drainage systems in approximately 66 acres of the Christopher Shores area of the Southeast Community. Street flooding is an issue for residents especially when it hampers their ability to evacuate the area when major storm events are predicted.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise, Tropical/Coastal Storm
Goal(s) Addressed:	Goal 1
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	$5,600,000
Potential Funding Sources:	Stormwater Fees, CIP
Lead Agency/Department Responsible:	Engineering
Implementation Schedule:	Construction 2022
ADDITIONAL COMMENTS	

NEWPORT NEWS MITIGATION ACTION 20		
Deep Creek Shoreline Stabilization. Stabilize the shoreline at Menchville Marina on Deep Creek.		
BACKGROUND INFORMATION		
Site and Location:	Menchville Marina, 494 South Menchville Road	
Cost Benefit:	Restore and stabilize approximately 300 LF of shoreline along Deep Creek at the Menchville Marina. Existing conditions include old wooden posts and nuisance vegetation, as well as erosion problems.	
MITIGATION ACTION DETAILS		
Hazard(s) Addressed:		Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Landslide/Coastal Erosion
Goal(s) Addressed:		Goal 1
Priority (High, Moderate, Low):		Low
Impact on Socially Vulnerable Populations:		Low – the area has low NRI Coastal Flood Risk
Estimated Cost:		$600,000
Potential Funding Sources:		Stormwater Fees, CIP
Lead Agency/Department Responsible:		Engineering
Implementation Schedule:		Construction 2022
ADDITIONAL COMMENTS		

POQUOSON

POQUOSON MITIGATION ACTION 1	
Continue participating in the National Flood Insurance Program and the Community Rating System, with a goal of becoming a Class 7 community. Continue enforcement of standards in existing floodplain management ordinance that meet and exceed NFIP minimum requirements. Encourage additional staff to become Certified Floodplain Managers. **Study feasibility of implementing additional floodplain management ordinance changes, including:** **1. Changes to the definition of "substantial improvement" that would require accumulation of costs of improvements and repairs of buildings, based on issued building permits, over a set time period; and,** **2. Coastal A Zone regulations that apply coastal high hazard area requirements in areas delineated by FEMA as subject to wave heights between 3 feet and 1.5 feet high.**	
BACKGROUND INFORMATION	
Site and Location:	Special Flood Hazard Areas of Poquoson
Cost Benefit:	Additional measures to manage floodplains can further reduce flood response needs in the long-term, and reduce flood insurance premiums through CRS rating changes in the near-term. The NFIP and related flood mapping and development regulations have proven benefits nationwide.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.5
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate/High – the area has relatively moderate or relatively high NRI flood risk, which includes analysis of social vulnerability.
Estimated Cost:	Travel costs and staff time
Potential Funding Sources:	Existing budgets; HMGP 5% Initiative
Lead Agency/Department Responsible:	Building Inspections
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

POQUOSON MITIGATION ACTION 2	
Elevate, relocate, acquire, retrofit or floodproof structures in hurricane prone areas. Flood protection may include minor localized flood reduction projects, as well. Wind retrofit measures are also included and may be appropriate for some structures, especially publicly-owned structures. This action includes Mitigation Reconstruction projects.	
BACKGROUND INFORMATION	
Site and Location:	Flood-prone areas Citywide, and Citywide for wind retrofits
Cost Benefit:	Retrofit measures that address flood- and wind-prone structures, particularly those designated as repetitive loss or severe repetitive loss by the NFIP, have quantifiable benefits by reducing future damages to the structures. FEMA will now fund hazard mitigation projects that include sea level rise estimates.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2; Goal 3
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate/High – the area has relatively moderate or relatively high NRI flood risk, which includes analysis of social vulnerability.
Estimated Cost:	In multiple $250,000 phases as grant money becomes available. Individual structure costs vary.
Potential Funding Sources:	DHS: BRIC, HMGP, FMA, RFC; USDA; Virginia CFPF
Lead Agency/Department Responsible:	Emergency Management and Building Inspections
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

POQUOSON MITIGATION ACTION 3	
Implement the Shoreline Management Plan developed by Virginia Institute of Marine Science, as conditions warrant.	
BACKGROUND INFORMATION	
Site and Location:	Shorelines Citywide
Cost Benefit:	Implementation is not costly and could be absorbed by existing department budgets. Materials to share with property owners and training for staff (and interested property owners) are available from VIMS at very low cost. Adding links from the City web page to the VIMS toolbox is low cost but would provide valuable information to property owners.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Sea Level Rise and Land Subsidence, Landslide/Coastal Erosion
Goal(s) Addressed:	Goal 1, Objectives 1.3, 1.6; Goal 2, Objective 2.1; Goal 3, Objectives 3.1, 3.3, 3.4
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate/High – the area has relatively moderate or relatively high NRI flood risk, which includes analysis of social vulnerability.
Estimated Cost:	Staff time only
Potential Funding Sources:	Existing budgets; DHS: HMGP 5% Initiative
Lead Agency/Department Responsible:	Planning Department, Permitting, and Engineering
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
Currently, Virginia's Shoreline Erosion Advisory Service is not funded. Property owners need guidance on best management shoreline protection methods from reliable sources and not necessarily just from shoreline repair contractors. The *Poquoson Comprehensive Plan 2008-2028*, Environmental Management Element, Shoreline Sub-Element, states as its second goal, "Develop a shoreline management plan to ensure property shoreline protection and create a framework for incentive[s] based on programs to encourage less intrusive means of shoreline protection." While permitting incentives were considered that might encourage living shorelines, City staff determined that permit fees and review times are already as low as possible.	

POQUOSON MITIGATION ACTION 4	
Continue to increase flood and wind protection and flood access/egress for critical facilities and infrastructure. Elevate new critical facilities, retrofit existing facilities as necessary, and elevate roads to provide access to elevated critical facilities. Retrofits may include but are not limited to: installation of emergency backup power, elevation of structure or components, relocation or retrofit of building components, and installation of tidal/flap valves on drainage structures. Coordinate with public utilities to protect or retrofit transformers, critical infrastructure and overhead power lines.	
BACKGROUND INFORMATION	
Site and Location:	Critical facilities Citywide.
Cost Benefit:	Benefits of mitigating flood damage to critical facilities are realized by all citizens through the city's ability to maintain the highest operational capabilities post-disaster. Flooding of roads prevents access to elevated critical facilities. Benefits are based on reduced response times, and longevity of critical infrastructure. Elevation of roads could reduce evacuation times once flooding begins, and protect roadbeds from erosion associated with sea level rise in the future.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.4, 1.5
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate/High – the area has relatively moderate or relatively high NRI flood risk, which includes analysis of social vulnerability.
Estimated Cost:	Cost will be based on measures chosen for each building
Potential Funding Sources:	DHS: BRIC, HMGP, HMGP 5% Initiative, FMA, RFC; Stafford Act Section 406 - post-disaster mitigation funds under Public Assistance for damaged public facilities; Virginia CFPF
Lead Agency/Department Responsible:	Public Works/Engineering, Fire Department, Police Department, Public Utilities
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
Some vital infrastructure such as storm sewer and sanitary sewer are subject to flooding, and possibly vulnerable to sea level rise in the future.	

POQUOSON MITIGATION ACTION 5	
Collect and share hazard-related data in GIS-compatible format, including but not limited to: **1) add tide gauges for flood prediction and collect high water marks and calculate flood frequency for all coastal storms;** **2) continue to collect Elevation Certificates for each structure in the 100-year floodplain and post online for property owner use;** **3) use sidescan LIDAR to collect additional data regarding structure elevations Citywide;** **4) incorporate new software for the assessor's database that includes flood elevation data;** **5) use drone-produced real-time storm surge/tidal conditions mapping developed in conjunction with NASA and ODU; and,** **6) inventory and prioritize low-lying secondary roads and intersections critical to evacuation.**	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Collection of elevation information and retention of Elevation Certificates can reduce surveying costs for property owners and buyers in the future. The partnership with NASA for real-time mapping has been a very successful and low-cost venture.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Sea Level Rise and Land Subsidence, Landslide/Coastal Erosion, Winter Storm, Hazardous Materials Incident
Goal(s) Addressed:	Goal 3, Objectives 3.2, 3.3, 3.4
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate/High – the area has relatively moderate or relatively high NRI flood risk, which includes analysis of social vulnerability.
Estimated Cost:	Staff time Post-disaster surveys could be used to collect structure elevations at approximately $300/structure (for a large number of structures at once)
Potential Funding Sources:	NASA and ODU; HRPDC, USACE: FPMS; DHS: HMGP, HMGP 5% Initiative; USGS; Virginia CFPF
Lead Agency/Department Responsible:	Engineering, Building Inspections, Emergency Management
Implementation Schedule:	Ongoing

ADDITIONAL COMMENTS
The City Building Inspector continues to compile and digitize a collection of Elevation Certificates for existing structures, elevated/mitigated structures and new structures, and he maintains pertinent data from the forms in a digital format. City has collected high water marks after recent floods and anticipates doing so again in the future. City notifies residents on low-lowing roads of evacuation needs early via CodeRed, posts digital signage and advises them to move personal property early in the evacuation process.

POQUOSON MITIGATION ACTION 6	
Review and update Pre-Disaster Debris Management Plan.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Pre-disaster debris management reduces damage to structures and infrastructure from flood and wind. Also, regular clean-up requirements can reduce the costs of post-disaster debris clean-up. City could also have access to the additional 5-percent cost incentive from FEMA's Public Assistance money.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Tornado, Winter Storm
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.4, 1.5, 1.6; Goal 2, Objective 2.1
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	Staff time
Potential Funding Sources:	Existing capital budgets; HMGP, BRIC or FMA (with very clearly articulated benefits for flood damage reduction); Virginia CFPF
Lead Agency/Department Responsible:	Public Works, Solid Waste
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
City recently purchased two new tractors for pre-event debris clearance.	

POQUOSON MITIGATION ACTION 7	
Coordinate with public utilities, and use City resources to trim trees in the public right-of-way.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Benefits include reduced debris clean-up costs and increased utility service reliability.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Tropical/Coastal Storm, Tornadoes, Winter Storm
Goal(s) Addressed:	Goal 1, Objectives 1.3, 1.5
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	$100,000, including contributions from utility providers
Potential Funding Sources:	Existing capital budgets, HMGP. In some cases, utilities may be eligible for some FEMA grant monies, as well.
Lead Agency/Department Responsible:	Public Works, utility providers; City has agreement with York County for keeping roadways clear to accommodate evacuations
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

POQUOSON MITIGATION ACTION 8			
Eliminate barriers to the orderly evacuation of citizens: **1) Elevate and widen the causeway to Hampton (Wythe Creek Road);** **2) Widen Victory Boulevard;** **3) Continue car evacuation agreement with Langley Motor Speedway to allow citizens to park cars there prior to expected flooding; and,** **4) Address low-lying roadways/intersections identified in Mitigation Action #5, including use of temporary flood barriers for critical resident evacuation routes and first responder access/egress.**			
BACKGROUND INFORMATION			
Site and Location:	Wythe Creek Road and Victory Boulevard		
Cost Benefit:	These two roadways are considered critical infrastructure for the evacuation and protection of citizens in Poquoson. Wythe Creek Road floods regularly at high tide, cutting off the route and requiring all citizens to evacuate via Victory Boulevard. Providing a no-cost alternative for parking vehicles out of harm's way encourages people to consider the advantages and consequences of evacuating cars and people.		
MITIGATION ACTION DETAILS			
Hazard(s) Addressed:		Flooding, Tropical/Coastal Storm, Sea Level Rise and Land Subsidence, Wildfire, Hazardous Materials Incident	
Goal(s) Addressed:		Goal 1, Objective 1.5; Goal 3, Objectives 3.1, 3.3, 3.4	
Priority (High, Moderate, Low):		High	
Impact on Socially Vulnerable Populations:		Moderate/High – the area has relatively moderate or relatively high NRI flood risk, which includes analysis of social vulnerability.	
Estimated Cost to Poquoson:		Wythe Creek Road - $19.8 million Victory Boulevard - $22.7 million	
Potential Funding Sources:		VDOT, Hampton, York County and other partners; Virginia CFPF	
Lead Agency/Department Responsible:		Engineering and City Manager's Office	
Implementation Schedule:		Wythe Creek Road is scheduled for construction in 2022; Victory Boulevard widening is in the planning stages.	
ADDITIONAL COMMENTS			
The City also has emergency access roads which are normally closed but which can be linked together in case of evacuation or emergency.			

POQUOSON MITIGATION ACTION 9	
Support and maintain decal system for re-entry to the City following a disaster. Use social networking to strengthen the system.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Benefits accrue to: 1. property owners through reduced secondary damage (*e.g.,* from car wakes on flooded streets); and, 2. Police operating budgets through reduced traffic management costs, better response times and more efficient use of staff following a disaster.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Tornadoes, Earthquake
Goal(s) Addressed:	Goal 1, Objectives 1.4, 1.5; Goal 2; Goal 3, Objective 3.1
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	$2,500 annually
Potential Funding Sources:	Capital budget; DHS: HMGP 5% Initiative
Lead Agency/Department Responsible:	City Manager's Office; Emergency Management
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
Gawkers and sightseers from outside Poquoson are not cognizant of the added damage and inconvenience their visits can inflict. A low-cost decal system was put in place in 2010, and together with police presence at key entry points to the City, officials can now control re-entry.	

POQUOSON MITIGATION ACTION 10	
Support and maintain Code Red, the City's Reverse 911 system. Prepare messages to release to citizens before and after a natural hazard event.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Other methods of notifying citizens require massive amounts of staff time which exceed budgetary restraints. Code Red quickly and efficiently uses existing infrastructure to notify property owners of appropriate pre- and post-disaster mitigation actions.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Tornado, Winter Storm, Earthquake, Wildfire, Hazardous Materials Incident, Drought, Extreme Heat, Pandemic Flu or Communicable Disease
Goal(s) Addressed:	Goal 1, Objectives 1.4, 1.5; Goal 2
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	$10,000 to $15,000
Potential Funding Sources:	Existing budgets; DHS: HMGP 5% Initiative
Lead Agency/Department Responsible:	Emergency Management
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
While the Code Red system is already functioning, an opportunity to use the system to urge property owners to take mitigative actions exists. Identification of persons with disabilities has been built into the dispatch notifications.	

POQUOSON MITIGATION ACTION 11	
Protect flood-prone natural resources as a buffer against sea level rise, including, but not limited to: **1) Protect in perpetuity the 69 acres of natural land at the end of Poquoson Avenue donated to the City;** **2) Provide additional access points for the City's Blueway system, a series of canoe and kayak water trails in and around the City and Plum Tree Island; and,** **3) Provide opportunities for retail and residential development on land that is less prone to flooding and sea level rise, such as the Big Woods area.**	
BACKGROUND INFORMATION	
Site and Location:	Eastern portion of the City, especially undeveloped portions along the water.
Cost Benefit:	Just as damages from sea level rise are not easily quantifiable, the benefits of adjusting to sea level rise are also more abstract. These measures are relatively low in cost compared to the damages that flooding will continue to inflict in Poquoson if no adjustments are made.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Sea Level Rise and Land Subsidence, Flooding, Tropical/Coastal Storm, Landslide/Coastal Erosion
Goal(s) Addressed:	Goal 1, Objectives 1.2, 1.6
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate/High – the area has relatively moderate or relatively high NRI flood risk, which includes analysis of social vulnerability.
Estimated Cost:	1) Existing budgets for legal and real estate costs. 2) Access points on the Blueway may incur costs to the city as additional sites are identified. Costs would be dependent on site amenities. 3) Staff time
Potential Funding Sources:	Existing budgets; DCR: VRTF, L&WCF, VCWRLF; Virginia CFPF
Lead Agency/Department Responsible:	Parks, City Manager's Office, Planning
Implementation Schedule:	Ongoing

ADDITIONAL COMMENTS
A long-term plan of gradual adjustment begins with small steps. This action highlights the opportunity to identify additional ways to protect flood-prone areas with multiple benefits for citizens in the long- and short-term. While zoning regulations may protect land in the short-term, zoning can be altered by future officials. CRS points may be available for sub-action #1, especially for the recently protected 6 acres set aside for parks.

POQUOSON MITIGATION ACTION 12	
Continue to participate in coalition with Virginia Tech and others using drones for storm/event damage assessment and wildland fire management.	
BACKGROUND INFORMATION	
Site and Location:	Eastern portion of the City, primarily
Cost Benefit:	This low-cost method of assessing damage after a storm or to assess wildfire potential in undeveloped areas has benefits for the reduction of spreading wildfire risk and the management of post-flood redevelopment.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Sea Level Rise and Land Subsidence, Flooding, Tropical/Coastal Storm, Wildfire, Tornado, Landslide/Coastal Erosion
Goal(s) Addressed:	Goal 3, Objectives 3.1, 3.2, 3.3, 3.4
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	Staff time
Potential Funding Sources:	Existing budgets; DCR: VRTF, L&WCF, VCWRLF; DHS: HMGP 5% Initiative
Lead Agency/Department Responsible:	City Manager's Office
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
The City has drones and trained drone operators available to implement this action.	

WILLIAMSBURG

WILLIAMSBURG MITIGATION ACTION 1	
Maintain and improve drainage system maintenance, including increased sediment and debris clearance. Purchase additional equipment for pre-storm debris clearance. Explore turf options for parking lots, streetscapes and underground retention where feasible, particularly in Colonial Williamsburg.	
BACKGROUND INFORMATION	
Site and Location:	Drainageways citywide.
Cost Benefit:	The City's network of structures, channels and underground pipes that carry stormwater help reduce flooding, especially during high frequency events. Maintenance is required to keep the system functioning effectively.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Landslide/Coastal Erosion
Goal(s) Addressed:	Goal 1, Objective 1.3, 1.4, 1.5
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	$40,000
Potential Funding Sources:	Existing Budget and CIP
Lead Agency/Department Responsible:	Public Works, Colonial Williamsburg, College of William & Mary
Implementation Schedule:	This is a continuous activity of the City's Public Works Department.
ADDITIONAL COMMENTS	
Smoke testing on sewer system is part of the action. Cross training on stormwater management problem detection with other departments is critical for maintenance in Williamsburg and will continue.	

WILLIAMSBURG MITIGATION ACTION 2	
Continue participating in the National Flood Insurance Program. Review and update floodplain management ordinance to include current resilience standards. Continue enforcement of standards in existing floodplain management ordinance that meet and exceed NFIP minimum requirements.	
BACKGROUND INFORMATION	
Site and Location:	Special Flood Hazard Areas of Williamsburg
Cost Benefit:	The NFIP and related flood mapping and development regulations have proven benefits nationwide.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.6
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	Staff time
Potential Funding Sources:	Existing budgets
Lead Agency/Department Responsible:	Designated Floodplain Manager
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

WILLIAMSBURG MITIGATION ACTION 3	
Maintain StormReady designation through the National Weather Service.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	StormReady helps arm communities with the communication and safety skills needed to save lives and property--before, during and after the event. StormReady helps community leaders and emergency managers strengthen local safety programs.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Tornado, Winter Storm, Extreme Heat
Goal(s) Addressed:	Goal 1, Goal 2, Goal 3
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	<$2,000 annually
Potential Funding Sources:	Local funds
Lead Agency/Department Responsible:	Fire Department
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

WILLIAMSBURG MITIGATION ACTION 4	
Continue Colonial Williamsburg Tree Maintenance Program. Expand in-house crew.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Seasonal inspections and trimming reduce storm damage from trees, particularly in the historic area, and increase guest safety.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Winter Storm, Tornado, Tropical/Coastal Storm, Wildfire, Landslide/Coastal Erosion
Goal(s) Addressed:	Goal 1, Objectives 1.3, 1.4, 1.5, 1.6
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	<$5,000 annually
Potential Funding Sources:	Private – CWF
Lead Agency/Department Responsible:	CWF Landscape crew with City assistance; College of William & Mary
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
This action will be coordinated with the Fire Department to make sure fire equipment access is maintained, as well. Choice of species and wind resistance is especially important when selecting trees for the colonial area and the College of William & Mary. Goals of this program include guest safety, building preservation, scouting with 24-hour phone line, and overall tree risk assessment. Pre-storm checklists and procedures begin each hurricane season and are increased one week prior to potential storm landfall. The Colonial Williamsburg Arboretum is a Level 2 Certified Arboretum comprised of 18th-century tree and woody shrub varieties. The collection features 25 period species of oak trees and more than 30 historic gardens. The Arboretum is home to 20 Virginia state champion trees and two national champion trees.	

WILLIAMSBURG MITIGATION ACTION 5		
Continue shelter generator maintenance and monitoring program. Assess need for and uses of additional shelter at William & Mary Tennis Center.		
BACKGROUND INFORMATION		
Site and Location:	Shelters citywide	
Cost Benefit:	The maintenance and daily monitoring of shelter generators helps ensure that these facilities operate at full capacity when needed.	
MITIGATION ACTION DETAILS		
Hazard(s) Addressed:		Flooding, Flooding Due to Impoundment Failure/High Hazard Dam, Tropical/Coastal Storm, Tornado, Winter Storm, Earthquake, Wildfire, Extreme Heat, Hazardous Materials Incident
Goal(s) Addressed:		Goal 1, Objective 1.3
Priority (High, Moderate, Low):		Moderate
Impact on Socially Vulnerable Populations:		Moderate
Estimated Cost:		$4,000 annually
Potential Funding Sources:		Local funds; DHS: HMGP 5% Initiative
Lead Agency/Department Responsible:		Fire Department
Implementation Schedule:		Ongoing
ADDITIONAL COMMENTS		
Generator status is continually monitored through a computer system accessed by Fire Department personnel.		

WILLIAMSBURG MITIGATION ACTION 6	
Strengthen GIS digital mapping program. Efforts include, but are not limited to, constant data updates with regard to water/sewer/SWM utilities, improved geodata and cloud use with data migration to a portal for use by public and by practitioners in the field. Additional hazard data to be added may include radon exposure in conjunction with William & Mary researchers.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	The City's ongoing efforts to increase databases related to hazards is reflected in this plan. Additional databases help staff and planners recognize and plan for various hazards, persons with disabilities, evacuations and response.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Tornado, Winter Storm, Earthquake, Wildfire, Hazardous Materials Incident, Landslide/Coastal Erosion, Radon Exposure
Goal(s) Addressed:	Goal 1; Goal 2; Goal 3, Objective 3.2
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	$100,000
Potential Funding Sources:	Local funds; DHS: HMGP 5% Initiative
Lead Agency/Department Responsible:	IT, William & Mary
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
New layers are continually added to the system. Staff training on use of the map data is included in the cost estimate. City maintains handheld GPS unit for data collection. The City's goals with regard to GIS are to leverage hazard data for public safety purposes and to create a data driven, efficient system of City administration.	

WILLIAMSBURG MITIGATION ACTION 7	
Expand capacity/training for CERT groups and neighborhood-serving organizations to include communication about mitigation and response.	
BACKGROUND INFORMATION	
Site and Location:	Citywide, with particular emphasis on vulnerable neighborhoods with less access to social or broadcast media
Cost Benefit:	Local residents are better able to address or communicate the needs of their specific neighborhoods. CERT members can expand capacity of City staff to communicate, mitigate and respond more effectively.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Tornado, Winter Storm, Earthquake, Wildfire, Drought, Extreme Heat, Hazardous Materials Incident, Landslide/Coastal Erosion, Radon Exposure, Pandemic Flu or Communicable Disease
Goal(s) Addressed:	Goal 1; Goal 2, Objective 2.1; Goal 3, Objective 3.1
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	$50,000
Potential Funding Sources:	HSGP/CCP grants, local funding; DHS: HMGP 5% Initiative, BRIC
Lead Agency/Department Responsible:	Emergency Management, partnering with James City County Emergency Management and College of William & Mary
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
CERT team is very active in Williamsburg and training is provided to members at least 2 times per year. They participate in 1 exercise per year and refresher training is also provided. During COVID, CERT remained active with monthly radio reports and other training and outreach.	

WILLIAMSBURG MITIGATION ACTION 8	
Expand social media and use of Everbridge mass notification system for pre- and post-disaster information distribution; partner with CERT for assistance.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Getting information to citizens before, during and after disaster events is critical to reducing damage, reducing panic and creating a resilient citizen base that responds positively to government messages.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Tornado, Winter Storm, Earthquake, Wildfire, Drought, Extreme Heat, Hazardous Materials Incident, Flooding Due to Impoundment Failure/High Hazard Dam, Pandemic Flu or Communicable Disease
Goal(s) Addressed:	Goal 2; Goal 3, Objectives 3.3, 3.4
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	$10,500 annually
Potential Funding Sources:	Locality funding, VDEM Radiological funding DHS: HMGP 5% Initiative
Lead Agency/Department Responsible:	Communications Specialist, Emergency Management
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
In recent years, the role of the City's Public Information Officer has expanded. The prominence of social media points to a need to refine activity on Twitter, Facebook, Instagram and other programs. Need to be pro-active and targeted in messages. Identify specific messages, links. Identify other information that City can disseminate and the most effective methods, such as short videos, maps, links, photos, and infographics.	

WILLIAMSBURG MITIGATION ACTION 9	
Per the *William & Mary Hazard Mitigation Plan* (2014), implement mitigation projects to protect historical and critical infrastructure at the College of William & Mary: **1) dry or wet floodproof vulnerable basements;** **2) implement corrective actions necessary to ensure compliance of Lake Matoaka Dam with state dam safety regulations;** **3) weatherize buildings to reduce damage associated with water infiltration through roofs and windows;** **4) continue rooftop inspection program, looking for signs of wear or damage;** **5) elevate building mechanical systems above potential areas of flooding and standing water; and,** **6) Identify areas affected by the City's drainage system and collaborate on means of improvement to improve stormwater flow.**	
BACKGROUND INFORMATION	
Site and Location:	Campuswide; the *William & Mary Hazard Mitigation Plan* (2014) identifies priority buildings.
Cost Benefit:	Partnerships with the College benefit citizens, students and staff by reducing need for emergency response and protecting all who live in the City.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Flooding Due to Impoundment Failure/High Hazard Dam, Tropical/Coastal Storm, Tornado, Winter Storm, Earthquake
Goal(s) Addressed:	Goal 1; Goal 3: Objectives 3.1, 3.2, 3.4
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	Costs to be developed as individual projects are developed
Potential Funding Sources:	DHS: BRIC, HMGP
Lead Agency/Department Responsible:	College of William & Mary
Implementation Schedule:	Ongoing

ADDITIONAL COMMENTS
The Lake Matoaka Dam project significantly reduces the potential for dam failure. Components include: installing articulated block armor along the backside of the dam to protect the earthen structure from failure during a storm where the roadway is overtopped. Brick-faced training walls on both sides will channel the water from the overtopping flood to the armored section where it then flows across the downstream face to the discharge channel of College Creek. The block will be covered with topsoil and grass so will not be visible. Currently, in the event of a storm event that results in flow overtopping the dam, the dam will likely fail resulting in the loss of Jamestown Road which will adversely impacts the ability of emergency responders to reach citizens of Williamsburg and William and Mary students. Also, dam failure will sever the utilities under the road (electric power, communications, water and sewer) which will result in loss of service. Dating back several years the grounds department has been doing 2 to 3 stormwater mitigation projects per year. Furthermore, many of the newly installed planting beds are infiltration beds. Examples include the ADA ramp planting beds at T-Hall and the planting bed behind Blow Hall. These are above and beyond the requirements of the MS4 plan. The outfall and BMP facility renovations each year are done to either upgrade or correct the deficiencies with these structures. We also regrade gravel roads to mitigate storm water erosion in these areas. This past summer (2021) the road/path off Compton road was regraded due to severe erosion and the tripping hazard it posed to the students and staff using the path. Project is in the planning stage to raise the stormwater pipe under Yates Drive to correct a blockage on the north side of Yates Hall.

WILLIAMSBURG MITIGATION ACTION 10	
Prepare elements of Continuity of Operations Plan (COOP) to address cyber security, utility continuity and redundancies, and communications.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Plans that reduce the impacts of ongoing disasters save taxpayer dollars by bringing businesses back online sooner and providing normal services to citizens in need.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 1
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	Staff time
Potential Funding Sources:	CIP, DHS/VDEM
Lead Agency/Department Responsible:	Emergency Management
Implementation Schedule:	Within 2 years of plan adoption
ADDITIONAL COMMENTS	

WILLIAMSBURG MITIGATION ACTION 11	
Address command and control coordination for large assembly hazard events.	
BACKGROUND INFORMATION	
Site and Location:	Areas where large assemblies are permitted, such as the Grand Illumination each December, especially those near the railroad tracks.
Cost Benefit:	Organized command and control reduces loss of life and property associated with large gatherings.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Tornado, Earthquake, Hazardous Materials Incident
Goal(s) Addressed:	Goal 1: Objective 1.5; Goal 3: Objectives 3.1, 3.4
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	Staff time
Potential Funding Sources:	DHS/VDEM
Lead Agency/Department Responsible:	Emergency Management
Implementation Schedule:	Within 2 years of plan adoption
ADDITIONAL COMMENTS	

JAMES CITY COUNTY

JAMES CITY COUNTY MITIGATION ACTION 1	
Protect critical facilities, including refuges, while increasing potential refuge capacity and/or protected areas. Protection measures may include emergency generators or other power sources, wind or flood retrofits, elevation, relocation, or reconstruction.	
BACKGROUND INFORMATION	
Site and Location:	Countywide
Cost Benefit:	The purpose of this action is to maintain citizen safety, and continuity of county operations during a disaster event. Under new guidance, FEMA will now fund hazard mitigation projects that include sea level rise estimates.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 1, Objective 1.3, 1.4, 1.5
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	To be determined based on corrective actions selected
Potential Funding Sources:	DHS: BRIC, HMGP, HMGP 5% Initiative, FMA, EMPG
Lead Agency/Department Responsible:	Emergency Management
Implementation Schedule:	Continuing
ADDITIONAL COMMENTS	

JAMES CITY COUNTY MITIGATION ACTION 2	
Mitigate flooding problems identified in the flood studies performed for Powhatan Creek watershed. Measures may include, but are not limited to improvements to road crossings by increasing flow capacity, or installing over-topping protection, and stream restoration.	
BACKGROUND INFORMATION	
Site and Location:	Powhatan Creek watershed
Cost Benefit:	Lower cost improvements to roadways are expected to provide significant benefits in this area.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.4, 1.5
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate - NRI Coastal Flood Risk
Estimated Cost:	$6,000,000
Potential Funding Sources:	VDOT, Federal Transportation Administration, DHS
Lead Agency/Department Responsible:	General Services Stormwater
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

JAMES CITY COUNTY MITIGATION ACTION 3	
Conduct annual meeting with VDOT and utilities to identify hazard areas and potential projects to mitigate those areas.	
BACKGROUND INFORMATION	
Site and Location:	Countywide
Cost Benefit:	Keeping roads and utilities operational during high frequency events and maximizing their operability during disasters is a countywide priority.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Winter Storm, Tropical/Coastal Storm, Tornado, Earthquake, Hazardous Materials Incident, Wildfire
Goal(s) Addressed:	Goal 1, Objective 1.3, 1.4, 1.5; Goal 3, Objective 3.1, 3.3, 3.4
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	Staff time
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Emergency Management
Implementation Schedule:	Annually
ADDITIONAL COMMENTS	

JAMES CITY COUNTY MITIGATION ACTION 4	
Elevate, acquire, relocate, retrofit or floodproof structures in flood-prone areas. Flood protection may include minor localized flood reduction projects, as well. Wind retrofit measures are also included and may be appropriate for some structures, especially publicly-owned structures. This action includes Mitigation Reconstruction projects.	
BACKGROUND INFORMATION	
Site and Location:	Flood-prone areas Countywide, and Countywide for wind retrofits. Particular focus on Chickahominy Haven and Powhatan Shores, as well as repetitive flood loss areas throughout the County.
Cost Benefit:	Retrofit measures that address flood- and wind-prone structures, particularly those designated as repetitive loss or severe repetitive loss by the NFIP, have quantifiable benefits by reducing future damages to the structures. FEMA will now fund hazard mitigation projects that include sea level rise estimates.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3; Goal 3, Objective 3.1
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate/Low – three repetitive flood loss areas on Chickahominy River have relatively moderate NRI flood risk as do the 5 along Powhatan Creek. The areas near Lake Powell and James Terrace have low NRI flood risk.
Estimated Cost:	Historically, approximately $90,000 per structure. However, this may change based on funding availability.
Potential Funding Sources:	DHS: BRIC, HMGP, FMA, RFC; USDA and 5% initiative funds; Virginia CFPF
Lead Agency/Department Responsible:	Community Housing
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

JAMES CITY COUNTY MITIGATION ACTION 5	
Continue strengthening the County's Floodplain Management Program with the following actions: **1) Review floodplain ordinance regularly for appropriateness of higher standards and necessary updates;** **2) Provide specialized training and support for Certified Floodplain Manager (CFM) certification for floodplain plan reviewers, inspectors and permit processors;** **3) Continue to assess repetitive loss data annually for loss accuracy, geographic accuracy, and determination whether structure(s) on property have been mitigated and if so, by what means. Provide corrections as necessary using FEMA AW-501;** **4) Maintain current CRS Class 5 rating or better; and,** **5) Building Safety and Permits plans examiners to provide information and resources to help builders and owners evaluate hydrostatic (flood) vent options. Materials to be available on department's website. Request FEMA QuickGuide for Virginia from DCR.**	
BACKGROUND INFORMATION	
Site and Location:	Flood-prone areas Countywide
Cost Benefit:	The NFIP has a proven record of reducing annual flood damages through floodplain regulations that guide design of flood-prone properties.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Winter Storm, Tropical/Coastal Storm; Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.5; Goal 3, Objective 3.2
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate/Low – three repetitive flood loss areas on Chickahominy River have relatively moderate NRI flood risk as do the 5 along Powhatan Creek. The areas near Lake Powell and James Terrace have low NRI flood risk.
Estimated Cost:	Staff time
Potential Funding Sources:	Virginia CFPF; Virginia NFIP Community Assistance Program State Support Services Element
Lead Agency/Department Responsible:	Community Development/General Services , Emergency Management, Virginia DCR
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

JAMES CITY COUNTY MITIGATION ACTION 6	
Continue outreach efforts through "Flood Fluent" web site, hurricane and winter weather preparedness activities through FEMA and NOAA, and the social media outreach activities of Emergency Management.	
BACKGROUND INFORMATION	
Site and Location:	Countywide
Cost Benefit:	Benefits derive from reduced flood insurance premiums and increased public knowledge as a result of this initiative. The approach reduces long-term costs by: 1) minimizing need to repeat messages; 2) involving outreach/marketing professionals from within County government; 3) investigating regional partnerships that could result in additional cost savings through cost sharing; 4) using existing programs and resources to maximum advantage.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise, Tropical/Coastal Storm, Winter Storm, Landslide/Coastal Erosion, Tornado, Earthquake, Wildfire, Drought, Extreme Heat and Hazardous Materials Incident, Flooding Due to Impoundment Failure/High Hazard Dam
Goal(s) Addressed:	Goal 2,; Goal 3
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	Less than $7,500 annually
Potential Funding Sources:	Existing budgets and staff time; DHS: PDM, HMGP, HMGP 5% Initiative
Lead Agency/Department Responsible:	Emergency Management (lead)
Implementation Schedule:	Ongoing

ADDITIONAL COMMENTS
Audiences include, but are not limited to: property owners, new residents, tourists, businesses, County officials, pet owners, and schoolchildren. Stakeholders may include: various County departments, HRPDC, Peninsula Housing and Builders Association, Parent Teacher Associations, VDEM, DEQ, and DCR. Potential outreach needs include: flood risk awareness, focus on repetitive loss property owners in outreach efforts, contingency planning for businesses, response guidance with emphasis on community resiliency, publicizing the County's mitigation efforts, informing property owners of long-term and short-term property protection measures (*e.g.,* protecting vinyl siding windows from wind damage, flood vent demos and displays), creating a dedicated web site/social media sites for floodplain management permitting process, early preparation of post-disaster permitting and redevelopment materials such as press releases, videos, brochures, forms, and fees. Use questionnaires on social media to garner feedback.

JAMES CITY COUNTY MITIGATION ACTION 7	
Conduct annual Hazard Mitigation Workshop to update and share hazard mitigation information, discuss potential projects. Invite relevant County departments, non-profit agencies and other stakeholders. Develop annual Hazard Mitigation Potential Project List with ready packages for submittal as funding becomes available.	
BACKGROUND INFORMATION	
Site and Location:	Countywide
Cost Benefit:	Ready packages for submittal will: • allow the County to increase focus on hazard mitigation opportunities; • closely track hazard mitigation efforts, implementation, and successes; and, • maximize opportunities to move forward with specific mitigation actions identified over time.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.4, 1.5; Goal 3, Objectives 3.1., 3.3; Goal 4, Objectives 4.1, 4.2
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	Staff time
Potential Funding Sources:	Existing budgets
Lead Agency/Department Responsible:	Emergency Management, Finance, Community Development/General Services , VDEM, Silver Jackets, VFMA
Implementation Schedule:	Immediately
ADDITIONAL COMMENTS	

JAMES CITY COUNTY MITIGATION ACTION 8	
Implement regulations and procedures to ensure that site development projects, including those initiated by the County, are consistent with the protection of environmentally sensitive areas and the maintenance of the County's overall environmental quality so that development projects do not exacerbate current or future flooding in flood prone areas.	
BACKGROUND INFORMATION	
Site and Location:	Countywide
Cost Benefit:	Protecting new development from increasing current or future flooding may increase development costs in the near-term but reduces response and repair costs in the future.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Landslide/Coastal Erosion
Goal(s) Addressed:	Goal 1: Objectives 1.1, 1.2, 1.3, 1.6
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	TBD on project-specific basis
Potential Funding Sources:	DHS: BRIC; Virginia CFPF
Lead Agency/Department Responsible:	All
Implementation Schedule:	Within 3 years of plan adoption
ADDITIONAL COMMENTS	
This action is also included in the County's Comprehensive Plan, *2045: Our County, Our Shared Future.*	

JAMES CITY COUNTY MITIGATION ACTION 9	
Finalize, fund and implement the County's Flood Resiliency Plan and associated projects, which are adopted herein by reference. Projects are expected to include shoreline erosion and stream restoration projects among others. Three watershed management plans are also expected to begin in the near future (2 are updates and 1 is new), which will prioritize stream restoration needs and outline priorities for CIP funding.	
BACKGROUND INFORMATION	
Site and Location:	Countywide
Cost Benefit:	Flood resiliency planning will take into account future conditions for precipitation and flooding in an effort to reduce not just short term average annual flood damages, but also long-term damages.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Landslide/Coastal Erosion
Goal(s) Addressed:	Goal 1; Goal 3
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate/Low – three repetitive flood loss areas on Chickahominy River have relatively moderate NRI flood risk as do the 5 along Powhatan Creek. The areas near Lake Powell and James Terrace have low NRI flood risk.
Estimated Cost:	Staff time for Resiliency Plan; detailed project costs to be determined in planning process
Potential Funding Sources:	CIP; Virginia CFPF; DHS: BRIC, FMA, HMGP; USACE: SFCP, FPMS
Lead Agency/Department Responsible:	Community Development/General Services
Implementation Schedule:	Within 1 year of plan adoption
ADDITIONAL COMMENTS	

YORK COUNTY

YORK COUNTY MITIGATION ACTION 1	
Continue outreach efforts using the following steps: 1. **Assess County's public information needs** 2. **Formulate multi-hazard messages** 3. **Identify outreach projects to convey the messages** 4. **Examine other public information initiatives** 5. **Implement**	
BACKGROUND INFORMATION	
Site and Location:	Countywide
Cost Benefit:	The organized nature of the approach reduces long-term costs by: 1) minimizing need to repeat messages; 2) investigating regional partnerships that could result in additional cost savings through cost sharing; 3) using existing programs and resources to maximum advantage.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Winter Storm, Landslide/Coastal Erosion, Tornado, Earthquake, Wildfire, Drought, Extreme Heat and Hazardous Materials Incident, Flooding Due to Impoundment Failure/High Hazard Dam, Radon Exposure, Pandemic Flu or Communicable Disease
Goal(s) Addressed:	Goal 2, Objective 2.1; Goal 3
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	Less than $7,500
Potential Funding Sources:	Existing budgets and staff time
Lead Agency/Department Responsible:	Emergency Management, Development Services
Implementation Schedule:	Within 2 years of plan adoption

ADDITIONAL COMMENTS
Audiences include: property owners, elected officials, businesses, County officials, pet owners, and schoolchildren. Stakeholders may include: various County departments, HRPDC, Peninsula Housing and Builders Association, Parent Teacher Associations, VDEM, DEQ, DCR, and American Red Cross. Potential outreach needs include: content and method of public service announcements, flood risk awareness, focus on repetitive loss property owners in outreach efforts, contingency planning for businesses, publicizing the County's mitigation efforts, informing property owners of long-term and short-term property protection measures (*e.g.,* protecting vinyl siding windows from wind damage), creating a dedicated web site/social media sites for floodplain management permitting process, increasing property owner awareness of flood zone location and flood insurance availability, awareness of the flood hazard in general, and information about the Letter of Map Amendment process regarding the FEMA FIRM, early preparation of post-disaster permitting and redevelopment materials such as press releases, videos, brochures, forms, and fees. Use questionnaires on social media to garner feedback.

YORK COUNTY MITIGATION ACTION 2	
Continue strengthening the County's Floodplain Management Program with the following actions: **1) Review and update floodplain ordinance regularly and continue to provide annual Floodplain Management Report;** **2) Consider regulating land outside 100-year floodplain but subject to future flooding as a result of sea level rise;** **3) Continue participating in the Community Rating System;** **4) Collect lowest floor elevation data for flood-prone structures;** **5) Continue specialized training and support for Certified Floodplain Manager (CFM) certification for floodplain plan reviewers, inspectors and permit processors; and,** **6) Continue to assess repetitive flood loss data annually for loss accuracy, geographic accuracy, and determination whether structure(s) on property have been mitigated and if so, by what means. Provide corrections as necessary using FEMA AW-501.**	
BACKGROUND INFORMATION	
Site and Location:	Flood-prone areas Countywide
Cost Benefit:	The NFIP has a proven record of reducing annual flood damages through floodplain regulations that guide design of flood-prone properties.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Flooding Due to Impoundment Failure/High Hazard Dam, Winter Storm, Tropical/Coastal Storm, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.4; Goal 3, Objective 3.2
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High – The majority of the county's repetitive loss areas have relatively high NRI flood risk, which includes analysis of social vulnerability.
Estimated Cost:	Staff time
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Public Works and Development Services
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

YORK COUNTY MITIGATION ACTION 3	
Retrofit or floodproof structures in flood-prone areas; projects may include elevation, acquisition, relocation and minor localized flood reduction projects. Wind retrofit measures are also included and may be appropriate for some structures, especially publicly-owned structures. This action includes Mitigation Reconstruction projects. Tie mitigation efforts to outreach efforts listed in action #1 and encourage property owners to perform minor retrofits on their own.	
BACKGROUND INFORMATION	
Site and Location:	Flood-prone areas Countywide, and Countywide for wind retrofits.
Cost Benefit:	Retrofit measures that address flood- and wind-prone structures, particularly those designated as repetitive loss or severe repetitive loss by the NFIP, have quantifiable benefits by reducing future damages to the structures. Under new guidance, FEMA will now fund hazard mitigation projects that include sea level rise estimates.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.5
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	High – The majority of the county's repetitive loss areas have relatively high NRI flood risk, which includes analysis of social vulnerability.
Estimated Cost:	In multiple phases as grant money becomes available. Individual structure costs vary.
Potential Funding Sources:	DHS: BRIC, HMGP, FMA, RFC; USDA; Virginia CFPF
Lead Agency/Department Responsible:	Emergency Management, Public Works, Planning
Implementation Schedule:	Ongoing as opportunities are identified
ADDITIONAL COMMENTS	

YORK COUNTY MITIGATION ACTION 4	
Develop public outreach materials to educate citizens about the wildland fire hazard and the wildland/urban interface.	
BACKGROUND INFORMATION	
Site and Location:	Wildfire urban interface zones countywide
Cost Benefit:	Knowledge of wildfire hazards can be helpful in encouraging homeowners to mitigate the hazard themselves. Low-cost measures are available to responsibly mitigate the wildfire hazard, especially during high risk times.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Wildfire
Goal(s) Addressed:	Goal 2, Objective 2.1
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	Staff time
Potential Funding Sources:	DHS: HMGP 5% Initiative
Lead Agency/Department Responsible:	Department of Fire and Life Safety
Implementation Schedule:	Within 5 years of plan adoption
ADDITIONAL COMMENTS	

YORK COUNTY MITIGATION ACTION 5	
Maintain program for continued assessment and mitigation of identified stormwater "choke points"; ensure roads remain flood free for evacuation of low-lying areas.	
BACKGROUND INFORMATION	
Site and Location:	Countywide; especially ensuring access/egress to the Seaford and Back Creek Road areas.
Cost Benefit:	Pre-disaster assessment and action to alleviate choke points can reduce flooding damage and improve the stormwater system's ability to perform as designed.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Landslide/Coastal Erosion, Winter Storm
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.4, 1.5
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	This program is absorbed into staff time spent on stormwater program and thus is not budgeted separately.
Potential Funding Sources:	Existing budgets
Lead Agency/Department Responsible:	Public Works
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

YORK COUNTY MITIGATION ACTION 6	
Evaluate critical facilities for safety and sustainability during emergencies. Take appropriate corrective actions, which may include but are not limited to: providing backup power sources, wind retrofits and flood retrofits.	
BACKGROUND INFORMATION	
Site and Location:	Countywide to include generators to boost effectiveness of York High School and construction of a new Sheriff's Office with generator power
Cost Benefit:	Critical facility operation protects the public, maintains governmental operations and furthers community sustainability.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.4
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	To be determined
Potential Funding Sources:	DHS: BRIC, HMGP, HMGP 5% Initiative
Lead Agency/Department Responsible:	Department of Fire and Life Safety
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

YORK COUNTY MITIGATION ACTION 7	
Continue support of the Newport News Department of Public Utilities (Waterworks) forest management program to mitigate wildfire hazards and promote the health of forests within the reservoir watersheds.	
BACKGROUND INFORMATION	
Site and Location:	Waterworks reservoir watersheds in the County
Cost Benefit:	This ongoing program reduces the number of fires, and works to control pine beetle infestations. Forest thinning is a primary control mechanism. This is one of many programs the utility implements related to hazard mitigation. Additional benefits from environmental or ecosystem benefits may be included in the benefits cost analysis.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Wildfire, Winter Storm
Goal(s) Addressed:	Goal 1, Objective 1.3; Goal 3, Objectives 3.1, 3.3, 3.4
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	Staff time
Potential Funding Sources:	Waterworks Enterprise Fund, existing budgets; DHS: HMGP
Lead Agency/Department Responsible:	Department of Fire and Life Safety
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

YORK COUNTY MITIGATION ACTION 8	
Manage shoreline erosion through the following actions: **1. Request and share VIMS staff recommendations for shoreline erosion control permit applications with Wetlands Board citizen members; and,** **2. Continue to include shoreline erosion control element in the Comprehensive Plan.**	
BACKGROUND INFORMATION	
Site and Location:	Shorelines countywide
Cost Benefit:	
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Landslide/Coastal Erosion
Goal(s) Addressed:	Goal 1, Objectives 1.2, 1.3, 1.6; Goal 3, Objectives 3.1, 3.3, 3.4
Priority (High, Moderate, Low):	Low
Impact on Socially Vulnerable Populations:	Moderate – NRI Hurricane Risk
Estimated Cost:	Staff time
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Development Services Department, Planning Division, Public Works
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

YORK COUNTY MITIGATION ACTION 9	
Increase knowledge of hazardous materials storage areas to reduce impacts from overlapping hazard events through the following: **1) Create and maintain geodatabase of known storage locations of hazardous materials;** **2) Add hazmat data to dispatch system so that first responders can better visualize sites during response;** **3) Use data layer to build better response capabilities; and** **4) Analyze data in conjunction with other hazard layers (flood, sea level rise, wildfire, etc.) to identify problem areas and possible retrofits to reduce risk.**	
BACKGROUND INFORMATION	
Site and Location:	Countywide
Cost Benefit:	Database provides critical information for hazard planning, especially when hazards overlap. For example, knowing the location of hazardous materials in the floodplain can be a critical element in floodplain management planning.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Hazardous Materials Incident, Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Winter Storm, Earthquake, Wildfire
Goal(s) Addressed:	Goal 1, Objectives 1.2, 1.3; Goal 3, Objective 3.2
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	$5,000 to $10,000
Potential Funding Sources:	Existing budgets; DHS: HMGP 5% Initiative
Lead Agency/Department Responsible:	Fire and Life Safety, Information Technology (GIS), PLEPC
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
County has hazard point layers that requires continual update and maintenance. Peninsula LEPC is working to establish this capability throughout the Peninsula region.	

YORK COUNTY MITIGATION ACTION 10	
Install and maintain high water marks signs and gauges in flood-prone areas.	
BACKGROUND INFORMATION	
Site and Location:	Flood-prone areas countywide
Cost Benefit:	Drivers who are aware of the extent of high water on roads can avoid unsafe travel, avoiding damage to humans, rescue personnel, and vehicles.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm
Goal(s) Addressed:	Goal 2; Goal 3
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High – The majority of the county's repetitive loss areas have relatively high NRI flood risk, which includes analysis of social vulnerability.
Estimated Cost:	Estimated $200 per sign post, installed
Potential Funding Sources:	HRPDC; VDOT; DHS: BRIC, HMGP, HMGP 5% Initiative; Virginia CFPF; USACE: FPMS
Lead Agency/Department Responsible:	Public Works
Implementation Schedule:	Within 5 years of plan adoption
ADDITIONAL COMMENTS	
High water signs and markers have been strategically placed in low-lying areas of York County. They are regularly inspected and maintained - especially during the approach of significant storms. York County has investigated tidal gauges/sensors through VIMS and the City of Newport News. County is currently relying on the gauge near the USCG Base (Yorktown).	

YORK COUNTY MITIGATION ACTION 11	
Consider expanding existing Pre-Disaster Debris Management Plan to refocus beyond stormwater management on public property and to include public outreach and hazardous materials facilities. Remove existing trees and debris that pose hazard during natural disaster.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Pre-disaster debris management reduces damage to structures and infrastructure from flood, wind and possibly snow. Also, regular clean-up requirements can reduce the costs of post-disaster debris clean-up. County could also have access to the additional 5-percent cost incentive from FEMA's Public Assistance money.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Tornado, Winter Storm, Earthquake, Wildfire
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.4, 1.5; Goal 2; Goal 3, Objective 3.1
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	Staff time
Potential Funding Sources:	Existing capital budgets; HMGP, HMGP 5% Initiative, BRIC or FMA (with very clearly articulated benefits for flood damage reduction); Virginia CFPF
Lead Agency/Department Responsible:	Public Works
Implementation Schedule:	Within 3 years of plan adoption
ADDITIONAL COMMENTS	
Prior to any significant storm, Public Works inspects and cleans every ditch within the County. Any hazards or debris found in the ROW are removed. The County does not enter private property to remove existing hazards without a Right of Entry Permit. This action is only done on an as needed basis (for example, it was done following Hurricane Isabel in 2003). Consider adding language that encourages citizens to perform pre-storm inspections and take action on their own to reduce risk.	

YORK COUNTY MITIGATION ACTION 12	
Align existing Disaster Recovery Plan with regional expectations. As Hampton Roads region develops a regional plan, continually monitor progress to ensure York County has all necessary components up to date.	
BACKGROUND INFORMATION	
Site and Location:	Countywide
Cost Benefit:	Recovery plans reduce vulnerability after an event by helping to ensure that “return to normalcy” is coupled with mitigation strategies to address long-term vulnerability.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 1; Goal 2: Objective 2.3; Goal 3: Objectives 3.1, 3.3, 3.4
Priority (High, Moderate, Low):	Low/Moderate
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	Staff time
Potential Funding Sources:	DHS: BRIC, HMGP; Virginia CFPF
Lead Agency/Department Responsible:	Planning Division, Emergency Management
Implementation Schedule:	Within 5 years of plan adoption and in accordance with regional plan schedule
ADDITIONAL COMMENTS	

YORK COUNTY MITIGATION ACTION 13	
Review and consider adoption of International Residential Code Appendix F, Radon Control Methods. This appendix to the Virginia USBC contains provisions intended to mitigate the transfer of radon gases from the soil into dwelling units.	
BACKGROUND INFORMATION	
Site and Location:	Countywide, although measures could be targeted to high radon concentrations areas of the County if future data collection and mapping provides improved data
Cost Benefit:	Mitigation measures to resist radon entry into new construction and prepare the building for post-construction radon mitigation (if necessary) require minimum cost at the time of construction.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Radon Exposure
Goal(s) Addressed:	Goal 1: Objectives 1.2, 1.5; Goal 3: Objective 3.1
Priority (High, Moderate, Low):	Low
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	Staff time
Potential Funding Sources:	Existing budgets
Lead Agency/Department Responsible:	Building Regulation
Implementation Schedule:	Within 5 to 7 years after plan adoption
ADDITIONAL COMMENTS	
See requirements at: https://codes.iccsafe.org/content/IRC2018/appendix-f-radon-control-methods	

YORK COUNTY MITIGATION ACTION 14	
Modify County Comprehensive Plan (Charting the Course to 2035) to account for hazard mitigation and flood resiliency.	
BACKGROUND INFORMATION	
Site and Location:	Countywide
Cost Benefit:	Cost is minimal to incorporate hazard mitigation plan elements, such as actions, goals and objectives, into an accompanying plan for the county's future. Plan integration helps reduce conflict and re-emphasize important concepts in the mitigation planning arena.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	All
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	Minimal
Potential Funding Sources:	CIP, Virginia CFPF
Lead Agency/Department Responsible:	Planning Division
Implementation Schedule:	In conjunction with next scheduled Comp Plan update
ADDITIONAL COMMENTS	

NORFOLK

NORFOLK MITIGATION ACTION 1	
Maintain and protect the City's beaches and shorelines using structural means.	
BACKGROUND INFORMATION	
Site and Location:	Chesapeake Bay, Willoughby Bay, Elizabeth River, Lafayette River, Pretty Lake shorelines
Cost Benefit:	Increased frequency and severity of flooding in Norfolk is expected to dramatically increase flood damages in coming years. Without well-planned protection measures, Norfolk's shoreline is particularly vulnerable to erosion resulting from floods and sea level rise. FEMA will now fund hazard mitigation projects that include sea level rise estimates for calculating benefits.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Sea Level Rise and Land Subsidence, Flooding, Landslide/Coastal Erosion, Tropical/Coastal Storm Surge
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3; Goal 3, Objectives 3.1, 3.3
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High –The majority of the census tracts along the shoreline have relatively high or very high NRI flood risk, which includes analysis of social vulnerability.
Estimated Cost:	$300,000,000 (5-year expenditure)
Potential Funding Sources:	USACE, General funds, CIP, CFPF, Municipal Bonds, Special Service District Assessments, DHS: HMGP, BRIC
Lead Agency/Department Responsible:	Office of Resilience, Public Works
Implementation Schedule:	Ongoing
COMMENTS	
Multiple activities are covered under this effort, including breakwater and other structural features, beach surveys and source identification, and environmental permitting. Following completion of the recent USACE beach nourishment project, periodic renourishment is required on the average of once every nine years in order to maintain the integrity of the flood and storm protection. Norfolk completes biennial dune surveys and wave gauge monitoring as part of its maintenance commitment to the USACE. In January 2022, Norfolk was awarded up to $249.3M for Coastal Storm Risk Management; $134M needed from nonfederal sponsor. See Norfolk Action 2 for related nonstructural CSRM projection measures.	

NORFOLK MITIGATION ACTION 2		
Maintain and protect the City's beaches and shorelines using natural shoreline protection measures.		
BACKGROUND INFORMATION		
Site and Location:	Chesapeake Bay, Willoughby Bay, Elizabeth River, Lafayette River, Pretty Lake shorelines	
Cost Benefit:	Increased frequency and severity of flooding in Norfolk is expected to dramatically increase flood damages in coming years. Natural protection measures help the shoreline adjust to sea level rise with less intervention. FEMA will now fund hazard mitigation projects that include sea level rise estimates.	
MITIGATION ACTION DETAILS		
Hazard(s) Addressed:	Sea Level Rise and Land Subsidence, Flooding, Landslide/Coastal Erosion, Tropical/Coastal Storm Surge	
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.6; Goal 3, Objectives 3.1, 3.3	
Priority (High, Moderate, Low):	High	
Impact on Socially Vulnerable Populations:	High –The majority of the census tracts along the shoreline have relatively high or very high NRI flood risk, which includes analysis of social vulnerability.	
Estimated Cost:	$50,000,000	
Potential Funding Sources:	USACE, General funds, CIP, CFPF, Municipal Bonds, Special Service District Assessments, DHS: HMGP, BRIC	
Lead Agency/Department Responsible:	Office of Resilience, Public Works	
Implementation Schedule:	Ongoing	
COMMENTS		
Multiple activities are covered under this effort, including shoreline restoration, and dune planting and stabilization and environmental permitting. Features include Natural and Nature Based Features (NNBFs). The first segment of the Coastal Storm Risk Management project with the USACE calls for 7,200 lf new living shorelines (+3,800 lf mitigated), and 5,250 lf of oyster reefs.		

NORFOLK MITIGATION ACTION 3	
Provide educational engagement and improve communications to residents to increase awareness of vulnerability to multiple hazards. Focus on hurricanes, sea level rise, flooding, nuisance flooding and severe repetitive flood losses. **Provide engagement that increases citizens' ability to take mitigative actions prior to disaster event. Focus on hurricane preparedness and flood mitigation.**	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Public education can have numerous intangible benefits from the public safety peace of mind. It can result in preventing or lessening damage caused by disasters and can save lives. Teaching citizens how to protect their lives and property themselves has tangible benefits to property owners and the City by reducing the need to for disaster response and increasing community resiliency.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All Hazards
Goal(s) Addressed:	Goal 1: Objectives 1.1, 1.2, 1.4, 1.5: Goal 2
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	$50,000
Potential Funding Sources:	Operating Budget, DHS: HMGP, HMGP 5% Initiative
Lead Agency/Department Responsible:	Emergency Preparedness & Response, Chief Resilience Officer, Planning, Public Works, Chief Marketing Officer
Implementation Schedule:	Ongoing

COMMENTS
Outreach to floodplain residents and repetitively flooded areas is a part of the community's CRS program and will continue. This action is also part of the City's Strategy for Continued Compliance with the NFIP.

NORFOLK MITIGATION ACTION 4	
Continue to implement capital improvements that improve stormwater management and control flooding, especially for undersized and out-of-date drainage systems and patterns.	
BACKGROUND INFORMATION	
Site and Location:	Citywide. Projects mitigate flooding and run-off problems throughout the City. New projects will be chosen as opportunities to improve city TMDL requirements and stormwater capacity are identified.
Cost Benefit:	Annual damage occurs to homes and businesses in vulnerable areas due to poor drainage. FEMA will now fund hazard mitigation projects that include sea level rise estimates.

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Landslide/Coastal Erosion
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.4, 1.5
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	Approx. $19,000,000 per year
Potential Funding Sources:	General funds, CIP, DHS: HMGP & BRIC, Private funds; Virginia CFPF
Lead Agency/Department Responsible:	Public Works
Implementation Schedule:	Ongoing

COMMENTS
Hazard Mitigation Grants should be considered as a potential funding source and used as a basis for property protection. Existing consultant's study has identified multiple flood mitigation measures. Additional projects will be identified throughout city that will improve drainage capacity as well as improve water quality. The new Watershed Master Plan recently awarded by the Virginia CFPF will update the 2012 Citywide Drainage Master Plan with additional criteria within the prioritization formula to include Social Vulnerability Index as a priority input. Projects and designs should be prepared for future applications of funds when they become available.

NORFOLK MITIGATION ACTION 5	
Identify and improve critical facilities and infrastructure to minimize flood and wind damage, specifically targeting schools, EOC and emergency shelters. Action may also include placing utility lines underground or preemptive traffic systems for emergency vehicles. **Purchase and install generators or other continuous power sources for critical facilities and infrastructure. This action may include, but is not limited to pump stations, EOC, shelters, underpasses and important traffic signals.** **Include critical public facility generator requirements and required connection materials in the USACE Emergency Power Facility Assessment Tool (EPFAT).**	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Critical facilities are located within the floodplain due to built environment of the City. Providing protected utilities and backups are necessary to properly aid in protecting and serving citizens. Maintaining a functioning EOC is vital to response and recovery efforts Citywide from a large variety of possible hazards. Damage occurs yearly with damaged equipment and vehicles stuck in underpasses. During Hurricane Isabel, City lost +90 percent of traffic signal operations for various time periods. Under new guidance, FEMA will now fund hazard mitigation projects that include sea level rise estimates.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.4, 1.5
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	$1,000,000
Potential Funding Sources:	DHS: HMGP, BRIC, Virginia CFPF; ARPA
Lead Agency/Department Responsible:	Public Works, Emergency Preparedness & Response, Public Utilities
Implementation Schedule:	Ongoing

COMMENTS
This action may include multiple projects including, upgrading of utilities and emergency connections, as well as improving transportation access to buildings and flood protection of facilities.

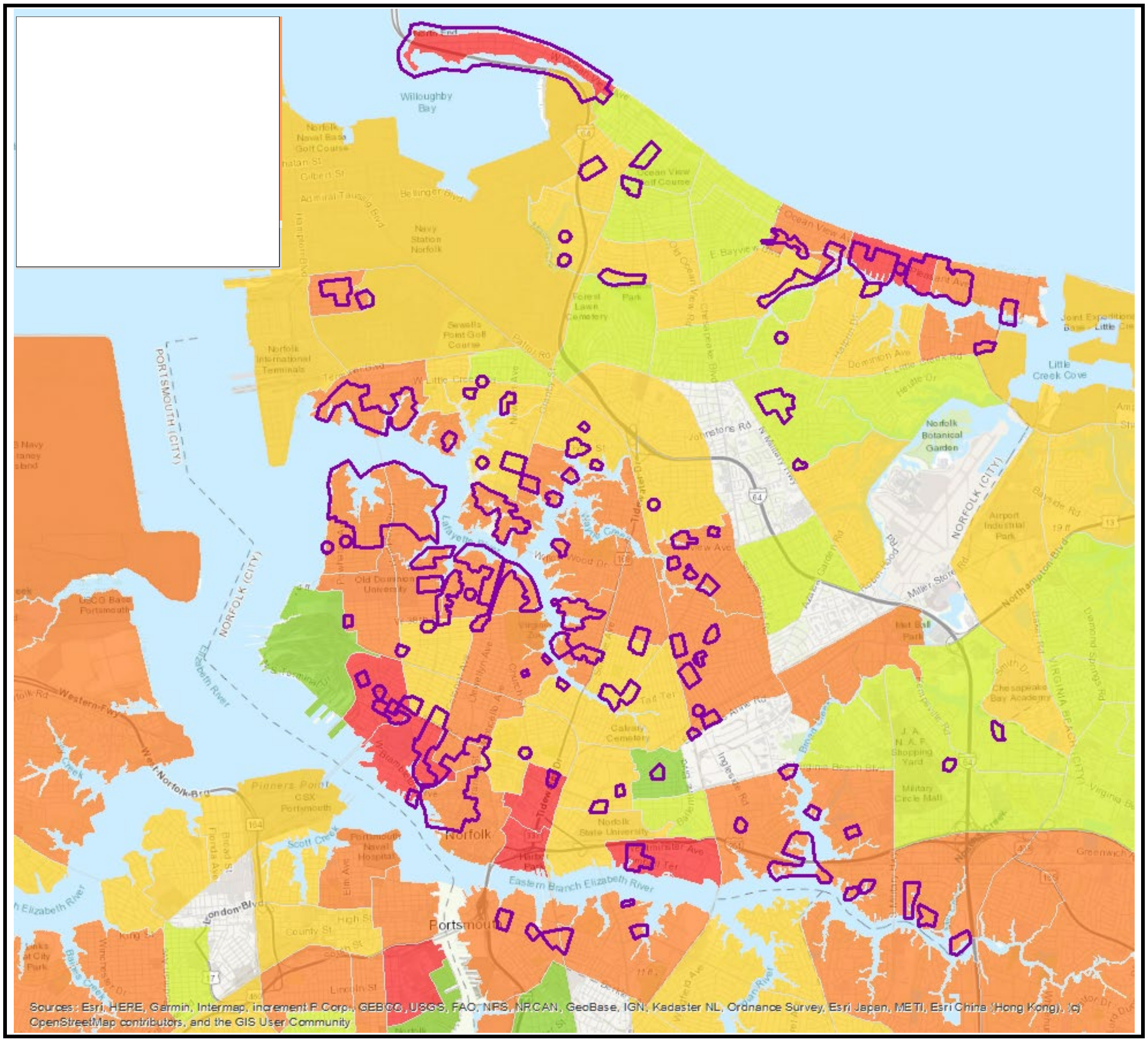
NORFOLK MITIGATION ACTION 6
Protect flood-prone structures through the following ongoing actions: 1) **Incorporate CDC's Social Vulnerability Index tools to align actions with the City's commitment to being a diverse, equitable and inclusive city;** 2) **Give highest priority to protection of "severe repetitive losses" as defined by the National Flood Insurance Program (NFIP), including verifying the location of all repetitive losses, verifying location and need for mitigation;** 3) **Second highest priority to mitigation of historic resources, or meeting the Secretary of the Interior's standards for eligibility as a historic resource. Historic resources should be protected in place, or relocated; raised not razed;** 4) **Prepare Repetitive Loss Area Analyses for CRS credit under CRS Activity 512(b);** 5) **Elevate, acquire, relocate or otherwise retrofit structures. This action includes Mitigation Reconstruction projects for non-historic resources, ground floor conversion projects and basement fill projects.** 6) **Target potential properties or clusters of properties on low elevations near wetlands for purchase and conversion to public open space;**

BACKGROUND INFORMATION	
Site and Location:	Floodplains throughout the City, particularly those with high social vulnerability
Cost Benefit:	Repetitive losses and severe repetitive losses drain public funds for disaster response and require repeated expenditures on the part of property owners. Mitigation actions that fix the problems long-term are cost effective when average annual damages exceed average annual costs of retrofitting, elevating or acquiring the structure. Under new guidance, FEMA will now fund hazard mitigation projects that include sea level rise estimates.

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2; Goal 3, Objective 3.2
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Very High – Norfolk has 114 repetitive flood loss areas; 87 of them (or 76%) are located

	in areas designated as having Relatively High or Very High NRI flood risk. See map excerpt below for additional detail.
Estimated Cost:	$5,000 to $300,000 per structure.
Potential Funding Sources:	DHS: HMGP, FMA, BRIC, FMA; USACE: FPMS; Virginia CFPF
Lead Agency/Department Responsible:	City Planning
Implementation Schedule:	Ongoing

COMMENTS
Structures insured through the NFIP are often eligible for more grant funds than uninsured structures. The repetitive flood loss areas provided in Section 5 of this plan will help identify areas of the City to be addressed through this action. Measures should include parcel scale, neighborhood scale, and watershed scale protection measures. Parcel scale measures include rain barrels, pervious pavers, and rain gardens amongst other best practices.


Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

NORFOLK MITIGATION ACTION 7	
Implement a full rollout of Crisis Track to improve post-event damage assessment procedures so that damages, event frequencies, and other data are more readily available for mitigation planning and fully integrated into VDEM and FEMA's SDE Tool.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Crisis Track will allow easier processing of post-disaster permits and assessments, increasing reliance on the system and integration with VDEM systems for assessing damage.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Tornado, Winter Storm, Earthquakes, Flooding Due to Impoundment Failure/High Hazard Dam
Goal(s) Addressed:	Goal 3, Objective 3.2
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	Staff time
Potential Funding Sources:	HMGP, HMGP 5% Initiative, City funds, VDEM
Lead Agency/Department Responsible:	Information Technology, Emergency Preparedness & Response, Finance, City Planning, Neighborhood Services
Implementation Schedule:	Ongoing
COMMENTS	
Create and implement a post-incident data collection plan which would organize city staff, volunteers and damage assessment teams. Include pre-approved documents and procedures with regard to substantial damage/improvement and personnel to conduct inspections/determinations.	

NORFOLK MITIGATION ACTION 8	
Implement actions to improve Community Rating System (CRS) classification to at least a Class 4 with a 30 percent discount on most flood insurance policies.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	The City's Class 5 rating currently results in flood insurance premium savings of 25%. The dollars saved go back into property owners' pockets to spend in the local economy. Implementing additional activities creditable under CRS is expected to increase the number of policies Citywide, thus decreasing reliance on City and federal resources after a flood. Many of the measures suggested by CRS activities are non-structural in nature and help reduce the flood vulnerability of new and substantially improved construction.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Objective 1.2; Goal 2, Goal 3
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	$500,000
Potential Funding Sources:	Staff time; Virginia CFPF
Lead Agency/Department Responsible:	Planning & Community Dev.; Public Works
Implementation Schedule:	Within 3 years
COMMENTS	
Lobby for changes to State stormwater requirements to obtain CRS Watershed Management Plan credit.	

NORFOLK MITIGATION ACTION 9	
Assess and protect historic resources and structures from flooding and sea level rise. Measures should include short-, medium- and long-term solutions.	
BACKGROUND INFORMATION	
Site and Location:	Historic structures and areas throughout the City
Cost Benefit:	Historic structures throughout the city are located in flood prone areas. Value of historic resources are more than just the value of the structure which adds value to normal mitigation methods.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2; Goal 3, Objective 3.2
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High – All of the City's historic districts with one exception are in areas of Very High or Relatively High NRI Flood Risk. (Ballentine Place is rated Moderate.)
Estimated Cost:	Staff time/consultant fees estimated at $50,000 to resurvey existing historic areas with new surveys estimated at $75,000
Potential Funding Sources:	DHS: BRIC, HMGP, FMA, RFC; Virginia CFPF; NPS, VDHR, Preservation Virginia
Lead Agency/Department Responsible:	City Planning, Chief Resilience Officer
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
Initial methods should include updating surveys of listed historic areas and structures. Other neighborhoods should be reviewed and determined if the structures and integrity of the neighborhood have been preserved to allow for additional surveys. Different methods should be explored to preserve and protect structures, including generation of FEMA approved guidance for protection of these structures and areas that differ from current allowed practices for residential and non-residential structures.	

NORFOLK MITIGATION ACTION 10	
Identify and implement resilient strategies throughout the city to provide better watershed, neighborhood and parcel specific flood protection and mitigation. Perform feasibility study for coastal storm risk protection for Norfolk southside neighborhoods based on future sea level rise and flood conditions. Other projects include, but are not limited to recommendations of the Joint Land Use Study in conjunction with the City of Virginia Beach and the U.S. Navy, as well as the Norfolk Coastal Storm Risk Management solutions.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Resilient strategies range from small to larger scale projects. Ability to provide protection to properties at risk with innovative measures are necessary to protect entire city.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1; Goal 3
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Variable based on individual projects.
Estimated Cost:	+$60,000,000
Potential Funding Sources:	DHS: BRIC, HMGP, FMA, RFC, ACOE, City CIP, HUD; USACE; Virginia CFPF; OLDCC through DoD MIR Review; ARPA
Lead Agency/Department Responsible:	Chief Resilience Officer, Public Works, City Planning, Emergency Preparedness and Response
Implementation Schedule:	Ongoing

ADDITIONAL COMMENTS

Methods should include hard infrastructure and green infrastructure. Multiple methods can be joined together to provide better protection to the properties and all citizens.

JLUS recommendations include:
Willoughby Bay Shoreline Floodwall
Willoughby Spit Floodplain Management Strategy
Pretty Lake Storm Surge Barrier
Norview Avenue Drainage Study
Resilient Underpass Pump Station Study
Lafayette River Annex Vulnerability Study
Mason Creek Flood Mitigation Strategy
Wastewater Treatment Plant Vulnerability Assessment
Terminal Boulevard Rail and Roadway Grade Separation (new rail underpass)

Norfolk Coastal Storm Risk Management solutions are shown in the diagram below.

Recommended Plan Pertinent Data

Nonstructural Measures

Nonstructural Measure	Total Structures	Nonresidential	Residential	Historic*
Basement Fill	176	1	175	33
Basement Fill + Floodproofing	1	1	0	0
Basement Fill + Elevation	89	0	89	4
Buyout	76	6	70	27
Floodproofing	140	140	0	5
Elevation	624	0	624	12
Total	1,106	148	958	81

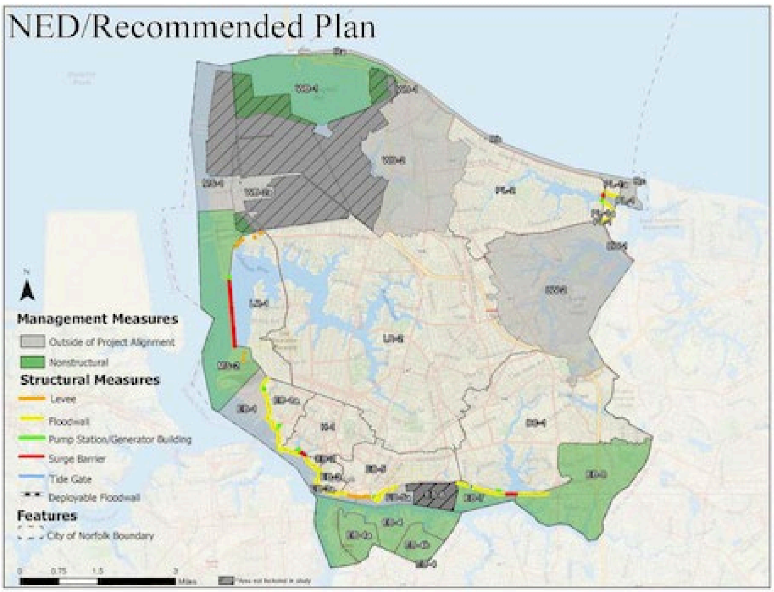
*Non-residential and Residential

Structural Measures

- Four storm surge barriers
- Nearly nine miles of floodwall and one mile of levee
- Nine tide gates
- Four pump stations

City of Norfolk Supporting Activities

- Modern floodplain management and zoning regulations
- Hazard mitigation plan in place
- Hurricane evacuation plan in place
- Joint Land Use Study with the Navy and Virginia Beach
- Adopted green infrastructure master plan



Environmental Impacts Summary

- Wetlands 2.5 acres
- Mudflats 2 acres
- Open water 20 acres
- All will be mitigated
- Environment coordination is ongoing, CZMA concurrence received
- EPA EIS Rating: EC-2

US Army Corps of Engineers Norfolk District

CITY OF NORFOLK, VIRGINIA

Coastal Storm Risk Management Feasibility Study North Atlantic Coast Comprehensive Study Focus Area

NORFOLK MITIGATION ACTION 11	
Explore partnership with NASA to use Interferometric Synthetic Aperture Radar (InSAR) to study changes in the rate of localized subsidence and possible links to relative sea level rise.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	InSAR makes high-density measurements over large areas by using radar signals from Earth-orbiting satellites to measure changes in land-surface altitude at high degrees of measurement resolution and spatial detail. It is often less expensive than obtaining sparse point measurements from labor-intensive spirit-leveling and GPS surveys, and can provide millions of data points in a region about 10,000 square kilometers.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding; Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 3: Objectives 3.2, 3.3, 3.4
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	TBD
Potential Funding Sources:	Virginia CFPF; National Science Foundation; ODU ICAR
Lead Agency/Department Responsible:	Office of Resilience, NASA
Implementation Schedule:	Within 2 years
ADDITIONAL COMMENTS	

NORFOLK MITIGATION ACTION 12	
Update the City's Combined Coastal and Precipitation Flooding Master Plan to meet the minimum CRS requirements for a Watershed Master Plan	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	The CRS watershed master will provide Norfolk with a tool it can use to make decisions that will reduce the increased flooding from development on a watershed-wide basis and incorporate future conditions to inform CIP investment decisions and land development policy that addresses existing flood problems.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Sea Level Rise and Land Subsidence, Flooding, Tropical/Coastal Storm Surge
Goal(s) Addressed:	Goal 1, Objectives 1.2, 1.6; Goal 2, Objective 2.1; Goal 3, Objectives 3.1, 3.3, 3.4
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	$350,000
Potential Funding Sources:	General funds, CIP, Virginia CFPF
Lead Agency/Department Responsible:	Office of Resilience, Public Works, Planning
Implementation Schedule:	Ongoing
COMMENTS	
The City of Norfolk was awarded a $315,000 grant from the Virginia CFPF for this effort. Norfolk will provide $35,000 and solicit a consultant to facilitate development of the watershed master plan, incorporating future conditions and including social vulnerability as a factor within the prioritization formulae.	

NORFOLK MITIGATION ACTION 13	
Obtain direct technical assistance to incorporate green infrastructure, social vulnerability, and environmental justice into Benefit-Cost Analysis/Ratio (BCA/R) calculations for structural/hybrid flood protection measures for the Southside communities of Berkley and Campostella.	
BACKGROUND INFORMATION	
Site and Location:	Southside communities of Berkley and Campostella
Cost Benefit:	The BCR methodology used for the CSRM feasibility study does not account for the decades of redlining and disinvestment that has plagued the Southside and depressed BCR inputs such as property assessments. The Southside has “Very High Social Vulnerability,” with low access to transportation, making the population difficult to evacuate. Southside is a “disadvantaged community” (EO 14008) and is surrounding by heavy industry which will bring environmental toxins and life-threatening debris into the community in the event that only nonstructural flood protection measures are provided.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Sea Level Rise and Land Subsidence, Flooding, Tropical/Coastal Storm Surge, Hazardous Materials Incident
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.4, 1.5, 1.6; Goal 3, Objectives 3.2, 3.4
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	$100,000 - $250,000
Potential Funding Sources:	BRIC, General funds, CIP, Virginia CFPF
Lead Agency/Department Responsible:	Office of Resilience
Implementation Schedule:	Ongoing
COMMENTS	
The Southside community is historic, with large portions listed on the National Register of Historic Places.	

NORFOLK MITIGATION ACTION 14	
Increase number of real-time flood inundation storm sensors installed throughout the City and made available for public API integration within Norfolk Open GIS Data portal.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Storm sensors optimization within a real-time continuous-simulation model will allow City staff and the public to refine the inputs necessary to inform high-tech outputs such as a refined Digital Elevation Model for Norfolk, real-time STORM Dashboard map, flooded street re-router for Waze GPS app, tailwater conditions for urban coastally-influenced stormwater systems.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Sea Level Rise and Land Subsidence, Flooding, Tropical/Coastal Storm Surge
Goal(s) Addressed:	Goal 1, Objectives 1.5; Goal 3, Objectives 3.2, 3.3, 3.4
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	$250,000 - $750,000
Potential Funding Sources:	General funds, CIP, Virginia CFPF, HRPDC
Lead Agency/Department Responsible:	Office of Resilience, Public Works, EOC
Implementation Schedule:	Ongoing
COMMENTS	
The City of Norfolk was awarded a $315,000 grant from the Virginia CFPF for this and related efforts. The HRPDC was the recipient of a grant to install multiple storm sensors throughout Hampton Roads, including five in Norfolk.	

PORTSMOUTH

PORTSMOUTH MITIGATION ACTION 1	
Develop a post-disaster continuity of operations plan to assist in more rapid recovery after a disaster.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	By identifying post-disaster processes for almost all City department functions across an array of hazard events, and putting these processes on paper, the plan would aid staff and temporary staff in keeping processes running smoothly and not contributing to additional conflicts.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 1, Objectives 1.4, 1.5; Goal 3
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	$25,000
Potential Funding Sources:	Staff time, DHS planning grants, HMGP 5% Initiative; ARPA
Lead Agency/Department Responsible:	Emergency Management, Planning, Permits & Inspections, Engineering, Public Works
Implementation Schedule:	Phase II is being planned and awaiting funding
ADDITIONAL COMMENTS	
Identifying post-disaster processes/functions for all departments could feed into a recovery plan for future disasters.	

PORTSMOUTH MITIGATION ACTION 2	
Designate non-flood-prone pickup points within the city evacuation zones to assist citizens who must rely on alternative or public transportation to evacuate.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	As seen with Hurricane Katrina, the evacuation of large numbers of residents after a hazard event has already commenced adds layers of difficulty and danger. Promoting and providing safe pickup points will reduce hazards to citizens.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Objectives 1.4, 1.5; Goal 3
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High – The majority of the City's repetitive flood loss areas Very High or Relatively High NRI flood risk.
Estimated Cost:	Staff time for identification of population centers and publicizing the pickup points
Potential Funding Sources:	City budgets
Lead Agency/Department Responsible:	Emergency Management, Planning
Implementation Schedule:	Within 2 years
ADDITIONAL COMMENTS	
Locations have been established for hurricane evacuation, along with agreement with HRT to help in an event. More robust analysis is needed to refine pickup points and also determine points of distribution during an emergency.	

PORTSMOUTH MITIGATION ACTION 3	
Hurricane/flood outreach/education to residents and businesses. Determine new and best way(s) to get information to the most vulnerable and least connected residents.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Protection of personal property and lives.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 2, Objective 2.1
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High – The majority of the City's repetitive flood loss areas Very High or Relatively High NRI flood risk.
Estimated Cost:	$20,000
Potential Funding Sources:	City budgets; use free FEMA materials when available; HMGP 5% Initiative; Virginia CFPF
Lead Agency/Department Responsible:	Emergency Management, Planning
Implementation Schedule:	Continuous
ADDITIONAL COMMENTS	
Flyers have been used in the past, primarily on topic of flooding with some information on hurricanes. These are sent out to those in the flood zones. Fire Dept sends out notifications on social media through City Marketing department.	

PORTSMOUTH MITIGATION ACTION 4	
Identify sources and evaluate use of available data to pinpoint the location of persons with disabilities for mitigation, evacuation, response, recovery.	
BACKGROUND INFORMATION	
Site and Location:	Citywide areas of high social vulnerability
Cost Benefit:	Protection of persons with disabilities before, during and after hazard events has broad benefits for protecting lives and property.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 1, Objectives 1.4, 1.5; Goal 3, Objective 3.2
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	To be determined as projects are identified.
Potential Funding Sources:	City budgets; DHS: HMGP 5% Initiative
Lead Agency/Department Responsible:	Planning, GIS
Implementation Schedule:	Within 2 years
ADDITIONAL COMMENTS	
City contractor will review available data sources on vulnerability indices as potential addendum to this plan. Certain data is difficult to obtain because of privacy concerns (e.g. health department raw data).	

PORTSMOUTH MITIGATION ACTION 5	
Implement additional flood monitoring stations to track real-time water levels in targeted areas to support response efforts. Leverage regional efforts to determine best technology, including cost effectiveness analysis.	
BACKGROUND INFORMATION	
Site and Location:	Olde Towne/ Downtown, Paradise Creek/ Cradock
Cost Benefit:	Enable real-time assessment of flood levels which will allow more responsive warnings and alerts to be broadcast.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Objectives 1.3, 1.4, 1.5; Goal 3, Objective 3.2
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	High – The majority of the City's repetitive flood loss areas Very High or Relatively High NRI flood risk.
Estimated Cost:	$80,000 plus $10,000 annual maintenance
Potential Funding Sources:	USGS, FEMA, State, City budgets; DHS: HMGP 5% Initiative
Lead Agency/Department Responsible:	Planning, Emergency Management, HRPDC
Implementation Schedule:	Within 5 years
ADDITIONAL COMMENTS	
System in place to collect and report data. Still in process of improving functionality of software.	

PORTSMOUTH MITIGATION ACTION 6	
Systematically track and map areas that sustain non-tidal flooding and "sunny day" flooding, with focus on currently flooded streets and areas susceptible to future flooding. Allow community to sign up for notifications when streets flood and pair floodwater sensors with rain gauge data to improve prediction capability. Expand number of sensors.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Tracking where flooding actually occurs will allow mitigation action and projects to be directed to those areas. Flooded roads reduce functionality of transportation system, hampering commerce and emergency response.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 3, Objective 3.2
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	High – The majority of the City's repetitive flood loss areas Very High or Relatively High NRI flood risk.
Estimated Cost:	Staff time
Potential Funding Sources:	City CIP budget
Lead Agency/Department Responsible:	Engineering, Planning, Emergency Management, Public Works, GIS; DHS: HMGP 5% Initiative; Virginia CFPF
Implementation Schedule:	Continuous
ADDITIONAL COMMENTS	
Desired expansion of existing sensors should focus on accuracy and cost effectiveness.	

PORTSMOUTH MITIGATION ACTION 7	
Protect City's critical infrastructure: 1) implement Citywide drainage improvement projects; 2) elevate city emergency generators above the base flood elevation plus 2 feet freeboard; 3) retrofit/elevate/relocate existing facilities to provide future flood protection.	
BACKGROUND INFORMATION	
Site and Location:	Citywide. Specific examples include Old Town Stormwater Pump Station, new pump station being planned, and Frederick Boulevard corridor upgrades.
Cost Benefit:	Frequent flooding in these areas damages cars, structures and contents. Damages to city infrastructure will also be reduced.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.4, 1.5
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	High – The majority of the City's repetitive flood loss areas Very High or Relatively High NRI flood risk.
Estimated Cost:	$500,000,000
Potential Funding Sources:	City CIP budget, stormwater funds, FEMA, State; DHS: HMGP
Lead Agency/Department Responsible:	Engineering, Public Works
Implementation Schedule:	Long term; as funding becomes available
ADDITIONAL COMMENTS	
Long-term program. Several projects (e.g. Street drainage, sea-wall, pump station etc.) have been initiated.	

PORTSMOUTH MITIGATION ACTION 8	
Implement action items from 2015 Floodplain Management Plan and Repetitive Flood Loss Plan.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Each action has separate costs and benefits identified in Plan. FEMA will now fund hazard mitigation projects that include sea level rise estimates.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Goal 2, Goal 3
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	High – The majority of the City's repetitive flood loss areas Very High or Relatively High NRI flood risk.
Estimated Cost:	As shown in the plan
Potential Funding Sources:	City budgets, DHS: BRIC, HMGP, Severe Repetitive Loss, stormwater funds; Virginia CFPF
Lead Agency/Department Responsible:	Planning, Emergency Management
Implementation Schedule:	Ongoing. Some long-term as funding available
ADDITIONAL COMMENTS	
Not planning to update the 2015 plan as City as largely transitioned to regional hazard mitigation plan for this role and future Plan/Strategies to be developed.	

PORTSMOUTH MITIGATION ACTION 9	
Mitigate flood-prone and repetitive flood loss structures. Mitigation measures may include acquisition, relocation, elevation, or other retrofit measures to provide flood protection. This action includes Mitigation Reconstruction projects. Develop a guide or adapt an existing manual that advises residents/property owners how they can retrofit their buildings for increased sustainability and resiliency.	
BACKGROUND INFORMATION	
Site and Location:	Within the City's flood zones
Cost Benefit:	Benefits for individual structures are based on the average annual damages, which is based on the structure's lowest floor elevation and frequency of flooding. FEMA will now fund hazard mitigation projects that include sea level rise estimates.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	High – The majority of the City's repetitive flood loss areas Very High or Relatively High NRI flood risk.
Estimated Cost:	$10,000 to $200,000 per structure (paid by citizen or through grant funds obtained by citizen)
Potential Funding Sources:	DHS: BRIC, HMGP, FMA, RFC; Virginia CFPF
Lead Agency/Department Responsible:	Planning, Emergency Management
Implementation Schedule:	Continuous
ADDITIONAL COMMENTS	
At this time, City does not desire to pay for mitigation of individual structures. City intends to provide options, knowledge/technical support, resources and information to support residents in individual efforts.	

PORTSMOUTH MITIGATION ACTION 10	
Determine whether Repetitive Flood Loss properties have been mitigated.	
BACKGROUND INFORMATION	
Site and Location:	Repetitive flood loss areas throughout the City
Cost Benefit:	Repetitively flooded structures strain local and federal resources after disasters, and detract from the fiscal solvency of the NFIP. The NFIP focuses mitigation efforts and funds on properties listed as repetitive losses; therefore, checking the accuracy of the list is a necessity for the NFIP, States and, through this action, local governments.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1; Goal 3, Objective 3.2
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High – The majority of the City's repetitive flood loss areas Very High or Relatively High NRI flood risk.
Estimated Cost:	Staff time estimated at $50 per structure x 220 structures = $11,000
Potential Funding Sources:	DHS: BRIC, HMGP, HMGP 5% Initiative, FMA, RFC
Lead Agency/Department Responsible:	Planning
Implementation Schedule:	Continuous
ADDITIONAL COMMENTS	
City is continuing to track homeowner efforts via permitting process. FEMA has not made any additional data available on RL/SRL properties.	

PORTSMOUTH MITIGATION ACTION 11	
Advocate for improved and increased grants for mitigation activities from State and Federal sources.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	The current processes are long and cumbersome. More streamlined processes and access to mitigation funds will aid in the mitigation of flooded properties and areas.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 3, Objectives 3.1, 3.2, 3.3, 3.4
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	Staff time
Potential Funding Sources:	City budgets
Lead Agency/Department Responsible:	Planning, Emergency Management, Permits & Inspections, Engineering
Implementation Schedule:	Continuous
ADDITIONAL COMMENTS	
City would prefer HMGP funds benefit citizens directly for improvements on private property and to provide additional avenues for mitigation efforts.	

PORTSMOUTH MITIGATION ACTION 12	
Review and revise City's series of procedures and pre-approved messages to ensure that Code sections do not conflict and do not hamper recovery efforts and that permitting is streamlined and efficient. Leverage technology to facilitate prompt permit processing during or after an event using mobile and electronic means.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Ensuring that processes are in place prior to a disaster event will speed recovery and increase the community's resilience.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Winter Storm, Wildfire, Earthquake
Goal(s) Addressed:	Goal 1; Goal 3, Objective 3.1
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	Staff time
Potential Funding Sources:	City budgets; DHS: HMGP 5% Initiative
Lead Agency/Department Responsible:	Planning, Permits & Inspections, Engineering, Public Works, Emergency Management
Implementation Schedule:	Within 5 years
ADDITIONAL COMMENTS	

PORTSMOUTH MITIGATION ACTION 13	
Review existing plans to ensure that they integrate mitigation concepts. Ensure that future plans integrate mitigation concepts detailed in the Hazard Mitigation Plan.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Ensuring that plans incorporate mitigation concepts and strategies will aid the City's resilience.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 3, Objective 3.1
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	Staff time
Potential Funding Sources:	City budgets
Lead Agency/Department Responsible:	Planning, Permits & Inspections, Engineering, Public Works, Emergency Management
Implementation Schedule:	Ongoing as new plans are developed
ADDITIONAL COMMENTS	
Build One Portsmouth Comp Plan adopted was successful implementation of this concept.	

PORTSMOUTH MITIGATION ACTION 14	
Implement green infrastructure for flood and stormwater abatement.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Green infrastructure can be a cost-effective approach for improving water quality and can provide multiple environmental, economic, and community benefits. Under HMGP grants, additional benefits from environmental or ecosystem benefits may be included in the benefits cost analysis.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.6
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	High – The majority of the City's repetitive flood loss areas Very High or Relatively High NRI flood risk.
Estimated Cost:	To be determined
Potential Funding Sources:	City CIP budget, stormwater funds, FEMA, EPA, State; DHS: HMGP, BRIC; Virginia CFPF
Lead Agency/Department Responsible:	Planning, Engineering, Public Works
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
Some projects are being initiated (*e.g.* Court Street Improvements). Future projects are prioritizing the use of green infrastructure.	

PORTSMOUTH MITIGATION ACTION 15	
Replace the Seawall.	
BACKGROUND INFORMATION	
Site and Location:	Downtown
Cost Benefit:	The Portsmouth waterfront seawall and bulkhead is a major element of the downtown waterfront. It is aging and in need of replacement to ensure safety of citizens and visitors. It is impacted daily by pedestrian and vessel use, weather and the waters of the river.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.5; Goal 3
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High
Estimated Cost:	$20,000,000
Potential Funding Sources:	City CIP budget, stormwater funds, FEMA, State
Lead Agency/Department Responsible:	Engineering
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
Significant components of the seawall have been replaced; project is approximately 75% complete.	

PORTSMOUTH MITIGATION ACTION 16	
Create dialogs with other governmental (e.g. HRT, HRSD, Port of Virginia) and non-governmental (e.g. Dominion Virginia Power, Verizon, etc) stakeholders to encourage and coordinate incorporation of mitigation strategies into projects and policies that affect Portsmouth's citizens and visitors.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Ensuring that our partner organizations incorporate mitigation concepts and strategies into their projects and policies will aid the City's resilience.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Tornado, Winter Storm, Earthquake, Wildfire, Hazardous Materials Incident
Goal(s) Addressed:	Goal 3
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	Staff time
Potential Funding Sources:	City budgets; DHS: HMGP 5% Initiative
Lead Agency/Department Responsible:	Planning, Engineering, Emergency Management
Implementation Schedule:	Continuous
ADDITIONAL COMMENTS	
Coordination is ongoing as the City leverages regional meetings to promote mutually beneficial projects. As an example, Dominion has undergounded assets due to high wind assessment in the Churchland area. The recently completed regional Joint Land Use Study with the City of Chesapeake and the U.S. Navy is another example.	

PORTSMOUTH MITIGATION ACTION 17	
Develop inventory of first floor elevations (and possibly Elevation Certificates) of structures in flood zones in low- to moderate-income housing areas.	
BACKGROUND INFORMATION	
Site and Location:	Citywide low to moderate areas
Cost Benefit:	In order to assess any potential mitigation actions, first floor elevations (at a minimum) will be needed. Assisting low to moderate income homeowners to obtain this information will allow these structures to be protected from future flooding.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding
Goal(s) Addressed:	Goal 1; Goal 3, Objective 3.2
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	High – The majority of the City's repetitive flood loss areas Very High or Relatively High NRI flood risk.
Estimated Cost:	To be determined
Potential Funding Sources:	USACE, FEMA, HUD; DHS: HMGP 5% Initiative
Lead Agency/Department Responsible:	Planning
Implementation Schedule:	Within 5 years
ADDITIONAL COMMENTS	
City and corporate partners are initiating a new project to provide accurate data collection for a large number of structures in a short timeframe.	

PORTSMOUTH MITIGATION ACTION 18	
Continue implementing City's Heat Injury Prevention Plan and position cool buildings for easiest access by high vulnerability populations and neighborhoods.	
BACKGROUND INFORMATION	
Site and Location:	High vulnerability areas citywide
Cost Benefit:	This low cost plan, when implemented, prevents heat injuries by making existing City buildings available to people without access to air conditioning.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Extreme Heat, Tropical/Coastal Storm (and associated power outages)
Goal(s) Addressed:	Goal 1: Objectives 1.4, 1.5; Goal 2
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	Facility operating costs and minimal staff time to prepare outreach
Potential Funding Sources:	Facility operating costs/utilities
Lead Agency/Department Responsible:	Emergency Management
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

SUFFOLK

SUFFOLK MITIGATION ACTION 1	
Protect repetitively flooded infrastructure and structures through elevation, acquisition, relocation, retrofits or repurposing. Other structural means are included, as appropriate, for protecting critical infrastructure. This action includes Mitigation Reconstruction projects.	
BACKGROUND INFORMATION	
Site and Location:	Throughout the City
Cost Benefit:	In rural areas of the city, roads flood each time there is a significant rainfall. In the urban downtown, commercial structures flood frequently. FEMA now funds hazard mitigation projects that include sea level rise estimates.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.4, 1.5
Priority (High, Moderate, Low):	Low
Impact on Socially Vulnerable Populations:	Low/Moderate - Repetitive flood loss areas at Bennetts Creek Ln, Yeates Drive and Bracey Drive have relatively moderate NRI flood risk, which includes analysis of social vulnerability. All other repetitive loss areas are rated Low.
Estimated Cost:	$10,000 to $200,000 per structure; infrastructure protection costs to be determined
Potential Funding Sources:	DHS: BRIC, HMGP, FMA, RFC; Virginia CFPF
Lead Agency/Department Responsible:	Emergency Management and Public Works
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

SUFFOLK MITIGATION ACTION 2	
Provide emergency power to critical infrastructure, critical facilities and critical roadway intersections during extended power outages. Increase emergency generator capabilities at school facilities used as shelters to meet ADA functional needs requirements.	
BACKGROUND INFORMATION	
Site and Location:	Throughout the City
Cost Benefit:	Maintaining basic city functions in the aftermath of both major and minor events is important for the safety of citizens and the environment. Emergency power is mandatory at the shelters to address access and medical equipment that requires electricity. Under new guidance, FEMA will now fund hazard mitigation projects that include sea level rise estimates.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 1, Objectives 1.3, 1.4
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	$500,000
Potential Funding Sources:	Existing Budgets; DHS: HMGP, HMGP 5% Initiative
Lead Agency/Department Responsible:	Public Utilities, Public Works, Facility Management
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
City Hall, Public Works Operations, and Public Works Operations Yards at Whaleyville, Holland and Chuckatuck all have emergency backup generators installed and functional. 36 traffic signals have backup gas generators and 22 signals have battery only backup. New requirement mandates any new signal built or rehabilitated must have a permanent backup generator.	

SUFFOLK MITIGATION ACTION 3	
Provide hurricane and flood outreach and education materials to residents within the City to make flood protection information available to property and business owners and renters.	
BACKGROUND INFORMATION	
Site and Location:	Throughout City floodplains, with materials available at public libraries, recreation centers and City Hall
Cost Benefit:	Protection of personal property and lives
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Objectives 1.2, 1.5; Goal 2
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	$2500
Potential Funding Sources:	Existing budgets; use free FEMA materials; DHS: HMGP 5% Initiative
Lead Agency/Department Responsible:	Emergency Management
Implementation Schedule:	Within 2 years
ADDITIONAL COMMENTS	

SUFFOLK MITIGATION ACTION 4	
Continue to implement capital improvements that improve stormwater management and control flooding, especially for undersized and out-of-date drainage systems and patterns. This action includes all initiatives identified in the 2022 Resilience Plan.	
BACKGROUND INFORMATION	
Site and Location:	City-wide. Projects mitigate flooding and run-off problems throughout the City, including drainage projects previously identified and planned such as Oldetown Drainage Project and Oakland Drainage Project
Cost Benefit:	Annual damage occurs to homes and business in vulnerable areas due to poor drainage. Additional green infrastructure values from environmental or ecosystem benefits should be included in the benefits cost analysis.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Landslide/Coastal Erosion
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.4, 1.5; Goal 3, Objective 3.1
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low/Moderate - Repetitive flood loss areas at Bennetts Creek Ln, Yeates Drive and Bracey Drive have relatively moderate NRI flood risk, which includes analysis of social vulnerability. All other repetitive loss areas are rated Low.
Estimated Cost:	Estimated $1,000,000 annually, but variable based on several factors
Potential Funding Sources:	General funds, DHS: BRIC, HMGP, Private funds; Virginia CFPF
Lead Agency/Department Responsible:	Public Works
Implementation Schedule:	Ongoing

COMMENTS
Hazard Mitigation Grants should be considered as a potential funding source and used as a basis for property protection.

SUFFOLK MITIGATION ACTION 5	
Develop a Resilience Plan that incorporates a stormwater drainage plan to address issues in flood-prone areas; prioritize and implement plan recommendations. This action includes all initiatives identified in the 2022 Resilience Plan.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Flooding as a result of stormwater accumulation can exacerbate coastal flooding, contributing to flood damages of cars, structures, roads and other infrastructure. Nuisance flooding can result in businesses closed down. Additional green infrastructure values from environmental or ecosystem benefits should be included in the benefits cost analysis.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.4, 1.5
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low/Moderate - Repetitive flood loss areas at Bennetts Creek Ln, Yeates Drive and Bracey Drive have relatively moderate NRI flood risk, which includes analysis of social vulnerability. All other repetitive loss areas are rated Low.
Estimated Cost:	$250,000 to $3,000,000
Potential Funding Sources:	General funds; Virginia CFPF
Lead Agency/Department Responsible:	Planning and Public Works
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

SUFFOLK MITIGATION ACTION 6	
Continue strengthening the City's Floodplain Management Program with the following actions: **1) Reviewing and adopting State Model Floodplain Ordinance, including 1 foot freeboard elevation requirement;** **2) Incorporating floodplain requirements into permit process with information in the online FAQs, BFE required on the building permit application (as required by NFIP), creating and posting online standardized forms for substantial improvement/damage determination;** **3) Providing specialized training and support Certified Floodplain Manager (CFM) certification for applicable City staff;** **4) Preparing educational materials in the permit office on the value of flood insurance, freeboard and NFIP compliance; and,** **5) Continuing participation in the Severe Repetitive Loss program.**	
BACKGROUND INFORMATION	
Site and Location:	Floodplains throughout the City
Cost Benefit:	• The NFIP has a proven record of reducing annual flood damages through floodplain regulations that guide design of flood-prone properties. • Freeboard - More stringent measures for flood prone structures have a very small upfront cost that is recovered within approximately 10 years through lower flood insurance costs. The reduction in average annual damages with just 1 foot of freeboard is substantial.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.5; Goal 2; Goal 3
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low/Moderate - Repetitive flood loss areas at Bennetts Creek Ln, Yeates Drive and Bracey Drive have relatively moderate NRI flood risk, which includes analysis of social vulnerability. All other repetitive loss areas are rated Low.
Estimated Cost:	Staff time
Potential Funding Sources:	Negligible
Lead Agency/Department Responsible:	Planning (lead) and Public Works
Implementation Schedule:	Within 4 years
ADDITIONAL COMMENTS	

SUFFOLK MITIGATION ACTION 7	
Verify the geographic location of each NFIP repetitive loss property, and determine if that property has been mitigated and, if so, by what means.	
BACKGROUND INFORMATION	
Site and Location:	Repetitive flood loss areas throughout the City
Cost Benefit:	Repetitively flooded structures strain local and federal resources after disasters, and detract from the fiscal solvency of the NFIP. The NFIP focuses mitigation efforts and funds on properties listed as repetitive losses; therefore, checking the accuracy of the list is a necessity for the NFIP, States and, through this action, local governments.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding and Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Objective 1.1; Goal 3, Objective 3.2
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low/Moderate - Repetitive flood loss areas at Bennetts Creek Ln, Yeates Drive and Bracey Drive have relatively moderate NRI flood risk, which includes analysis of social vulnerability. All other repetitive loss areas are rated Low.
Estimated Cost:	Staff time estimated at $100 per structure x 13 structures = $650
Potential Funding Sources:	DHS: BRIC, HMGP, HMGP 5% Initiative, FMA, RFC; VDEM
Lead Agency/Department Responsible:	Planning
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
An initial attempt to contact property owners by mail will be followed up by phone calls, and site visits as necessary. Receipt of data from FEMA or State officials is problematic.	

SUFFOLK MITIGATION ACTION 8	
Retrofit Primary Shelters in the City to conform to the Ultimate Design Wind Speed for Risk Category 3 structures as referenced in the current edition of the Uniform Statewide Building Code, Part 1 (USBC).	
BACKGROUND INFORMATION	
Site and Location:	Citywide locations
Cost Benefit:	According to the Suffolk Public Schools Director of Facilities, none of the schools in the City designated as shelters are engineered to withstand winds greater than 90 mph. A Category 2 or greater hurricane would result in residents having to take shelter outside the City. Transportation costs for such an evacuation would be staggering.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Flooding Due to Impoundment Failure/High Hazard Dam, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Tornado, Winter Storm, Earthquake, Wildfire, Hazardous Materials Incident, Extreme Heat
Goal(s) Addressed:	Goal 1, Objectives 1.3, 1.4, 1.5
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	To be determined
Potential Funding Sources:	Capital budgets; DHS
Lead Agency/Department Responsible:	Capital Programs Director and Public Schools Director of Facilities and Planning
Implementation Schedule:	5 to 7 years
ADDITIONAL COMMENTS	
Hurricane shutters may provide a partial solution for some structures at a lower cost than complete retrofits.	

SUFFOLK MITIGATION ACTION 9	
Install markers indicating the flood water depth along streets or roads subject to tidal, riverine or urban flooding.	
BACKGROUND INFORMATION	
Site and Location:	Flood prone areas citywide; City is developing a program to prioritize the installation of these signs starting with the arterial and collector highways and priority routes within the City's urbanized area.
Cost Benefit:	Elevated water levels in recent weather events have caused damage and down time to emergency vehicles while responding to calls for assistance. These markers can also be useful during droughts to indicate low water levels.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Drought
Goal(s) Addressed:	Goal 1, Objective 1.5; Goal 2
Priority (High, Moderate, Low):	Low
Impact on Socially Vulnerable Populations:	Low/Moderate - Repetitive flood loss areas at Bennetts Creek Ln, Yeates Drive and Bracey Drive have relatively moderate NRI flood risk, which includes analysis of social vulnerability. All other repetitive loss areas are rated Low.
Estimated Cost:	<$10,000
Potential Funding Sources:	Public Works annual operating budget; DHS: BRIC, HMGP 5% Initiative; Virginia CFPF
Lead Agency/Department Responsible:	Traffic Engineering, Emergency Management
Implementation Schedule:	3 to 5 years
ADDITIONAL COMMENTS	
Other alternatives considered included developing a policy regarding emergency vehicle operations on flooded streets or roads; however, flood depth markers would have added benefits by alerting a broader audience of citizens and commuters regarding areas with unsafe water levels for driving. Savings of up to $5,000 per City vehicle in repairs could be realized.	

SUFFOLK MITIGATION ACTION 10	
Retrofit the East Suffolk Recreation Center with an emergency generator to support shelter operations for that section of the City.	
BACKGROUND INFORMATION	
Site and Location:	East Suffolk
Cost Benefit:	When school is in session, using a school as a shelter is a conflict. The Recreation Center is a potential alternative. Also, this center would add a second ADA-compatible shelter to the City's shelter inventory, increasing accessibility for persons with disabilities.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Tornado, Winter Storm, Earthquake, Wildfire, Extreme Heat, Hazardous Materials Incident
Goal(s) Addressed:	Goal 1, Objectives 1.3, 1.4
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Low/Moderate - Repetitive flood loss areas at Bennetts Creek Ln, Yeates Drive and Bracey Drive have relatively moderate NRI flood risk, which includes analysis of social vulnerability. All other repetitive loss areas are rated Low.
Estimated Cost:	$7500
Potential Funding Sources:	Capital Budget (for generator), Mitigation Grant (for quick-connect); DHS: HMGP 5% Initiative
Lead Agency/Department Responsible:	Capital Programs and Facilities, Department of Parks and Recreation
Implementation Schedule:	5 to 7 years
ADDITIONAL COMMENTS	

SUFFOLK MITIGATION ACTION 11	
Work with the owner to rehabilitate Godwin's Millpond Dam.	
BACKGROUND INFORMATION	
Site and Location:	6145 Godwin Boulevard, Suffolk
Cost Benefit:	Potential impacts of dam failure include: 1 roadway (Route 10 for .04 miles downstream), 1 home, and 3 businesses. The dam impounds 165.00 acre-feet at normal pool.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding due to Impoundment Failure/High Hazard Dam, Flooding
Goal(s) Addressed:	Goal 1, Objective 1.3
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Relatively Low
Estimated Cost:	To be determined based on additional inspection and analysis of retrofits needed.
Potential Funding Sources:	FEMA: HHPD; owner resources; CIP
Lead Agency/Department Responsible:	Fire & Rescue
Implementation Schedule:	3 to 5 years
ADDITIONAL COMMENTS	
Godwin's Millpond Dam was assessed "poor" in 2018 by DCR. The high hazard potential earthen dam is located along Chuckatuck Creek and has a drainage area of 6.87 square miles.	

VIRGINIA BEACH

VIRGINIA BEACH MITIGATION ACTION 1	
Relocate the ComIT Data Center.	
BACKGROUND INFORMATION	
Site and Location:	ComIT Data Center, Building 2, 2405 Courthouse Drive
Cost Benefit:	There have historically been marginal flooding problems in Building 2 that included: 1) Flooding from a leak in the fire sprinkler system on 1st floor. 2) Flooding from leaks in the roof's drainage system. 3) Water backup on the Data Center sub-floor, due to the drainage system, which has occurred on multiple occasions. 4) In 2004, there were two occasions of flooding due to equipment failure in Building 1 where damage and loss of service was avoided only because on-site staff discovered the flood before water reached the Data Center. 5) During Hurricane Isabel, it was necessary to shut down all computer systems in Data Center and physically move equipment to 2nd floor. Moving equipment carries associated risks and at least two servers were corrupted during process.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Winter Storm
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.4, 1.5
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	To be determined
Potential Funding Sources:	DHS: HMGP, FMA, BRIC, RFC; Existing budgets
Lead Agency/Department Responsible:	ComIT
Implementation Schedule:	Within 1.5 years
ADDITIONAL COMMENTS	
In recent years, the importance of data management to overall City operations has increased the priority of this action. Project is nearing completion. Building 2 construction is in progress. The COMIT Data Center is relocating from the basement of Building 2 to the third floor of Building 2. This work is part of the Building 1, 2 & 11 Phase I Renovation which began in February 2021. The third floor and IT pathways are estimated to be completed in the first quarter of calendar 2022. Installation and turn up of IT equipment is estimated to be complete by the third quarter of calendar year 2022 or sooner.	

VIRGINIA BEACH MITIGATION ACTION 2	
Strengthen the City's Floodplain Management Program with the following actions: 1) Continue participating in the National Flood Insurance Program. Continue enforcement of standards in existing floodplain management ordinance that meet and exceed NFIP minimum requirements; 2) Incorporate floodplain management tools/regulations into existing development review procedures; 3) Continue participation in the Community Rating System in order to reduce property owner premiums for flood insurance; 4) Provide specialized training and support Certified Floodplain Manager (CFM) certification for floodplain plan reviewers, inspectors and permit processors; 5) Prepare educational materials in the permit office on the value of flood insurance, freeboard and NFIP compliance; 6) Participate in the Severe Repetitive Loss program to mitigate flood-prone structures; and, 7) Consider changes to floodplain management ordinance to regulate repetitive flood losses and increase ICC availability, limit the size of enclosures beneath elevated structures in coastal high hazard areas, map and regulate a future conditions 100-year floodplain, and regulate Coastal A Zones to Zone V standards.	
BACKGROUND INFORMATION	
Site and Location:	Floodplains throughout the City
Cost Benefit:	• The NFIP has a proven record of reducing annual flood damages through floodplain regulations that guide design of flood-prone properties. • The large number of flood-prone properties and repetitive flood losses in Virginia Beach merits additional investigation to determine what measures have been taken by property owners to protect structures and what additional measures may have measurable benefits.

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Objective 1.2; Goal 2, Goal 3
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate/High – Most of the City's repetitive flood loss areas are in NRI Relatively Moderate, Relatively High or Very High Flood Risk areas. Exceptions are areas behind Brandon Middle School, near Paca Lane/Newtown Road, Thalia Shores, and Thoroughgood neighborhoods.
Estimated Cost:	Staff time
Potential Funding Sources:	DHS: HMGP, FMA, BRIC; Virginia CFPF
Lead Agency/Department Responsible:	Planning and Public Works
Implementation Schedule:	Ongoing

ADDITIONAL COMMENTS
-The City officially entered the CRS program as a Class 7 on May 1, 2019. - There are currently 8 CFMs within the Planning and Community Development Department and 3 CFMs employed within other City departments. Additionally, one of our CFMs serves as a board member of the Virginia Floodplain Management Association. In 2021, the Planning and Community Development Department sent 5,000 annual NFIP letters to homeowners near and within identified repetitive flooding areas. - Annual floodplain and flood insurance information is available in the permits office as well as numerous other public offices. - The Office of Emergency Management applies for and manages elevation and acquisition projects for the severe repetitive loss program and continues to identify structures for future mitigation. Currently, OEM is performing elevations of 2 FEMA grants and acquisitions on 1 FEMA grant. Additionally, the City received an FY19 FMA grant award in November 2022 to elevate 6 residences.

VIRGINIA BEACH MITIGATION ACTION 3	
Create coalition of business owners, including some who have implemented mitigation actions in the past, to promote the value of hazard protection and help identify and implement retrofit/elevation/acquisition projects in the business community.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	The hardening of businesses supports their ability to recover from potential disasters, thereby helping sustain citizens' way of life in the aftermath of a hazard event.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Active Threat, Civil Unrest, Cyber Infrastructure Attack, Power Outage, Structure Fire, Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Landslide/Coastal Erosion, Winter Storm
Goal(s) Addressed:	Goal 1, Objective 1.1; Goal 2, Objective 2.1; Goal 3
Priority (High, Moderate, Low):	Low
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	Minimal
Potential Funding Sources:	Existing Budgets; DHS: BRIC, HMGP 5% Initiative; Private funds
Lead Agency/Department Responsible:	Emergency Management
Implementation Schedule:	Within 5 years
ADDITIONAL COMMENTS	
Two members of the Virginia Beach Emergency Management Office participated in the Resilient Enterprise Solutions (RES) Home Raising Academy, launched in Hampton Roads in 2020. Various commerce sectors participated in the Home Raising Academy including local government, construction, and real estate. The training curriculum included an introduction to the NFIP, Flood Maps, Elevation Certificates, Outreach, Proactive Selling, Financing & Insurance, and Home Elevation.	

VIRGINIA BEACH MITIGATION ACTION 4	
Better define what is considered a critical facility and update the City's critical facility list annually. Provide emergency power to critical infrastructure, critical facilities, pump stations and critical roadway intersections during extended power outages. Emergency power and quick connect wiring is needed for critical intersections. Generator capability is needed at multiple school facilities used as shelters.	
BACKGROUND INFORMATION	
Site and Location:	Critical Intersections identified by Police Department and Public Works Building 18: Human Resources (Has a partial building generator that supports the IT function). Various Stormwater Pump stations Various Sewer Pump stations Various Public Schools: Those designated as shelters, focusing on the high schools as the top priority.
Cost Benefit:	Maintaining basic city functions in the aftermath of both major and minor events is important for the safety of citizens and the environment. Emergency power is mandatory at the shelters to address access and medical equipment that requires electricity.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Active Threat, Civil Unrest, Complex Coordinated Terrorist Attack, Cyber Infrastructure Attack, Power Outage, Structure Fire, Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Tornado, Winter Storm, Earthquake, Extreme Heat
Goal(s) Addressed:	Goal 1, Objectives 1.3, 1.4, 1.5; Goal 3, Objective 3.1
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	$3,500,000
Potential Funding Sources:	Existing Budgets; DHS: HMGP, HMGP 5% Initiative
Lead Agency/Department Responsible:	Public Utilities, Public Works, Sheriff, Emergency Management
Implementation Schedule:	Ongoing

ADDITIONAL COMMENTS
Generator projects at the Central Plant and EMS Headquarters have been completed. Central Plant Generator- $5.3 million project cost. Work substantially completed June 23, 2021. This included the instillation of 2 (n+1) generators for 100% back-up power of the Municipal Center central heat/cooling plant. This will enable uninterrupted heat and air conditioning to be provided to City Hall, Operations Buildings, School Administration Building, the Police Department (VB Police Head Quarters and 1st Precinct), the Correctional Center, and the Juvenile Detention Center. The Correctional Center Buildings (7A, 7B, and &C) all have whole building generator back-up. Building 21: Fire Administration has a partial building generator for emergency lighting. EMS HQ Generator- $472,000 project cost. Work substantially completed July 13, 2020. The project provided for whole building generator power for the backup emergency communications (911/311) center and backup emergency operations center (EOC) at the EMS Headquarters Building located at 4160 Virginia Beach Boulevard.

VIRGINIA BEACH MITIGATION ACTION 5	
Design or retrofit public safety facilities vulnerable to wind damage and/or flooding.	
BACKGROUND INFORMATION	
Site and Location:	Three EMS volunteer facilities are vulnerable to flooding or wind damage. EMS Rescue 1 is vulnerable to flooding. EMS Rescue 8 and 14 are vulnerable to wind load hazards. EMS Headquarters is not designed for wind load hazard.
Cost Benefit:	EMS Rescue 1, 8, and 14 are volunteer owned public safety facilities built on city land through long term lease agreements and offer critical life-safety operations. EMS Headquarters is a city owned building that houses the backup emergency communications (911 / 311) center and the backup emergency operations center (EOC) along with EMS Administration and Training. Vulnerability to flooding and wind damage could threaten the availability of this capability during a flood or high wind event.

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Active Threat, Civil Unrest, Complex Coordinated Terrorist Attack, Cyber Infrastructure Attack, Power Outage, Structure Fire, Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Winter Storm
Goal(s) Addressed:	Goal 1, Objectives 1.2, 1.3, 1.4, 1.5
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Project dependent
Estimated Cost:	To be determined
Potential Funding Sources:	DHS: HMGP, Virginia CFPF
Lead Agency/Department Responsible:	Public Works and Public Safety Departments
Implementation Schedule:	Long-term, over a 15-year period

ADDITIONAL COMMENTS
The city has conducted formal analyses of critical facilities and HMGP grants were obtained to harden some facilities. As HMGP funds become available through the State, additional grant requests should be prepared and ready to submit for "shovel-ready" projects. Older public safety facilities are incorporating retrofits as repairs are scheduled. New facilities are built to current standards with freeboard making them more resistant to flooding. All are designed to sustain up to 117mph winds.

VIRGINIA BEACH MITIGATION ACTION 6	
Provide educational outreach to residents to increase awareness of vulnerability to multiple hazards and preventative actions that can be taken. Focus on hurricane preparedness, sea level rise and flooding.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	By training community leaders in how to protect hazard-prone properties, the City spreads information on the value of retrofitting directly to those in need at low cost.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All Hazards
Goal(s) Addressed:	Goal 2, Objective 2.1; Goal 3, Objective 3.1
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	$30,000
Potential Funding Sources:	DHS: HMGP, HMGP 5% Initiative; Operating Budget; FEMA materials available free
Lead Agency/Department Responsible:	Emergency Management and Communications
Implementation Schedule:	Within 2 years
ADDITIONAL COMMENTS	
The city has multiple programs and strategies for the dissemination of emergency preparedness information, but it is currently coming out of multiple offices and this will assist in streamlining the information. This action is part of Virginia Beach's strategy for continued compliance with the NFIP.	

VIRGINIA BEACH MITIGATION ACTION 7	
Replace, as necessary, and maintain the existing regional interoperable communications system.	
BACKGROUND INFORMATION	
Site and Location:	Citywide and Southside Hampton Roads region
Cost Benefit:	Modern interoperable communications systems support preparedness, response and recovery activities for all hazards.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Active Threat, Civil Unrest, Complex Coordinated Terrorist Attack, Cyber Infrastructure Attack, Power Outage, Structure Fire, Transportation Hazard-Incident, Flooding, Flooding Due to Impoundment Failure/High Hazard Dam, Tropical/Coastal Storm, Tornado, Winter Storm, Earthquake, Wildfire, Extreme Heat, Hazardous Materials Incident
Goal(s) Addressed:	Goal 2; Goal 3, Objectives 3.1, 3.3
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	$10,000,000
Potential Funding Sources:	DHS: HMGP, others; CIP
Lead Agency/Department Responsible:	ComIT
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
The city has modernized much of its communication systems to include interoperability of city systems, as well as regional systems. New systems require maintenance and replacement on a regular basis.	

VIRGINIA BEACH MITIGATION ACTION 8	
Protect Atlantic Ocean and Chesapeake Bay shorelines from storm damage. Continue work with the Army Corps of Engineers and other federal agencies to ensure ongoing maintenance of the Hurricane Protection Project and other maintained beaches within the city.	
BACKGROUND INFORMATION	
Site and Location:	Atlantic Ocean and Chesapeake Bay shorelines, particularly Resort Area and Sandbridge
Cost Benefit:	Severe and frequent shoreline erosion in this economically valuable area merits structural protection on an ongoing basis. Multiple project reports contain detailed information on the costs and benefits of these projects. City continues to provide beach replenishment as funds and projects allow, which continues to provide ongoing storm protection to $3 billion worth of homes and businesses from Rudee Inlet to Fort Story.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Sea Level Rise and Land Subsidence, Winter Storm; Landslide/Coastal Erosion
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.4, 1.5; Goal 3, Objectives 3.1, 3.3
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate/High
Estimated Cost:	Estimated $14,000,000 every ten years
Potential Funding Sources:	COE, CIP, Special Tax District, TGIF, SSD, TIF
Lead Agency/Department Responsible:	Public Works
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
In addition to maintaining existing “engineered beaches”, the City should seek additional beaches or shorelines to be considered for structural hardening. The City’s beach restoration program currently focuses on six key areas: Ocean Park Beach Restoration, Cape Henry Beach Restoration, Chesapeake Beach Replenishment, Resort Beach, Sandbridge Beach, and Croatan Beach.	

VIRGINIA BEACH MITIGATION ACTION 9	
Maintain a dam inventory and monitor the condition of dams within the City making improvements when needed. Develop a dam safety plan to address protection, preparedness, response, and rebuilding for high hazard dams and areas in dam inundation zones.	
BACKGROUND INFORMATION	
Site and Location:	Area downstream from dams in Virginia Beach
Cost Benefit:	Infrastructure in dam inundation zones is susceptible to flooding but may not be protected from flooding should a dam failure or breech occur.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Flooding Due to Impoundment Failure/High Hazard Dam
Goal(s) Addressed:	Goal 1, Objectives 1.2, 1.3, 1.4, 1.5, 1.6; Goal 3
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Project location dependent
Estimated Cost:	To be determined
Potential Funding Sources:	DHS: BRIC, FMA, RFC, HMGP, HMGP 5% Initiative, HHPD
Lead Agency/Department Responsible:	Public Works and Public Utilities
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
Virginia DCR is increasingly involved in this action and recent regulatory changes have affected which dams are regulated.	

VIRGINIA BEACH MITIGATION ACTION 10		
Improve and/or update alert, warning and notification capabilities. Potential capabilities include: **1) Utilizing the City's CRM registration portal and additional support services;** **2) Maintenance and addition of sensor installations for data collection as part of the VB StormSense Network to enhance Alexa voice assisted AI and intelligent predictive visualization platform.**		
BACKGROUND INFORMATION		
Site and Location:	Citywide	
Cost Benefit:	Low cost hazard notification through the use of cellular phones and computers can now reach large segments of the population quickly. Notifying residents of low-lying flood-prone areas before flooding occurs helps reduce flood damages to cars, structures, and possessions. Traffic problems associated with evacuations, frequent flooding and other hazard events can cause secondary economic disasters and major disruptions to citizens' lives in Hampton Roads.	
MITIGATION ACTION DETAILS		
Hazard(s) Addressed:		Flooding, Tropical/Coastal Storm, Tornado, Winter Storm, Landslide/Coastal Erosion, Earthquake, Wildfire, Extreme Heat, Hazardous Materials Incident
Goal(s) Addressed:		Goal 2
Priority (High, Moderate, Low):		Moderate
Impact on Socially Vulnerable Populations:		Low
Estimated Cost:		$1,000,000
Potential Funding Sources:		DHS: HMGP, HMGP 5% Initiative; Private funds; CFPF
Lead Agency/Department Responsible:		Emergency Management, IT, Communications
Implementation Schedule:		Improvements within 4 years; Ongoing Warning and Notification

ADDITIONAL COMMENTS
Action focuses on keeping up with new types of social media and the most modern methods of communicating with citizens in the event of a disaster. This action includes identification and real-time mapping of frequently flooded roads and will incorporate special planning regarding evacuation routes for persons with disabilities (nursing homes, assisted living facilities, hospitals). VB StormSense sensor network was established within a 3-year period and currently provides real-time water levels from 50 sensors in Virginia Beach at 6-minute intervals, including 10 USGS sensors. The data is currently used by Public Works in addition to 10 USGS Sensors for road closures and street-level flooding. Several sensors have flood levels of Action, Minor, Moderate and Major stages assigned. National Weather Service (NWS) at Wakefield is planning to add a few sensors to their Advanced Hydrologic Predication Service (AHPS). The data is currently accessed internally through mapping applications using mobile devices in near real-time. The system also provides real-time data through Alexa skill. The applications are planned for release in the first quarter of 2022. A subscription service for citizens is in development that will be connected with RAVE alerting system. A predictive visualization system is in early stages of development to support the mitigation goals. In 2019, the City entered into a partnership with WAZE for traffic notification to citizens for road closures due to natural hazards. In 2022 and beyond, Google/Waze is planning to provide the technical capabilities for CVB and their partners in our region to develop and implement communication of safety message templates to all drivers that use the Waze app within a partners geographical boundary. The messages will appear in the language that the user sets their Waze app to display. Qualified partners, such as CVB, may select one safety message to post quarterly in a partner's geographical area. The message will appear in the app when the vehicle is stopped for more than 10 seconds and automatically disappears with the first movement of the vehicle. Waze users may see the message twice per quarter. Waze will share the number of impressions made from the campaign on a monthly basis. Waze will be sharing more information with CVB and their partners about how to participate once they have the results and best practices to share from their launch partners (VDOT, Miami-Dade, LA County DPW, Penn Turnpike, and Mass DOT). - release date TBA. The City also obtained the RAVE alerting system in 2019 which has the ability to create a Smart 911 profile for a caller. The City is currently in the process of training staff on the RAVE alerting system and drafting an updated public alert and warning notification plan.

VIRGINIA BEACH MITIGATION ACTION 11	
Retrofit existing stormwater management system throughout the City into state-of-the-art facilities to minimize flooding after heavy storms while also addressing water quality objectives.	
BACKGROUND INFORMATION	
Site and Location:	Citywide. Over the last year, City commenced or completed actual stormwater and drainage improvement projects in 8 neighborhoods to retrofit aging undersized infrastructure and/or based on analysis by citywide master stormwater modeling in certain watersheds. Capital improvement program projects associated with these neighborhoods include: - Aragona Drainage Improvements - Ashville Park Drainage Improvements - Chubb Lake/Bradford Lake - College Park and Level Green Drainage Improvements - Eastern Shore Drive Drainage - Southern Canal/Lead Ditch - Windsor Woods Drainage
Cost Benefit:	Frequent flooding in the City is a result of numerous factors. Updating stormwater management facilities will help reduce both nuisance flooding of yards, roads and intersections, and more severe flooding that affects structures.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.4, 1.5
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate/High – Most of the City's repetitive flood loss areas are in NRI Relatively Moderate, Relatively High or Very High Flood Risk areas.
Estimated Cost:	To be determined
Potential Funding Sources:	Stormwater Management Program; DHS: BRIC, HMGP; Virginia CFPF
Lead Agency/Department Responsible:	Public Works
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
City currently has 36 active projects and programs in the Flood Control Section of the Stormwater Capital Improvement Program (CIP).	

VIRGINIA BEACH MITIGATION ACTION 12	
Mitigate incursion of storm surge and tidal inundation of low-lying areas. Investigate coastal barrier technologies and tidal stream diversion techniques.	
BACKGROUND INFORMATION	
Site and Location:	Shorelines and tidal tributaries Citywide
Cost Benefit:	Costs and benefits of various projects are continuously updated and compared. Projects are prioritized based on those that provide the greatest benefits to existing structures and infrastructure. Possible projects may include, but are not limited to: tide gates, check valves, or road/bridge/structure elevation. FEMA will now fund hazard mitigation projects that include sea level rise estimates.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.4, 1.5
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate/High – Most of the City's repetitive flood loss areas are in NRI Relatively Moderate, Relatively High or Very High Flood Risk areas.
Estimated Cost:	To be determined
Potential Funding Sources:	Stormwater Management Program; DHS: HMGP
Lead Agency/Department Responsible:	Public Works
Implementation Schedule:	Ongoing and Long Term
ADDITIONAL COMMENTS	
Nor'easters, hurricanes and tropical storms, and some severe thunderstorms produce heavy precipitation in low-lying areas, creating runoff that cannot flow into tidal bodies at high tide. As sea level rises over the long-term, areas affected by this problem are expected to increase. The City of Virginia Beach is developing plans to address both repetitive flooding and projected increases in flooding caused by sea level rise through the City's Comprehensive Sea Level Rise and Recurrent Flooding Response Plan. The plan is an effort between local government and various stakeholders (corporate and individual) to collect, sort, interpret, and understand the data behind how sea level rise is affecting our City and how we should best respond.	

VIRGINIA BEACH MITIGATION ACTION 13	
Elevate, acquire, relocate or retrofit structures in flood prone areas that have suffered repetitive flood damage. This action includes Mitigation Reconstruction projects.	
BACKGROUND INFORMATION	
Site and Location:	Within the City's flood-prone areas
Cost Benefit:	Benefits for individual structures are based on the average annual damages, which is based on the structure's lowest floor elevation and frequency of flooding. FEMA will now fund hazard mitigation projects that include sea level rise estimates.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm
Goal(s) Addressed:	Goal 1, Objective 1.1, 1.2, 1.3
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate/High – Most of the City's repetitive flood loss areas are in NRI Relatively Moderate, Relatively High or Very High Flood Risk areas.
Estimated Cost:	$50,000 to $300,000 per structure
Potential Funding Sources:	DHS: BRIC, HMGP, FMA, RFC; Virginia CFPF
Lead Agency/Department Responsible:	Planning, Emergency Management
Implementation Schedule:	Within 5 years
ADDITIONAL COMMENTS	
16 residences are in the process of being elevated with FMA funding at the time of this plan. Additionally, the City received an FY19 FMA grant award in November 2022 to elevate 6 residences.	

VIRGINIA BEACH MITIGATION ACTION 14	
Acquire open space in strategic locations that can provide management benefits for multiple mitigation objectives. Objectives may include but are not limited to: flood control, water quality, public access to waterways, preserving or creating tree canopy, and preserving unique ecological and cultural heritage sites. Incorporation of the Parcel Level Mitigation Program for these projects.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Benefits from open space acquisition can occur in several categories for a single project. A flood-prone area can be set aside for recreation and flood control, for example.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Landslide/Coastal Erosion, Winter Storm
Goal(s) Addressed:	Goal 1, Objective 1.6; Goal 3
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Project dependent
Estimated Cost:	TBD
Potential Funding Sources:	DHS: BRIC, HMGP, FMA, RFC; USACE; USDA, Agricultural Extension
Lead Agency/Department Responsible:	Agriculture; Parks and Recreation; Public Works; Emergency Management
Implementation Schedule:	Long-term, 5 to 10 years

ADDITIONAL COMMENTS
The Agriculture Reserve Program continues to assist the AG farmers/landowners with the option of preserving their AG land versus selling off for house development options. During Fiscal Year 2021 there were 379.58 acres added to the program. This included acquiring 22 development rights on a total of 6 parcels in the southern watersheds. There is now a cumulative total of 10,366.32 acres and 898 development rights captured in the Agricultural Reserve Program. In addition, there were recent changes to the City's ARP ordinance. These changes allow Virginia Beach to target other sensitive and valuable farmland for not only agriculture and forest land protection but also other valuable green infrastructure functions. Parks and Recreation: No new land acquisition of open space has occurred. The city is attempting to acquire a small piece of non-developable property from a shopping center owner to create water access for a kayak launch as well as provide for bank stabilization and outfall for new stormwater quality facility in the Kempsville section of the city. The 2019 FMA Acquisition grant application included 3 properties that will be demolished and returned to open space, incorporated into an existing city park. The grant was awarded in October 2020 and the acquisition project initiated shortly after.

VIRGINIA BEACH MITIGATION ACTION 15	
Verify the geographic location of each NFIP repetitive loss property, and determine if that property has been mitigated and, if so, by what means. Prepare Repetitive Loss Area Analyses for CRS credit.	
BACKGROUND INFORMATION	
Site and Location:	Repetitive flood loss areas throughout the City
Cost Benefit:	Repetitively flooded structures strain local and federal resources after disasters and detract from the fiscal solvency of the NFIP. The NFIP focuses mitigation efforts and funds on properties listed as repetitive losses; therefore, checking the accuracy of the list is a necessity for the NFIP, States and, through this action, local governments.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding (Storm Surge)
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2; Goal 3, Objective 3.2
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate/High – Most of the City's repetitive flood loss areas are in NRI Relatively Moderate, Relatively High or Very High Flood Risk areas.
Estimated Cost:	Staff time estimated at $50 per structure x 500 structures = $25,000
Potential Funding Sources:	DHS: BRIC, HMGP, HMGP 5% Initiative, FMA, RFC; VDEM; HRPDC
Lead Agency/Department Responsible:	Emergency Management
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
Through the CRS process each rep loss property was mapped and evaluated for mitigation in 2018.	

VIRGINIA BEACH MITIGATION ACTION 16	
Develop a local hurricane evacuation framework/plan and identify communication networks for evacuation messaging.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	The state evacuation plan does not take all local factors into account and may not be sufficient for some residents of Virginia Beach. Local planning will facilitate evacuation when needed and better focus evacuation messaging to reduce confusion, speed evacuation and reduce the number of people in danger.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Winter Storm, Earthquake, Wildfire, Hazard Materials Incident
Goal(s) Addressed:	Goal 1: Objectives 1.4, 1.5; Goal 2: Objectives 2.1, 2.2; Goal 3: Objective 3.1, 3.2, 3.3, 3.4
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High – neighborhoods most in need of evacuation are areas of NRI high hurricane risk, which includes analysis of social vulnerability
Estimated Cost:	Staff time
Potential Funding Sources:	DHS/VDEM; HRPDC
Lead Agency/Department Responsible:	Emergency Management, Communications Office
Implementation Schedule:	Within 2 years of plan adoption
ADDITIONAL COMMENTS	
While evacuation planning typically focuses on hurricanes and coastal storms, the procedures may be used in other emergencies.	

VIRGINIA BEACH MITIGATION ACTION 17	
Promote and sustain local programs such as the Parcel Level Mitigation Program (PLMP) to provide flood protective actions such as acquisition, flood vents, relocating utilities, elevation etc. to vulnerable flood areas. Utilize grant funding to expand capabilities of PLMP when appropriate and eligible.	
BACKGROUND INFORMATION	
Site and Location:	Flood prone areas Citywide, especially high social vulnerability repetitive flood loss areas
Cost Benefit:	Flood protective actions reduce long-term repair and recovery costs.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Flooding due to Impoundment Failure/High Hazard Dam
Goal(s) Addressed:	Goal 1: Objectives 1.1, 1.2, 1.4, 1.5; Goal 2: Objectives 2.1, 2.2, 2.3
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate/High – Most of the City's repetitive flood loss areas are in NRI Relatively Moderate, Relatively High or Very High Flood Risk areas.
Estimated Cost:	Cost vary based on each structure's needs. Acquisition and elevation are more costly than small retrofits such as relocating utilities or installing flood vents.
Potential Funding Sources:	Virginia CFPF; DHS: HMGP, BRIC; USACE: FPMS
Lead Agency/Department Responsible:	Emergency Management
Implementation Schedule:	Within 5 years of plan adoption
ADDITIONAL COMMENTS	

VIRGINIA BEACH MITIGATION ACTION 18	
Monitor and enhance the City's cybersecurity capabilities to protect the City from cybersecurity threats especially during or immediately after a disaster or emergency.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Major cities' operational reliance on cyber technology increases the importance that the technology remains operational during or after a disaster. Disaster-related or disaster-concurrent outages can rapidly increase the costs of damage and the time needed to return to normal operations. Attempted cyberattacks can also increase following a natural disaster.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Cyber Infrastructure Attack, Active Threat, Complex Coordinated Terrorist Attack, Explosives, Radiological Attack, Flooding, Tropical/Coastal Storm, Tornado, Winter Storm, Earthquake, , Hazardous Materials Incident, Pandemic Flu or Communicable Disease, , Extreme Heat
Goal(s) Addressed:	Goal 1: Objectives 1.2, 1.3, 1.4, 1.5
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	TBD
Potential Funding Sources:	DHS
Lead Agency/Department Responsible:	IT (Cybersecurity)
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

VIRGINIA BEACH MITIGATION ACTION 19	
Facilitate discussions with agencies responsible for providing local transportation to encourage them to evaluate, improve, and/or establish local and regional transportation plans to address the transportation needs of vulnerable populations such as the elderly, college and university students, those with disabilities, visitors, etc. in the event of an evacuation.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	The state evacuation plan does not take all local factors into account and may not be sufficient for some residents of Virginia Beach with limited transportation options. Local planning will facilitate evacuation when needed and provide transport options to speed evacuation and reduce the number of people in danger.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Winter Storm, Earthquake, Wildfire, Hazard Materials Incident, Civil Unrest, Power Outage, Water Utility Disruption / Contamination.
Goal(s) Addressed:	Goal 1: Objectives 1.4, 1.5; Goal 2: Objectives 2.1, 2.2; Goal 3: Objective 3.1, 3.2, 3.3, 3.4
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	High
Estimated Cost:	Staff time
Potential Funding Sources:	DHS/VDEM; HRPDC
Lead Agency/Department Responsible:	Planning (Transportation), Emergency Management
Implementation Schedule:	Within 5 years of plan adoption
ADDITIONAL COMMENTS	
Hampton Roads Transit (HRT) is responsible for providing local public transportation within Virginia Beach. Virginia Beach does not have control over HRT's operation requirements.	

VIRGINIA BEACH MITIGATION ACTION 20	
Review all City rules, regulations, policies, procedures, ordinances and plans to ensure a consistent approach that aligns with hazard mitigation goals, objectives and actions.	
BACKGROUND INFORMATION	
Site and Location:	Countywide
Cost Benefit:	Cost is negligible but speaking about hazards with a consistent message informs citizens, and continually reinforces the City's stance on important issues for staff and elected officials.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	All
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	n/a
Potential Funding Sources:	n/a
Lead Agency/Department Responsible:	Planning, Emergency Management
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
Many new programs and initiatives over the past 5 years have been implemented across many departments. Public Works stormwater management and erosion and sediment control regulations, CRS goals, floodplain management ordinance revisions, all require similar starting points. The City has made a lot of progress on each of these, but additional review will help with consistency. *Sea Level Wise* calls for ensuring that flood mitigation practices identified in a future Flood Mitigation Plan are incorporated into future Comprehensive Plan and this hazard mitigation plan.	

VIRGINIA BEACH MITIGATION ACTION 21	
Implement the action items and projects outlined in *Sea Level Wise*, particularly the following high priority items: **1) identify regional flood risk reduction projects that could be pursued with neighboring jurisdictions, such as the City of Norfolk;** **2) increase freeboard to 3 feet or to a future design flood elevation;** **3) require mechanical and electrical systems to be elevated to design flood elevation (with freeboard);** **4) expand height allowance for buildings outside the SFHA, where property owners want to elevated structures to reduce flood risk;** **5) (paraphrased and combined) include sea level rise and future flooding considerations in designing adequate drainage controls, and in development of subdivision/site plans; and,** **6) develop informational materials on how to renovate historic properties to enhance flood resilience consistent with historic preservation requirements.**	
BACKGROUND INFORMATION	
Site and Location:	Areas subject to future flooding citywide
Cost Benefit:	All of these elements will reduce future flood damages.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1: Objectives 1.1, 1.2, 1.3, 1.5
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	Staff time
Potential Funding Sources:	n/a
Lead Agency/Department Responsible:	Planning, Emergency Management, Public Works
Implementation Schedule:	Within 4 years of plan adoption
ADDITIONAL COMMENTS	

CHESAPEAKE

CHESAPEAKE MITIGATION ACTION 1	
Maintain participation in National Flood Insurance Program and Community Rating System. Continue enforcement of standards in existing ordinance that meet and exceed NFIP minimum requirements. Consider updates to 2013 floodplain management ordinance to include protection of areas outside the current SFHA subject to future flooding as sea level rises, and additional restrictions on rehabilitation of existing structures in the SFHA such as freeboard and substantial damage requirements. Goal to become CRS Class 6 community.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	The NFIP and related flood mapping and development regulations have proven benefits nationwide. Elevating structures to 1.5 feet above the BFE has a benefit cost ratio of 6:1, according to FEMA (*2008 Supplement to the 2006 Evaluation of the National Flood Insurance Program's Building Standards)*. CRS benefits accrue through increased insurance coverage, improved hazard awareness and reduced flood insurance premiums. New construction and future development are protected from floods through existing standards that meet or exceed NFIP minimum requirements.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Winter Storms
Goal(s) Addressed:	Goal 1, Objective 1.1, 1.2, Goal 2, Goal 3
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate/High – most of the repetitive flood loss areas have very high or relatively high NRI flood risk, especially the largest area southwest of Battlefield Commons
Estimated Cost:	Travel costs and staff time
Potential Funding Sources:	Existing budgets
Lead Agency/Department Responsible:	Emergency Management
Implementation Schedule:	Annually
ADDITIONAL COMMENTS	
Chesapeake is a CRS Class 7 community.	

CHESAPEAKE MITIGATION ACTION 2		
Acquire, elevate, relocate, retrofit or floodproof structures in flood prone areas. Flood protection may include minor localized flood reduction projects, as well. This action includes Mitigation Reconstruction projects.		
BACKGROUND INFORMATION		
Site and Location:	Flood loss areas Citywide	
Cost Benefit:	Retrofit measures that address flooded structures, particularly those designated as repetitive loss or severe repetitive loss by the NFIP, have quantifiable benefits. The City is proposing to collect elevation data as part of this action in order to more easily make cost-benefit analyses of these structures. Under new guidance, FEMA will now fund hazard mitigation projects that include sea level rise estimates.	
MITIGATION ACTION DETAILS		
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Winter Storm	
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2	
Priority (High, Moderate, Low):	High	
Impact on Socially Vulnerable Populations:	Moderate/High – most of the repetitive flood loss areas have very high or relatively high NRI flood risk, especially the largest area southwest of Battlefield Commons	
Estimated Cost:	In multiple $750,000 phases as grant money becomes available.	
Potential Funding Sources:	City CIP; DHS: BRIC, HMGP, HMGP 5% Initiative, FMA, RFC; USACE: SFCP, FPMS; HUD: CDBG; USDA: WPFP; Virginia CFPF	
Lead Agency/Department Responsible:	Emergency Management	
Implementation Schedule:	Ongoing	

ADDITIONAL COMMENTS
The City of Chesapeake Office of Emergency Management continues to apply for grants for Acquisitions. 5 of the 7 applications are being processed from the 2018 FMA Grant. 2 applications were submitted for houses in 2019 and 3 applications were submitted for houses in 2020. Additionally, stormwater flood protection reduction projects are scheduled for numerous subdivisions in the SFHA. There are 3,869 structures identified as being within repetitive flood loss areas. Locally funded projects may be creditable under the Community Rating System. Detailed activities to support this overall mitigation action include: 1. Coordinate with the City Surveyor in Public Works Department to complete Elevation Certificates for structures when doing other survey work in repetitive flood loss areas. 2. Use pictometry to further refine repetitive flood loss area identification and to collect approximate first floor elevation information for structures in those areas. 3. Use Public Works Department expertise to identify retrofit measures for flood-prone structures. This may be creditable under CRS. 4. Regularly crosscheck real estate market with repetitive flood loss list. Purchase of empty structures may be possible at lower cost.

CHESAPEAKE MITIGATION ACTION 3	
Conduct detailed vulnerability review: cross reference locations of existing manufactured homes and manufactured home parks relative to repetitive flood loss areas and new FEMA 100-year floodplains. Review their vulnerability to flood and wind hazards. Implement measures to retrofit, relocate, or acquire vulnerable units. This action may include Mitigation Reconstruction projects.	
BACKGROUND INFORMATION	
Site and Location:	Flood-prone areas Citywide
Cost Benefit:	While the value of manufactured homes is quite low, the costs to elevate or retrofit them to protect from flood and wind can be low, as well. The costs to determine locations and review vulnerability are minimal versus the cost of additional hazard damage.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Tornado, Winter Storm, Earthquake, Wildfire
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	TBD
Estimated Cost:	Staff time for analysis; approx. $150,000 for retrofit measures such as elevation assistance and tie-downs
Potential Funding Sources:	Virginia CFPF; DHS: BRIC, HMGP, HMGP 5% Initiative, FMA, RFC; USACE: SFCP, FPMS; HUD: CDBG; USDA: EWP, WPFP, WSP
Lead Agency/Department Responsible:	Emergency Management, with support from GIS and Engineering Division
Implementation Schedule:	within 2 years of plan adoption
ADDITIONAL COMMENTS	
Manufactured homes and their occupants are particularly vulnerable to wind and flood hazards. The cost of minor retrofits can have exponential benefits in reducing the risk to lives. Procedures are in place for prohibiting new manufactured homes in SFHA; this action addresses existing structures.	

CHESAPEAKE MITIGATION ACTION 4		
Protect critical facilities from damage. Measures may include installation of emergency backup power, elevation of structure or components, relocation or retrofit of building components.		
BACKGROUND INFORMATION		
Site and Location:	Critical facilities Citywide	
Cost Benefit:	Benefits of mitigating flood damage to critical facilities are realized by all citizens by maintaining operational capabilities post-disaster.	
MITIGATION ACTION DETAILS		
Hazard(s) Addressed:		All
Goal(s) Addressed:		Goal 1, Objectives 1.1, 1.2, 1.3, 1.4, 1.5
Priority (High, Moderate, Low):		High for Jail High for Fire Station #2 Medium for Schools Low for other Critical Facilities
Impact on Socially Vulnerable Populations:		
Estimated Cost:		TBD
Potential Funding Sources:		DHS: BRIC, HMGP, HMGP 5% Initiative, FMA, RFC; USACE; Virginia CFPF
Lead Agency/Department Responsible:		Emergency Management, with GIS and Public Works Engineering Division
Implementation Schedule:		Ongoing

ADDITIONAL COMMENTS
New Public Safety building/EOC can withstand Category 3 hurricane or earthquake and has multiple redundancy infrastructure built into the building. All community centers and conference center outfitted with generators. The city has also completed the work on two new Fire Stations, Sta #10 in Bowers Hill & Sta #7 in Southern Chesapeake. Sta #10 serves both as a Fire Station and Logics Center for the department, increasing the city's ability to prepare, respond and mitigate following a disaster. Sta #7 is dual use facility, as a Fire Station and a newly added Police Precinct.

CHESAPEAKE MITIGATION ACTION 5	
Flow test and inspect existing City-owned and grant-funded dry hydrants annually to help maintain operability.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Chesapeake has determined that maintaining the highest level of operability for the existing system is more feasible than installing new hydrants.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Wildfire
Goal(s) Addressed:	Goal 1, Objective 1.2, 1.3, 1.4
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	Staff time
Potential Funding Sources:	Existing Budgets
Lead Agency/Department Responsible:	Fire Department
Implementation Schedule:	Ongoing per annual maintenance schedule
ADDITIONAL COMMENTS	
Installation of additional hydrants has proven challenging. This alternative presents a reasonable cost-effective method for maintaining capacity to fight wildfire. There are currently 56 dry hydrants in Chesapeake, mainly in the southern part of the City. This project is overseen by a Captain in the Fire Department who is assisted by a Supervisor in Public Utilities. Hydrants are regular schedule of maintenance and testing. This is not only done for operational purposes, but for training purposes of field forces, especially new recruits in the field.	

CHESAPEAKE MITIGATION ACTION 6	
Seek and use additional revenue sources and local matching funds for mitigation planning and projects.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Local funding sources for mitigation projects can further the benefits of available federal funding. Untapped and unusual funding sources likewise reduce the burden of mitigation on Chesapeake citizens.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 3, Objectives 3.3, 3.4
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	Staff time
Potential Funding Sources:	DHS: BRIC; Virginia CFPF; American Rescue Plan Act; USACE
Lead Agency/Department Responsible:	Emergency Management
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
NEMAC submits recommendations annually to City Council regarding the status of current mitigation projects and this plan, programmatic problems, an inventory of new potential mitigation projects and unmet needs. City Council evaluates those needs against internal funding sources. NEMAC aggressively pursues and seeks public and private grants to support mitigation activities, and enlists a number of other stakeholders in this process. Related resources may address multiple objectives, such as environmental issues, preparedness, sustainability, and blight reduction. NEMAC is prepared to pursue special appropriations and grants that are available after a disaster. City has obtained and continues to apply for FEMA grants for acquiring repetitive flood loss homes and has committed Capital Improvement Funds to mitigate flooding. City has applied for PDM funds for mitigation purposes to install generators at Public Utilities Pump Stations. City uses emergency management grant funds to enhance its Alert and Everbridge system to warn citizens of flooding issues, along with other potential disasters.	

CHESAPEAKE MITIGATION ACTION 7		
Continue to implement a Pre-Disaster Homeowner Tree Preventive Maintenance and Hazard Awareness Program.		
BACKGROUND INFORMATION		
Site and Location:	Citywide	
Cost Benefit:	A low-cost effort can bring many benefits to individual property owners and significantly reduce response costs after a disaster. Benefits accrue to the City through reduced response needs, to homeowners through reduced damages, and through reduced vulnerability wildfire.	
MITIGATION ACTION DETAILS		
Hazard(s) Addressed:		Tornado, Tropical/Coastal Storm, Winter Storms, Wildfires
Goal(s) Addressed:		Goal 2, Objective 2.1
Priority (High, Moderate, Low):		Moderate
Impact on Socially Vulnerable Populations:		Low
Estimated Cost:		Approximately $7,500
Potential Funding Sources:		USDA, Soil and Water Conservation District, Va. Tech Agricultural Extension; DOI - LWCF; Virginia CFPF
Lead Agency/Department Responsible:		Parks and Recreation Department, Emergency Management, Development and Permits
Implementation Schedule:		Ongoing
ADDITIONAL COMMENTS		
This program expands on existing programs in the City that focus on the value of trees, particularly healthy old-growth trees, and how to properly care for trees to prevent them from causing additional damage during wind events. Chesapeake has been designated as a “Tree City USA” for over 27 years, protects trees in the Chesapeake Bay Preservation Area, and has a “What is a Tree?” program for schoolchildren in conjunction with the Agriculture Department. The Chesapeake Arboretum is active in tree resource management and will be approached about participating. A “Prune in June” campaign may be considered as a possible focus for this mitigation action. City to hire Urban Forester/City Arborist in 2022. Messaging has gone out to homeowners regarding what to do following a storm on how to care for damaged trees. Public Communications routinely sends messaging regarding pre-storm maintenance. City works with Garden Clubs and the VT Cooperative Extension to craft and disseminate important information.		

CHESAPEAKE MITIGATION ACTION 8	
Improve stormwater management infrastructure. Implement preventive maintenance schedule and system upgrades. Projects typically include replacement and upgrade of existing facilities, enlarging pipes/ ditches to provide for increased capacity and construction of stormwater management facilities/BMPs to provide flood control and water quality compliance. Provide replacement schedule for stormwater management and inspection equipment and vehicles, including purchases of plows for new trucks to assist with dual purpose of snow removal.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Maintaining and improving the stormwater system provides Citywide benefits from both high and low frequency flood events. The preventive maintenance schedule is a relatively new activity that will help sustain the highest level of operability for the existing system. Equipment replacement prevents downtime, purchases can be more cost effective than repair expenses on depreciated equipment, and new equipment provides for potential for use in other natural event responses (such as Winter Storms).
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Winter Storm
Goal(s) Addressed:	Goal 1, Objective 1.1, 1.2, 1.3, 1.4, 1.5
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate/High – most of the repetitive flood loss areas have very high or relatively high NRI flood risk, especially the largest area southwest of Battlefield Commons
Estimated Cost:	$1.8 million
Potential Funding Sources:	Approved and proposed budgets and stormwater utility fees; Virginia CFPF
Lead Agency/Department Responsible:	Public Works/Engineering/Operations
Implementation Schedule:	Ongoing

ADDITIONAL COMMENTS
While NEMAC recognizes these activities are already ongoing, their importance to maintaining a functioning and effective stormwater system during flood events is critical to hazard management in Chesapeake. Engineering has Master Drainage Plan that identifies watersheds and completed watershed studies identifying system deficiencies and required improvements. Department maintains list of funded and unfunded projects Unfunded projects list is reviewed and updated regularly to ensure flooding and poor drainage areas citywide are addressed. Public Works schedules and provides for regular maintenance and repairs to ensure the existing stormwater system is functioning as intended.

CHESAPEAKE MITIGATION ACTION 9	
Part I. Maximize training and educational opportunities for NEMAC, City staff, elected officials, CERT members and citizen/neighborhood/civic league leaders regarding hazard mitigation, disaster preparedness and the relationship of mitigation to reduced recovery needs. Use modern social media forums such as NextDoor. Provide samples of retrofitting tools and examples of products. **Part II. Accommodate training and related support for at least two staff in the Department of Development and Permits to receive and maintain Certified Floodplain Manager (CFM) certification through the ASFPM.**	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Many training opportunities are already available through FEMA, VDEM, and other agencies. Costs to provide or make arrangements for the training in Chesapeake are minimal versus the benefits of a well-informed citizenry and highly trained floodplain management staff.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 2, Objective 2.1
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	Less than $12,000 over five years
Potential Funding Sources:	Existing budgets, staff time; DHS: HMGP 5% Initiative
Lead Agency/Department Responsible:	Emergency Management Department of Development and Permits
Implementation Schedule:	Ongoing as opportunities arise
ADDITIONAL COMMENTS	
City Staff in OEM and Development & Permits have taken classes on Floodplain Management. OEM staff have taken classes on CRS. OEM continues to oversee NEMAC. City CERT Coordinator continues to train citizens on Disaster Preparedness and being Response Ready. Citizens are taught how to mitigate before, during, and after a disaster, and not be a burden on emergency resources. The CERT Coordinator and members of CERT conduct outreach initiatives, and since COVID slowed down the ability for CERT to meet, members worked with various groups to provide online training on disaster preparedness. Two Development & Permits personnel and two Office of Emergency Management personnel have attended EMI Floodplain Management Courses. D&P personnel will continue toward CFM certification. OEM and D&P personnel will continue to take classes in NFIP & CRS. OEM and D&P actively take part in CRS / Wetlands Watch Workgroup Meetings	

CHESAPEAKE MITIGATION ACTION 10	
Conduct Hazardous Environmental Action Team (HEAT) program to oversee industrial facilities, particularly hazardous facilities, to discuss hazards and mitigation alternatives.	
BACKGROUND INFORMATION	
Site and Location:	Industrial facilities Citywide
Cost Benefit:	Reduces the likelihood of compounding incidents, thereby reducing response costs.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Winter Storm, Wildfire, Hazardous Materials Incident
Goal(s) Addressed:	Goal 1, Objective 1.2, 1.3, 1.4
Priority (High, Moderate, Low):	Low
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	$8,000
Potential Funding Sources:	Existing budgets; DHS: HMGP 5% Initiative
Lead Agency/Department Responsible:	Emergency Management
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
HEAT Team is tasked with preventing and investigating environmental crimes such as illegal dumping of chemicals and waste, illegal transportation and/or storage of hazmat, chemical releases into atmosphere and waterways, burial of hazmat, and failure to report chemical releases. Team members serve on LEPC and help review emergency plans, hazmat management plans, and TIER II reports that are submitted. Team works closely with Emergency Management Office, DEQ, EPA and USCG. Program reduces illegal handling, storage and discharge of hazmat. Members are committed to educating residents and businesses on negative impacts to the environment of illegal dumping and polluting.	

CHESAPEAKE MITIGATION ACTION 11	
Support and maintain City's new Reverse-911 system. Prepare messages to release to citizens before and after a natural hazard event.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Other methods of notifying citizens require massive amounts of staff time which exceeds budgetary restraints. Reverse 911 quickly and efficiently uses existing infrastructure to notify property owners of appropriate pre- and post-disaster mitigation actions.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 2
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	$7,500
Potential Funding Sources:	Existing budgets; DHS: HMGP 5% Initiative
Lead Agency/Department Responsible:	Emergency Management
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
The City continues to subscribe to Everbridge (Chesapeake Alert) with enhanced features to allow additional public outreach. Messages have been developed and pre-approved for alerting citizens to potential flooding, and a weather alert component has been incorporated in partnership with NWS, Wakefield. OEM and 911 Dispatch have more trained IPAWS Users, which will allow the City to broadcast WEA messages should an incident occur and notifications are needed quickly.	

CHESAPEAKE MITIGATION ACTION 12	
Prevent sanitary sewer inflows to the system during flood events. Smoke test public and private sanitary sewer infrastructure to determine priorities.	
Site and Location:	Sewer infrastructure Citywide
Cost Benefit:	The consequences and costs of sanitary sewer inflows during a flood event are high for reasons related to human health and damage to infrastructure. Smoke tests are a low-cost alternative to televising all sanitary sewer lines and allow more detailed (and costly) methods to be used only where problems are identified during smoke tests.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm
Goal(s) Addressed:	Goal 1, Objectives 1.3, 1.4, 1.5
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	$525,000, annually
Potential Funding Sources:	Existing capital budgets
Lead Agency/Department Responsible:	Public Utilities
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
Over 10% of the system is checked annually.	

CHESAPEAKE MITIGATION ACTION 13	
Continue lease agreement and maintenance of facilities along the Dismal Swamp Canal Trail to accommodate recreational use of the floodplain.	
BACKGROUND INFORMATION	
Site and Location:	Along the Dismal Swamp Canal
Cost Benefit:	Recreational use of this vast floodplain area is the highest and best use, especially in light of projected sea level rise. Facilities to make this area accessible and enjoyed by so many residents of Hampton Roads and northeast North Carolina are low cost.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Winter Storm, Tropical/Coastal Storm, Wildfire
Goal(s) Addressed:	Goal 1, Objective 1.6; Goal 3, Objective 3.4
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High
Estimated Cost:	$400,000
Potential Funding Sources:	VDOT, USACE and others, as deemed appropriate
Lead Agency/Department Responsible:	Parks and Recreation
Implementation Schedule:	Ongoing

ADDITIONAL COMMENTS
The Dismal Swamp Canal Trail is a former section of Virginia State Route 17, now a multi-use trail open to bicycling, walking, running, horseback riding, and boating. The north trailhead is located at the intersection of Dominion Blvd. and Old Rt. 17 in Chesapeake, and runs south 8.5 miles, adjacent to the Dismal Swamp Canal. This multipurpose-linear nature trail threads through some of the most uniquely historical and ecologically-significant habitats in the United States. The Dismal Swamp Canal Trail is an historic, environmental and outdoor recreation delight open to walkers, hikers, boaters, bicyclists, and horse owners. Trail improvements have been completed, including paved parking areas and two separate restroom facilities. Trail was recently fully repaved in 2020. The City continues to lease and maintain facilities adjacent to and on the Dismal Swamp Canal Trail. As a sign of the City's commitment to sharing the story of the Dismal Swamp, they have secured funding and designed a Historic Village concept on Glencoe Street (and near the Superintendent's House). The concept includes the move and restoration of a historic schoolhouse previously located on Benefit Road, addition of a Visitor Center and additional structures to share the history of Indigenous communities in the region, maroon communities in the Swamp, the Underground Railroad and its relationship to the Swamp, and the story of the canal with regard to regional trade. Future plans include full restoration of the Superintendent's House in conjunction with the USACE.

CHESAPEAKE MITIGATION ACTION 14		
Continue outreach efforts through a strategically-developed plan to inform and educate citizens before, during and after disasters. Develop pre-approved letters and notification system for structure significantly damaged after any disaster, particularly flood-prone structures with stringent repair requirements.		
BACKGROUND INFORMATION		
Site and Location:	Citywide	
Cost Benefit:	The organized nature of the approach reduces long-term costs by: 1) minimizing need to repeat messages; 2) involving outreach/marketing professionals from within City government; 3) investigating regional partnerships that could result in additional cost savings through cost sharing; 4) using existing programs and resources to maximum advantage.	
MITIGATION ACTION DETAILS		
Hazard(s) Addressed:		All, but primarily Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Winter Storm
Goal(s) Addressed:		Goal 1, Goal 2, Goal 3
Priority (High, Moderate, Low):		High
Impact on Socially Vulnerable Populations:		Low
Estimated Cost:		Less than $7,500
Potential Funding Sources:		Existing budgets and staff time; DHS: BRIC, HMGP, HMGP 5% Initiative
Lead Agency/Department Responsible:		Emergency Management (lead) Planning & Development Public Communications
Implementation Schedule:		Ongoing

ADDITIONAL COMMENTS
The departments of Public Communications, IT, OEM, Police, and Fire meet as a Workgroup that focuses on messaging to the citizens and public before, during, and after a disaster. Boilerplate messaging is constantly reviewed and updated and can be redefined based on the incident or disaster. Last year the Workgroup worked with VDEM to adjust the “Know Your Zone” color coding to make more sense regarding the zones that were more likely to flood. The Workgroup created direct messaging that goes out strategically at the start of hurricane season. The state provided some basic messaging and key points that the Workgroup enhanced and made Chesapeake specific. The Public Communications and Information Technology departments, routinely tracks website hits, “likes”, shared posts, retweets, etc. to gauge the effectiveness of the campaign and the overall success of the Workgroup.

CHESAPEAKE MITIGATION ACTION 15	
Acquire open space in strategic locations that can provide multi-objective management benefits. Objectives may include but are not limited to: flood control, water quality, public access to waterways, preserving or creating tree canopy, and preserving unique ecological and cultural heritage sites. Acquire repetitive flood loss properties up for sale for via trustee sale.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Benefits from open space acquisition can occur in several categories for a single project. A flood-prone area can be set aside for recreation and flood control, for example.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Landslide/Coastal Erosion, Winter Storm, Tornado, Winter Storm, Wildfire
Goal(s) Addressed:	Goal 1, Objective 1.6; Goal 3
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate/High – most of the repetitive flood loss areas have very high or relatively high NRI flood risk, especially the largest area southwest of Battlefield Commons
Estimated Cost:	TBD
Potential Funding Sources:	DHS: BRIC, HMGP, FMA, RFC; USACE; USDA, Va. Tech Agricultural Extension, DOI – LWCF; Virginia CFPF
Lead Agency/Department Responsible:	Planning & Development; Parks, Recreation and Tourism
Implementation Schedule:	Long-term, 5 to 10 years
ADDITIONAL COMMENTS	
Projects may tie in with the recently adopted Green Sea Blueway and Greenway Plan. Since 2017, the City has acquired Cornland School, a cultural heritage site, and completed task of moving it out of flood-prone location, and is in the process of elevating the school. City is acquiring Newton Neck parcel adjacent to Dominion Boulevard Veterans Bridge and putting it under conservation easement. The park site is adjacent to many flood-prone neighborhoods. Future park design will include flood prevention measures. Parks, Recreation and Tourism is acquiring several FEMA properties, including adjacent to Costa Avenue. Design for Blue Heron Landing Park in Indian River planning area is complete. New design boasts significantly more pervious area than before, along with a significant increase of trees, shrubs, and improved landscaping.	

CHESAPEAKE MITIGATION ACTION 16	
Identify, create database, and plan uses for data regarding vulnerable populations. Uses may include targeted outreach, emergency notification and specialized evacuation planning. Study high social vulnerability repetitive flood loss areas to identify opportunities to support property owners and renters with recommended property-specific flood damage reduction tools and methods.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Outreach and early notification of events to vulnerable populations aids in evacuation, re-entry, sustainability and community resiliency.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Tornado, Winter Storm, Earthquake Wildfire, Extreme Heat, Hazardous Materials Incident
Goal(s) Addressed:	Goal 2; Goal 3, Objective 3.2
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	High
Estimated Cost:	$10,000
Potential Funding Sources:	DHS: UASI, BRIC, HMGP, HMGP 5% Initiative; Virginia CFPF
Lead Agency/Department Responsible:	Emergency Management (lead) Public Communications
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
City continues to work with state Shelter Coordinator to update databases of those with functional needs. The City now has a MIH (Mobile Integrated Health Coordinator), who is also creating a database of vulnerable populations. MIH Team regularly checks on citizens that have medical issues but do not need constant medical oversight. City has databases of those in modular home parks, in high risk areas near chemical facilities, and in repetitive flood areas. These groups can easily be notified using Everbridge should an incident occur. Messaging can also be sent should general information need to go out to the public in these areas.	

ISLE OF WIGHT COUNTY

ISLE OF WIGHT COUNTY MITIGATION ACTION 1

Acquire, elevate, relocate or retrofit structures in coastal high hazard areas and other flood prone areas that have suffered repetitive flood damage. This action includes Mitigation Reconstruction projects.

BACKGROUND INFORMATION	
Site and Location:	Within the VE and AE flood zones along the James River and associated tributaries in Isle of Wight County
Cost Benefit:	Just 17 structures alone in the VE zone suffered damages in 1999 during Hurricane Floyd ($62,000), and 2003 from Hurricane Isabel ($476,483). One structure was recently acquired. FEMA will now fund hazard mitigation projects that include sea level rise estimates.

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.5
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate – All repetitive flood loss areas are located in NRI relatively moderate flood risk areas, with the exception of an area near Jones Town Driver and Annisons Lane
Estimated Cost:	$3,400,000 (approximately $200,000/property) per phase. Up to 5 phases are planned. One recent acquisition cost $135,000.
Potential Funding Sources:	DHS: BRIC, HMGP, FMA, RFC; Virginia CFPF
Lead Agency/Department Responsible:	Planning and Zoning
Implementation Schedule:	Ongoing – County has ongoing process to assess needs

ADDITIONAL COMMENTS

There are 16 properties with structures located in the VE flood zone that are targeted for participation. The project will have to be performed in phases as grant funds are made available. Acquisition and demolition of structures represent land use changes that the County may be able to claim as credits under new Chesapeake Bay Total Maximum Daily Load (TMDL) requirements. Careful tracking of these projects can also contribute significant points to the Community Rating System classification (see Mitigation Action 2).

ISLE OF WIGHT COUNTY MITIGATION ACTION 2	
Strengthen floodplain management program through the following: **1) Continue participation in the National Flood Insurance Program and the Community Rating System;** **2) Conduct annual outreach to flood prone property owners;** **3) Review all existing environmental ordinances, such as the CBPA, Floodplain and Stormwater Management Ordinances, to ensure they include the best practicable protection measures, including guiding new development away from flood hazard areas; and** **4) Require new development in Coastal A Zones to meet Zone V standards for design and construction.**	
BACKGROUND INFORMATION	
Site and Location:	Countywide, Isle of Wight County
Cost Benefit:	Participation in the CRS at a Class 9 rating would result in 5% premium savings on most flood insurance policies. A Class 8 rating saves property owners 20% on premiums in the SFHA.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2; Goal 2
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate – All repetitive flood loss areas are located in NRI relatively moderate flood risk areas, with the exception of an area near Jones Town Driver and Annisons Lane
Estimated Cost:	Staff time
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Planning and Zoning
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
This action is part of the County's Strategy for Continued Compliance with the NFIP, and echoes policies and actions recommended in the Comprehensive Plan.	

ISLE OF WIGHT COUNTY MITIGATION ACTION 3	
Develop and maintain a stormwater drainage plan to address issues in flood-prone areas; prioritize and implement plan recommendations.	
BACKGROUND INFORMATION	
Site and Location:	Countywide
Cost Benefit:	Flooding as a result of stormwater accumulation can exacerbate coastal flooding, contributing to flood damages of cars, structures, roads and other infrastructure. Nuisance flooding can result in businesses closed down.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.4, 1.5
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate – All repetitive flood loss areas are located in NRI relatively moderate flood risk areas, with the exception of an area near Jones Town Driver and Annisons Lane
Estimated Cost:	$250,000 to $3,000,000
Potential Funding Sources:	General funds; DHS: HMGP
Lead Agency/Department Responsible:	Utility Services
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

ISLE OF WIGHT COUNTY MITIGATION ACTION 4	
Implement countywide Transportation Plan adopted in 2010 as part of the County Comprehensive Plan; include coordination with the Virginia Department of Transportation to address safety along all evacuation routes, including culvert redesigns and other installations to alleviate flooding.	
BACKGROUND INFORMATION	
Site and Location:	Countywide
Cost Benefit:	Safe evacuation routes are mandatory for citizen protection during hazard events.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Winter Storm
Goal(s) Addressed:	Goal 1, Goal 3
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate – All repetitive flood loss areas are located in NRI relatively moderate flood risk areas, with the exception of an area near Jones Town Driver and Annisons Lane
Estimated Cost:	Planning is underway; individual project costs to be determined through planning efforts
Potential Funding Sources:	General funds, VDOT and Federal assistance
Lead Agency/Department Responsible:	Planning and Public Works/Utility Services, VDOT, HRPDC
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
U.S. 460 is a priority for the County. County added a transportation planner/VDOT liaison to staff.	

ISLE OF WIGHT COUNTY MITIGATION ACTION 5	
Replace, as necessary, and maintain the existing regional interoperable communications system.	
BACKGROUND INFORMATION	
Site and Location:	Countywide and Southside Hampton Roads region
Cost Benefit:	Modern interoperable communications systems support preparedness, response and recovery activities for all hazards.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All Hazards
Goal(s) Addressed:	Goal 1; Goal 3, Objectives 3.1, 3.3, 3.4
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	$10 million to $14 million
Potential Funding Sources:	DHS: HMGP, HMGP 5 % Initiative, others; CIP
Lead Agency/Department Responsible:	Emergency Services
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
Replacement is needed and scheduled for near future.	

ISLE OF WIGHT COUNTY MITIGATION ACTION 6	
Verify the geographic location of each NFIP repetitive loss property, and determine if that property has been mitigated and, if so, by what means.	
BACKGROUND INFORMATION	
Site and Location:	Repetitive flood loss areas throughout the County
Cost Benefit:	Repetitively flooded structures strain local and federal resources after disasters, and detract from the fiscal solvency of the NFIP. The NFIP focuses mitigation efforts and funds on properties listed as repetitive losses; therefore, checking the accuracy of the list is a necessity for the NFIP, States and, through this action, local governments.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2; Goal 3, Objective 3.2
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate – All repetitive flood loss areas are located in NRI relatively moderate flood risk areas, with the exception of an area near Jones Town Driver and Annisons Lane
Estimated Cost:	Staff time estimated at $50 per structure x 18 structures = $900
Potential Funding Sources:	DHS: BRIC, HMGP, HMGP 5% Initiative, FMA, RFC
Lead Agency/Department Responsible:	Planning and Zoning
Implementation Schedule:	Within 2 years of plan adoption and in conjunction with CRS initial application
ADDITIONAL COMMENTS	
An initial attempt to contact property owners by mail will be followed up by phone calls, and site visits as necessary.	

ISLE OF WIGHT COUNTY MITIGATION ACTION 7	
Identify and address multiple hazards along high traffic evacuation routes throughout county, to include removal of utility poles and burying utility lines.	
BACKGROUND INFORMATION	
Site and Location:	High hazard areas for flood, and other areas of community importance (intersections, evacuation routes, critical facilities, and critical businesses)
Cost Benefit:	Overhead utilities are at risk of failure from several types of hazard events. By burying these lines underground, the vulnerability is dramatically reduced.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Winter Storm, Tropical/Coastal Storm, Tornado, Earthquake, Landslide/Coastal Erosion
Goal(s) Addressed:	Goal 1, Objectives 1.2; Goal 3, Objectives 3.3, 3.4
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	To be determined
Potential Funding Sources:	CIP, Private Funds
Lead Agency/Department Responsible:	Public Works, VDOT, HRPDC
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
Burying electrical power lines must be reviewed with Dominion Virginia Power for potential opportunities within the community. Much of Hampton Roads evacuates through Isle of Wight County; therefore, safe, evacuation routes are a high priority for the region as well. New development is required to have underground power lines. VDOT maintains road ROWs and regularly conducts tree trimming.	

ISLE OF WIGHT COUNTY MITIGATION ACTION 8	
Continue use of social media before, during and after hazard events.	
BACKGROUND INFORMATION	
Site and Location:	Countywide
Cost Benefit:	Minimal cost to reach larger audience more effectively
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 2; Objective 2.1
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	Minimal cost/staff time
Potential Funding Sources:	DHS: HMGP 5% Initiative
Lead Agency/Department Responsible:	Public Information
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
The prominence of social media points to a need to refine activity on Twitter, Facebook, Instagram and other programs. Need to be pro-active and targeted in messages. Identify specific messages, links. Other information that we will need to spread and the most effective methods, such as short videos, maps, links, photos, and infographics.	

ISLE OF WIGHT COUNTY MITIGATION ACTION 9	
Obtain StormReady designation through NOAA.	
BACKGROUND INFORMATION	
Site and Location:	Countywide
Cost Benefit:	StormReady helps arm communities with the communication and safety skills needed to save lives and property--before, during and after the event. StormReady helps community leaders and emergency managers strengthen local safety programs.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Tornado, Winter Storm, Wildfire
Goal(s) Addressed:	Goal 1, Goal 2, Goal 3
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	Staff time
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Emergency Management
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

ISLE OF WIGHT MITIGATION ACTION 10	
Continue developing a post-disaster continuity of operations plan to assist in more rapid recovery after a disaster.	
BACKGROUND INFORMATION	
Site and Location:	Countywide
Cost Benefit:	By identifying post-disaster processes for almost all County department functions and putting these processes on paper, the plan would aid staff and temporary staff in keeping processes running smoothly and not contributing to additional conflicts.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Tornado, Landslide/Coastal Erosion, Winter Storm, Earthquake, Wildfire, Hazardous Materials Incident
Goal(s) Addressed:	Goal 1, Objectives 1.4, 1.5; Goal 3
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	$25,000
Potential Funding Sources:	Staff time, DHS planning grants
Lead Agency/Department Responsible:	Emergency Management, Planning, Permits & Inspections, Engineering, Public Works
Implementation Schedule:	Within 2 years
ADDITIONAL COMMENTS	
The County has made progress refining procedures, but there is more work to do to finalize the plan.	

ISLE OF WIGHT MITIGATION ACTION 11	
Formalize a Green Infrastructure Network Plan to preserve the County's large undisturbed forests, preserve scenic landscapes, provide habitat, reduce stormwater runoff, maintain air quality and moderate temperature. Include a riparian buffer protection strategy for those areas in the Blackwater River Watershed which are not protected by CBPA.	
BACKGROUND INFORMATION	
Site and Location:	Watersheds countywide
Cost Benefit:	Protecting land prior to development is critical for long-term protection of land and water resources.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Landslide/Coastal Erosion
Goal(s) Addressed:	Goal 1, Objectives 1.2, 1.6
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	Staff time
Potential Funding Sources:	Virginia CFPF
Lead Agency/Department Responsible:	Community Development
Implementation Schedule:	Within 2 years of plan adoption
ADDITIONAL COMMENTS	
These actions are also in the County's Comprehensive Plan.	

SMITHFIELD

SMITHFIELD MITIGATION ACTION 1	
Provide training for member(s) of Town staff to become Certified Floodplain Manager (CFM) through the Association of State Floodplain Managers (ASFPM).	
BACKGROUND INFORMATION	
Site and Location:	Throughout Town
Cost Benefit:	Training related to implementation of floodplain management regulations, permitting, reading Flood Insurance Rate Maps, and other topics will help Town staff properly administer floodplain management regulations, thereby protecting future development from flood damage.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Landslide/Coastal Erosion
Goal(s) Addressed:	Goal 1, Objective 1.1
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	<$1,000 for conference attendance, test taking, and ASFPM membership
Potential Funding Sources:	Existing budgets
Lead Agency/Department Responsible:	Planning and Engineering
Implementation Schedule:	Within 2 years
ADDITIONAL COMMENTS	
This action is part of the Town's Strategy for Continued Compliance with the NFIP.	

SMITHFIELD MITIGATION ACTION 2	
Review information required on the Zoning Permit Application to ensure continued compliance with the NFIP.	
BACKGROUND INFORMATION	
Site and Location:	Throughout Town
Cost Benefit:	Identification of floodplain zones during the Zoning Permit review process provides this hazard information to developers and property owners early in the construction process to help ensure compliance with floodplain management regulations.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding
Goal(s) Addressed:	Goal 1, Objective 1.2
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	Staff time
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Planning and Engineering
Implementation Schedule:	Within 2 years
ADDITIONAL COMMENTS	
The NFIP requires that applicants for a floodplain permit provide certain flood hazard information (e.g., Base Flood Elevation, flood zone, Flood Insurance Rate Map identifying information) on the permit application. Coordination with the County, which administers the building permit, may be required. This action is part of the community's Strategy for Continued Compliance with the NFIP.	

SMITHFIELD MITIGATION ACTION 3	
Identify strategic locations throughout town to remove utility poles and bury utility lines.	
BACKGROUND INFORMATION	
Site and Location:	High hazard areas for flood, and other areas of community importance (intersections, critical facilities, and critical businesses)
Cost Benefit:	Overhead utilities are at risk of failure from several types of hazard events. By burying these lines underground, the vulnerability is dramatically reduced.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Winter Storms, Tropical/Coastal Storm, Tornado, Earthquake, Landslide/Coastal Erosion
Goal(s) Addressed:	Goal 1, Objectives 1.2, 1.3, 1.4, 1.5
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	To be determined
Potential Funding Sources:	CIP, Private Funds
Lead Agency/Department Responsible:	Public Works
Implementation Schedule:	Long-term, over a 10-year period
ADDITIONAL COMMENTS	
Burying electrical power lines must be reviewed with Dominion Virginia Power for potential opportunities within the community.	

SMITHFIELD MITIGATION ACTION 4	
Verify the geographic location of each NFIP repetitive loss property, and determine if that property has been mitigated and, if so, by what means.	
BACKGROUND INFORMATION	
Site and Location:	Repetitive flood losses
Cost Benefit:	Repetitively flooded structures strain local and federal resources after disasters, and detract from the fiscal solvency of the NFIP. The NFIP focuses mitigation efforts and funds on properties listed as repetitive losses; therefore, checking the accuracy of the list is a necessity for the NFIP, States and, through this action, local governments.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding
Goal(s) Addressed:	Goal 1, Objective 1.1, 1.2; Goal 3, Objective 3.2
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	Staff time
Potential Funding Sources:	DHS: BRIC, HMGP, HMGP 5% Initiative, FMA, RFC
Lead Agency/Department Responsible:	Planning and Zoning
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
An initial attempt to contact property owners by mail will be followed up by phone calls, and site visits as necessary.	

SMITHFIELD MITIGATION ACTION 5	
Waterworks Dam/Smithfield Lake - Examine options to either bring dam into compliance with state regulations at a cost of more than $1.5 million, or decommission dam which may cost less, or as much as two times that, depending on the type of environmental restoration chosen for the lakebed.	
BACKGROUND INFORMATION	
Site and Location:	Waterworks Dam is on the west side of Smithfield.
Cost Benefit:	Actions are mandated regardless of cost.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Winter Storm, Earthquake, Flooding Due to Impoundment Failure
Goal(s) Addressed:	Goal 1, Objective 1.2, 1.3, 1.4, 1.5
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	$250,000 for the study. Mitigation action costs to be determined by study.
Potential Funding Sources:	DEQ, DCR, Town funds
Lead Agency/Department Responsible:	Town Engineer
Implementation Schedule:	Within 2 years
ADDITIONAL COMMENTS	
On October 7, 2007, excessive rainfall caused the dam to be topped, resulting in dam erosion and damage to the roadway running along the top of the dam. In 2010, heavy rains weakened the structure. Repair project was put out for bids in October 2017. In 2020, the town was informed they needed to repair the dam to get another operating permit.	

SMITHFIELD MITIGATION ACTION 6	
Increase fuel storage at reverse osmosis water plant, allowing for extended operations during emergency situations.	
BACKGROUND INFORMATION	
Site and Location:	Town's water plant
Cost Benefit:	Due to size of the generator, the most cost effective option is to increase fuel capacity rather convert to natural gas.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Tropical/Coastal Storm, Tornado, Winter Storm, Earthquake, Wildfire
Goal(s) Addressed:	Goal 1, Objective 1.3, 1.4, 1.5
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	Estimated $100,000, depending on the size of the tank and ability to locate additional fuel storage
Potential Funding Sources:	DHS: BRIC, HMGP, HMGP 5% Initiative; Town funds
Lead Agency/Department Responsible:	Plant Manager
Implementation Schedule:	3 to 5 years
ADDITIONAL COMMENTS	
Currently, the generator at the plant has a 48-hour run time. The town also has the ability to store around 48 hours of water supply in tanks, giving the town a 4-day supply depending on usage.	

SMITHFIELD MITIGATION ACTION 7	
Purchase variable message roadway signs, primarily for traffic control during flood events.	
BACKGROUND INFORMATION	
Site and Location:	Flood-prone roadways throughout the Town
Cost Benefit:	Signs will reduce damage by rerouting traffic around flooded areas, and increase availability of public safety staff for more important tasks. Signs will have other uses beyond traffic control for floods, improving the department's ability to get information out to the public and motorists.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm
Goal(s) Addressed:	Goal 1, Objective 1.5; Goal 2
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	$13,000 per sign
Potential Funding Sources:	Highway budget, VDOT; DHS: HMGP 5% Initiative
Lead Agency/Department Responsible:	Town Engineer
Implementation Schedule:	Purchase 1 sign per year for the next 5 years
ADDITIONAL COMMENTS	
Several roadways flood during even higher frequency events, so being able to reroute traffic around these roadways becomes even more critical during major storm events.	

SMITHFIELD MITIGATION ACTION 8	
Change generators at critical facilities from diesel to natural gas.	
BACKGROUND INFORMATION	
Site and Location:	Critical facilities throughout the town, including but not limited to: Public Works Maintenance Building, Police Department, and Sewer Pump Stations
Cost Benefit:	Recovery from major disasters requires continuity of operations for the town, to the extent possible.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 1, Objectives 1.3, 1.4
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	To be determined based on availability of natural gas and whether individual generators can be converted or will have to be replaced.
Potential Funding Sources:	DHS: UASI, BRIC, HMGP, HMGP 5% Initiative
Lead Agency/Department Responsible:	Public Works
Implementation Schedule:	Begin work immediately, starting with the oldest and most critical systems
ADDITIONAL COMMENTS	
Delivery of fuel during disasters is problematic and the town wants to improve ability to maintain continuity of operations.	

WINDSOR

WINDSOR MITIGATION ACTION 1	
Provide training for member of Town staff to become a Certified Floodplain Manager (CFM) through the Association of State Floodplain Managers (ASFPM).	
BACKGROUND INFORMATION	
Site and Location:	Throughout Town
Cost Benefit:	Training related to implementation of floodplain management regulations, permitting, reading Flood Insurance Rate Maps, and other topics will help Town staff properly administer floodplain management regulations, thereby protecting future development from flood damage.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Landslide/Coastal Erosion
Goal(s) Addressed:	Goal 1, Objective 1.2
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	<$1,000 for conference attendance, test taking, and ASFPM membership
Potential Funding Sources:	Existing budgets
Lead Agency/Department Responsible:	Planning and Zoning
Implementation Schedule:	Within 2 years
ADDITIONAL COMMENTS	
This action is part of the community's Strategy for Continued Compliance with the NFIP.	

WINDSOR MITIGATION ACTION 2	
Review information required on the Zoning Permit Application to ensure continued compliance with the NFIP.	
BACKGROUND INFORMATION	
Site and Location:	Throughout Town
Cost Benefit:	Identification of floodplain zones during the Zoning Permit review process provides this hazard information to developers and property owners early in the construction process to help ensure compliance with floodplain management regulations.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding
Goal(s) Addressed:	Goal 1, Objective 1.2
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	Staff time
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Town Manager
Implementation Schedule:	Within 2 years
ADDITIONAL COMMENTS	
The NFIP requires that applicants for a floodplain permit provide certain flood hazard information (e.g., Base Flood Elevation, flood zone, Flood Insurance Rate Map identifying information) on the permit application. Coordination with the County, which administers the building permit, may be required. This action is part of the community's Strategy for Continued Compliance with the NFIP.	

FRANKLIN

FRANKLIN MITIGATION ACTION 1	
Use existing stormwater and drainage studies to prioritize and implement recommended improvements. Evaluate use of stormwater fee to fund future projects.	
BACKGROUND INFORMATION	
Site and Location:	Citywide, with particular emphasis on Broad Street ditch, the Armory Drive ditch/ROW, and High Street north of the hospital.
Cost Benefit:	Stormwater drainage minimizes road closures, reduces damage to structures.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.4, 1.5
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High
Estimated Cost:	City is currently completing a planning document that outlines recommended improvements and cost estimates for each.
Potential Funding Sources:	ARPA; DHS: BRIC, HMGP, FMA
Lead Agency/Department Responsible:	Public Works
Implementation Schedule:	Within 2 to 3 years
ADDITIONAL COMMENTS	

FRANKLIN MITIGATION ACTION 2	
Maintain participation in the National Flood Insurance Program and the Community Rating System (CRS) and explore options for improving rating (currently a Class 9). Partner with Virginia DCR floodplain managers to update Appendix D of the Zoning Ordinance Floodplain Regulations.	
BACKGROUND INFORMATION	
Site and Location:	Flood insurance policyholders in the 100-year floodplain would be the primary beneficiaries. Standard X-Zone policyholders would also benefit up to a maximum 10 percent discount.
Cost Benefit:	Although there are numerous benefits to participation in CRS, the most quantifiable is the premium discounts to flood insurance policyholders. By reducing the amount residents pay in flood insurance premiums, this money is returned to the community and can be spent locally. Furthermore, many CRS communities experience a dramatic increase in the number of policies due to their outreach, which results in a reduction in uninsured losses after a flood. Then, Increased Cost of Compliance funds available to policyholders after a flood can be a valuable mitigation tool.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Goal 2, Goal 3
Priority (High, Moderate, Low):	Medium
Impact on Socially Vulnerable Populations:	High
Estimated Cost:	There is no cost for submitting a CRS application, other than staff time. Additional hours are required for annual reviews and cycle applications every 5 years. FEMA/ISO will provide application assistance.
Potential Funding Sources:	Existing budgets.
Lead Agency/Department Responsible:	Community Development
Implementation Schedule:	Within 1 to 2 years
ADDITIONAL COMMENTS	
CRS provides a structured incentive program to address flood hazards by rewarding policyholders with premium discounts, enhancing public safety, reducing damage to property and public infrastructure, avoiding economic disruption and losses, reducing human suffering, protecting the environment, and increasing the flood insurance policy base.	

FRANKLIN MITIGATION ACTION 3	
Compile elevation and flood damage data, including but not limited to: **1) Ensure all flood-prone businesses have based flood elevations posted inside;** **2) Link gauge data and high water mark data in a digital environment to facilitate evacuation, notification and other community flood awareness elements;** **3) Continue to participate in the river gaging program (entered 5 year contract in 2020);** **4) Maintain completed FEMA Elevation Certificates in a publicly-accessible format.**	
BACKGROUND INFORMATION	
Site and Location:	Throughout City's flood hazard areas.
Cost Benefit:	Data will support analysis of costs and benefits of flood mitigation measures, particularly for repetitively flooded structures. Benefits accrue through reduced staff time in preparing mitigation grant applications, and improved accuracy of cost-benefit analyses and evacuation plans.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2; Goal 2; Goal 3, Objective 3.2
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High
Estimated Cost:	Staff time; approximately 100 hours.
Potential Funding Sources:	USACE: FPMS (high water marks, structure elevations), HRPDC: LIDAR DHS: HMGP, HMGP 5% Initiative
Lead Agency/Department Responsible:	Fire and Rescue, Department of Tourism, Community Development
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
Gathering data to create an accurate cost-benefit analysis can be a particularly daunting part of the grant application process. By compiling data on historic floods and detailed damages in a single location/document, the City will support flood mitigation projects, both structural and nonstructural. Detailed elevation data in the Downtown Business District will assist in both evacuation planning and mitigation prioritization.	

FRANKLIN MITIGATION ACTION 4	
Work with the Department of Tourism and property owners to identify and implement wet and dry floodproofing projects to protect structures from future flood events. Floodproofing projects should be viewed from a holistic perspective while considering available technology and the building's age. Current floodplain management ordinance regulates floodproofing and residential elevations. Identify projects by providing flood audits to business owners. Mitigation projects may include acquisition, elevation, mitigation reconstruction projects, and retrofitting.	
BACKGROUND INFORMATION	
Site and Location:	Downtown Franklin
Cost Benefit:	Initial flood audits conducted by a structural engineer, together with detailed first floor elevations, will aid in prioritizing mitigation projects to ensure that implemented projects maximize the reduction in average annual flood damages and reduce economic strain on businesses and the City.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.5; Goal 2
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High
Estimated Cost:	$2,500 to $10,000 per structure
Potential Funding Sources:	DHS: HMGP, RFC ACE: FPMS HRPDC SBA loans
Lead Agency/Department Responsible:	Community Development
Implementation Schedule:	Within 2 years
ADDITIONAL COMMENTS	
Investigate the potential for "peer-to-peer" mentoring with other communities that have implemented historic downtown flood mitigation projects. Potential communities in the region with successful downtown flood mitigation projects include Grundy and Staunton, Virginia and Belhaven, North Carolina. The HRPDC can assist.	

FRANKLIN MITIGATION ACTION 5	
Conduct community disaster awareness campaign through the City's email newsletter to interested citizens, social media platforms through City of Franklin, Franklin Fire & Rescue and Franklin Police pages, and the cable Public, Education and Government (PEG) Channel. Address mitigation actions for multiple hazards, including purchase of flood insurance.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	For low cost, the City can distribute information on a variety of hazards to interested citizens on a regular basis. Benefits accrue when citizens aware of hazards begin to take actions to protect lives and property.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Tornado, Winter Storm, Earthquake, Wildfire, Drought, Extreme Heat, Hazardous Materials Incident, Landslide/Coastal Erosion
Goal(s) Addressed:	Goal 2
Priority (High, Moderate, Low):	Moderate/Low
Impact on Socially Vulnerable Populations:	High
Estimated Cost:	Minimal costs for staff time. Materials are available from FEMA and other agencies for free.
Potential Funding Sources:	Existing budgets. DHS: HMGP 5% Initiative
Lead Agency/Department Responsible:	Fire and Rescue, American Red Cross
Implementation Schedule:	Within one year.
ADDITIONAL COMMENTS	

FRANKLIN MITIGATION ACTION 6	
Increase protection and access/egress for critical facilities and infrastructure, primarily as a result of flooding. Elevate or floodproof new critical facilities; retrofit, relocate or repurpose existing facilities, or develop alternative options with close localities, and protect existing power line infrastructure. Mitigation projects may include acquisition, elevation, mitigation reconstruction projects, or retrofitting.	
BACKGROUND INFORMATION	
Site and Location:	Citywide, with particular emphasis on: 1. Evaluating relocation of main fire station out of the Special Flood Hazard Area (100-year floodplain); 2. Regionally, along power line right-of-ways; and, 3. Wastewater treatment plant mitigation or relocation.
Cost Benefit:	Benefits are reduced response times, longevity of critical infrastructure and reduced downtime for utilities after a disaster. The fire station was constructed in 1979 and was flooded in 1999 and 2006. The wastewater treatment plant was built in the 1950s and is also located in the Special Flood Hazard Area and is subject to regular inundation. Recently completed Franklin Southampton shared Water/Sewer Study outlines costs and benefits of various alternatives.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Winter Storm
Goal(s) Addressed:	Goal 1, Objective 1.1, 1.2, 1.3, 1.4, 1.5
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High
Estimated Cost:	Relocation of Fire Station estimated at +$9 million. Relocation or Mitigation of Wastewater Treatment Plan estimated at +$70 million
Potential Funding Sources:	ARPA; DHS: BRIC, HMGP, FMA; ACE: FCW, SFCP Dominion
Lead Agency/Department Responsible:	Fire Station – Franklin Fire & Rescue Public Works, with Franklin Power & Light, and Dominion
Implementation Schedule:	Within 1 to 2 years
ADDITIONAL COMMENTS	
Existing power lines in the floodway and floodplain are current issues of concern. Some power lines are outside of the City but provide power to the City and there is concern that power outages during floods could be extensive. The City is actively raising electrical panels and other equipment to higher locations, and is evaluating raising the substation. The City should move forward with identification of available, non-flood-prone sites for a new Fire Station.	

FRANKLIN MITIGATION ACTION 7	
Reduce the prevalence of hazardous trees by: **1) Conducting routine inspection and tree-trimming maintenance conducted by Public Works on a yearly basis; and** **2) coordinating with the Beautification Committee to prepare and distribute guidelines for property owners on how to properly care for aging trees, especially at the onset of hurricane season. Use PEG channel for distribution.**	
BACKGROUND INFORMATION	
Site and Location:	Franklin is a designated "Tree City USA" and the Beautification Committee administers an ordinance regulating tree pruning on publicly owned property.
Cost Benefit:	Benefits accrue through reduced damages to people, structures and vehicles. Reduced power outages get the City back to full operability faster.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Tropical/Coastal Storm, Winter Storm, Wildfire
Goal(s) Addressed:	Goal 1, Objective 1.2, 1.5; Goal 2
Priority (High, Moderate, Low):	Low
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	Staff time
Potential Funding Sources:	VDOF Urban and Community Forestry Assistance, VDOT Transportation Enhancement Grants
Lead Agency/Department Responsible:	Public Works tree trimming team
Implementation Schedule:	within 1 year
ADDITIONAL COMMENTS	
Tree failure has been identified by citizens as a significant hazard concern. During high wind events, trees that have not been properly pruned represent a hazard to people, structures, power lines, and vehicles. City continuously share Department of Forestry guidelines with the public.	

FRANKLIN MITIGATION ACTION 8	
Coordinate with CSX to regulate and manage the amount, types and times of hazardous materials transport through Franklin, and in preparing for potential hazardous material incidents.	
BACKGROUND INFORMATION	
Site and Location:	CSX rail lines
Cost Benefit:	Through the low-cost exchange of transport information with the railroads, Franklin officials can maximize preparedness, and reduce potential damage from an incident occurring during peak travel times or special events.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Hazardous Materials Incident
Goal(s) Addressed:	Goal 1, Objectives 1.2, 1.3, 1.5; Goal 3, Objective 3.4
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High
Estimated Cost:	Minimal
Potential Funding Sources:	n/a
Lead Agency/Department Responsible:	Fire and Rescue
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
Currently, staff are working with CSX to determine what hazardous materials travel through Franklin. The nearby Town of Boykins in Southampton County has passed an ordinance prohibiting overnight or longer-term parking of hazardous materials rail cars within town limits.	

FRANKLIN MITIGATION ACTION 9	
Continue upgrades to radio system to increase interoperability between departments and neighboring communities.	
BACKGROUND INFORMATION	
Site and Location:	Citywide and Neighboring Agencies
Cost Benefit:	Improved response capability builds community sustainability and increases citizen confidence in City services.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Tornado, Winter Storm, Earthquake, Wildfire, Extreme Heat, Hazardous Materials Incident
Goal(s) Addressed:	Goal 1, Objective 1.4
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High
Estimated Cost:	$1.6 million
Potential Funding Sources:	ARPC; DHS: BRIC, HMGP, HSGP
Lead Agency/Department Responsible:	Police; Fire and Rescue
Implementation Schedule:	Within 2 to 3 years
ADDITIONAL COMMENTS	
Franklin is working on this action currently using ARPA funds. Goal is to connect departments on local and regional levels.	

FRANKLIN MITIGATION ACTION 10	
Expand offside capabilities to city departments and citizens. Install citywide wireless network that will allow users to have access to computer network in a mobile environment. Provide signage for residents/travelers on how to connect to network.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Improves response capability, thereby reducing damages.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Tornado, Winter Storm, Earthquake, Wildfire, Extreme Heat, Hazardous Materials Incident
Goal(s) Addressed:	Goal 1, Objective 1.4
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High
Estimated Cost:	$330,196
Potential Funding Sources:	ARPA; DHS: BRIC, HMGP, HMGP 5% Initiative, HSGP
Lead Agency/Department Responsible:	Police
Implementation Schedule:	2 years
ADDITIONAL COMMENTS	
Install a citywide wireless network that will allow emergency responders to access internet, street level maps of city, HAZMAT information, pre-fire plans, and VCIN/NCIC for law enforcement. Interoperable communications of information exchanged via secure instant messaging. Allows interoperability of outside agencies responding to an incident within the City of Franklin. Several systems have been tested in recent years, but none found adequate for designated purposes.	

FRANKLIN MITIGATION ACTION 11	
Upgrade existing GIS system to incorporate wetlands, NFIP flood maps and other risk information into the site plan review process for new development. Incorporate risk from tidal surge and rising sea levels on rivers and consider how floodplains will change over time.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	A very low cost mitigation action with the benefit of raising awareness of flood hazards at a time when the (readily available) information can be used in the development process to protect new structures and infrastructure.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Landslide/Coastal Erosion
Goal(s) Addressed:	Goal 3, Objective 3.2
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	High
Estimated Cost:	Staff time
Potential Funding Sources:	Existing budgets; DHS: HMGP 5% Initiative
Lead Agency/Department Responsible:	Community Development, Clerk's Office, Revenue Office
Implementation Schedule:	Immediately
ADDITIONAL COMMENTS	
Currently, staff are working with Clerk's Office, Revenue Office and GeoDecisions on overall GIS use/system. Currently have a wetlands test layer.	

FRANKLIN MITIGATION ACTION 12	
Help businesses develop multi-disaster recovery plans.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Disaster recovery plans minimize or eliminate disruptions to the local economy and may reduce the need for insurance claims or business assistance after events.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 2
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	High
Estimated Cost:	$30,000
Potential Funding Sources:	DHS: HSGP
Lead Agency/Department Responsible:	Community Development, with Chamber of Commerce, Franklin Southampton Economic Development and Department of Tourism, HRPDC
Implementation Schedule:	Within 2 years
ADDITIONAL COMMENTS	
Businesses with disaster recovery plans in place will reduce or eliminate the impact of future disasters on themselves and Franklin's local economy. The identification of potential hazard mitigation measures (i.e., building retrofits/elevation, secondary storage facilities, backup systems) should be encouraged. Staff are currently working with agencies and departments listed above to identify additional strategies and methods to include economic relief, recovery and incentives to bring in new businesses. Relocation of Community Development is also under consideration to provide continuity of permitting operations.	

FRANKLIN MITIGATION ACTION 13	
Identify and repair or demolish unsafe, unsanitary or hazardous housing and other structures, including those in repetitive flood loss areas. Mitigation projects may include acquisition, relocation, elevation, mitigation reconstruction projects, and/or retrofitting.	
BACKGROUND INFORMATION	
Site and Location:	Citywide
Cost Benefit:	Unsafe housing increases the potential for loss of life and property due to several hazards. By identifying housing vulnerable to natural hazards and prioritizing those structures for repair or demolition, average annual damages due to hazards can be reduced.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Winter Storm, Tornado, Hazardous Materials Incident, Wildfire, Radon Exposure
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3; Goal 2, Objective 2.1
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High
Estimated Cost:	Costs vary based on structure needs. Generally, costs for demolition start at about $10,000 per structure, while rehabilitation and elevation together start at approximately $100,000 per structure.
Potential Funding Sources:	ARPA; HUD: CDBG DHS: BRIC, FMA, HMGP, RFC (CDBG funds may be applied as a non-Federal match to DHS grant funds)
Lead Agency/Department Responsible:	Community Development & Franklin Fire
Implementation Schedule:	Within 2 years of plan adoption
ADDITIONAL COMMENTS	
Community has an ongoing housing needs assessment that must be partnered with this initiative. City is planning action in the near future using ARPA and CDBG funds.	

FRANKLIN MITIGATION ACTION 14	
Verify the geographic location of identified NFIP repetitive loss structures, and determine if those properties have been mitigated and, if so, by what means.	
BACKGROUND INFORMATION	
Site and Location:	Repetitive flood loss areas throughout the City
Cost Benefit:	Repetitively flooded structures strain local and federal resources after disasters, and detract from the fiscal solvency of the NFIP. The NFIP focuses mitigation efforts and funds on properties listed as repetitive losses; therefore, checking the accuracy of the list is a necessity for the NFIP, States and, through this action, local governments.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 3, Objective 3.2
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High
Estimated Cost:	Costs are being reevaluated.
Potential Funding Sources:	DHS: BRIC, HMGP, HMGP 5% Initiative, FMA, RFC
Lead Agency/Department Responsible:	Planning
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	
An initial attempt to contact property owners by mail will be followed up by phone calls, and site visits as necessary.	

SOUTHAMPTON COUNTY

SOUTHAMPTON COUNTY MITIGATION ACTION 1	
Protect existing and future critical facilities from damage due to flooding, tropical storm, earthquake and tornado. Projects may include: **1) Modify floodplain management ordinance to require new public safety buildings be located outside 500-year floodplain and that a detailed flood study be conducted to determine limits of the 100- and 500-year floodplains for proposed public safety buildings near approximate A Zone floodplain;** **2) continue mapping water and sewer lines countywide, including the towns, in order to identify problems and retrofit/upgrade needs in order to protect utilities from damage and provide continuity of operations during disaster;** **3) Retrofit new Sheriff's Office and EOC to protect from flooding, including access and egress; and,** **4) Ensure retrofitted Courthouse is protected from flooding.**	
BACKGROUND INFORMATION	
Site and Location:	To be determined
Cost Benefit:	The current EOC is subject to flooding which can hinder response efforts during flood events. Benefits accrue by increasing response capabilities and reducing average annual flood damages and predicted downtime for critical public safety structures and lifelines.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding; Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Tornado, Earthquake
Goal(s) Addressed:	Goal 1, Objectives 1.3, 1.4
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	High – repetitive flood loss areas in the county are NRI relatively high or very high flood risk
Estimated Cost:	Staff time
Potential Funding Sources:	Existing budgets; DHS: HMGP 5% Initiative
Lead Agency/Department Responsible:	County Administrator's Office
Implementation Schedule:	Within 3 years
ADDITIONAL COMMENTS	

SOUTHAMPTON COUNTY MITIGATION ACTION 2	
Consider amendment to subdivision ordinance that requires solicitation to the Virginia Department of Forestry for wildfire mitigation comments on proposed major subdivisions in the County.	
BACKGROUND INFORMATION	
Site and Location:	To be determined
Cost Benefit:	During the site plan review process, comments regarding smart wildfire avoidance techniques, such as defensible space, can be incorporated into the project design.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Wildfire
Goal(s) Addressed:	Goal 1; Goal 3, Objective 3.4
Priority (High, Moderate, Low):	Low
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	Staff time
Potential Funding Sources:	VDOF
Lead Agency/Department Responsible:	Community Development
Implementation Schedule:	Within 5 years
ADDITIONAL COMMENTS	

SOUTHAMPTON COUNTY MITIGATION ACTION 3	
Protect repetitively flooded structures, including the County courthouse, from flood damage. Modifications could include floodproofing retrofits, elevation of structure and/or critical components, acquisition, relocation or repurposing the structure. This action includes Mitigation Reconstruction projects.	
BACKGROUND INFORMATION	
Site and Location:	Countywide
Cost Benefit:	Average annual flood damages would be reduced through mitigation actions.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Winter Storm
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.4, 1.5
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High – repetitive flood loss areas in the county are NRI relatively high or very high flood risk
Estimated Cost:	To be determined
Potential Funding Sources:	DHS: BRIC, HMGP, FMA, RFC; HSGP
Lead Agency/Department Responsible:	County Administrator’s Office
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

SOUTHAMPTON COUNTY MITIGATION ACTION 4	
Complete five remaining countywide drainage studies that prioritize drainage maintenance requirements and stormwater management projects to minimize flooding problems. Implement recommendations.	
BACKGROUND INFORMATION	
Site and Location:	One study proposed for each County planning area (Newsoms has been completed)
Cost Benefit:	The exact nature of flooding problems merits additional study before the costs and benefits of individual flood mitigation projects can be calculated with accuracy, and in order to determine which drainage maintenance projects maximize benefits from reduced flooding. Much of the County has only been studied to show approximate A Zone floodplains.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.4, 1.5
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High – repetitive flood loss areas in the county are NRI relatively high or very high flood risk
Estimated Cost:	$250,000
Potential Funding Sources:	DHS: BRIC, HMGP, HSGP; USDA: WPFP
Lead Agency/Department Responsible:	County Administrator's Office
Implementation Schedule:	Within 5 years of plan adoption
ADDITIONAL COMMENTS	
Many storm drainage ditches were constructed in the 1930's and are not maintained.	

SOUTHAMPTON COUNTY MITIGATION ACTION 5	
Institute web-based educational program to provide multi-hazard structural protection techniques to property owners. Include information on responsible tree pruning.	
BACKGROUND INFORMATION	
Site and Location:	Countywide
Cost benefit:	Low-cost protection measures help citizens help themselves.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Tornado, Winter Storm, Earthquake, Wildfire, Radon Exposure
Goal(s) Addressed:	Goal 2, Objectives 2.1, 2.2
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	Approximately $2,500 annually
Potential Funding Sources:	DHS: BRIC, HGSP, HMGP, HMGP 5% Initiative; American Red Cross; FEMA materials available at no charge
Lead Agency/Department Responsible:	Community Development
Implementation Schedule:	Within 1 year
ADDITIONAL COMMENTS	
Particular life/safety concerns were identified, specifically related to driving on roads that have been or could be flooded, and promoting water conservation techniques during widespread power outages.	

SOUTHAMPTON COUNTY MITIGATION ACTION 6	
Verify the geographic location of all NFIP repetitive losses, and make inquiries as to whether the properties have been mitigated, and if so, by what means.	
BACKGROUND INFORMATION	
Site and Location:	Countywide
Cost Benefit:	Average annual flood damages are reduced through mitigation actions.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1; Goal 3, Objective 3.2
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High – repetitive flood loss areas in the county are NRI relatively high or very high flood risk
Estimated Cost:	To be determined
Potential Funding Sources:	DHS: BRIC, HMGP, HMGP 5% Initiative, FMA, RFC; HSGP
Lead Agency/Department Responsible:	Community Development; HRPDC, VDEM
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

SOUTHAMPTON COUNTY MITIGATION ACTION 7	
Maintain Certified Floodplain Manager (CFM) certification and training for two County employees.	
BACKGROUND INFORMATION	
Site and Location:	Countywide
Cost Benefit:	Training related to implementation of floodplain management regulations, permitting, reading Flood Insurance Rate Maps, and other topics will help staff properly administer floodplain management regulations, thereby protecting future development from flood damage.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2
Priority (High, Moderate, Low):	High.
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	$1,000 per person
Potential Funding Sources:	Department training funds
Lead Agency/Department Responsible:	Department of Community Development
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

SOUTHAMPTON COUNTY MITIGATION ACTION 8	
Enact tree preservation or landscape ordinance for new construction in all zoning designations.	
BACKGROUND INFORMATION	
Site and Location:	Countywide
Cost Benefit:	Tree protection and landscape requirements mitigate effects of erosion and can contribute to stormwater management for new construction by requiring greater pervious areas and retention of existing landscaped areas.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Landslide/Coastal Erosion, Winter Storm, Wildfire
Goal(s) Addressed:	Goal 1, Objectives 1.1, 1.2, 1.3, 1.5, 1.6, Goal 3, Objective 3.1
Priority (High, Moderate, Low):	Low
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	Staff time only
Potential Funding Sources:	DHS: HMGP 5% Initiative
Lead Agency/Department Responsible:	County Administrator/Public Works Department/Community Development Department
Implementation Schedule:	within 3 years of plan adoption
ADDITIONAL COMMENTS	
County is adopting new zoning designation with landscaping requirements. Tree preservation and landscaping are also addressed in proposed solar energy ordinance now under consideration.	

SOUTHAMPTON COUNTY MITIGATION ACTION 9	
Encourage Litter Control Council and citizen groups to become more involved in roadside clean-ups to keep roadside ditches clear of debris.	
BACKGROUND INFORMATION	
Site and Location:	Countywide
Cost Benefit:	Citizen involvement in ditch maintenance reduces costs to VDOT for ditch maintenance.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Landslide/Coastal Erosion, Winter Storm
Goal(s) Addressed:	Goal 1, Objectives 1.2, 1.5, 1.6, Goal 2, Objective 2.1; Goal 3, Objective 3.3
Priority (High, Moderate, Low):	Low
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	<$5,000
Potential Funding Sources:	Grants for Litter Control Council
Lead Agency/Department Responsible:	Public Works (staff liaison to Litter Control Council)
Implementation Schedule:	Over the next 5 to 7 years
ADDITIONAL COMMENTS	

SOUTHAMPTON COUNTY MITIGATION ACTION 10	
Increase use of Reverse 911 by citizens. Registration for the service is required and is currently advertised primarily on county web site.	
BACKGROUND INFORMATION	
Site and Location:	Countywide
Cost Benefit:	Reverse 911 has a cost to the County, but increased users are needed to make the system as cost-effective as possible.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 1, Objectives 1.2, 1.4, 1.5, Goal 2, Objective 2.1, Goal 3, Objective 3.1
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	<$2,500
Potential Funding Sources:	To be determined.
Lead Agency/Department Responsible:	Sheriff's Office
Implementation Schedule:	Within 2 years of plan adoption
ADDITIONAL COMMENTS	
Sheriff's Office has plans in place for advertisement.	

SOUTHAMPTON COUNTY MITIGATION ACTION 11	
Include hazard mitigation priorities in budget preparation discussions and other County functions, such as comprehensive land use planning.	
BACKGROUND INFORMATION	
Site and Location:	Countywide
Cost Benefit:	The process for funding other mitigation actions included in this plan must begin with countywide budget priorities. There is no cost to including a discussion of the hazards and vulnerability to which the county is exposed, but the benefits accrue as mitigation actions get implemented.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 1, Objectives 1.2, 1.3, 1.4, 1.5; Goal 3, Objectives 3.1, 3.3
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	Staff time
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Director/Coordinator of Emergency Management
Implementation Schedule:	Annually
ADDITIONAL COMMENTS	
Funds for mitigation efforts are necessary. Some costs are minimal (e.g., direct mail, web updates), some are expensive (e.g., structural mitigation, relocation of critical facilities). It is important for all County staff to look at hazard mitigation as a set of on-going actions rather than as a hard copy plan on the bookshelf. County Comprehensive Plan is currently undergoing revision and hazard mitigation-related goals and objectives will be incorporated.	

SOUTHAMPTON COUNTY MITIGATION ACTION 12		
Implement drainage plan for Newsoms area. The plan was created through a DHCD grant that is currently funded and underway until early 2023. Seek additional funding sources.		
BACKGROUND INFORMATION		
Site and Location:	Newsoms	
Cost Benefit:	Drainage study and plan are completed and provide steps necessary to fix drainage problems and repair damaged homes.	
MITIGATION ACTION DETAILS		
Hazard(s) Addressed:		Flooding
Goal(s) Addressed:		Goal 1, Objectives 1.1, 1.2, 1.3, 1.4, 1.5; Goal 2, Objective 2.1; Goal 3, Objectives 3.1, 3.3
Priority (High, Moderate, Low):		High
Impact on Socially Vulnerable Populations:		High
Estimated Cost:		$50,000 - $500,000, per plan, which was broken into several geographic areas, so phased implementation is feasible.
Potential Funding Sources:		DHS: HMGP
Lead Agency/Department Responsible:		Director/Coordinator of Emergency Management
Implementation Schedule:		Annually
ADDITIONAL COMMENTS		
Three more phases of the plan are anticipated.		

SOUTHAMPTON COUNTY MITIGATION ACTION 13	
Develop long-term housing plan, including consideration of adopting the Property Maintenance Section of the USBC to address existing housing deficiencies. Long-term plan should include housing for displaced populations in the incorporated and unincorporated parts of Southampton County in the event of a disaster.	
BACKGROUND INFORMATION	
Site and Location:	Countywide, with particular focus on flood-prone and socially vulnerable population centers in the towns.
Cost Benefit:	Disaster resilience is only achieved when the hardest hit citizens can return to a new normal, safe from repeat events. By focusing on population centers and identifying future housing needs for socially vulnerable populations, the County will reduce future costs and uncertainty in a post-disaster scenario.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Tornado, Winter Storm, Earthquake, Wildfire, Hazardous Materials Incident, Radon Exposure
Goal(s) Addressed:	Goal 1: Objectives 1.1, 1.2, 14, 1.5
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High/Moderate
Estimated Cost:	TBD
Potential Funding Sources:	Virginia CFPF; DHS: BRIC, HMGP; HUD: CDBG; Virginia Department of Housing and Community Development; HRPDC
Lead Agency/Department Responsible:	Sheriff's Office, Community Development, Social Services
Implementation Schedule:	Within 3 years of plan adoption
ADDITIONAL COMMENTS	

SOUTHAMPTON COUNTY MITIGATION ACTION 14	
Conduct additional watershed mapping for the Blackwater and Nottaway Rivers, similar to the recently completed effort on the Meherrin River.	
BACKGROUND INFORMATION	
Site and Location:	Blackwater and Nottaway River watersheds
Cost Benefit:	Better mapping facilitates better regulation of stormwater and other development-related impacts in the watersheds.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding
Goal(s) Addressed:	Goal 3: Objective 3.2
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	High – repetitive flood loss areas in the county are NRI relatively high or very high flood risk
Estimated Cost:	TBD
Potential Funding Sources:	USACE, Silver Jackets, County General Fund
Lead Agency/Department Responsible:	Community Development
Implementation Schedule:	Within 5 years of plan adoption
ADDITIONAL COMMENTS	

SURRY COUNTY

SURRY COUNTY MITIGATION ACTION 1	
Increase staff resources for emergency management.	
BACKGROUND INFORMATION	
Site and Location:	Countywide
Benefit Cost:	Insufficient staffing increases the demands on existing staff and can be problematic in program administration during disasters.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 1: Objectives 1.2, 1..3, 1.4, 1.5; Goal 2
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	$60,000 to $80,000 per position
Potential Funding Sources:	County Budget and Staffing Plan; DHS
Lead Agency/Department Responsible:	Emergency Services
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

SURRY COUNTY MITIGATION ACTION 2	
Establish signage notifications for additional high water marks along creeks and rivers in floodprone areas.	
BACKGROUND INFORMATION	
Site and Location:	To be determined.
Benefit Cost:	Signage that notifies drivers about how high the water is helps reduce water rescues and save lives.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding; Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1: Objective 1.5; Goal 2; Goal 3: Objectives 3.3, 3.4
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	High – northern Census tract with 3 repetitive flood loss areas Low – southern Census tract with 1 repetitive flood loss area
Estimated Cost:	<$5000
Potential Funding Sources:	Staff, VDOT
Lead Agency/Department Responsible:	Emergency Services
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

SURRY COUNTY MITIGATION ACTION 3	
Protect critical facilities and infrastructure. Measures may include retrofitting of existing buildings and facilities as shelters, stormwater management or drainage improvements, elevation or relocation of structures or facilities out of hazard-prone locations. Continue to install the necessary electrical hook-up, wiring, and switches to allow readily-accessible connections to emergency generators at key critical public facilities.	
BACKGROUND INFORMATION	
Site and Location:	County facilities throughout the County
Benefit Cost:	Continuity of operations after a hazard event is dependent upon operational utilities, shelters, communications and medical services.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 1: Objectives 1.2, 1.3, 1.5; Goal 2
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	TBD
Potential Funding Sources:	CIP, DHS: HMGP; Virginia CFPF
Lead Agency/Department Responsible:	Public Safety
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

SURRY COUNTY MITIGATION ACTION 4	
Distribute brochures and use other means to educate the public regarding preparedness and mitigation. Conduct annual preparedness days for hazards to include floods, wind, and earthquakes. Use social media to quickly and effectively inform the public.	
BACKGROUND INFORMATION	
Site and Location:	Countywide
Benefit Cost:	Damage from hazard events is reduced when citizens are prepared and knowledgeable about mitigation techniques to protect their lives and property, and preparedness techniques for staying safe when events happen.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 2
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	Staff time; less than $2500 annually
Potential Funding Sources:	DHS materials; CIP
Lead Agency/Department Responsible:	Public Safety
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

SURRY COUNTY MITIGATION ACTION 5	
As part of continuing participation in the NFIP and a new application to the Community Rating System, request list of NFIP repetitive flood losses to ensure accuracy. Review will include verification of the geographic location of each RL property and determination if mitigated and by what means. Provide corrections if needed by filing form FEMA AW-501. Update flood ordinance to clarify freeboard requirement.	
BACKGROUND INFORMATION	
Site and Location:	Countywide
Benefit Cost:	Community Rating System participation may reduce flood insurance premiums throughout the County.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1: Objective 1.1; Goal 3: Objective 3.2
Priority (High, Moderate, Low):	Low
Impact on Socially Vulnerable Populations:	High – northern Census tract with 3 repetitive flood loss areas Low – southern Census tract with 1 repetitive flood loss area
Estimated Cost:	Staff time investment in CRS application is significant.
Potential Funding Sources:	VDEM
Lead Agency/Department Responsible:	Department of Planning and Zoning
Implementation Schedule:	within 2 years of plan adoption
ADDITIONAL COMMENTS	
Discussions with VDEM and the regional PDC's may transfer some of the repetitive flood loss monitoring to VDEM in the future.	

SURRY COUNTY MITIGATION ACTION 6	
Improve GIS and 911 capabilities with better data collection, integration and functionality.	
BACKGROUND INFORMATION	
Site and Location:	Countywide
Benefit Cost:	Emergency Management and hazard response functionality are improved with high level data integration and geographic/spatial data.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Flooding Due to Impoundment Failure/High Hazard Dam, Tropical/Coastal Storm, Tornado, Winter Storm, Earthquake, Wildfire, Extreme Heat, Hazardous Materials Incident, Pandemic Flu or Communicable Disease
Goal(s) Addressed:	Goal 3: Objectives 3.2, 3.4
Priority (High, Moderate, Low):	Low
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	TBD
Potential Funding Sources:	Public Safety Answering Points (PSAP) Operations Grant
Lead Agency/Department Responsible:	Planning and Zoning
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

SURRY COUNTY MITIGATION ACTION 7	
Protect public and private property through a variety of measures, including but not limited to: acquisition, elevation or relocation of structures from hazard prone areas, retrofitting of existing buildings, and minor structural flood control projects.	
BACKGROUND INFORMATION	
Site and Location:	Countywide
Benefit Cost:	Protecting structures in hazard-prone locations, particularly floodplains, has been shown to reduce future damages.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Flooding Due to Impoundment Failure/High Hazard Dam, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Landslide/Coastal Erosion, Tornado, Earthquake, Winter Storm, Wildfire, Radon Exposure
Goal(s) Addressed:	Goal 1: Objectives 1.1, 1.2, 1.3, 1.4, 1.5; Goal 2: Objective 2.1
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	High – northern Census tract with 3 repetitive flood loss areas Low – southern Census tract with 1 repetitive flood loss area
Estimated Cost:	TBD
Potential Funding Sources:	DHS: HMGP, BRIC, FMA; Virginia CFPF; USACE: FPMS, SFCP
Lead Agency/Department Responsible:	Public Safety; Planning and Zoning
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

TOWN OF CLAREMONT

TOWN OF CLAREMONT MITIGATION ACTION 1	
Protect public and private property through a variety of measures, including but not limited to: acquisition, elevation or relocation of structures from hazard prone areas, retrofitting of existing buildings, and minor structural flood control projects.	
BACKGROUND INFORMATION	
Site and Location:	Throughout the Town
Benefit Cost:	Protecting structures in hazard-prone locations, particularly floodplains, has been shown to reduce future damages.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Sea Level Rise and Land Subsidence, Tropical/Coastal Storm, Landslide/Coastal Erosion, Tornado, Earthquake, Winter Storm, Wildfire, Radon Exposure
Goal(s) Addressed:	Goal 1: Objectives 1.1, 1.2, 1.3, 1.4, 1.5; Goal 2: Objective 2.1
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High
Estimated Cost:	TBD
Potential Funding Sources:	DHS: HMGP, BRIC, FMA; Virginia CFPF; USACE: FPMS, SFCP
Lead Agency/Department Responsible:	Mayor
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

TOWN OF CLAREMONT MITIGATION ACTION 2	
Protect critical facilities and infrastructure. Measures may include retrofitting of existing buildings and facilities as shelters, stormwater management or drainage improvements, elevation or relocation of structures or facilities out of hazard-prone locations.	
BACKGROUND INFORMATION	
Site and Location:	Throughout the Town
Benefit Cost:	Continuity of operations after a hazard event is dependent upon operational utilities, shelters, communications and medical services.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 1: Objectives 1.2, 1.3, 1.5; Goal 2
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	TBD
Potential Funding Sources:	DHS: HMGP; Virginia CFPF; USACE: FPMS
Lead Agency/Department Responsible:	Mayor
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

TOWN OF CLAREMONT MITIGATION ACTION 3	
Continue to work with VDOT to develop an alternative ingress/egress to Claremont Beach.	
BACKGROUND INFORMATION	
Site and Location:	Claremont Beach
Benefit Cost:	
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding, Tropical/Coastal Storm, Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1: Objectives 1.1, 1.2, 1.3, 1.4, 1.5; Goal 3
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	High
Estimated Cost:	TBD
Potential Funding Sources:	Virginia CFPF; DHS: HMGP
Lead Agency/Department Responsible:	Mayor
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

TOWN OF CLAREMONT MITIGATION ACTION 4	
Review NFIP repetitive loss and severe repetitive loss property list to ensure accuracy. Verify location of each property and determine if that property has been mitigated and by what means.	
BACKGROUND INFORMATION	
Site and Location:	Throughout the Town
Benefit Cost:	
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flooding; Sea Level Rise and Land Subsidence
Goal(s) Addressed:	Goal 1: Objective 1.1, 1.2; Goal 3: Objective 3.2
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	High
Estimated Cost:	Approximately 5 hours staff time
Potential Funding Sources:	Existing budgets
Lead Agency/Department Responsible:	Mayor
Implementation Schedule:	within 1 year of data receipt
ADDITIONAL COMMENTS	

TOWN OF CLAREMONT MITIGATION ACTION 5	
Distribute brochures and use other means to educate the public regarding preparedness and mitigation.	
BACKGROUND INFORMATION	
Site and Location:	Throughout the Town
Benefit Cost:	Prepared and knowledgeable citizens can help reduce damage from events and protect their own property.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 1: Objectives 1.1, 1.2, 1.4, 1.5; Goal 2
Priority (High, Moderate, Low):	Moderate
Impact on Socially Vulnerable Populations:	Moderate
Estimated Cost:	Minimal, as many materials are readily available from American Red Cross, FEMA and other entities
Potential Funding Sources:	Existing budgets
Lead Agency/Department Responsible:	Mayor
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

TOWN OF DENDRON

TOWN OF DENDRON MITIGATION ACTION 1	
Protect public and private property through a variety of measures, including but not limited to: acquisition, elevation or relocation of structures from hazard prone areas, retrofitting of existing buildings, and minor structural flood control projects. **Distribute materials that teach residents about mitigation measures for protection of their own lives and property from a wide range of hazards.**	
BACKGROUND INFORMATION	
Site and Location:	Throughout the Town
Benefit Cost:	Protecting structures in hazard-prone locations, particularly floodplains, has been shown to reduce future damages.
MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	All
Goal(s) Addressed:	Goal 1: Objectives 1.1, 1.2, 1.3, 1.4, 1.5; Goal 2
Priority (High, Moderate, Low):	High
Impact on Socially Vulnerable Populations:	Low
Estimated Cost:	TBD
Potential Funding Sources:	DHS: HMGP, BRIC, FMA; Virginia CFPF; USACE: FPMS, SFCP
Lead Agency/Department Responsible:	Mayor
Implementation Schedule:	Ongoing
ADDITIONAL COMMENTS	

PLAN MAINTENANCE PROCEDURES

Contents

2022 UPDATE

Section 8 was updated to modify the scope and to include all 25 communities participating in this planning process.

INTRODUCTION

This section discusses how the *Mitigation Strategy* will be implemented by the communities and how the overall Hazard Mitigation Plan will be evaluated and enhanced over time. This section also discusses how the public and participating stakeholders will continue to be involved in the hazard mitigation planning process in the future. This section consists of the following three subsections:

- IMPLEMENTATION
- MONITORING, EVALUATION AND ENHANCEMENT
- CONTINUED PUBLIC INVOLVEMENT

IMPLEMENTATION

44 CFR Requirement
Part 201.6(c)(4)(i): The plan will include a plan maintenance process that includes a section describing the method and schedule of monitoring, evaluating and updating the mitigation plan within a five-year cycle.

In addition to the assignment of a lead department or agency, an implementation time period has been established for each mitigation action in order to assess whether actions are being implemented in a timely fashion. Each community will seek funding sources to implement mitigation projects in both the pre-disaster and post-disaster environments. When applicable, potential funding sources have been identified for proposed actions listed in each *Mitigation Action Plan*.

44 CFR Requirement
Part 201.6(c)(4)(ii): The plan maintenance process will include a process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms such as comprehensive or capital improvement plans, when appropriate.

Emergency Management officials in each community will be responsible for determining additional implementation procedures beyond those listed within the *Mitigation Action Plan*. This includes further integrating the Hazard Mitigation Plan into other local planning documents such as comprehensive, resilience or capital improvement plans, when appropriate. The members of the planning committees for each community remain charged with ensuring that the goals and strategies of new and updated local planning documents (such as Comprehensive Plans and Zoning Ordinances) are consistent with the goals and actions of the Hazard Mitigation Plan, and that those planning documents will not contribute to an increased level of hazard vulnerability in the region.

Opportunities to integrate the requirements of this Plan into other local planning mechanisms will continue to be identified through future meetings of each community's mitigation planning committee and through the five-year review process described in this section.

Each community will integrate the tenets of this mitigation plan into relevant local government decision making processes or mechanisms. The primary means for integrating mitigation strategies into other local planning documents will be accomplished through the revision, update, and implementation of the Mitigation Action Plan that requires specific planning and administrative tasks (i.e., plan amendments, ordinance revisions, capital improvement projects). In addition, each community will incorporate existing planning processes and programs addressing the impacts of climate change, resiliency programs, flooding and sea level rise hazard mitigation into this document by reference.

MONITORING, EVALUATION AND ENHANCEMENT

Periodic revisions and updates to the Plan are required to ensure that the goals of the Plan are kept current, taking into account potential changes in hazard vulnerability and mitigation priorities. In addition, revisions may be necessary to ensure that the Plan is in full compliance with changing federal, state and local regulations. Periodic evaluation of the Plan will also ensure that specific mitigation actions are being reviewed and carried out according to the *Mitigation Action Plan*.

The Hazard Mitigation Planning Working Group will continue to meet at least annually and following any disaster events warranting a re-examination of the mitigation actions, thus continuously updating the Plan to reflect changing conditions and needs within the communities. An annual report on the Plan will be developed and presented to elected officials through HRPDC in order to report progress on the actions identified in the Plan and to provide information on the latest legislative requirements. The report may also highlight proposed additions or improvements to the Plan. The report will be released to the media and made available to the public via appropriate methods, such as the HRPDC web site.

Each community has designated a lead person and agency responsible for the monitoring, evaluation and enhancements to the plan. Those position titles and agencies are shown in Tables 2.2a and 2.2b as rows marked with an asterisk. The individuals are the primary contacts moving forward with plan implementation.

ANNUAL PROGRESS REPORTS

Each community's hazard mitigation planning committee will be responsible for producing an annual progress report to evaluate the Plan's overall effectiveness. As part of the contract for preparing this plan, the contractor is providing a mitigation action plan spreadsheet in Appendix F that lists all mitigation actions for each community and the region. Updating this spreadsheet with status information will allow periodic progress checkups that can feed into the annual progress reports.

FIVE-YEAR PLAN REVIEW

At a minimum, the Plan will be reviewed and must be updated every five years by the hazard mitigation planning committees as required by DMA 2000. The purpose of the review and update is to determine whether there have been any significant changes that may, in turn, necessitate changes in the types of mitigation actions proposed. New development in identified hazard areas, an increased exposure to hazards, the increase or decrease in capability to address hazards, and changes to federal or state legislation are examples of factors that may affect the content of the Plan.

The plan review provides community officials with an opportunity to evaluate those actions that have been successful and to explore the possibility of documenting potential losses avoided due to the implementation of specific mitigation measures. The plan review also provides the opportunity to address mitigation actions that may not have been successfully implemented. Each community will be responsible for reconvening and conducting the five-year review, although it is expected that the HRPDC will again lead the effort to update the plan in five years. During the five-year plan review process, the following questions will be considered as criteria for assessing the effectiveness and appropriateness of the Plan:

- Do the goals and actions address current and expected conditions?
- Has the nature or magnitude of hazard risk changed?
- Are current resources adequate to implement the Plan?
- Should additional local resources be committed to address identified hazard threats?
- Are there any issues that have limited the current implementation schedule?
- Has the implementation of identified mitigation actions resulted in expected outcomes?
- Has the committee measured the effectiveness of completed hazard mitigation projects in terms of specific dollar losses avoided?
- Did the community, agencies and other partners participate in the plan implementation process as proposed?

Following the five-year review, any revisions deemed necessary will be summarized and implemented according to the reporting procedures and plan amendment process outlined in this section. Upon completion of the review and update process, the Plan will be submitted to the VDEM State Hazard Mitigation Officer for review and approval. The State Hazard Mitigation Officer will submit the Plan amendments to FEMA for final review as required by DMA 2000.

DISASTER DECLARATION

Following a state or federal disaster declaration, the hazard mitigation planning committee will reconvene and the Plan will be revised as necessary to reflect lessons learned or to address specific circumstances arising from the event. Community committees may find it necessary to convene following localized emergencies and disasters, or when pursuing funding for a specific mitigation project, in order to determine if administrative changes to the Plan are warranted.

REPORTING PROCEDURES

The results of the five-year review will be summarized by the committee in a report that will include an evaluation of the effectiveness of the Plan and any required or recommended changes or amendments. The report will also include a brief progress report for each mitigation action, including the identification of delays or obstacles to their completion along with recommended strategies to overcome them. Any necessary revisions to the Plan must follow the plan amendment process outlined herein.

PLAN AMENDMENT PROCESS

Upon initiation of the amendment process, the community(ies) will forward information on the proposed change(s) to interested parties, including affected municipal departments. Information will also be forwarded to the VDEM. This information will be disseminated in order to seek input on the proposed amendment(s) for not less than a 5-day review and comment period.

At the end of the 5-day review and comment period, the proposed amendment(s) and all comments will be forwarded to HRPDC for final consideration. The committee, or the AHAC in temporary stead of convening the entire Steering Committee, will review the proposed amendments along with the comments received from other parties, and if acceptable, the committee will submit a recommendation for the approval and adoption of changes to the Plan.

IMPORTANT: Minor revisions to the plan may be approved by each community's Chief Administrative Officer, while substantial amendments and addendums must be approved by the community's elected governing body.

In determining whether to recommend approval or denial of a Plan amendment request, the following factors will be considered by the committee:

- There are errors, inaccuracies or omissions made in the identification of issues/needs in the Plan;
- New issues/needs have been identified which are not adequately addressed in the Plan;
- There has been a change in data or assumptions from those upon which the Plan is based.

Upon receiving the recommendation from the committee and prior to adoption of the Plan, each community's governing body will hold a public hearing. The governing body will review the recommendation from the committee (including the factors listed above) and any oral or written comments received at public hearing(s). Following that review, the governing body will take one of the following actions:

- Adopt the proposed amendments as presented;
- Adopt the proposed amendments with modifications;
- Refer the amendments request back to the committee for further revision; or
- Defer the amendment request back to the committee for further consideration and/or additional hearings.

CONTINUED PUBLIC INVOLVEMENT

44 CFR Requirement
Part 201.6(c)(4)(iii): The plan maintenance process will include a discussion on how the community will continue public participation in the plan maintenance process.

Public participation is an integral component of the mitigation planning process. As described above, significant changes or amendments to the Plan will require a public hearing prior to any adoption procedures.

Other efforts to involve the public in the maintenance, evaluation and revision process will be made. These efforts differ by community based on each community's individual needs, public response and whether the community has been recently affected by a hazard event. Examples of how communities in Hampton Roads already engage the public during the interim planning period, or of how they may choose to approach this task in the future, include:

- Advertise meetings of the committee in local newspapers, public bulletin boards, web sites, social media and City buildings. Designating a diverse community mitigation committee through official resolution of the governing board, and then scheduling regular meetings of the committee and advertising those meetings aggressively has worked well for some communities.
- Designate willing citizens and private sector representatives as official members of the planning committee. While real estate, financial and construction industry leaders are natural partners in mitigation planning, look beyond these to include business leaders, large employers, and representatives of local military installations and transportation hubs, such as the Port of Virginia. Cultural institutions, like Jamestown-Yorktown Foundation, are an important component in the economy of Hampton Roads and their collections are vulnerable to many of the hazards discussed in the plan. Neighborhood groups, civic leagues and other citizen groups are a valuable source of mitigation ideas for specific areas.
- Engage elected officials and planning commission members in the process, beyond simply providing updates or reports. Elected officials have a responsibility to protect the health, safety and welfare of their constituents and their support is critical to successful implementation of the Mitigation Action Plan in every Hampton Roads community.
- Use local media to update the public about any maintenance or periodic review activities taking place. The media have moved beyond traditional print and televised media and their social media presence can be valuable in disseminating information about upcoming meetings or activities. Local non-profits can also be invaluable in spreading the word about mitigation planning meetings open to the public.
- Use questionnaires, open houses, fairs and other community events to obtain ongoing public comments on the Plan and its implementation. Many local emergency managers effectively use community events to inform and advise the public on preparedness and evacuation, but the venues can also be valuable for informing the citizenry about the components of effective mitigation, how their community is implementing their Mitigation Action Plan and gathering information from the public to inform the next plan revision.
- Use community web sites, social media and list-servs to advertise any maintenance or periodic review activities taking place. Periodic surveys on social media can be a fun way to raise awareness.
- Hold area-specific meetings on a regular basis to solicit feedback from neighbors. Such meetings, held in public venues, can be used to distribute literature, educate citizens on

mitigation actions they can implement on their own, and solicit input on how the mitigation process can be more effective for their area or neighborhood.

- Integrate mitigation action plans, goals and objectives, and other plan elements into other community planning objectives. When a community's comprehensive or resiliency planning process includes similar team members and incorporates or references pieces of the hazard mitigation plan, the public gains familiarity with the links between the plans and the ways in which the efforts complement each other.
- Maintain hard copies of the Plan in public libraries, on the web, or other appropriate venues. While many citizens are engaged in community affairs through computer technology, keeping hard copies of the plan in public venues with a business card or other contact information for providing feedback or answering questions is an old-fashioned but necessary way of reaching a much larger segment of citizens.

Table 8.1 provides summary feedback from individual community's committee leaders indicating how they anticipate their community will include the public in the 5-year period following adoption.

TABLE 8.1: INCLUDING THE PUBLIC DURING PLAN IMPLEMENTATION PERIOD

SUBREGION	COMMUNITY	Advertise committee meetings	Designate citizens, private sector reps as members of committee	Use local media to update public on maintenance activities	Use questionnaires, open houses to obtain public comment	Use web sites to advertise maintenance activities	Maintain copies of the plan in libraries, on the web, or other venues	Other
Peninsula	Hampton	✓	✓	✓	✓	✓	✓	annual update to Council
	Newport News	✓	✓	✓	✓	✓	✓	
	Poquoson	✓	✓	✓	✓	✓	✓	
	Williamsburg	✓		✓		✓	✓	
	James City County	✓	✓	✓	✓	✓	✓	
	York County				✓		✓	
Southside	Norfolk				✓	✓	✓	annual update to Council
	Portsmouth	✓		✓	✓	✓	✓	
	Suffolk						✓	
	Virginia Beach	✓		✓		✓	✓	
	Chesapeake		✓	✓	✓	✓	✓	
Western Tidewater	Isle of Wight County	✓		✓	✓	✓	✓	
	Smithfield	✓		✓			✓	
	Franklin	✓		✓		✓	✓	
	Southampton County				✓	✓	✓	
	Surry County	✓		✓		✓	✓	

OPPORTUNITIES FOR IMPROVEMENT

The 2022 plan update process represents the second time that the FEMA-recommended mitigation planning process in the Hampton Roads region has been addressed on such a large regional basis. Some previous plans were regional in nature but covered a smaller geographic area with many shared traits. As such, several opportunities for improving the plan and planning process are outlined below in **Table 8.2**, primarily as suggestions or strategies that may enhance the planning process effectiveness for either individual communities in the coming 5-year period of implementation, or for future updates of the entire plan.

TABLE 8.2: OPPORTUNITIES FOR IMPROVEMENT

Mitigation Planning Step	Opportunities
Phase I: Organize Resources Step 1. Get Organized Step 2. Plan for Public Involvement Step 3. Coordinate with Other Departments & Agencies	1. Continue to distribute Memorandum of Intent to Participate for all communities in the early stages of the planning process. 2. Engage public information officers, resiliency officers, equity officers, web site managers and other community communications specialists from each community throughout the process. 3. Ensure representatives from small communities are drawn into the planning process with multiple opportunities for comment and participation. 4. The survey in the 2022 update process was issued immediately prior to another regional survey going out with similar questions. This shortened time period for response, unfortunately. Such conflicts are hard to foresee in such a large study area. 5. The regional planning authority should continue to ask and rely on communities to reach out to large businesses, military installations, educational and medical institutions, neighborhood associations, non-profits, utilities and other groups to spur their involvement in the process, but communities need to provide documentation of these "asks" that is then included in the plan.
Phase II: Assess Risk Step 4. Identify the Hazards Step 5. Assess the Risks	1. Virtual meetings limited the feedback received after presentation of HIRA to the committee. 2. Distributing small elements of the assessment to the committee for review may increase participation and feedback. 3. Provide more detailed assessment/review of the dam safety data and help communities focus mitigation action plan on dam reconstruction/repair/removal.
Phase III: Develop Mitigation Plan Step 6: Review Mitigation Alternatives Step 7: Draft an Action Plan Step 8: Set Planning Goals	1. Provide a review form for each community to document their review and approval of each plan section. 2. "Office Hours" with consultant worked well for developing each community action plan but did not include all stakeholders. Reassess this approach once COVID restrictions are lifted.

[DRAFT] Annual Monitoring Plan and Post-Construction Monitoring Report

Marsh Restoration in Back Bay, Virginia Beach, VA

Prepared by: Dewberry Engineers, Inc.

[July 6, 2023]

[REPORT VERSION [DRAFT]]

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INTRODUCTION

This project is intended to implement one of the nature-based projects proposed in Virginia Beach's "Sea Level Wise" (SLW) Adaptation Strategy[1] adopted by the Virginia Beach City Council in June 2020. The SLW Adaptation Strategy presents a holistic framework for addressing flood risks across the City, consisting of four general strategies – natural mitigations, engineered defenses, adapted structures, and prepared communities. These strategies were applied to each major watershed in the City and tailored to their unique characteristics and risk profiles. The adaptation vision for the Lower Southern Rivers Drainage Basin, where the proposed project is located, focuses on employing natural mitigation methodologies to strategically reduce flow into and within Back Bay, along with an integrated system of defense structures and complementary adaptation measures, such as land-use strategies, to improve flood storage and overall coastal resiliency. The Bonney Cove area of Back Bay, where the project site is proposed, is particularly suitable for the use of nature-based strategies given the low elevations of marshlands and documented historic degradation of habitat. Participants at the 'near-neighbor' public engagement meetings held during the SLW Adaptation Strategy development were supportive of these types of strategies.

The City has several dedicated Capital Improvement Program (CIP) initiatives for the Lower Southern Rivers Drainage Basin for implementation of these strategies. The City's Stormwater Green Infrastructure CIP has obligated approximately $421,700 in contracts to support field investigations, environmental assessments, and engineering designs of the project – a true indication of the City's commitment to nature-based approaches and the critical first step in a broader effort. During the General Election on November 2, 2021, Virginia Beach residents voted to authorize $567.5 million dollars in debt to fund the design and construction of 21 Phase 1 projects in the citywide Flood Protection Program. [2] The Back Bay Marsh Terrace project is included under the Stormwater Green Infrastructure Master Project.[3] Other Southern Watershed projects that received funding under the Flood Protection Program include the West Neck Creek Bridge City-Wide Sea Level Rise Strategy, the Pungo Ferry Road Improvements, and the Sandbridge/New Bridge Intersection Improvements projects.

Outside of this project, the Virginia Beach City Council has recently funded a $5.2 million dollar voluntary acquisition program to encourage flood-prone properties to apply for a buyout to enable the City to convert parcels to open space to serve as flood storage and a marsh migration buffer. The City's

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[1] City of Virginia Beach Sea Level Wise Adaptation Strategy webpage: https://www.vbgov.com/government/departments/public-works/comp-sea-level-rise/Pages/default.aspx

[2] City of Virginia Beach Flood Protection Program webpage: https://www.vbgov.com/government/departments/public-works/flood-protection-program/Pages/Flood-Protection-Program.aspx.

[3] Stormwater Green Infrastructure Page: https://www.vbgov.com/government/departments/public-works/flood-protection-program/Pages/Stormwater-Green-Infrastructure-.aspx

Stormwater Green Infrastructure CIP is also supporting the implementation of other natural and nature-based projects across the City, including a wetland and floodplain restoration project along the Eastern Branch of the Elizabeth River.

An assessment of restoration opportunities in the City's Lower Southern Rivers Drainage Basin with dual flood reduction and habitat restoration benefits identified the Bonney Cove area as a potential project site for several reasons. The Bonney Cove site has experienced significant historical ecological degradation. Historical shoreline data from 1869 indicates approximately 50% of present-day open water in Bonney Cove (260 acres) was previously marsh (Figure 1). Loss of the marsh island habitat within Bonney Cove has resulted in the opening of a secondary channel allowing increased flow exchange between the upper and lower bays. In comparison to shore-adjacent restoration, off-shore marsh restoration leveraging hydraulic modeling identified Bonney Cove as a location where marsh restoration has the potential to reduce the propagation of floodwaters through key pathways within Back Bay. The United States Fish and Wildlife Service (USFWS) and the Virginia Department of Wildlife Resources (VDWR) also identified Bonney Cove as a restoration priority as this area serves as an ideal location for Submerged Aquatic Vegetation (SAV) reestablishment and vital habitat for migratory birds and fish.

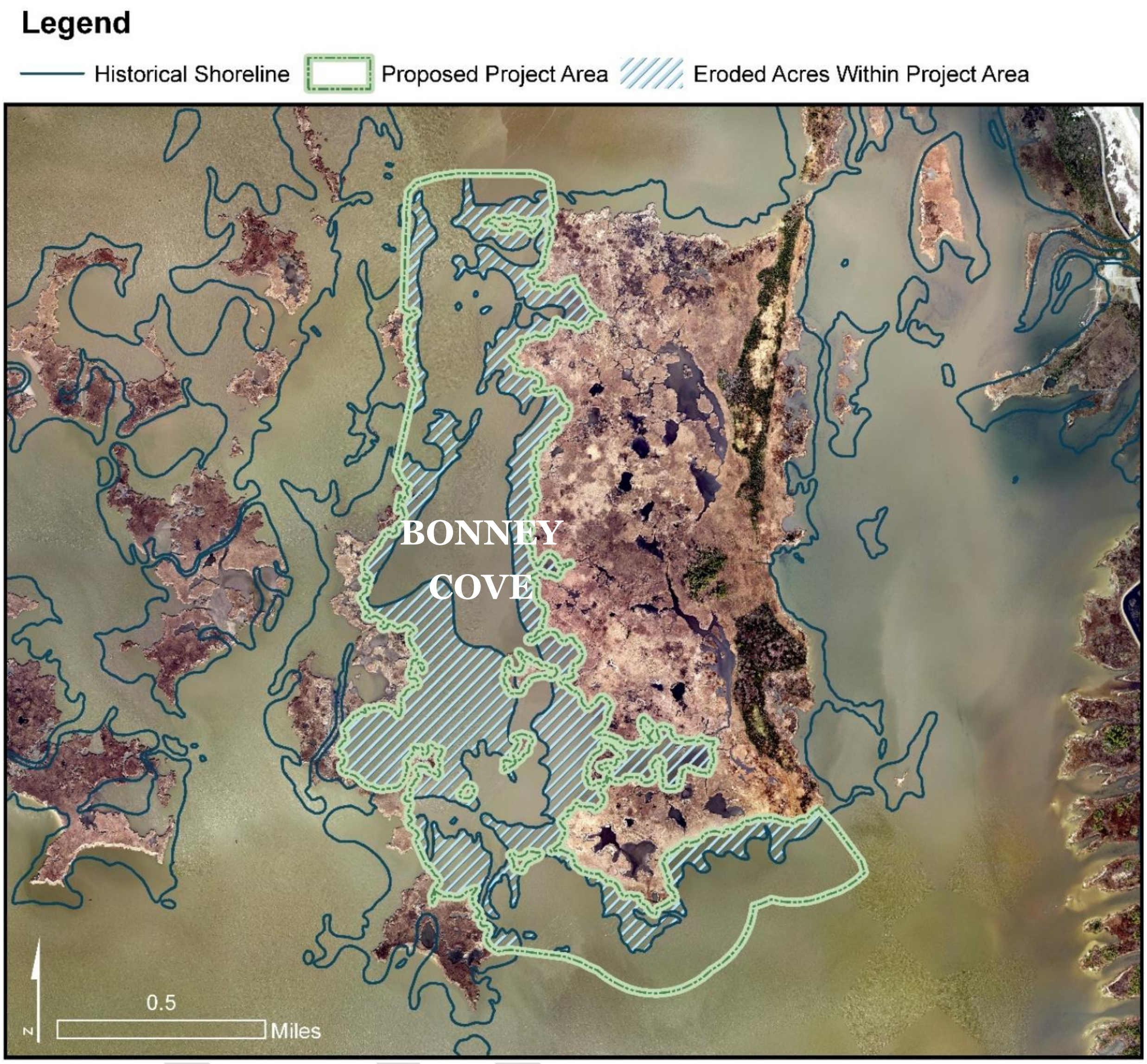

Figure 1: Historical marsh erosion within the project area.

The project is situated within the Bonney Cove area of Back Bay, spanning the western and southern lengths of Long Island, as shown in Figure 1.

Project Background

Marsh island restoration through terracing was identified as a particularly viable solution given Back Bay's shallow bottom and the historical loss of habitat. The marsh terraces are narrow man-made islands that will be arranged across areas that were historically marsh but are now shallow open water. A series of these islands, or terraces, are typically arranged in a chevron pattern. The overall field of terraces dissipates waves and slows down water moving through the area. In turn, the calmer water allows more sunlight to penetrate to the shallow bottom, promoting establishment and growth of marsh

and SAV habitats. Further, as opposed to one continuous marsh platform, marsh terraces maximize habitat for a variety of fish and wildlife species.

The Preferred Alternative includes the creation of 41 individual marsh terraces totaling approximately 25,000 linear feet (or an approximately 47-acre footprint) across Bonney Cove. These 47 acres of terraces are comprised of approximately 13 acres of emergent (low and high marsh) vegetated habitat, 14 acres of upland vegetated habitat, and 16 acres of submerged terrace habitat. Approximately 310 acres of suitable SAV habitat will remain in between the terraces.

Terrace Construction and Orientation

Terrace construction will begin in the northern extent of the project site, and the contractor will work towards the southern extent of the site. The contractor will complete each terrace, including installing plants, before moving to the next. Marsh terrace construction will occur over two years (2025 to 2026) and will pause annually between October 31st and March 1st to limit disturbance to wintering waterfowl and migration, in accommodation of BBNWR's requirement. Approximately 20 terraces will be constructed in 2025 ("Phase 1"), and 21 terraces will be constructed in 2026 ("Phase 2"). The following sections summarize the proposed design and construction approach.

Terraces will be generally oriented perpendicular to the predominant wind direction (south-southwest) to maximize wave energy reduction. The terraces will be segmented in a chevron (duck-wing) pattern to create the most favorable fish and swimming crustacean (termed "nekton") habitat, facilitate adequate circulation, and maintain navigability throughout the project area. The terraces will not be connected to the adjacent marsh to maintain a physical open water barrier to deter the invasion of Common Reed (*Phragmites australis*) stands.

The terraces will be spaced at approximately 300-foot intervals in the northern and southern quarters and span 15 feet in width, and at least 600-foot intervals in the center and span 30 feet in width. This arrangement will lessen the amount of open water and subsequent wave action at the northern and southern ends of the site and provide space for marine-based construction equipment. The design team reviewed the final spacing layout of the terraces to ensure navigability of a watercraft through the project site which will be required for post-construction monitoring, any needed maintenance, as well as community recreational access.

The terraces would consist of a sand filled core encapsulated by a high-strength blend of woven and non-woven geotextile fabrics ("geobags"). The sand for this material would need to come from offsite sources. Back Bay is too shallow to accommodate conventional barges for material placement. To avoid extensive impacts to the bottom of the bay, the slurry basin will pump sand for the project from the proposed Shipps Cabin Road staging area to Bonney Cove. The slurry pipeline will consist of approximately 10,424 linear feet of 12" diameter HDPE fused/welded pipeline that will be assembled on land and floated into its proposed alignment within Back Bay. The pipe would be marked by floats

every 5 feet and temporary signage as reasonable. It is anticipated the pipeline will be submerged to the bottom of the bay at channel crossings and adjacent to a duck hunting cabin adjacent to the alignment. By establishing a floating pipeline, it will limit disturbances to the subaqueous bottomlands along the alignment and allow for the retraction of the pipeline during the winter inactive periods and inclement weather events. Booster stations would be placed approximately every mile. These booster stations would consist of a pontoon mounted diesel engine pump capable of moving the sand slurry from the laydown area to the site. Given the distance to the site, four or five of these booster stations are anticipated to be necessary to create the sand cores of the terrace. It is estimated that 450 Gallons Per Minute (GPM) of sand slurry would be pumped through the pipe.

Once the cores are in place, long reach excavators would travel along the tops of the terraces and begin to shape the cross slopes. Appropriate materials for establishing vegetation atop the terraces will be primarily sourced from materials dredged during the Sandbridge Road Nimmo Parkway Phase VII-A project located immediately north of Back Bay (VMRC 15-1564, USACE IP NAO-2015-00151). Materials will be tested and screened to remove organics prior to application to the terraces. As needed, dredging sites adjacent to the proposed terrace locations that are confirmed to be devoid of SAV will be utilized to provide supplemental soil materials to top the proposed terraces[4]. It was determined that the in-situ bay sediment would be suitable for vegetation growth. The marsh terraces would be covered with 1 to 3 feet of suitable fill, depending on crest widths. Jute netting will cover the topsoil to control erosion and promote vegetation establishment. Coir logs will be places along the terrace slope controls to further promote vegetation establishment along the slope.

SAV Plantings

The City has partnered with Virginia Polytechnic Institute and State University ("Virginia Tech") to evaluate opportunities for restoring populations of native Wild Celery (*Vallisneria americana*) in Back Bay. The Virginia Tech research team has developed an innovative technique to grow Wild Celery in an aquaculture center that results in larger, mature plants that can better withstand Back Bay's turbidity. Once transplanted, plants are surrounded by cages to prevent predation. These founder colonies can be used for propagation throughout Back Bay. After terrace construction, the City will transplant Wild Celery in an area adjacent to the site. This founder colony will be used to strategically transplant Wild Celery in between the terraces for 5 years after construction (2026 – 2029) with the ultimate goal of establishing 10 acres of SAV vegetation in between the marsh terraces.

[4] The 60% preliminary design showed preliminary siting of these dredge areas based on avoidance of existing SAV habitat; however, pre-construction surveys of SAV would be required to re-delineate these dredging areas.

Terrace Plantings – Upland and Marsh Vegetation

The terraces' intertidal perimeter will be planted with appropriate emergent estuarine plant species (e.g., Saltmarsh Cordgrass [*Spartina alterniflora*] and Salt Meadow Hay [*Spartina patens*]) and brackish plant species (e.g., Big Cordgrass [*Spartina cynosuroides*]). These plants will be installed as soon as possible after construction to stabilize planting areas and protect the terrace from erosion. In addition to emergent grass, woody growth (i.e., shrubs and trees) within the terrace crest will be incorporated to protect the terraces' surfaces from rain and wind erosion and hold the landform together through substantial root systems.

Appropriate native species were identified based on the review of the reference marshes surrounding the project site and a review of water levels in Back Bay. Since the Bay's water levels are not affected by lunar tides and instead by wind-driven fluctuations, the project team evaluated average water elevations at the U.S. Geological Survey (USGS) Beggars Bridge Creek Gauge (Gauge ID 0204300267) from 2016 – 2021 to determine ranges of inundation to achieve functional marsh elevations throughout the project life, defined as:

- *Mean Low Water (MLW)*: the average low water at the site (10th Percentile: -0.62 ft NAVD88)
- *Mean High Water (MHW)*: the average high water at the site (95th Percentile: 1.22 ft NAVD88)
- *Mean Tide Level (MTL)*: halfway between MLW and MHW (0.3 ft NAVD88)
- *Upper Limit of Wetlands (ULW)*: approximately 1.5 times the mean tide range at the site (2.76 ft NAVD88)

These elevations were correlated to suitability for low marsh, high marsh, and upland species, as shown in Table 1.

Table 1: Proposed planting elevation zones.

Planting Zone	Definition	Elevation Range	Elevation (feet NAVD88)	Percentage of record where water reaches these elevations
Low Marsh	Marsh that is flooded frequently but exposed sometimes	MTL - MHW	0.3 – 1.2 ft	48%
High Marsh	Marsh that is generally only flooded during higher-than average water conditions	MHW – ULW	1.2 to 2.8 ft	7%
Upland Habitat	Habitat that is rarely flooded, only during extreme conditions	> ULW	> 2.8 ft	0%

Five planting schemas were identified to provide the highest possible environmental benefit in terms of erosion control, habitat diversity, and fetch reduction. The wider (30-foot) terraces will be planted with Bald Cypress (*Taxodium districhum*) trees capable of withstanding rising water levels. The full list of species and quantities is provided in the 95% design plan set.

The final engineered design component is the strategic placement of rock on the exposed perimeter terraces on the project site's north, west, and southern extents. The need for the rock armor was determined through analysis of wind data both from NOAA and ASCE-7-10 50-year return period anticipated 3-second gust values. These values were used to calculate fetch-generated waves at the project site. The calculations performed confirmed that armored protection would be required to protect the proposed terraces from the forces created by wave action. The stone sizes required for these features (Class II rip rap) were calculated following the procedures laid out in the USACE Coastal Engineering Manual (CEM) and Virginia Institute of Marine Science (VIMS) Living Shoreline Design Guidelines for Shore Protection in Virginia's Estuarine Environments. Two calculation methods, Hudson (1974) and Van Der Meer (1988), from the CEM were utilized to evaluate the range of acceptable rock armor for the exposed perimeter. These two methods calculate the armor stone size based on several design inputs including initial wave height, allowable damage level, revetment slope, and breaking versus non-breaking waves. The two methods often result in corresponding values that are used by the engineer to make an experienced determination on the final rock armor sizing. The rock armor will serve as a nature-based design element by acting as a substrate for the Wild Celery grass that has proven to be successful for SAV establishment in Back Bay (see Figure 2).

Figure 2: Example Back Bay SAV experiment; photo courtesy of Virginia Tech.

Monitoring Goals and Objectives

Annual post-construction monitoring of the site is required by the Virginia Marine Resource Commission (VMRC) (TBD) Permit (VMRC #XXXX-XXXX) and the U.S. Army Corps of Engineers (USACE) Individual Permit (NOA-20XX-XXXXX). [Insert details of the relevant permits and permit conditions]. The following goals, objectives, and metrics were established to enable consistent tracking of the primary living shoreline project components across each monitoring year.

1. **Monitoring Goal 1**: Establishment of a Sustainable Coastal Marsh Island System
   a. Objective 1a: Establish Emergent Marsh Habitat
      - Metric: For each monitoring year, the project area should maintain or increase the overall coverage of emergent marsh vegetation. There should be no significant signs of herbivory or invasive species establishment.

   b. Objective 1b: Establish Upland Habitat
      - Metric: For each monitoring year, the project area should maintain or increase the overall coverage of upland vegetation. There should be no significant signs of herbivory or invasive species establishment.
2. **Monitoring Goal 2**: Stability of Marsh Terraces
   a. Objective 2: Marsh Terrace Structures
      - Metric: For each monitoring year, the terrace structures should show no significant signs of damage, deterioration or extreme settlement.
3. **Monitoring Goal 3**: Establishment of a Sustainable SAV Community
   a. Objective 3: Establish SAV Communities

- Metric: For each monitoring year, the SAV planting areas should maintain or increase the overall coverage of SAV vegetation. There should be no significant signs of herbivory or invasive species establishment.

MONITORING PLAN

The monitoring plan includes stakeholders, a schedule for the annual monitoring inspections, the monitoring strategy/sampling plan, and approach for addressing any needs for maintenance.

Monitoring Stakeholders

An Environmental Scientist from Dewberry Engineers Inc. will perform the annual monitoring inspections and provide a copy of the monitoring report to the City of Virginia Beach, USACE, VDEQ, VMRC, and the City of Virginia Beach Wetlands Board as necessary. As owners of the project, the City of Virginia Beach will review monitoring recommendations and perform corrective actions as necessary.

Annual Inspection Schedule

Monitoring inspections should be conducted annually, during the peak growing season, which is defined by VMRC as between June and August. To enable consistent tracking of project performance from year to year, annual monitoring inspections will be conducted prior to the end of the growing season in September of each year, with annual reports to be submitted to regulatory stakeholders prior to November 30th [or an annual date defined in the permit conditions] of each year. The following outlines the monitoring inspection schedule and deliverables.

Phase 1 Post-Construction As-Built Report (Date: Prior to December 31st, 2025)

To serve as a baseline for the post-construction annual monitoring, an as-built report for the Phase 1 terraces will be completed following the construction of each phase of terraces and submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following.

- Coordinates and diagrams of established transects, as well as site photographs from photo stations 1-40 as defined in the Methods section.
- Final location of all planted vegetation (upland plantings, high marsh plantings and low marsh plantings).
- Final grade topographic surveys (plan, profile, and cross sections).
- Discussion of the project design versus as-built conditions.

Phase 2 Post-Construction As-Built Report (Date: Prior to December 31st, 2026)

To serve as a baseline for the post-construction annual monitoring, an as-built report for the Phase 2 terraces will be completed following the construction of each phase of terraces and submitted to the

City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following.

- Coordinates and diagrams of established transects, as well as site photographs from photo stations 41-80 as defined in the Methods section.
- Final location of all planted vegetation (upland plantings, high marsh plantings and low marsh plantings).
- Final location and extent of SAV plantings.
- Final grade topographic surveys (plan, profile, and cross sections).
- Discussion of the project design versus as-built conditions.

Year 1a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2026)

At the end of the first full growing season following planting of the Phase 1 terraces, a Year 1a monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 40 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 1 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion; it is anticipated that the wetland planting contractor will provide a one-year post construction maintenance and guarantee period for the wetland plantings.

Year 1b/2a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2027)

At the end of the first full growing season following planting of the Phase 2 terraces following planting, and the second full growing season of the Phase 1 terraces, a Year 1b/2a monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 1 conditions (for Phase 2 terraces) and to Year 2 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).

- Estimated percent cover and change in coverage from planted conditions to Year 1 conditions for SAV planting quadrants
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion; it is anticipated that the wetland planting contractor will provide a one-year post construction maintenance and guarantee period for the wetland plantings.

Year 2b/3a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2028)

At the end of the second full growing season of the Phase 2 terraces following planting, and the third full growing season of the Phase 1 terraces, a Year 2b/3a monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 2 conditions (for Phase 2 terraces) and to Year 3 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- Estimated percent cover and change in coverage from planted conditions to Year 2 conditions for SAV planting quadrants
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

Year 3b/4a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2029)

At the end of the third full growing season of the Phase 2 terraces following planting, and the fourth full growing season of the Phase 1 terraces, a Year 3b/4a monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 3 conditions (for Phase 2 terraces) and to Year 4 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).

- Estimated percent cover and change in coverage from planted conditions to Year 3 conditions for SAV planting quadrants
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

Year 4b/5a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2030)

At the end of the fourth full growing season of the Phase 2 terraces following planting, and the fifth full growing season of the Phase 1 terraces, a Year 4b/Final (Year 5a) monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 4 conditions (for Phase 2 terraces) and to Year 5 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- Estimated percent cover and change in coverage from planted conditions to Year 4 conditions for SAV planting quadrants
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

Year 5b Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2031)

At the end of the fifth full growing season of the Phase 2 terraces following planting, a Final (Year 5b) monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 41 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 5 conditions (for Phase 2 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- Estimated percent cover and change in coverage from planted conditions to Year 5 conditions for SAV planting quadrants

- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

Monitoring Strategy

The monitoring strategy consists of established transects with photo stations and quadrants that cover the area between transects. This approach enables monitoring of the four primary features of the living shoreline: uplands, low-marsh plantings, high-marsh plantings, and SAV*.

*Note: The planting scheme for SAV has not yet been established but it is anticipated that some SAV will be planted along the submerged portions of the marsh terraces. If more suitable planting locations are determined to be between terraces, separate transects will be established and sampled to track SAV survival apart from the proposed terrace transects.

Transects/Photo Points

A total of eighty (80) transects will be established across the project site, with 10 transects located along each of 8 terraces. Transects will span perpendicular to the length of each terrace from the ridge to the edge of the planted/vegetated area. See Figures 3 and 4 for graphic depictions of the proposed transect locations and layouts. Terraces were selected using a random stratified method to ensure representative terraces in each location within the project area (North Interior, North Exterior, South Interior, South Exterior), and of each planting scheme, were represented in the proposed monitoring plan. The selected terraces are as follows:

- North Interior: T-110, T-113
- North Exterior: T-100, T-106
- South Interior: T-124, T-131
- South Exterior: T-123, T-140

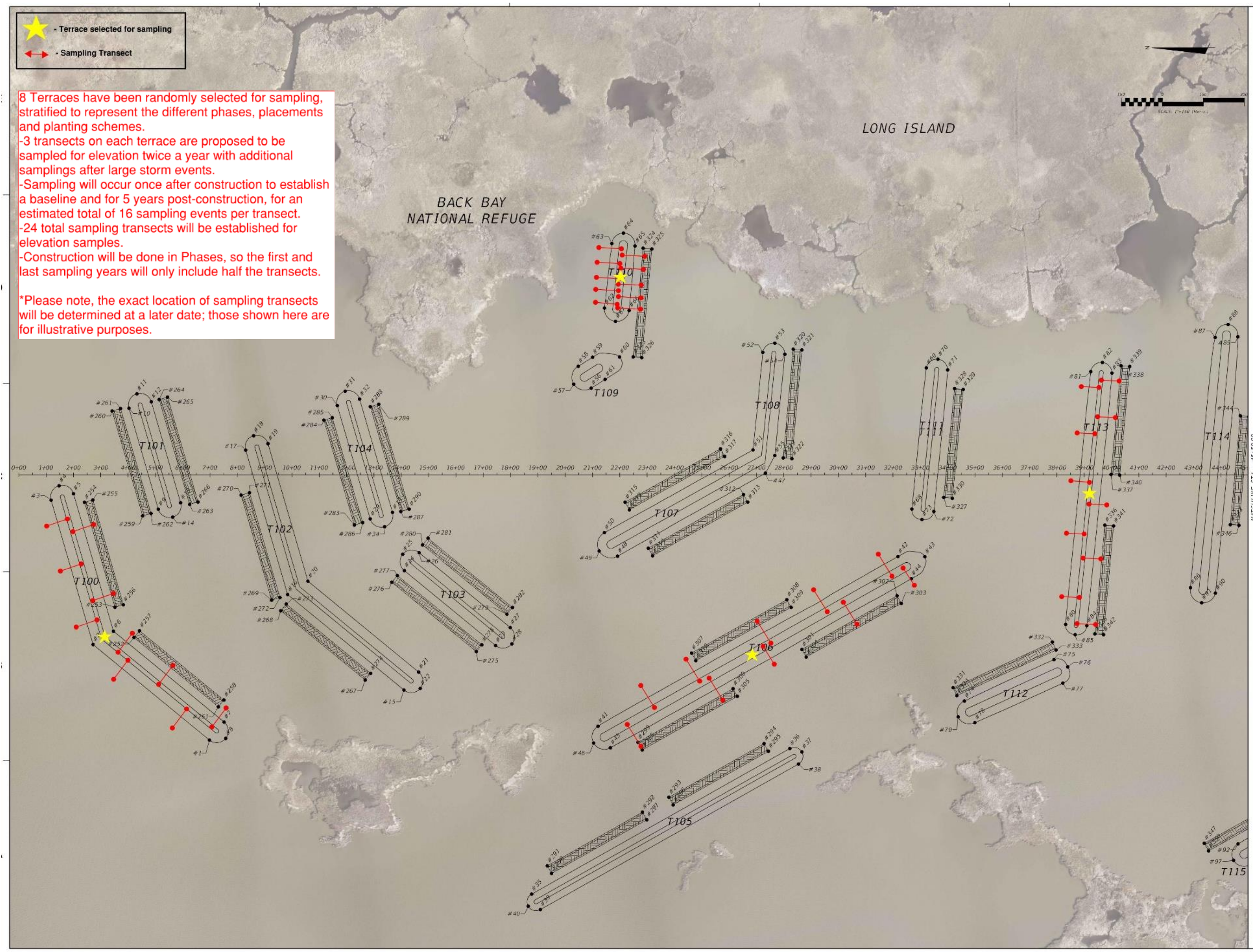

Figure 3: Monitoring design site plan – North Terraces

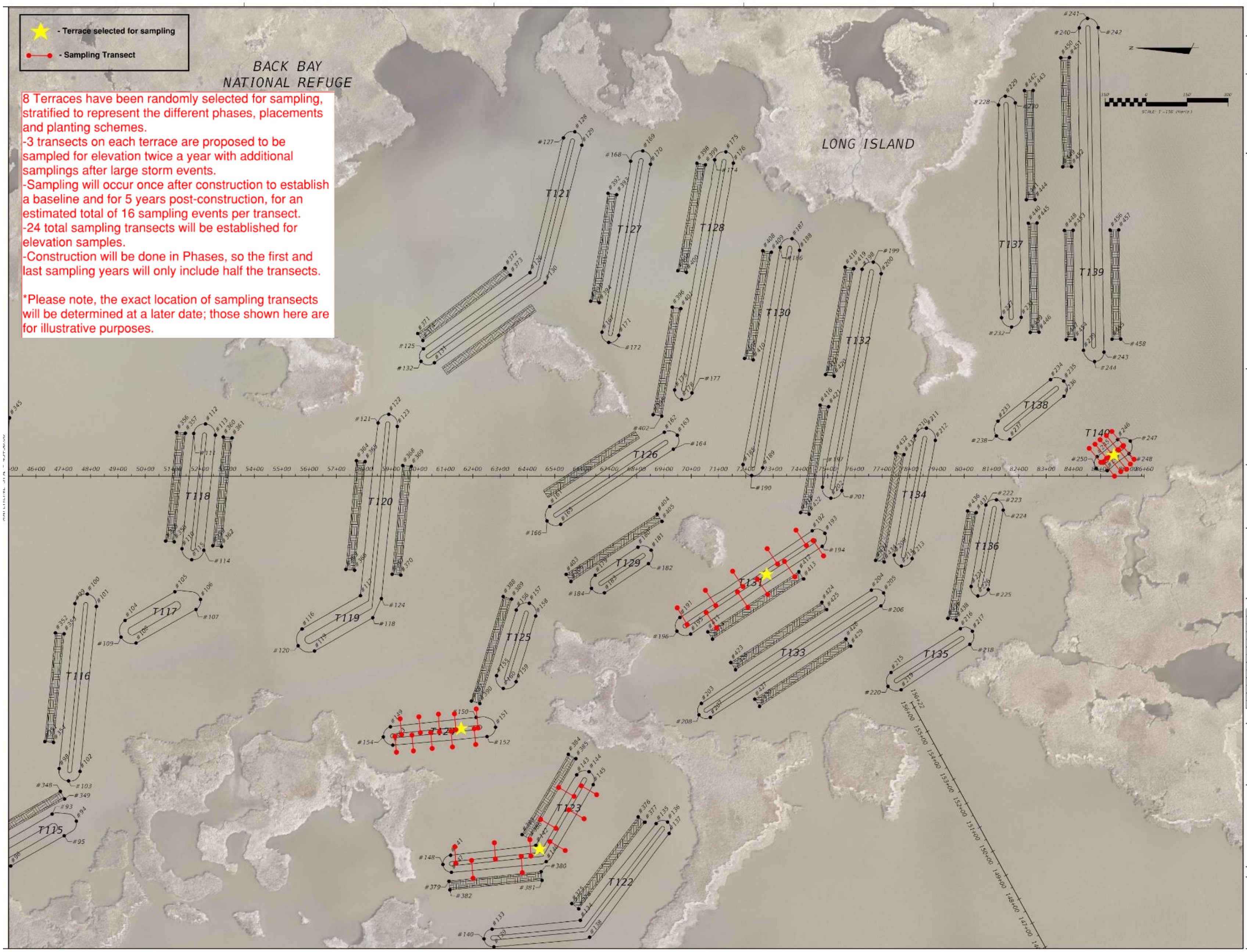

Figure 4: Monitoring design site plan – South Terraces

Permanent photo stations will be established at each quadrant along each transect to capture the design features/established habitats and vegetation. Figure 5 shows the general proposed locations (indicated by the red arrows/labels) for each quadrant and photograph station along each transect. Photos were shot from each photo location on [DATE]. These photos will be collected annually and compiled in Appendix B.

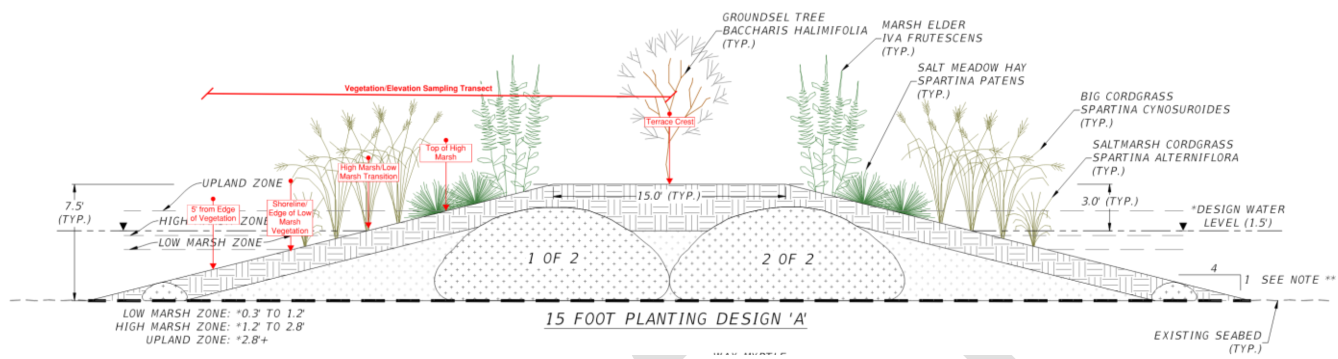

Figure 5: Photo station layout example

Quadrants

To estimate percent cover of vegetation, four (4) quadrants along each of ten (10) transects will be established on the eight selected terraces to allow for estimates of habitat coverage and planting survival. Estimates of coverage and survival were compared to post-construction conditions to evaluate changes.

Further, the following guiding questions were established to monitor overall project performance, presence of invasive species, and identify any needs for maintenance:

1. Are there specific problem areas where plants are dying or appear unhealthy?
2. Were any signs of herbivory observed?
3. Are there any undesirable plant species present?
4. Condition of the terrace structures: Is there any observed settlement, dislodged stone, significant debris etc.?
5. If an updated survey was conducted, are there any significant changes in the profile of the marsh terraces?
6. Does the upland portion of each terrace show any significant signs of erosion or loss of vegetation?

MONITORING RESULTS

Table 2: Low Marsh Vegetation Percent Cover Monitoring Results (Example Table – Terrace 1).

		Estimated Percent Coverage						Percent Change in Coverage (from Baseline)				
Terrace/ Transect	Photo Station Reference	Baseline (2024)	Year 1 (2025)	Year 2 (2026)	Year 3 (2027)	Year 4 (2028)	Year 5 (2029)	Baseline to Year 1	Baseline to Year 2	Baseline to Year 3	Baseline to Year 4	Baseline to Year 5
1 - 1	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
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1 – 5	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 6	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
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Overall		**Choose an item.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**

Table 3: High Marsh Vegetation Percent Cover Monitoring Results (Example Table – Terrace 1).

		Estimated Percent Coverage						Percent Change in Coverage (from Baseline)				
Terrace/ Transect	Photo Station Reference	Baseline (2024)	Year 1 (2025)	Year 2 (2026)	Year 3 (2027)	Year 4 (2028)	Year 5 (2029)	Baseline to Year 1	Baseline to Year 2	Baseline to Year 3	Baseline to Year 4	Baseline to Year 5
1 - 1	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
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1 – 6	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 7	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 8	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 9	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 10	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
Overall		**Choose an item.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**

Table 4: General Observations for Wetland Planting Areas on the Marsh Terraces (Example Table – Terrace 1)

Monitoring Questions	Terrace/Transect									
	1 - 1	1 - 2	1 - 3	1 - 4	1 - 5	1 - 6	1 - 7	1 - 8	1 - 9	1 - 10
Are there specific problem areas where plants are dying or appear unhealthy?	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☒ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.
Were any herbivory issues observed?	YES ☐ NO ☒ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☒ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.
Are there any undesirable plant species present?	YES ☐ NO ☒ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☒ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.
If updated survey was conducted, are there any significant changes in the profile of the living shoreline system?	YES ☐ NO ☒ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☒ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.

Table 5: General Observations for the Unplanted Structural Components of the Marsh Terraces (Example Table – Terrace 1)

Terrace/Transect										
Monitoring Questions	1 - 1	1 - 2	1 - 3	1 - 4	1 - 5	1 - 6	1 - 7	1 - 8	1 - 9	1 - 10
Are there any structural issues with the planted terrace structures (e.g. observed settlement, loss of topsoil, etc.)?	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.
Is there any observed growth in SAV on or adjacent to the marsh terraces?	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.

Are there any structural issues with the rock armoring on the terraces (e.g. observed settlement, dislodged stone, significant debris, etc.)?	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.

MAINTENANCE RECOMMENDATIONS

The following table outlines the recommendations for maintenance, including estimated quantities and specific guidance, based on the results of the [YEAR] monitoring results.

Table 6: Maintenance Recommendations Checklist

Design Feature/ Monitoring Objective	Maintenance Elements	Location & Estimated Quantity	Specific Guidance
Terrace Upland and Wetland Habitats and Wetland Soils – Monitoring Objectives 1a/1b	☐ Replace plants	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Add new plants	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Remove debris	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Remove invasive vegetation	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Add sand to eroding areas	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Replace waterfowl barrier	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.

Design Feature/ Monitoring Objective	Maintenance Elements	Location & Estimated Quantity	Specific Guidance
Terrace Structures & Stone Armoring, Monitoring Objective 2a/2b	☐ Re-place dislodged stones	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Add additional stone to address settlement	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Remove debris	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Repair sand cores or other structural elements	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
SAV Establishment, Monitoring Objective 3	☐ Replace plants	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Add new plants	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.

APPENDIX A: AS-BUILT PLANS

[Page left intentionally blank; as-built plans will be included in the Year 1 monitoring report]

APPENDIX B: MONITORING PHOTOGRAPHS

Table 7: Terrace 1 Transect 1 Photographs

Photograph from Photo Location 1A	Photograph from Photo Location 1B
Photograph from Photo Location 1C	Additional photos of any problem areas.

Table 8: Terrace 1 Transect 2 Photographs

Photograph from Photo Location 2A	Photograph from Photo Location 2B
Photograph from Photo Location 2C	Additional photos of any problem areas.

Table 9: Terrace 1 Transect 3 Photographs

Photograph from Photo Location 3A	Photograph from Photo Location 3B
Photograph from Photo Location 3C	Additional photos of any problem areas.

Table 10: Terrace 1 Transect 4 Photographs

Photograph from Photo Location 4A	Photograph from Photo Location 4B
Photograph from Photo Location 4C	Additional photos of any problem areas.

Table 11: Terrace 1 Transect 5 Photographs

Photograph from Photo Location 5A	Photograph from Photo Location 5B
Photograph from Photo Location 5C	Additional photos of any problem areas.

Table 12: Terrace 1 Transect 6 Photographs

Photograph from Photo Location 6A	Photograph from Photo Location 6B
Photograph from Photo Location 6C	Additional photos of any problem areas.

Table 13: Terrace 1 Transect 7 Photographs

Photograph from Photo Location 7A	Photograph from Photo Location 7B
Photograph from Photo Location 7C	Additional photos of any problem areas.

Table 14: Terrace 1 Transect 7 Photographs

Photograph from Photo Location 7A	Photograph from Photo Location 7B
Photograph from Photo Location 7C	Additional photos of any problem areas.

Table 15: Terrace 1 Transect 8 Photographs

Photograph from Photo Location 8A	Photograph from Photo Location 8B
Photograph from Photo Location 8C	Additional photos of any problem areas.

Table 16: Terrace 1 Transect 9 Photographs

Photograph from Photo Location 9A	Photograph from Photo Location 9B
Photograph from Photo Location 9C	Additional photos of any problem areas.

Table 17: Terrace 1 Transect 10 Photographs

Photograph from Photo Location 9A	Photograph from Photo Location 9B
Photograph from Photo Location 9C	Additional photos of any problem areas.

Dewberry

www.dewberry.com

It's Our Future: A Choice City

CITY OF VIRGINIA BEACH
COMPREHENSIVE PLAN

Policy Document

Adopted May 17, 2016
Amended January 17, 2017
Amended June 20, 2017
Amended December 12, 2017
Amended November 20, 2018
Amended June 2, 2020
Amended June 16, 2020
Amended February 16, 2021

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ACKNOWLEDGEMENTS

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- Economic Vitality Strategic Issue Team

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- City Manager's Working Group on Sea Level Rise and Recurrent Flooding
- Department of Parks & Recreation/Design and Development Division
- Department of Planning & Community Development/Environment & Sustainability Office
- Department of Public Works/Engineering – Stormwater Management
- Department of Public Works/Facilities & Building Maintenance Division
- Office of Emergency Management/Fire Department

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- Office of Volunteer Resources/City Manager's Office

Legal Review:
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Rural Area:

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- Department of Public Utilities

Transportation:

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- Department of Planning & Community Development
- Department of Public Works/Traffic Engineering Division
- Department of Public Works/Transportation Engineering Division
- Department of Parks & Recreation/Design and Development Division
- Strategic Growth Areas Office/Transportation Division
- Parsons Brinkerhoff – Virginia Beach Office

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- Strategic Growth Areas Office

Virginia Beach City Public Schools (VBCPS):

- Department of Facilities Planning & Construction, GIS Division

<u>Stakeholder Groups</u>

Citizens of Virginia Beach

City Council-Appointed Boards, Commissions, and Committees:

- Agriculture Advisory Commission
- Bayfront Advisory Committee
- Bikeways and Trails Advisory Committee
- Transition Area-Interfacility Traffic Area (ITA) Citizens Advisory Committee
- Virginia Beach Beautification Commission
- The Mayor's Commission on Aging

Central Business District Association

Farming Community Representatives:

- Steve Barnes
- John Cromwell
- Mike Cullipher
- Donald Horsley
- Bobby Vaughan
- Robert White
- Creeds Ruritan Club

Seatack Communities Civic League

Shore Drive Corridor Coalition

Virginia Beach Vision – Comprehensive Plan Task Force
City Staff Stakeholder Workshop Participants:

- Comptroller's Office
- Convention & Visitors Bureau
- Department of Agriculture
- Department of Communications/Media Services
- Department of Communications/Information Technology
- Department of Cultural Affairs
- Department of Emergency Communications/311
- Department of Finance
- Department of Fire/EMS
- Department of Health
- Department of Housing & Neighborhood Preservation
- Department of Human Services
- Department of Libraries
- Department of Management Services
- Department of Museums
- Department of Parks & Recreation
- Department of Planning & Community Development
- Department of Police
- Department of Public Utilities
- Department of Public Works
- Strategic Growth Areas Office
- Virginia Beach City Public Schools

EXECUTIVE SUMMARY

INTRODUCTION

The City of Virginia Beach turned 50 in 2013. "Live the Life" was the tagline and there was much to be celebrated by citizens and city leaders regarding our young city's many accomplishments up to that point in time. The then-recent list of accolades was indeed impressive and varied:

2011

- ✓ Ranked as the "9th Top Digital City in the U.S." (Center for Digital Government, April 2011)
- ✓ Named "5th Best City for Working Mothers" (*Forbes* Magazine, April 2011)
- ✓ List of "Family Friendly Cities" (*Ebony Magazine*, October 2011)
- ✓ "One of the Nation's 100 Best Cities for Young People" (America's Promise Alliance, December 2011)
- ✓ "Top 10 Best Walking Cities" (*Prevention Magazine*, December 2011)

2012

- ✓ "One of America's 50 Best Cities" (*Bloomberg Businessweek,* January 2012)
- ✓ "Best Run City in America" (*24/7 Wall Street Journal*, January 2012)
- ✓ "#2 Best City in America for Raising a Family" (*24/7 Wall Street Journal*, January 2012)
- ✓ "Seventh Healthiest City in America for Women" (*Women's Health* Magazine, January 2012)
- ✓ "Best 'Green' School Division Nationwide" (U.S. Green Building Council)
- ✓ Louisville Award for Innovation in Government for Municipal Energy Resources Management (Government Finance Officers Association)

2013

- ✓ William D. Sessoms, Jr. awarded "Policymaker/Elected Official of the Year" (Association of Defense Communities)
- ✓ "6th Happiest City in the Country in Which to Work" (Forbes.com declared, January 2013)
- ✓ Virginia Beach's Parks System ranked "8th in the Nation" (Trust for Public Land, June 2013)
- ✓ "2nd Most Business-Friendly City in America" (CNNMoney.com Report, June 2013)
- ✓ "Fittest City in America" (Facebook's Fittest Cities, July 2013)
- ✓ "One of the 10 Best Cities for Early Retirement" (*Kiplinger,* November 2013)

2014

- ✓ "A Top 10 Beach Town for Retirees" (CBS News, May 2014)
- ✓ "One of America's Top 10 Destinations for July 4th Celebrations" (Priceline.com, June 2014)
- ✓ "A Millennial Boomtown" (*Forbes*, August 2014)
- ✓ "One of America's Best Cities for Global Trade" (*Global Trade Magazine*, October 2014)
- ✓ "One of 2014's Most Searched Destinations on Yahoo!"(Yahoo!, December 2014)

- ✓ 2014 Gold Excellence Award (Economic Development Council for Real Estate Redevelopment and Reuse)

2015

- ✓ "2nd Hardest-Working City in America" (Wallet Hub, March 2015)
- ✓ "One of the 10 Most Beautiful Cities in the USA" (The Culture Trip, March 2015)
- ✓ "One of the Best 10 U.S. Beaches for Families" (Family Vacation Critic, April 2015)
- ✓ "One of the 10 Best Cities for Millennial College Students" (*USA Today*, April 2015)
- ✓ "One of America's Most Literate Cities" (USA Today, April 2015)
- ✓ "The Most Affordable City in America in Which to Start a Family" (Wise Bread, May 2015)
- ✓ "Best Large City for Veterans to Live" (*USA Today*, June 2015)
- ✓ "One of America's Best Boardwalks" (Fox News, July 2015)
- ✓ "4th Best City for First-Time Homebuyers" (Vox Business & Finance, July 2015)
- ✓ "A+ in Starting a Small Business" (Thumbtack.com, August 2015)
- ✓ "One of the 10 Best Cities to Live In" (WalletHub, August 2015)

These labels acknowledge what we already know about our city—that Virginia Beach is a great city that offers excellent choices for a variety of ages and lifestyles. We truly embrace our city motto, "*A Community for a Lifetime.*" We are, as the labels show, a "City of Choice" or, a choice city. Be it opportunities for young people, those just starting out as homebuyers and families, those who relish the outdoors and open spaces, small businesses and global companies, workers, the defense community and its veterans, retirees, and all who wish to recharge their souls within our beautiful natural landscape by the sea— we desire to be a place that people raise a family in, work in, and retire to.

To date, our accomplishments as a city are the result of taking the risk of merger between the City of Virginia Beach and Princess Anne County in 1963 and hard work and diligence ever since by visionary leadership and a committed citizenry. These accomplishments are also the result of a city governance model that has relied on listening to our citizens and businesses, continuous long-range planning, strategic planning, and capital investment in order to be responsive to our changing conditions and needs. We do this with a steadfast commitment to growing in a sustainable and resilient manner—fiscally, socially, and environmentally. Our citizens are engaged, talented, fun-loving, creative, innovative, and passionate. They, along with our business community, hold the City's leaders and public servants accountable to deliver the best services possible. *Living the life is what's expected here.*

A Community for a Lifetime

A CHOICE CITY

The strategic choices Virginia Beach has made over the years have set our course for the future. They also define who we are to the world. Clearly, the response has come back to us that Virginia Beach is a beach community in Coastal Virginia that offers many choices and is a choice city.

Choices have been made to grow in a safe, suburban pattern in the northern part of the city, yet retain our pristine and productive rural landscape and heritage in the southern part of the city. We have prided ourselves with building and nurturing stable suburban neighborhoods, commercial centers, schools, and community facilities. Our rural community has remained vibrant and protected for future generations to farm through effective land conservation programs, such as the Agricultural Reserve Program and historic preservation or open space easements. Our people highly value our natural resources and rural area and demand sound stewardship of them.

THE GREEN LINE

We choose to maintain the "Green Line" as the linchpin of our growth management strategy. The preservation of the Green Line is reinforced by a variety of other land use policies and programs in the City's Planning Areas. It has been 35 years since the Green Line was first introduced in the *1979 Comprehensive Plan*. Although the City has grown and matured considerably during that time, the Green Line is still critical to our ability to properly shape our future in a sustainable manner. The SGAs and Special Economic Growth Areas (SEGAs) designated in the *2003 and 2009 Comprehensive Plans*, respectively, address the need to keep the Green Line in place; yet, still provide for our city's future population growth, economic growth, and tax base growth. Below the Green Line today is found both public and private development in larger-lot development patterns, with an emphasis on quality public open space and recreation, connected by a trails network and greenways. The land use and urban infrastructure policies associated with the Green Line remain unchanged; however, at this juncture, we have a need to re-evaluate the capacity of the area south of it to accommodate development as new revelations about changing environmental conditions and how we can develop land sustainably have come to light.

PLANNING AREAS

How we want our land to be used in the future is described in **Chapter 1, Planning Areas**. Virginia Beach's Planning Areas and planned land use pattern offers many lifestyle choices. S**ection 1.1** presents the City's **2040 Planned Land Use Map.**

URBAN AREAS

Over time, due to the finite nature of land and its growing scarcity, coupled with a desire to effectively and efficiently manage growth and capital resources, yet grow in a more sustainable manner, choices were made to offer a third lifestyle choice to our citizens, businesses, visitors, and potential future residents—an urban form. Future urban form and development patterns are being directed to 8 strategic locations in our city, where existing infrastructure is located and has the capacity to absorb additional growth through infill development and both public capital investment and private redevelopment in the future. **Section 1.2 – Urban Areas** presents the guiding principles for and visions for the 8 Strategic Growth Areas (SGAs) -- at the Resort, Burton Station, Pembroke, Newtown, Rosemont, Lynnhaven, Hilltop, and Centerville. Collectively, the SGAs represent our city's "Urban Areas" and constitute only 2% of our gross land area.

All of the SGAs were master planned over a 6-year period between 2007 and 2013. Six of these areas are also where key transportation corridors are located that have the potential to become multi-modal in nature by introducing additional transportation choices. The SGA visions are long-range into the future, as it will take many years for our land development patterns to transform in this way, and for capital improvements and private investment choices to support them. Indeed, the SGAs have already begun to transform as the economy has rebounded since 2010, with the Burton Station, Newtown, Pembroke, and Resort SGAs experiencing most of the changes to date.

The Burton Station SGA, comprised of the historic Burton Station community and the Northampton Boulevard Corridor, have begun to realize long-neglected capital and private investment that is both improving the quality of life for residents and creating more attractive corridor aesthetics. Recent improvements to Wesleyan Drive and its intersection with Northampton Boulevard have eased congestion on a heavily traveled arterial serving two academic institutions.

Since the *Northampton Boulevard Corridor Strategic Growth Area Implementation Plan* was adopted in 2009, a few significant changing circumstances have affected some central components of the plan. First, the buffer area/relocated golf course planned around Burton Station Village will no longer be a golf course. Norfolk has decided to close the Lake Wright golf course as it was too expensive to maintain. Second, the 332,000 square foot phase I of the Norfolk Premium Outlets opened in 2017. Third, the Norfolk Airport Authority secured a rezoning approval from City Council for 36 acres of land from residential to industrial. Finally, approximately a dozen single family residences remain on Burton Station Road and due to truncation of Premium Outlets Boulevard by Norfolk, Burton Station needs to continue to connect to Miller Store Road. Based on these changed circumstances, the Northampton Boulevard Strategic Growth Area Implementation Plan (now called Burton Station Plan update) was approved in July, 2018.

Regent University Quad and University Village Concept - Centerville SGA Master Plan

The Centerville SGA is home to a rapidly growing institution of higher learning—Regent University— which has grown to become a 4-year college and a graduate school, and has an award-winning School of Law. Supported by corporate office development, the university's master plan was shared with city planners to create the concept of a future university village that will enable the university to grow and address its growing student housing needs. It would also allow surrounding residents to take advantage of university offerings in employment, dining, services, and small shops. This SGA, due to its lack of environmental and other constraints, affords an opportunity for economic development adjacent to the Interstate and a home to future Class A office space of a design that continues the architectural themes found on the campus. The municipal landfill at the western edge of the SGA will continue to operate into the foreseeable future, but the SGA plan envisions a new district park being designed there once it is closed, similar to the City's beloved and well-used Mt. Trashmore Park.

The Newtown SGA sits at the eastern terminus of the first segment of the region's light rail transit system, The Tide, with service only in Norfolk at present. In a landmark decision in 2015, City Council voted to continue developing plans to extend The Tide to Town Center through the Newtown SGA. Newtown's proximity to Town Center has the potential to echo the Town Center's vibrancy but at an appropriate scale and density adjacent to established residential neighborhoods. Historic Kempsville sits to the south of Newtown and is transforming into a mixed-use Suburban Focus Area that seeks to have a character that is reminiscent of Colonial Williamsburg, offering small shops and new housing choices. Intensive road and public space improvements have saddled its main intersection at Witchduck and Princess Anne Roads for a number of years, but private investment has begun as a result of these public investments.

"YNOT Wednesdays" Summer Concert Series - Sandler Center Plaza, Pembroke SGA

The Pembroke SGA has become the City's "Town Center" providing a much desired sense of place—and public gathering place-- as a Downtown. In just the past 15 years, a skyline has emerged that offers an exciting new residential, employment, shopping, and entertainment address. The City's oldest shopping mall, Pembroke Mall, has received a facelift and re-orientation that is more pedestrian friendly. Formally dominated by vehicular travel lanes that made it unsafe for pedestrians to cross, the Virginia Beach Boulevard corridor has been somewhat tamed to enable pedestrians to travel more safely between the two major destinations within the Core Area—Pembroke Mall and Town Center. The arts scene thrives at the Sandler Center, showcasing with both celebrity and local talent year-round. An increasing number of outdoor festivals and events offer free entertainment in every season.

Rosemont SGA, which lies immediately east of Pembroke SGA and the Town Center is planned to be a transit-oriented residential community for those who desire to live near Town Center but not in it. Transit extension is necessary for this vision to be fully realized, but commercial property owners already see that potential. They have begun to make improvements to attract new shoppers and enhance the shopping experience for existing customers.

The Lynnhaven and Hilltop SGAs have inherent redevelopment challenges as future growth areas, in that they are constrained by the presence of waterways, floodplains, wetlands, and aircraft high noise zones due to their proximity or adjacency to NAS Oceana. These SGAs have been carefully planned with our military facilities stakeholders. Planned land uses in these SGAs are compatible, yet also transit-ready should a decision be made in the future to extend public fixed-guideway transit east to the Oceanfront.

The Lynnhaven SGA has the potential to serve the city as an innovative industrial and service industry zone, while maintaining existing affordable housing for first-time homebuyers and seniors in the established neighborhoods of Eureka Park and Pinewood Gardens. Rediscovering the waterways that meander the Lynnhaven SGA by orienting our buildings toward them and creating more visual and public water access points along an extensive public trail system is an underlying design principle.

The long-range vision for Hilltop SGA, which is already a regional retail destination that features locally-owned restaurants, a plethora of grocery stores, and a variety of shops, builds on the area's strengths, yet introduces more greenspace. Incorporating greenspace through redevelopment opportunities can help address the SGA's stormwater management needs. In turn, this can create a healthier environment and visitor experience that welcomes more people out of their cars and outdoors as they move from place to place within the SGA. Industrial and commercial uses compatible with being in a military aircraft high noise zone have been relocated into this SGA at the southernmost end through the City's successful "YesOceana!" Program. The historic neighborhood of Oceana Gardens, which has a concentration of early 20th Century "Sears Kit Homes," is evolving with a new residential lot and density pattern that is more compatible with being located in a military aircraft Accident Potential Zone and high noise zone, while still trying to retain its character and charm.

ViBe Creative District "First Fridays" Art

The Resort Area SGA has received much capital investment in streetscape and utility improvements, including Rudee Walk, Pacific Avenue, and a new public parking structure on 25th Street. An innovative, flexible Form-Based Code is enabling new private development that provides a variety of housing types and a greater range of year-round shopping and entertainment for both residents and visitors, alike. An arts community has emerged in the Resort's ViBe Creative District and, as a result, more opportunities and choices are enabled in creative expression.

Now that master planning of the Strategic Growth Areas is complete, our focus has shifted to plan implementation and resourcing. In large measure, it necessitates refreshing our zoning and development regulations and design guidelines to enable the visions set forth in each plan. In addition to retrofitting public infrastructure to support higher density development and replacing aging infrastructure, improvements to transportation, traffic management, stormwater management, and streetscapes are needed. So is creating new public and green spaces. Initial public investment to accomplish some of these things has been instrumental in catalyzing private investment. It is a proven recipe for success based on the numbers we're seeing for return on investment. However, we cannot provide public resources for all of the SGAs simultaneously and at the same levels of support. Instead, we must strategically implement each plan, such that the energy from one fuels the startup of the next. This will foster a synergistic relationship between all of them.

There are also symbiotic relationships between the SGAs and the rest of the city. Implementing the SGA plans allows us to maintain the current pattern of development and density in the adjacent lower-density, safe suburban neighborhoods that our city is known for. Implementing the SGA plans also allows us to preserve our Rural Area and enable the Princess Anne Commons and Transition Area to be a true buffer between the Suburban and Rural Areas. All of the City's "Planning Areas," as described in Chapter 1, are intended to be mutually supportive. Becoming successful in the SGAs means becoming successful at achieving our land use goals in all other areas of the city.

SUBURBAN AREAS

Virginia Beach suburban neighborhood form

We choose to continue to preserve the suburban lifestyle for those who seek it as the primary lifestyle choice in Virginia Beach. Safe and healthy suburban neighborhoods and world-class public schools are what our City is known for and why people move here to raise their families. The Comprehensive Plan's **Section 1.3 - Suburban Area** sets for land use policies that seek balance in the appropriate mix of residential neighborhoods within our Suburban Area communities in order to find compatibility in density and design. Striking such a balance can often be a divisive decision, as less and less land has become available for large-scale new neighborhoods. Infill development on smaller, remaining parcels of land has become the norm. Our Suburban Area neighborhoods are also aging. Virginia Beach has prided itself in the stability of its housing stock and neighborhoods over the years. Neighborhood-serving retail centers are experiencing a range of conditions, from thriving to obsolete to transforming, and it is important that reinvestment and new investment in both our housing stock and commercial centers be an ongoing pursuit to maintain the stability of our Suburban Area.

Careful consideration must be paid to the extent to which our market can support additional retail uses, in addition to where they should be strategically located and of what type and design to best support planned growth areas and reflect local character. Adaptive reuse and reinvestment in neighborhood commercial centers are becoming a priority to ensure the continued viability of our Suburban lifestyle. Our challenge is to continue to allocate resources to code enforcement and home rehabilitation programs that have helped maintain strong neighborhoods, especially in light of historical reliance on federal and state housing assistance programs no longer being our current reality.

The Virginia Beach Sportplex, located in Princess Anne Commons, hosts many sporting events.

PRINCESS ANNE COMMONS & TRANSITION AREA

Section 1.4 - Princess Anne Commons & Transition Area, describe two key Planning Areas in Virginia Beach that are situated below the Green Line and north of the Rural Area. Princess Anne Commons, also referred to as Princess Anne Commons Strategic Economic Growth Area (SEGA), has evolved as a choice new destination for academic and medical institutions, sports and entertainment venues. Our planning for this area has been strategic because of its location under a military aircraft overflight area. Our economic development strategies have cultivated a strong alliance between these three industries to create a thriving community. Of recent note is our new target sector in biomedical research and development. Planning and resourcing public infrastructure to support continued strategic economic development in Princess Anne Commons is a high priority. Using a balanced approach between hard infrastructure and softer green infrastructure, we choose to continue to be able to meet a variety of desired stewardship, as well as federal and state-mandated environmental resource quality outcomes, including stormwater management and wetlands protection.

The Transition Area remains the penultimate buffer between the more densely populated and intensive land uses in the northern part of the city and the City's Rural Area to the south of Indian River Road. This area offers a choice for those who want to get away from the more densely-populated areas and into more open spaces, yet remain close to the conveniences of the Suburban Area. There is intended to be a noticeable difference here-- a transition-- as one travels from north to south through it and into the Rural Area.

Stormwater management features designed as open space amenities and an interconnected multiple-use public trail system are essential residential design elements in the Transition Area.

Open space is the primary consideration in site design, with a goal of achieving 50% cumulative open space at ultimate buildout. Context sensitivity is desired for building design and materials. Ideal uses are neighborhood-serving in both type and scale, not regional retail destinations and commerce centers as found in the Suburban Area. A vast network of public open space and multi-purpose trails is planned, and in part, is already built throughout the Transition

Area, enabling access to public recreation areas and individual mobility without reliance on the automobile.

Despite the designation and planning of the Strategic Growth Areas, development pressure in the Transition Area continues. This is in part due to the fact that it will be many years before the Strategic Growth Areas transform into their intended new pattern of more dense development. The Transition Area's low elevation and location at the headwaters of the Back Bay and North Landing River watersheds create a complex development landscape, however. A high groundwater table, documented sea level rise and recurrent flooding from wind-driven tides make stormwater management very challenging. We have come to realize that development must be treated differently here and that it may not be as developable as originally envisioned in previous Comprehensive Plans. Techniques for managing stormwater and other environmental quality goals that have worked well in other parts of the City have been found not to work as well in this area. As a result, new land use and development policies, design techniques, and regulations must be considered.

Multi-generational families farming in Virginia Beach.

RURAL AREA

The Rural Area and the rural way of life that has been present here for generations is described in **Section 1.5 - Rural Area.** The Rural Area offers yet another lifestyle choice for our residents. It is home to our vibrant agricultural industry—the third major element of our predominantly three-legged economy of tourism, the military, and agriculture. It is also a growing segment of our tourism industry.

The economic impact of the Rural Area is not limited to Virginia Beach, however; it is also a heavy user of the Port of Virginia, bringing our agricultural bounty to the world. It's big business for Virginia Beach. Preservation of our prime agricultural lands with long-established public utilities urban service boundaries and a successful Agricultural Reserve Program (ARP) has been effective. Although participation in the ARP has waned from its initial levels, reflecting an amassing of enrolled properties and retiring of stale residentially-zoned land, it remains a valuable and important growth management tool.

MILITARY INSTALLATIONS AND SUPPORT

Decades ago, our federal government chose to make Hampton Roads and Virginia Beach, in particular, a large home for its military commands and support services. The importance of this mission and federal resourcing of the various installations in Virginia Beach has only grown; Joint Expeditionary Base Little Creek-Ft. Story is now the City's largest public employer. Virginia Beach offers a training environment unparalleled elsewhere along the East Coast, enabling military personnel to train locally and remain with their families prior to deployment. Virginia Beach appreciates and chooses to support the military presence by ensuring that our land use policies are aligned with the missions of the various commands. This commitment and the various land use policies and cooperative land use review tools we use to achieve it are described in **Section 1.6 – Military Installations & Support.**

Learning from the past, we have reduced incompatible land use encroachment through partnership efforts between the City, the Commonwealth of Virginia, and the U.S. Navy such that we have now become a model defense community. Mutual cooperation on "beyond the fence line" issues have become institutionalized on a daily basis through memoranda of understanding, routine communication, and collaborative planning between city planners and their federal planning counterparts. The choices we have made in recent years have better positioned us, along with our state and military partners, to be a more resilient community, region, and state, should there be additional recommendations from Base Realignment and Closure Commissions in the future.

The U.S. Navy's Blue Angels in formation over Boardwalk during Neptune Festival.

TRANSPORTATION

The majority of our citizens have said they support pursuing additional transportation choices. Lifestyle choices for living, working, playing, and in-buying preferences are changing as the City's demographics shift to reflect a larger majority of Millennials (those born just prior to the Year 2000) and Baby Boomers (those born immediately after World War II). The Millennial generation is on track to outpace the number of Baby Boomers for the foreseeable duration. The mobility needs and choices of these two generations at opposite ends of the spectrum are strikingly similar in that they prefer greater mobility that doesn't require an automobile. As a choice city for both young professionals and retirees, our city is changing in response to this.

Example of "Complete Streets" safe intersection design for a variety of users

The *2009 Comprehensive Plan* introduced the concept of multi-modality— offering choices in transportation modes including vehicular, walking, biking, and mass transit—and presented a Master Transportation Plan inclusive of all of these modes. The desire to establish a Complete Streets Policy, or street design that is friendly to all users, was also a concept planted in the *2009 Comprehensive Plan*. **Section 2.1 - Master Transportation Plan**, presents the City's multi-modal transportation plan and is a state-mandated element of the local comprehensive plan.

Key transportation planning decisions that have affected not only our city, but the region as a whole, have been made since then. These include the opening of a starter light rail transit line in Norfolk and re-introduction of passenger rail service to Southside Hampton Roads in Norfolk. Planning for high-speed rail continues to be a focus at the state level through the Virginia Department of Rail and Public Transportation. A *Complete Streets Administrative Directive* was established in Virginia Beach through public involvement that mandates consideration of all users in all new street design and retrofit projects to the greatest extent practicable. Greater community connectivity, or the ability to move from place to place with ease and not necessarily in an automobile, is something that our citizens have also said is desirable for our city. The 2015 General Assembly asked localities to consider the needs of our most vulnerable citizens— our seniors and disabled persons—in our transportation and land use planning. Often being transit-dependent, it is vital they are enabled to be valued and active members of our community for a lifetime.

ENVIRONMENTAL STEWARDSHIP

The North Landing River system is part of the City's "Green Sea."

In addition to transportation, Virginia Beach citizens place the highest value on stewardship of our greatest asset—our natural landscape, with its extensive waterways and shorelines. Sixty-percent of Virginia Beach residents today were born here. They have chosen to remain, in part, because of our City's natural beauty. We are a tourist economy for the same reason. Businesses choose to locate here for the coastal lifestyle that is offered for their employees to live in, work, and play. An economic development spirit that celebrates our natural environment and is a sound steward of it is being cultivated and nurtured by our new *A Community Plan for a Sustainable Future*, adopted by City Council in 2013. This new plan seeks a triple bottom line of fiscal, social and environmental sustainability in all of our decisions.

New comprehensive planning legislation passed by the General Assembly in 2015 requires localities to plan for sea level rise and recurrent flooding. This topic is also heavy on the minds of our citizens, who have been experiencing repeated nuisance or more severe flooding events. Even before this state mandate, Virginia Beach had chosen to begin addressing these issues primarily through floodplain regulations, beach nourishment, and stormwater system retrofit projects. We realize now that, as new technology emerges to gather additional data that allows us to analyze our current and projected conditions, it will take something more extensive than that. We must add a greater array of tools to our toolkit that covers the spectrum of response measures, inclusive of mitigation, adaptation, and where necessary, retreat. We choose to be a resilient city. We can also choose to be a model for environmental stewardship and make reinvention a defining characteristic.

Section 2.2 - Environmental Stewardship Framework describes how we intend to address our challenges and be resilient.

HOUSING & NEIGHBORHOODS

People have chosen to make Virginia Beach their home for a variety of reasons. By the numbers and accolades, many find it an affordable and safe place to raise a family or as a retirement destination. Our neighborhoods are strong. **Section 2.3 - Housing & Neighborhoods**, presents our plan for maintaining the best things our housing and neighborhood choices have to offer and improving them over time, as needed. Home construction has slowed considerably since 2000, due to the combined effects of market oversaturation, finite land, aggressive growth management policies, and a period of severe economic recession in more recent years. Our demographics are diversifying with the large presence of Baby Boomers and Millennials, and the growing presence of minority populations. Their housing preferences, along with the period of economic recession, have resulted in a surge in new multi-family housing (apartments and townhomes). This type of construction has recently outpaced the more traditional single family-residential home construction in our Urban and Suburban Areas for the first time in the City's history. On the other hand, and from another perspective on the numbers, housing that is affordable to the largest segment of our population—our working residents and our younger generations-- is becoming scarce or has become unattainable in large measure.

Families enjoying one of many neighborhood and regional parks.

According to the most recent five-year forecast, both residential and commercial real estate assessments are expected to grow slowly at 2.5% each year over the forecasted period. Our housing market has necessarily hit the proverbial "reset" button. These new realities call on us to make concerted choices in order to continue to have healthy neighborhoods and be a choice city for a lifetime.

ECONOMIC VITALITY

Section 2.4 - Economic Vitality presents the City's land use goals and policies for ensuring that our city thrives economically and sustainably into the future. After many years of prosperity, we now find ourselves emerging from what has been an uncertain and volatile economic environment. The regional economy was affected by a significant decline in the housing market – the city's primary source of revenue. Defense spending, federal and state aid and consumer spending are not as strong as we have experienced prior to 2008. Future growth will depend on the city's ability to focus on the greater diversification of its economy, such as a focus on the biomedical and healthcare fields while growing and retaining our existing tourism industry as well as hallmark employers and our base of small businesses.

Virginia Beach has an emerging bio-medical research industry.

We have made strategic choices to enhance and diversify our economic vitality such that Virginia Beach can be a place where all citizens and businesses can prosper in 2040. We are able to create our own future because we are less dependent than ever before on the state and federal governments. The economy is again vibrant, growing, and more sustainable. We attract, retain, and grow high-caliber companies offering good salaries to employ our young adults and attract creative youth from other markets. This talented workforce lives and thrives in our city. There are rich opportunities for people of all ages to participate in our vitality. New and existing businesses benefit from a well-trained, diverse, and available workforce, even as those businesses' needs continually change. We have realized more than ever, the value of our small businesses and have become a leader in the new business growth and development of minority-owned firms.

We maximize our investment in infrastructure by developing our land so that it preserves our quality of life and physical environment and serves the needs of generations to come. The future growth or "regrowth" strategy underpinning the Strategic Growth Areas is where this will manifest the most in the future. Development is more sensitive to the environment, enabling us to attract more sustainable businesses. This sensitivity is valued highly by our citizens, the business community, and visitors. As an early leader in strategic partnerships, Science, Technology, Engineering, and Mathematics (STEM), and entrepreneurship innovation opportunities between Virginia Beach City Public Schools, Economic Development, and our institutions of higher education, Virginia Beach is yielding young people or those just starting their careers that are choosing to remain here and contribute productively to our community. They are the new generation of our workforce and they work differently.

Our ability to retain these bright minds is due, in part, to the high quality of life we continue to enjoy. These highly qualified STEM workers have, in return, served us well and given us the potential to become a national and international hub for the biomedical and healthcare industry.

We also have a unique workforce development and transitioning opportunity with veterans, who are exiting service and choosing to remain here, by offering them training to adapt their unique skill sets to the civilian workforce. And, as primarily defines our city, we will continue to retain and grow our existing tourism industry, as well as hallmark employers and our wealth of small businesses.

Workforce development education opportunities thrive at Tidewater Community College's Virginia Beach campus in Princess Anne Commons and in Virginia Beach City Public Schools.

PLAN IMPLEMENTATION

Chapter 3 - Plan Implementation describes our collective responsibility to monitor and report on our progress with implementing this Comprehensive Plan. It offers a variety of tools for doing so and to accomplish state planning mandates. A quick reference summary table of all Agenda for Future Action Recommendations is also included in this section.

LOOKING AHEAD TO THE YEAR 2040…ENVISION VIRGINIA BEACH

We know that our future holds continued promise, prosperity, and opportunity as we strive to be a "City for a Lifetime" for our present and future residents and businesses. **This Comprehensive Plan, *It's Our Future: A Choice City,*** looks ahead to the Year 2040. It is our blueprint and policy document guiding sustainable physical growth and development over the next 25 years. It is the City's seventh Comprehensive Plan and it builds on a strong foundation of continuous comprehensive planning initiatives begun in 1979 when the City's first Comprehensive Plan was adopted. To prepare this latest update to our Comprehensive Plan, we have carefully considered our past, our current conditions, recent trends, emerging issues, projections, and new state planning mandates. We have engaged our citizens to hear what they value and what is important to them over the next 20-25 years. Our Comprehensive Plan reflects our community values, aspirations, and choices, which are visualized in the word cloud below.


Regional
Light-rail
Arts
Alternative
Tourism
Family
International
Clean
World-class
Technology
Paths
Liveable-City
Cleanest
Connected
Fun
Business
Cultural
Memorable
Green-City
Jobs
Healthy-Life-Style
Walkways
Strong-families
Multi-use
Learning
Life-long
Best
High-skilled
region
Organic
Youth
Transportation
Diversity
New
Community
Character-building
facilities
Strong
in
waters
Healthy-food
energy
Children
Gateway
Local-food
tourism
airport
Multi-generationalfamily
Healthy
succeed
Bikeways
RegionalismAccess-World
education
Leader
Efficient
workforce
High-Tech
options
Athletics
effort
Bike
suceed
Parks
Beaches

CHAPTER 1 - PLANNING AREAS

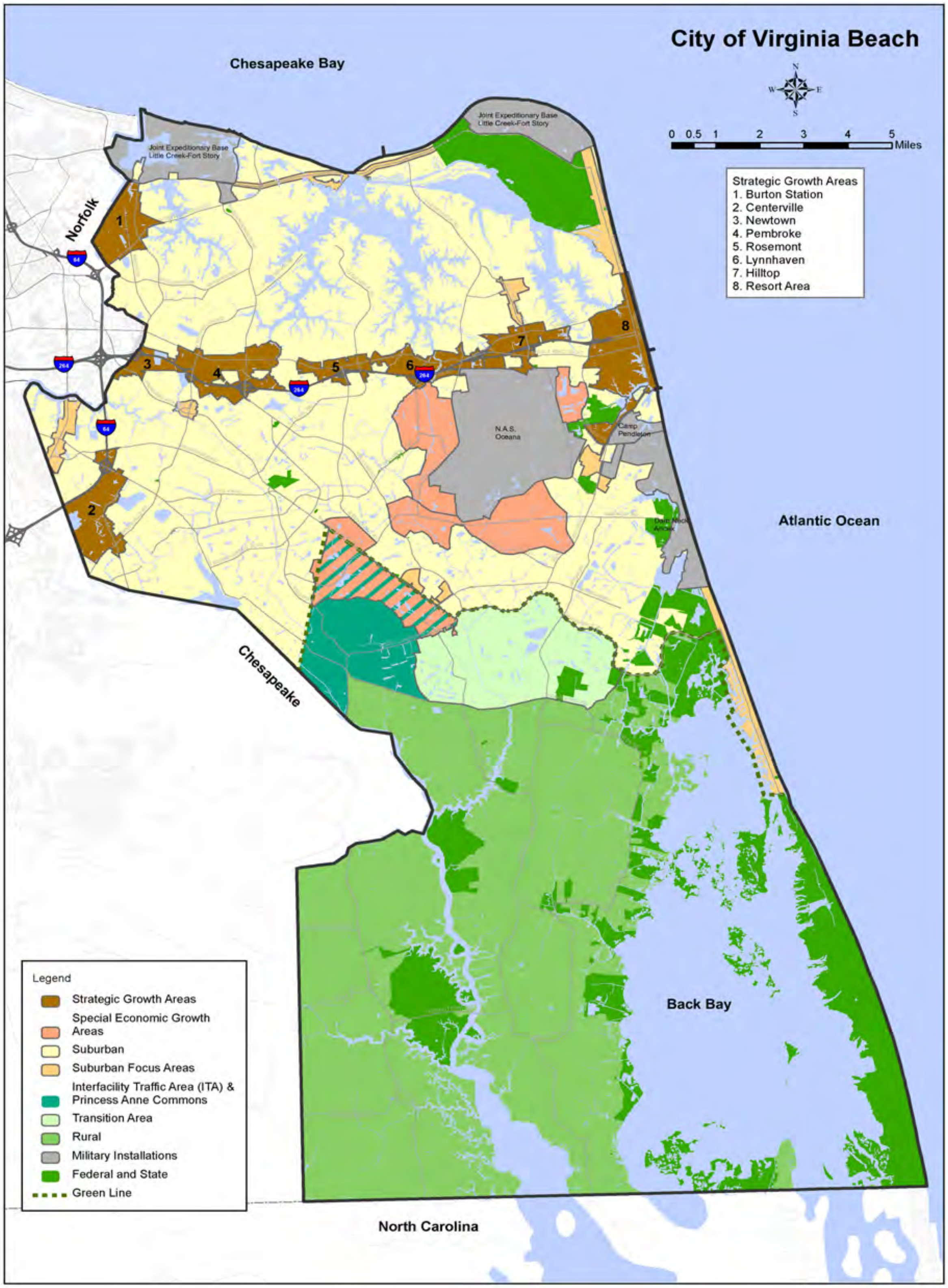
The City of Virginia Beach is divided into five "Planning Areas" in this Comprehensive Plan, which is located on the "Planning Areas/Planned Land Use Map" in Section 1.1.

Each Planning Area listed below represents our desired future land development pattern for that part of the City:

- Urban Areas (Strategic Growth Areas) – Section 1.2
- Suburban Area – Section 1.3
- Princess Anne Commons & Transition Area – Section 1.4
- Rural Area – Section 1.5
- Military Installations & Support – Section 1.6

These sections describe each Planning Area in detail and provide land use policies, as well as recommended actions to be undertaken in the future.

1.1 – Planning Areas Planned Land Use Map



Planned Land Use Map

1.2 - URBAN AREAS (STRATEGIC GROWTH AREAS)

INTRODUCTION

The vision of the Strategic Growth Areas (SGAs) embodies a vertical mix of urban uses, great streets and well-designed pedestrian connectivity, mobility and transit alternatives, urban gathering places, land use patterns that foster economic growth through efficient use and reuse of land, neighborhood protection, "green" building and infrastructure opportunities, and a variety of civic, commercial, artistic, and ethnically diverse areas.

Virginia Beach Town Center - Urban Lifestyle

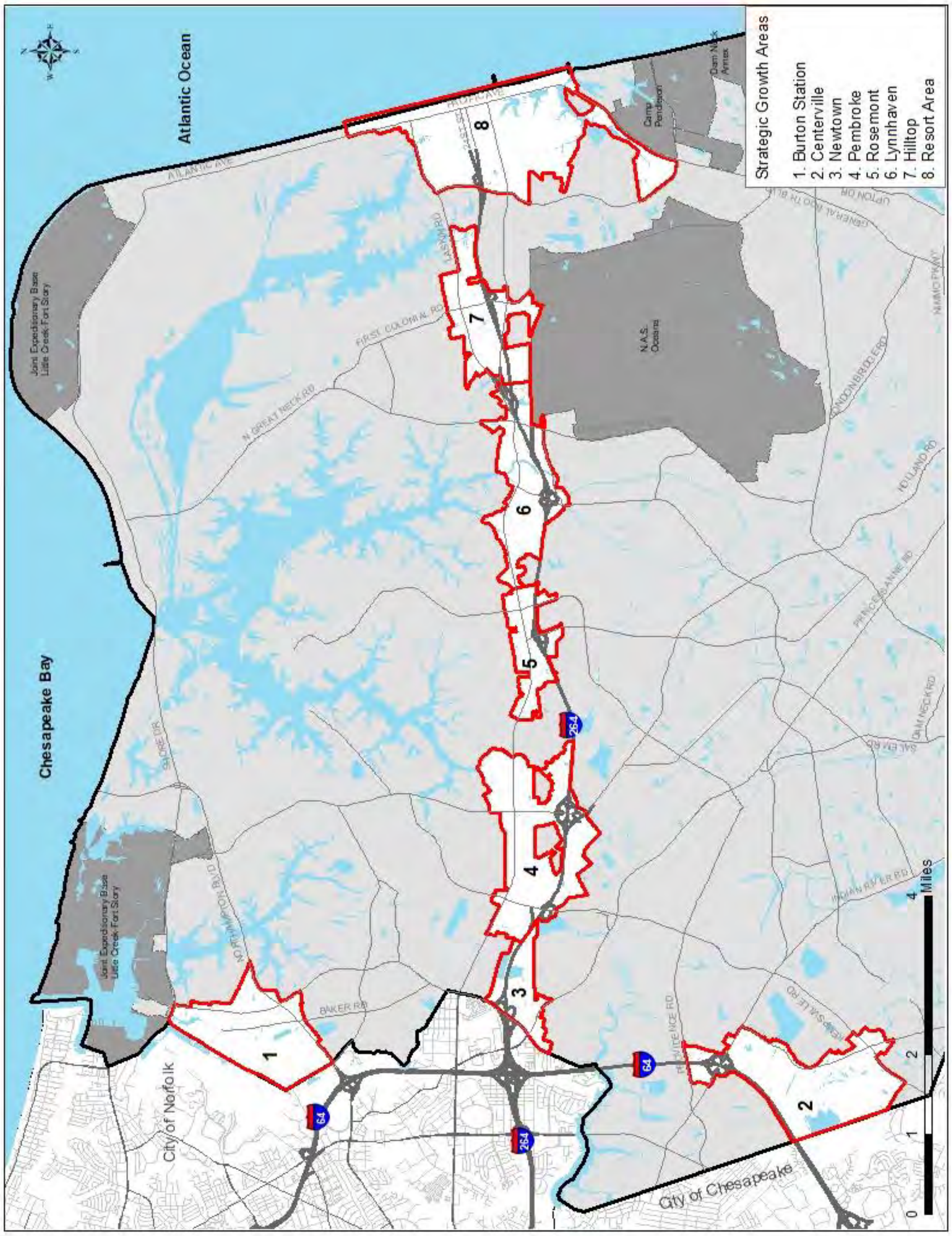
The City of Virginia Beach celebrated its 50th anniversary in 2013. Although we are a relatively young city, we have enjoyed robust growth throughout much of our history since merging with Princess Anne County. This rapid growth has resulted in a dwindling supply of undeveloped land. Recognizing the importance of preserving our Rural Area, we established planning policies in 1979, and introduced the 'Green Line' urban growth management tool at that time, to channel growth and infrastructure improvement to the northern half of the city. As developable land in this area built out over time in a sprawling suburban development pattern, the City Council recognized the need to accommodate future growth and preserve the established, stable residential neighborhoods in our Suburban Area. The solution was to identify areas that could be redeveloped into more urban-style areas - our Strategic Growth Areas (SGAs). These SGAs not only allow our city to continue to grow while preserving our Rural and Suburban Areas, they also create a third lifestyle option for our citizens to enjoy - Urban Areas.

STRATEGIC GROWTH AREAS (SGAs) ARE URBAN DEVELOPMENT AREAS (UDAs)

The SGAs were first designated in the *2003 Comprehensive Plan* as ideal places to absorb future growth by redeveloping carefully selected, somewhat obsolete or tired suburban-format area into a higher density, more efficient urban land use form. Over time, the City has refined its SGA location strategy. Today, there are 8 SGAs as follows, which can be found on the locator map located on p. 1-5.

- Burton Station
- Centerville
- Hilltop
- Lynnhaven
- Newtown
- Pembroke
- Resort
- Rosemont

STRATEGIC GROWTH AREAS LOCATOR MAP



Combined, these SGAs constitute only 2% percent of the City's total land area of 258 square miles. This decision by our city leaders came years before the Commonwealth of Virginia mandated localities in 2007 to designate Urban Development Areas (UDAs) in their Comprehensive Plans. This mandate became voluntary in 2012 and was further relaxed in 2015. Under the new definition, UDAs can be any area(s) designated in a Comprehensive Plan for higher density development that incorporates the principles of Traditional Neighborhood Development. Traditional Neighborhood Development embodies classic characteristics of traditional communities such as walkable neighborhood centers, interconnected streets and blocks, diversity of land uses, and easy access to jobs, housing, and recreation by a variety of travel options. Our SGAs have been found to meet the requirements of the Code of Virginia, Section 15.2-2223.1 regarding "Urban Development Areas."

The City has identified Strategic Growth Areas to:

- provide opportunities for continued physical and economic growth;
- help prevent urban sprawl;
- protect our established residential neighborhoods and rural areas;
- maximize infrastructure efficiency; offer more choice in built environments; and,
- create unique and exciting urban destinations.

GUIDING PRINCIPLES FOR STRATEGIC GROWTH AREAS

1. Encourage efficient use of land resources
2. Maximize use of infrastructure
3. Create a compatible mix of uses
4. Offer a range of transportation options
5. Design at a human scale
6. Promote transit-oriented development
7. Diversify our housing stock
8. Provide accessible parks, open spaces, and recreation facilities
9. Expand upon our green sustainable infrastructure
10. Cultivate Arts and Culture
11. Preserve designated historic resources
12. Plan for sea level rise and recurrent flooding

The following describes each of the SGA Guidelines Principles and intended outcomes for the SGAs:

1. ENCOURAGE EFFICIENT USE OF LAND RESOURCES

The land use techniques of higher density and more vertical development, infill development, regional stormwater management solutions, and structured parking are key components to successfully achieving a more efficient pattern of growth. The benefits include reduced sprawl, protection of existing stable neighborhoods, increased protection of farmland and open spaces, reduced dependence on the automobile and more cost-effective use of existing infrastructure.

Pembroke SGA - Urban Core District

2. MAXIMIZE USE OF EXISTING INFRASTRUCTURE

Urban development patterns promote a more efficient and cost-effective use of existing public infrastructure and services such as roads, schools, water, sewer, police, fire, rescue, and others. Numerous studies have demonstrated that development within appropriate areas where infrastructure and services already exist provides a more efficient and cost-effective use of public funds than continued expansion of infrastructure and services into undeveloped areas

3. CREATE A COMPATIBLE MIX OF USES

Providing a complementary and vertical blend of residential and non-residential uses within reasonable walking distances with well-designed connectivity to one another is an important part of a successful urban development strategy. Effective mixed-use developments also have a 'critical mass' where the mixture of uses is such that the need for an automobile for routine trips for goods and services is significantly diminished. Examples of mixed-use include the co-location of corner markets and shops lining streets with residential units located above. Architectural design considerations and control of the hours of business operation must be factored into the land use strategy. The careful placement of residences, offices, shops, educational and cultural institutions, recreation areas, public service facilities, and open spaces designed as part of an attractive, pedestrian-oriented, urban environment contributes to:

Concert goers enjoy evening entertainment at 31st Street Stage in Neptune Park

- independence of movement and ease of access between home and neighborhood-serving destinations;
- safer commercial areas due to the 24-hour presence of people or what is termed the 'eyes of the community';
- reduction in automobile dependency and opportunities for shorter work trips by focusing on mixed-use and transit-oriented development; and
- the development of a transit-oriented and multi-modal transportation system, in conjunction with planned development and mixed-use projects.

4. OFFER A RANGE OF TRANSPORTATION OPPORTUNITIES

As noted above, urban development patterns afford a greater choice of transportation alternatives and less congestion than is otherwise experienced in communities. A three year study, Measuring Sprawl and Its Impact, by researchers from Rutgers University, Cornell University, and Smart Growth America concluded that, "People living in more sprawling regions tend to drive greater distances, own more cars, breathe more polluted air, face greater risk of traffic fatalities, and walk and use transit less. This study shows that sprawl is a real, measurable phenomenon with real implications for peoples' everyday lives. Regions wishing to improve their quality of life should consider taking steps to reduce sprawl and promote smarter growth." [i]

Urban, mixed-use development that contains convenience, variety, and density of use, and integrates well-designed pedestrian systems, streetscapes, and transit opportunities can contribute to:

- decreased dependence on the automobile, especially the single-occupant vehicle;
- extension of safe, convenient and efficient light rail transit service that provides alternative mobility options, which can be particularly helpful in enabling young non-drivers, seniors, and those with physical disabilities to be fully engaged in community life;
- reduction in citywide Vehicle Miles Traveled (VMT);
- increased opportunities for more efficient and cost-effective forms of shared and mass transportation;
- increased opportunities with well-designed connectivity to commute by walking or biking;
- opportunities for local and metropolitan transit systems to link to regional and interstate transportation systems;
- cleaner air; and
- safer travel.

Vibrant urban places typically offer transportation choices

5. DESIGN AT A HUMAN SCALE

Part of what is required for urban, mixed-use developments to become acceptable patterns of development within communities is the creation or re-creation of well-designed areas that are safe, attractive, and convenient. It is important for these areas to be built at a 'human scale,' especially as people experience activity along the streets, sidewalks, and public spaces. For example, the sounds from outdoor cafes, people gathering around fountains in public plazas, and aromas from local coffee shops and bakeries all combine to create a sense of interest, excitement, and social interaction. There are distinct physical characteristics that define the built environment of the urban center. These include a vertical mix of residential and non-residential uses within architecturally interesting buildings and urban streetscapes designed with special paving, landscaping, lighting, and other features that create a visually exciting and inviting environment.

6. PROMOTE TRANSIT-ORIENTED DEVELOPMENT

Where mass transit stations are located, surrounding development should be designed to support their accessibility and use. Areas within one half mile of a transit station are particularly important as they represent "walksheds" for the stations. Transit-oriented development incorporates higher density, more compact, mixed-use developments as described above with significant pedestrian and bicycle infrastructure. Accommodating private use of automobiles is considered a secondary goal to other modes of transportation.

Example of Transit-Oriented design in Nashville, TN

7. DIVERSIFY OUR HOUSING STOCK

Providing a variety of housing choices in terms of type (for sale or rent), size (efficiencies, apartments, townhouses, row houses), and affordability is important to meet the needs of all our citizens and attract new businesses and workers to our city. A decent, affordable home should be a right, regardless of income. Being able to live where you work contributes to the quality of life not just for the individual, but for the community as well. When our workforce is able to live where they work, we all benefit. When people have decent, affordable and stable housing, children do better in school, it is easier to keep or secure a job, families have more disposable income to spend thereby benefiting the local economy, there are fewer health (mental and physical) issues, and family stability is much greater. All of the aforementioned circumstances strengthen our community. Incentives for the construction of workforce housing in areas of the city, including Strategic Growth Areas, in which the Comprehensive Plan recognizes increased density to be appropriate, are provided in the form of increased density allowances under the Workforce Housing Program. In some cases, high cost infrastructure requires public incentives to achieve affordability. Equally important is to ensure that workforce housing will be well-designed, of high quality, and well-integrated into the overall development of which it is a component. For additional information about the Workforce Housing Program visit www.vbgov.com/government/departments/housing-neighborhood-preservation/workforce-housing/Pages/default.aspx.

8. PROVIDE ACCESSIBLE PARKS, OPEN SPACE, AND RECREATION FACILITIES

Parks, open space, and recreation facilities support community engagement by providing residents with a venue for participation in, and attachment to, their communities. They provide a sense of place and offer essential life-enhancing qualities that aid community and individual well-being. The establishment of such facilities in newly developed or redeveloped areas should be purposefully planned in order to supplement existing recreational opportunities and maintain a high quality of life to be enjoyed by existing and future residents.

9. EXPAND GREEN INFRASTRUCTURE

Urban green space

Green infrastructure mitigates the negative impacts of land development by simulating natural processes in order to provide flood protection, cleaner air, cleaner water, wildlife habitat and corridors, and cultural and recreational opportunities. Green infrastructure elements can be woven throughout a watershed, from smaller scale elements that can be integrated into development sites to larger scale elements that span entire neighborhoods. Some examples are:

- *downspout disconnection* – routing rooftop drainage to rain barrels, cisterns or permeable areas;
- *rain gardens* – shallow, vegetated basins that collect and absorb rain from rooftops, sidewalks, and streets;
- *permeable pavements* – paved surfaces that infiltrate, treat, and/or store rainwater where it falls;
- *green streets and alleys* – green streets and alleys use a combination of vegetated and engineered strategies to manage rain, allowing it to soak into soil, filtering it, and reducing the amount of storm water transported to an outfall;
- *green roofs* – roofs covered with growing media and vegetation that absorbs heat and rainwater;
- *urban tree canopy* – planting and protecting trees provides shade and reduces storm water by intercepting precipitation; and,
- *park and conservation lands* – creating new open spaces and protecting sensitive natural areas within and adjacent to Strategic Growth Areas mitigates the water quality and flooding impacts of urban storm water, while providing cultural and recreational opportunities for residents.

"The Wave" - Public at the Oceanfront

10. CULTIVATE ARTS AND CULTURE

Arts and culture should be woven into the fabric of the community, becoming an integral force in urban design, the educational system, commerce, community celebrations, neighborhood life, and public sector institutions. We need to create space for the arts to take hold and grow. When designed and built with quality in mind, these physical and cultural elements galvanize to foster a positive sense of urban place - something that is enjoying a resurgence of public interest in many communities across the country.

Expanding public art and place-making beyond traditional objects to create events, spaces, and public places animates the City and brings the community together for unique public experiences. Programming for these experiences can be both temporary (event-based) and permanent installations that address community beautification. They can be integrated into redevelopment and new construction projects. Development, support, and promotion of multicultural facilities should be elevated to diversify the arts through both traditional and contemporary styles.

11. PRESERVE DESIGNATED HISTORIC RESOURCES

It is the policy of the City to use all available resources including those provided by the City's Historical Review Board, Historic Preservation Commission, and the Princess Anne County/Virginia Beach Historical Society to preserve designated historic resources. Efforts to retain these historic resources should be accomplished in a responsible and innovative manner. The efforts include providing land use planning guidance and tax credit assistance to owners of historic properties in order to help protect and preserve the City's limited number of valuable historic resources and surrounding open space areas. Owners of qualified properties should be encouraged to participate in the Virginia Beach Historical Register program and receive recognition for their contributions to our City's heritage.

Entertainment at the Francis Land House in Lynnhaven SGA, circa 1850

12. PLAN FOR SEA LEVEL RISE AND RECURRENT FLOODING

Due to our abundance of shoreline, sea level rise and recurrent flooding are topics of great concern for our city and the entire Hampton Roads region. Fortunately, our Strategic Growth Areas are generally well-placed at higher elevations and away from inland tidal waters. A few of the SGAs either border or contain existing inland tidal waters. These include:

- Thalia Creek on the eastern boundary of the Pembroke SGA;
- the southern tributaries of the Eastern Branch of the Lynnhaven River, which runs through the center of the Lynnhaven SGA to London Bridge Creek;
- Linkhorn Bay on the eastern border of the Hilltop SGA; and
- Lake Rudee, Lake Holly, Owls Creek, and the southern tributaries of the Resort SGA.

Accordingly, our SGA Plans recommend substantial buffers between new development and these waterways, and in some cases, reclaiming these buffer areas for open space as opportunities arise. The Sea Level Wise Adaptation Strategy assesses impacts to the Strategic Growth Areas and our City as a whole, as well as identifying strategy elements that will improve the City's resilience to the flood conditions of both today and tomorrow.

Thalia Creek Greenway in Pembroke SGA

DISTINCT QUALITIES

While they share many common goals, our Strategic Growth Areas also possess some distinct qualities. First, these areas vary in their ability to absorb the amount and type of new growth and redevelopment. For example, the Centerville, Newtown, Pembroke, and Rosemont SGAs are located along I-64, I-264, and Virginia Beach Boulevard near key highway interchanges and are unencumbered by AICUZ high noise or accident potential zones. These areas are most suitable for a blend of new residential and complementary non-residential uses in the form of attractive, more intense mixed-use centers.

Other Strategic Growth Areas may not be suitable for new residential growth but can expand upon their unique qualities, such as a regional shopping destination in the Hilltop SGA and coveted waterfront properties in the Lynnhaven SGA. The Burton Station SGA is strategically located to take advantage of regional truck, rail, air and maritime shipping services. The Resort Area is a key part of our travel and tourism industry that attracted 5.9 million overnight visitors, who spent $1.3 billion citywide in 2013. As this SGA continues to grow as a vacation and convention destination, introducing new residential and year-round uses that include practical shared structural parking strategies in compatible locations will further support this vital economic engine for our city.

IMPLEMENTING THE SGA PLANS

Having now adopted master plans for our eight Strategic Growth Areas (SGAs), we are positioned to realize the real return on investment put into such planning for our future to truly be "A Community for a Lifetime." Each SGA Plan includes an implementation section that prioritizes public and private projects needed to reach the long-term vision. The public and private sectors must work together to implement these plans.

Groundbreaking ceremony in Pembroke SGA

SGA DEVELOPMENT INCENTIVES

Identifying capital projects that will catalyze and support private development is essential to plan implementation. Each SGA Plan identifies key infrastructure initiatives to be considered and prioritized in the annual Capital Improvement Project (CIP) planning and budgeting process.
In addition to capital infrastructure projects, project-specific incentives are available to encourage development consistent with the City's adopted SGA Plans. On January 14, 2014, City Council approved a resolution updating a policy adopted in 2001, "Guidelines for Evaluation of Investment Partnerships for Economic Development." The updated policy focuses on partnerships that are consistent with plans for the City's Strategic Growth Areas (SGAs) and Special Economic Growth Areas (SEGAs). Qualifying projects must be financially feasible for the City and the private partner. Investment partnership incentives may take a variety of forms depending on the nature of the project. Most projects will have many, but not necessarily all, of the characteristics identified in the adopted resolution, but are nevertheless desirable projects. For assistance with developing in the SGAs or information regarding the Investment Partnership Incentives Policy, visit www.vbgov.com/government/departments/sga/Pages/default.aspx.

All customers with private development proposals are strongly recommended to contact the Department of Planning & Community Development prior to entering the design process. Staff is available to interpret the SGA Plan as it applies to the subject property, listen to the customer's goals for the property, and collaborate to find mutually agreeable development plans for both parties. Pre-design topics may include proposed land use, site design, building design, supporting infrastructure needs, how the proposal complements the SGA Plan, and any other questions or concerns about the project.

INTERIM USE POLICY

In order to achieve the long range vision identified in each SGA Plan, discretionary land use decisions affecting property in the Strategic Growth Areas should be based upon the guiding principles noted above. Following are area-specific planning recommendations, and applicable design principles that relate to development or redevelopment proposals in these areas. *Recognizing that the transformation of the SGAs will be gradual, and that land development is market driven, our objective is to achieve quality urban site design and building form with flexible building types that will enable a transition to recommended uses over time. Uses deemed inconsistent with the long-range vision in the adopted plans, but acceptable as interim uses given current market forces and land uses in the area, should be granted for a limited period of time.* These time periods may be extended on an annual basis if the Zoning Administrator and Director of Planning & Community Development find that the current development trend is not indicative of imminent redevelopment consistent with the adopted SGA plans.

UPDATING THE PLANS

Just as the Comprehensive Plan is reviewed in five-year cycles as required by the Code of Virginia, our SGA Plans will require periodic updates to adjust to changing circumstances, community goals, and market trends. These are living documents that adjust as redevelopment evolves. All plan revisions will be the product of the same open, collaborative process used to prepare all of our City's long-range plans.

Citizens help plan the SGAs

SGA PLANNING RECOMMENDATIONS

Master plans for each of the City's eight SGAs were prepared through extensive planning, research, analysis, and community engagement and have been adopted by reference as part of this Comprehensive Plan by the following amendment dates:

- Resort SGA (December 2, 2008),(Update June 2, 2020)
- Burton Station SGA (January 27, 2009), (Update November 20, 2018)
- Pembroke SGA (November 10, 2009)
- Newtown SGA (July 6, 2010)
- Rosemont SGA (September 13, 2011)
- Lynnhaven SGA (April 24, 2012)
- Hilltop SGA (August 28, 2012)
- Centerville SGA (March 26, 2013)

The boundaries of each SGA and the general area-specific recommendations from the SGA Master Plans are presented on the following pages. The detailed SGA Master Plans can be viewed at www.vbgov.com/government/departments/sga/Pages/default.aspx.

BURTON STATION STRATEGIC GROWTH AREA

DESCRIPTION

The Burton Station Strategic Growth Area (SGA) is predominantly industrial, but also has significant tracts of land devoted to residential and commercial uses with a considerable amount of undeveloped land that lacks a good network of internal streets. The SGA is located at the convergence of major highway, rail, and airport facilities, and benefits from nearby deep water ports and a major military installation.

The Burton Station community and the Northampton Boulevard Corridor have begun to realize long-neglected capital and private investment that is both improving the quality of life for residents and creating more attractive corridor aesthetics in both commercial and residential building design and streetscape landscaping. The original Northampton Boulevard Corridor SGA Implementation Plan was adopted by the City Council on January 27, 2009. In 2018, City Council adopted a revised Burton Station Strategic Growth Area Plan that completely replaces the 2009 version and is available in the online document library at www.vbgov.com/Planning .

VISION

The ultimate pattern of development envisions a revitalized Burton Station neighborhood that achieves a land use and design strategy that respects the heritage of Burton Station and is an integral part of a larger planned mixed use community with residential, commercial, open space and employment opportunities.

Improved Burton Station Road Concept

SGA DESIGN PRINCIPLES

- Respect traditions and context
- Optimize and extend connections
- Develop sustainable initiatives
- Provide a mix of uses
- Encourage economic development
- Improve the quality of life

PLAN RECOMMENDATIONS

The following summarizes the general recommendations of the *Burton Station SGA Master Plan 2018 Update*:

- Provide infrastructure including roads, utilities, and stormwater facilities needed to support existing commercial, industrial, and mixed use within this SGA.

PLAN IMPLEMENTATION STRATEGIES

Northampton Boulevard corridor redevelopment concept

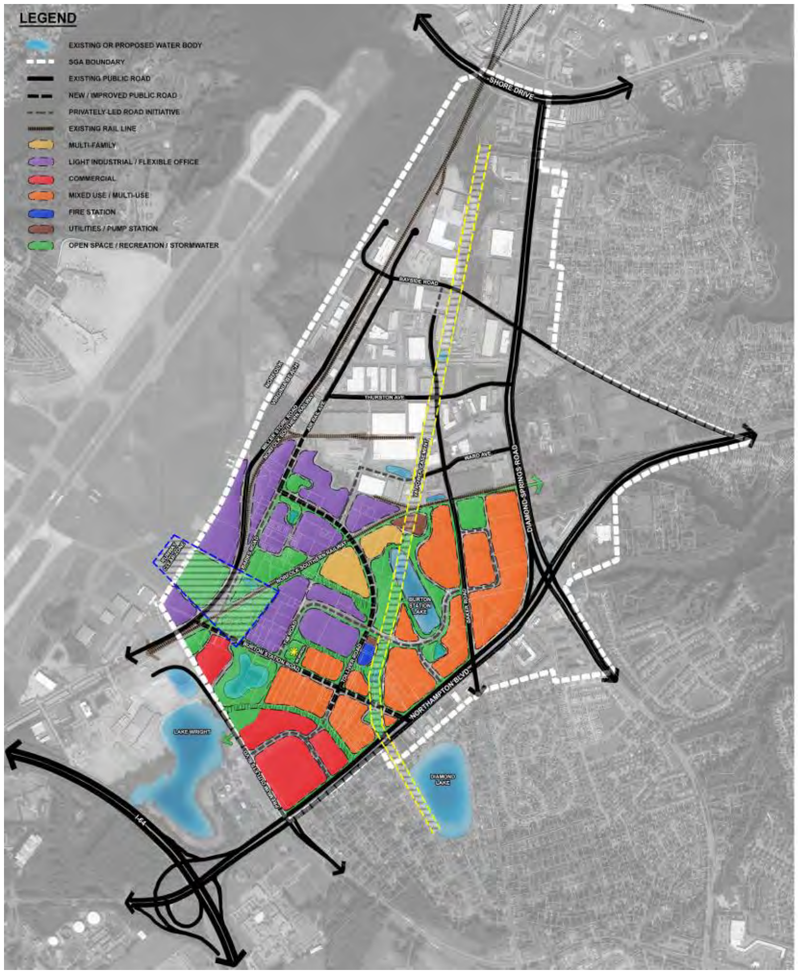
Recommended Action Plan

- Complete current City projects that are underway.
- Facilitate development in Burton Station Village.
- Fund CIP for Burton Station Road west improvements.
- Fund CIP for Tolliver Road west improvements.

Burton Station "Main Street" retail corridor concept

Programmed and Funded Capital Improvement Projects (CIPs)

- 7-036000 - Baker Road Culvert & Ditch Improvements. This project will address roadway/property flooding through design and construction to upgrade existing pipe/drainage system from Baker Road to Diamond Springs Road, north of Northampton Boulevard, to minimize roadway/property flooding.
- 9-081000 - Strategic Growth Area Projects, Burton Station Village Phase I. Property acquisition and drainage improvements.
- 9-022000 - Burton Station Road Improvements, Phase I. This project will provide basic and long needed utility services and standard roadway improvements including curb and gutter, sidewalk, and streetlights necessary to preserve and revitalize the existing residential community consistent with the phasing and implementation goals of the adopted SGA Plan.
- 9-091000 - Burton Station Road Improvements, Phase III. The purpose of this project is to provide a connection between Burton Station Road and Air Rail Drive via an extension of Tolliver Road to provide infrastructure necessary to promote future development consistent with the SGA Plan.
- 3-075000 – Fire/EMS Station Burton Station. This project provides for the design and construction of a new Fire and EMS station in the Burton Station area to serve residents and businesses in the area.
- For detailed Burton Station SGA Master Plan recommendations and information visit the online document library at www.vbgov.com/Planning.



Burton Station SGA Master Plan - Conceptual Plan

Burton Station Master Plan

CENTERVILLE STRATEGIC GROWTH AREA

DESCRIPTION

The Centerville Strategic Growth Area (SGA) is unique from other SGAs because it consists of several large-scale ownership and single-use areas, such as the Christian Broadcasting Network (CBN), Regent University, the City Landfill, and a private landfill. The relationship between these uses and their impact on one another, and surrounding residential neighborhoods, deserves special consideration. Located in the southwestern part of the City, the Centerville SGA is generally bound by Interstate 64, the City of Chesapeake, Centerville Turnpike, and Kempsville Road. The SGA's primary asset is its large expanse of undeveloped land fronting I-64 that offers economic development opportunity for future corporate office headquarters and expansion area for Regent University.

The Centerville SGA is home to a rapidly growing institution of higher learning - Regent University - and has become our city's first four-year college. The university shared its master plan with city planners to create the concept of a future university village that enables the university to expand and address its growing student housing needs while encouraging surrounding residents to take advantage of university offerings in employment, dining, entertainment, and small shops. This SGA, due to its lack of environmental constraints, affords an opportunity for significant economic development adjacent to the Interstate and a home to future Class A office space of a design that continues the architectural themes found on the campus. While the municipal landfill at the western edge of the SGA will continue to operate until it reaches capacity, the SGA plan envisions a new district park once it is closed that is modeled after the City's beloved and well-used Mt. Trashmore Park. The *Centerville SGA Master Plan* was adopted by the City Council on March 26, 2013 and is available in the online document library at www.vbgov.com/Planning.

VISION

The vision for the Centerville SGA is to become an education-oriented master-planned community, which capitalizes on the regional access and visibility provided by I-64, and the existing institutional anchors of CBN and Regent University. The Plan envisions a mixed-use central village with connected trails to campus life, diverse neighborhoods, office, retail, and open space.

Concept for Regent University Quad

SGA DESIGN PRINCIPLES

- Regenerate existing development areas to capitalize on existing public infrastructure investments.
- Build a mixed-use center for Centerville.
- Better connect to existing parks and the Regent University campus through expanded trail networks.
- Improve pedestrian and trail facilities to connect neighborhoods to future transit and neighborhood centers.
- Mitigate impacts to the Elizabeth River through stormwater best management practices.
- Continue to diversify housing choice, including workforce housing.
- Improve the jobs/housing balance to increase capture rate and decrease traffic congestion.

- Identify immediate and interim actions for the landfills to effectively mitigate against adverse impacts.
- Pursue a joint planning strategy with the City of Chesapeake.
- Build a transportation infrastructure network that provides for safety, equity, choice, and economy.
- Create an education-oriented, master-planned community as a unique identity for the Centerville SGA.

PLAN RECOMMENDATIONS

The following summarizes the general recommendations of the *Centerville SGA Master Plan*:

- Establish a multi-modal circulation structure to connect Regent University within itself and to surrounding neighborhoods and the regional transportation network.
- Preserve the existing character of the campus by placing buildings around quad spaces.
- Create new parks and open space systems to serve the University's students and faculty.
- Build a diversity of housing types to create a vibrant, authentic, and inclusive place.
- Mix residential with retail uses.
- Integrate a variety of natural and designed open space types.
- Buildings should front the streets with parking primarily located behind in shared facilities.
- Provide a 50-100 ft. buffer between development and I-64.
- Connect the Regent campus and residential areas through a street and trail network.
- Incorporate three to five-story suburban office development in the corporate office area.
- Develop shared sports facilities with the university.
- Take advantage of the proximity to highway location through improved street frontage.
- Continue the residential character of the surrounding area with the Brandon neighborhood expansion.

PLAN IMPLEMENTATION STRATEGIES

The Centerville SGA Plan builds on the momentum generated by the impending road expansion investments to stitch together a cohesive University district that initiates private development and redevelopment of individual parcels using the general street framework suggested by the Master Plan.

Recommended Action Plan

- Update zoning regulations based on the SGA plan recommendations.
- Implement Centerville's portion of the City-wide trail system as roads and streets are rebuilt.
- Develop a comprehensive stormwater management strategy.
- Provide development standards for frontage landscape, parking lot design, street furnishings, exterior signage, storefronts, and lighting.
- Implement the following key infrastructure improvements:
    - New Kempsville Road and Indian River Road intersection
    - Expansion of Centerville Turnpike and Indian River Road intersection
    - Widening of Centerville Turnpike from Indian River Road to Kempsville Road
    - Completion of Lynnhaven Parkway
    - Widening of Centerville Turnpike from Kempsville Road to City line
    - Realign entry into landfills and stabilize the slopes of Cell 1
    - Extension of the River Birch Run to connect to Centerville Turnpike
    - Completion of green network to Indian River Park along River Birch Run extension

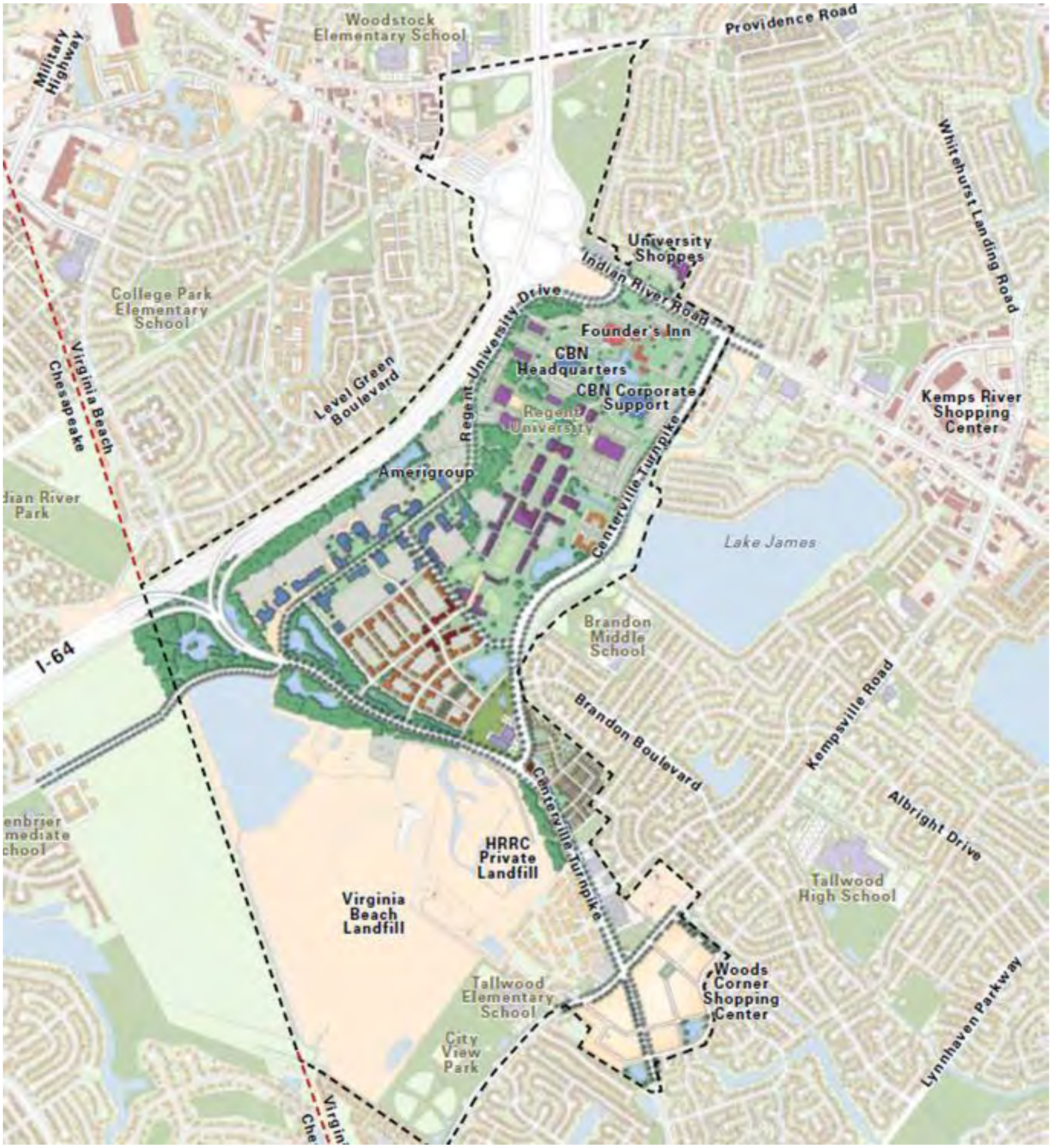
- Neighborhood park at back of Woods Corner Shopping Center
- Landfill/waste management facility buffers and stormwater management south and west of Centerville Turnpike
- Regional stormwater management system
- I-64 Interchange

Proposed "University Village" main street concept

Programmed and Funded Capital Improvement Projects (CIPs)

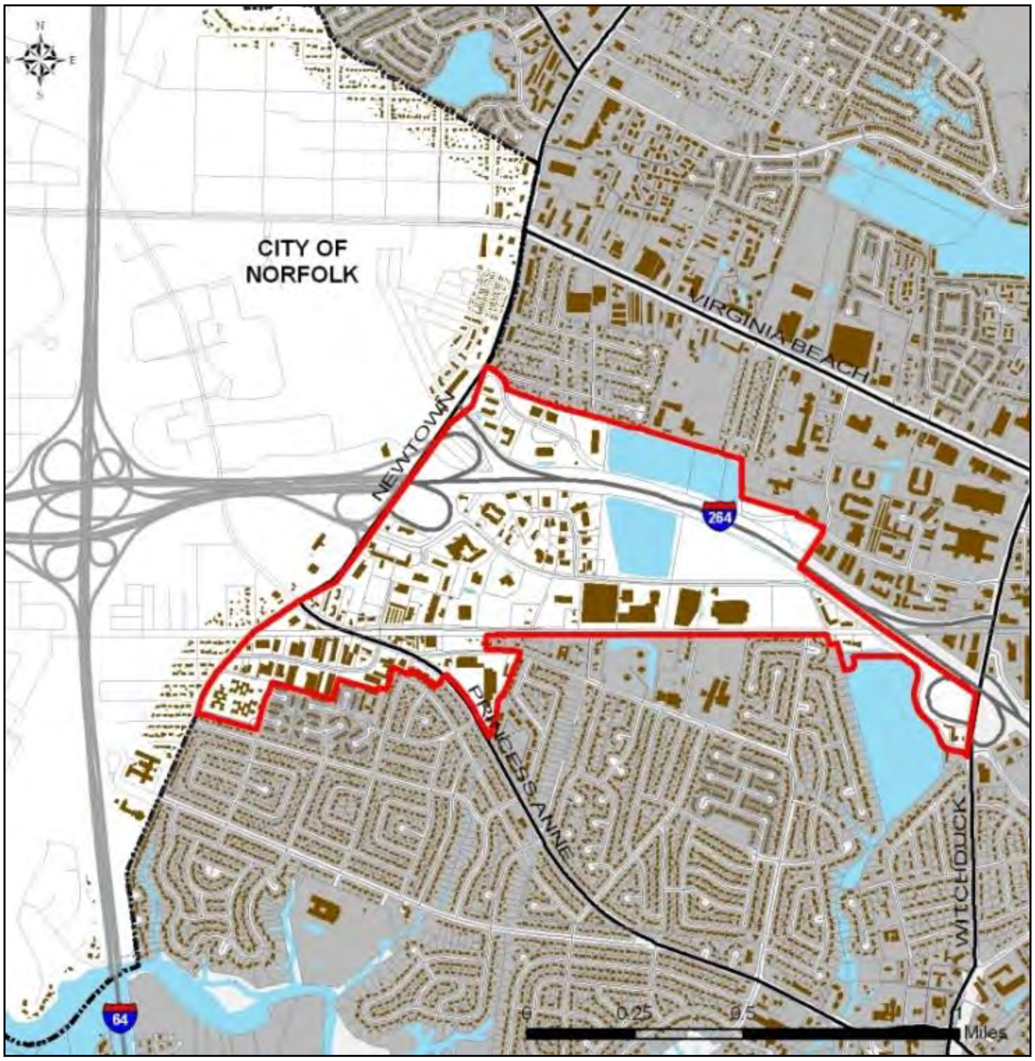
- 2-409000 - Centerville Turnpike – Phase II. This project addresses congestion in the Centerville area. This project is for the construction of a four-lane divided highway within a 130 foot right-of-way from Indian River Road to Kempsville Road, a distance of 1.85 miles. This project will provide improvements at the Indian River Road intersection, including triple left turn lanes onto Indian River Road from Centerville Turnpike. This project will include a four lane divided highway, sidewalk, on-street bicycle facilities, and landscaping.
- 2-093000 – Buses for Virginia Beach Transit Extension. This project funds 12 transit buses to support enhanced public transportation throughout the City in addition to feeding "The Tide" light rail system. With the extension of The Tide, there is a new bus route which will serve the Centerville SGA as it would extend north/south between the new Witchduck Light Rail Station to Greenbrier Mall area by way of Witchduck Road and Kempsville Road.
- 3-047000 – Landfill #2 Phase 1 Capping – The Phase 1 landfill cell is near capacity. Capping of completed landfill cells is required as part of the Virginia Solid Waste Permit #398.

For detailed *Centerville SGA Master Plan* recommendations and information visit the online document library at www.vbgov.com/Planning .



Centerville SGA Master Plan - Conceptual Plan

NEWTOWN STRATEGIC GROWTH AREA



DESCRIPTION

The *Newtown Strategic Growth Area* is a western gateway to the City of Virginia Beach and is bisected by I-264. The future pattern of growth for Newtown and Pembroke are deemed to complement one another. Much of the area is developed with low to mid-rise structures representing a mix of office and light industrial uses of varying quality. There are a number of undeveloped and underdeveloped properties located throughout this SGA. The easternmost transit stop on the Hampton Roads Transit Light Rail system, that serves Norfolk, is immediately west of this SGA. This transit stop is conveniently located for much of the Newtown SGA and will enable the redevelopment of the area as a transit-oriented district.

The Newtown SGA sits at the eastern terminus of the first segment of the region's light rail transit system, The Tide, with service only in Norfolk at present. In a landmark decision in 2015, City Council voted to continue developing plans to extend The Tide to Town Center through the Newtown SGA. Newtown's proximity to Town Center has the potential to echo the Town Center's vibrancy but at an appropriate scale and density adjacent to established residential neighborhoods. Historic Kempsville sits to the south of Newtown and is transforming into a mixed-use Suburban Focus Area that seeks to have a character reminiscent of Colonial Williamsburg, offering small shops and new housing choices.

Intensive road and public space improvements have saddled its main intersection at Witchduck and Princess Anne Roads for a number of years, but private investment has begun as a result of these public investments. The *Newtown SGA Master Plan* was adopted by the City Council on July 6, 2010 and is available in the online document library at www.vbgov.com/Planning .

VISION

The *Newtown SGA Plan* envisions land uses transitioning over time to reflect increased land values achieved by improved access and proximity to the light rail station in Norfolk. A new mixed-use district will emerge with a village center, state of the art business parks, an educational campus, and new residential neighborhoods integrated with workforce housing.

Proposed Southern Boulevard commercial and mixed-use redevelopment concept

SGA DESIGN PRINCIPLES

- Mixed-Use and Commercial Buildings – These buildings are focused around Princess Anne Road and Southern Boulevard, proximate to the transit corridor. These buildings should be placed close to the street to promote a pedestrian environment and range from two to five stories in height.
- Office and Institutional Campus Buildings – The Newtown SGA's location and access make it a premier office and institutional address. The office and institutional buildings that locate here should set a new standard in environmental quality, both in building technology and the indoor and outdoor spaces they create. In many cases, these buildings are located along water or other open space.
- Multi-Family Residential Buildings - With the planned improvements to both vehicular and mass transit options, multi-family housing will be an important component to the spectrum of housing offered. Apartments and condominiums will largely be three and four stories in height.
- Single-Family Residences – Newtown is proximate to many residential neighborhoods. The Plan seeks to stitch these neighborhoods together with additional single-family detached and attached housing.

- Parking Garages – The increased land values coming from the envisioned transit corridor and improvements to I-264 will make structured parking a viable and necessary component to development. These structures should be easy to access but screened architecturally with façade treatments and buildings, where possible.
- Improve pedestrian and trail facilities to connect neighborhoods to future transit and neighborhood centers.

PLAN RECOMMENDATIONS

The following summarizes the general recommendations of the *Newtown SGA Master Plan*:

- Reinforce the Newtown site as a "Gateway" into Virginia Beach.
- Create interconnected pedestrian and street frameworks.
- Build parks and open spaces throughout the site.
- Build mixed-use, mixed-income, transit-oriented development.
- Strengthen education and training institutions in the district.
- Build at a compatible scale next to existing neighborhoods.
- Extend a bicycle and trail system through the site.
- Position light rail station as a centerpiece in a gateway public space.
- Develop a shared parking strategy.
- Coordinate transportation improvements including Light Rail, Newtown Road, the Greenwich/Cleveland Flyover, and I-264 access/widening.
- Develop design guidelines for the district.

PLAN IMPLEMENTATION STRATEGIES

The *Newtown SGA Master Plan* transforms underutilized commercial property into a series of mixed-use development opportunities and public infrastructure improvements. A new street framework and block structure provides the access and visibility necessary to consider redevelopment at higher densities. The old commercial properties will be transformed into a new mixed-use center, state of the art business parks, an educational campus, new light industrial space, and new residential neighborhoods.

Recommended Action Plan

- Revise zoning code to regulate building form and update permitted uses.
- Develop design guidelines for the district.
- Install district directional signs on expressway and other major roads leading into the planning area.
- Install signs or community logo in strategic entry locations in order to develop a distinct sense of arrival to the district.
- Develop a shared parking strategy.
- Prepare an overall drainage master plan.
- Create an interconnected pedestrian, trail and street framework.
- Build parks and open spaces throughout the SGA.
- Improve Newtown Road and Princess Anne Road with sidewalks and lane adjustments.
- Redirect Greenwich Road to a new flyover to connect Cleveland Street north of I-264 and cul-de-sac the remainder of the road at the Lake.
- Extend Business Park Drive to create a loop to improve access to the business park.
- Establish a new street network to form a new mixed-use center.

- Build new residential streets in the old Arrowhead Industrial Park to create new development blocks.

Conceptual perspective of the Newtown SGA lakefront

Since the adoption of the *Newtown SGA Master Plan* City Council has taken two actions in support of light rail which significantly impact the *Newtown SGA Master Plan*:

- Adopted a resolution favoring the extension of light rail 3.2 miles from the Newtown Road Station in Norfolk to Virginia Beach Town Center. The extension would include a new station at Witchduck Road and two stations in the Town Center area – one near Kellam Road and one at Constitution Drive. This is called the Locally Preferred Alternative.
- Adopted a budget that includes plans to extend light rail to Town Center, with plans to double the city's bus service, build a walking-biking trail alongside the light rail, and build over 20 new bus shelters.

Based on these actions, a Transit-Oriented Development (TOD) implementation strategy should be developed through a public process for an implementation focus on development and redevelopment areas within one-half mile of the planned light rail stations.

Programmed and Funded Capital Improvement Projects (CIPs)

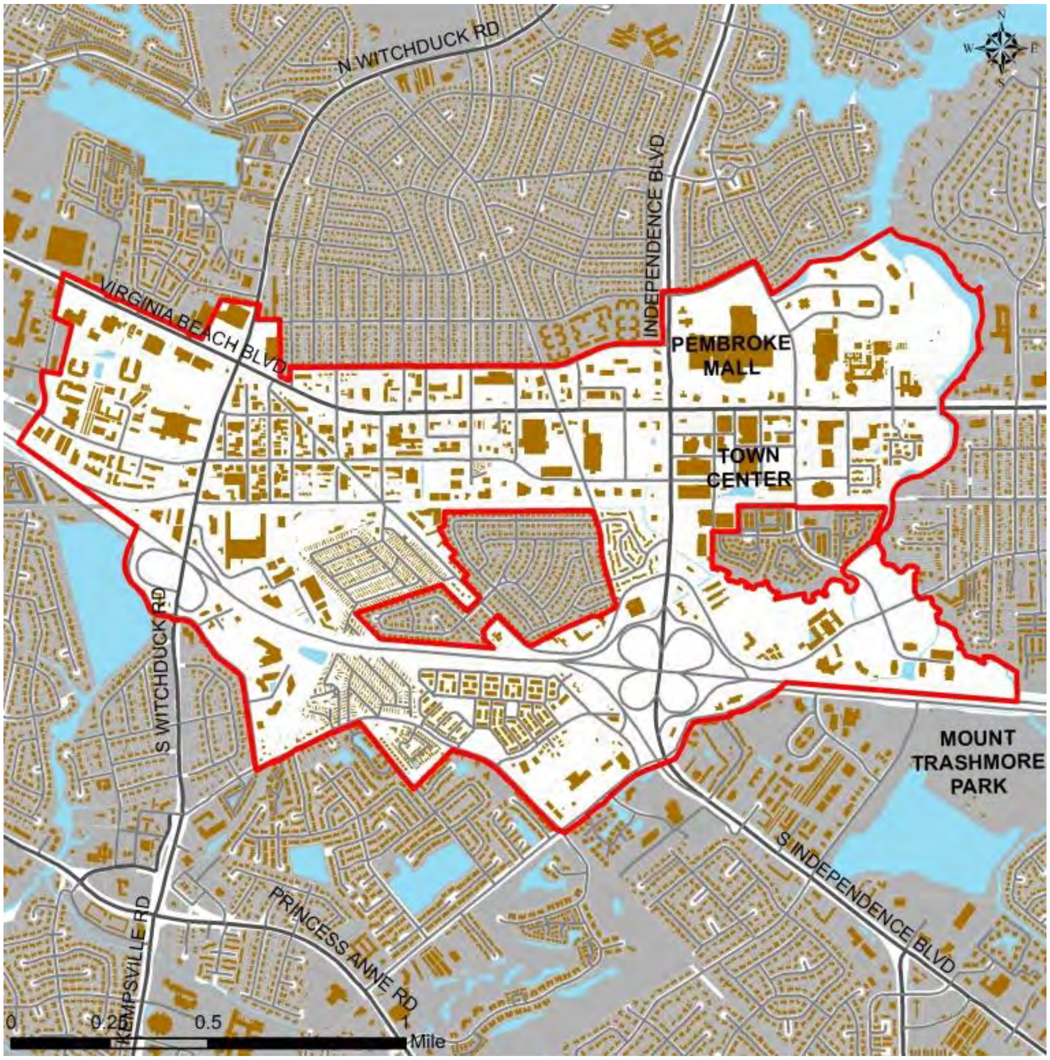
- 9-081000 – Strategic Growth Area Projects – This project will provide planning and design services, build or replace public infrastructure improvements, and acquire property as needed in order to support implementation of the eight SGAs.
- 2-092000 – Virginia Beach Transit Extension Project – This is a design-build project to extend light rail fixed guideway transit, "The Tide," from its terminus at the Newtown Station/Norfolk-Virginia Beach City line, east to Town Center at Constitution Drive.

- 2-093000 – Buses for Virginia Beach Transit Extension – This project funds 12 transit buses to support enhanced public transportation throughout the City in addition to feeding "The Tide" light rail system.
- 2-108000 – Light Rail Corridor Shared Use Pathway – This project will fund the design, construction, right-of-way acquisition and site furnishings required to create a shared-use pathway within and /or along the former Norfolk-Southern right-of-way in conjunction with the light rail extension project to provide additional modes of transportation.

For detailed *Newtown SGA Master Plan* recommendations and information visit the online document library at www.vbgov.com/Planning.

Newtown SGA Master Plan - Conceptual Plan

PEMBROKE STRATEGIC GROWTH AREA



DESCRIPTION

The Pembroke Strategic Growth Area (SGA) is a 1,200 acre tract of land located in the heart of the City, generally bound by Thalia Creek to the east, Jeanne and Broad Streets to the north, Clearfield Avenue to the west and Bonney and Baxter Roads to the south. For the most part, this SGA reflects a classic suburban pattern of development. It includes some residential and institutional uses but is dominated by commercial and industrial uses. An exception is Town Center. This vibrant, mixed-use urban center has established itself as a special destination within Virginia Beach and the larger metropolitan area. It is a well-designed urban center with a complement of office, retail, residential, educational, entertainment, cultural, restaurant, open spaces, and other uses. This SGA is served by Interstate 264 and two major arterial roadways, Virginia Beach Boulevard and Independence Boulevard. An unused rail line passes through extending from the Norfolk city line to the vicinity of the Oceanfront Resort Area.

Pembroke has become the City's "Town Center" providing a much desired sense of place central to the city. In just the past 15 years, an iconic skyline has emerged that offers an exciting new residential, employment, shopping, and entertainment address. The City's oldest shopping mall, Pembroke Mall, has received a facelift, and the Virginia Beach Boulevard corridor that was formerly dominated by the automobile now enables pedestrians to travel safely between the two destinations within Town Center. The arts scene thrives at the Sandler Center, showcasing both celebrity and local talent year-round, and an increasing number of outdoor festivals and events offer free entertainment in every season. The *Pembroke Strategic Growth Area 4 Implementation Plan* was adopted by the City Council on November 10, 2009 and is available in the online document library at www.vbgov.com/Planning.

CBD Bonney Area - Bonney Road development concept

VISION

The vision for the Pembroke SGA 4 is a central urban core with a vertical mix of uses, great streets, mobility and transit alternatives, gathering places, environmental and neighborhood protection, green buildings and infrastructure opportunities providing a variety of civic, commercial, artistic and ethnically diverse areas. The Master Plan describes and provides planning policies for six subareas or districts with each district having its own unique characteristics. These districts include:

- Central Business District (CBD) Core Area – the main business, cultural, and arts center of the Pembroke SGA;
- CBD Bonney Area – a mixed-use office, commercial, residential, and hospitality area to complement the adjacent;
- CBD Waterfront District – located along Thalia Creek combining the surrounding natural environment with recreational and cultural amenities;
- Central Village District – draws from a plethora of activities, interests, and a variety of housing options, all woven into an eclectic neighborhood supporting small business and entertainment venues;
- Western Campus District – a park-like academic and recreational setting that showcases a pedestrian-friendly area; and,

- Southern Corporate District – an urban corporate village defined by unique eye catching office buildings with planned greenways.

This framework concentrates a high density mix of complementary urban uses within a defined central area, creates a skyline for Virginia Beach and provides for decreasing land use densities from the core. Each of these Districts is described in detail in the *Pembroke SGA Master Plan*.

SGA DESIGN PRINCIPLES

- Efficient Use of Land Resources
- Full Use of Urban Services
- Compatible Mix of Uses
- Improve pedestrian and trail facilities to connect neighborhoods to future transit and neighborhood centers
- Transportation Opportunities
- Detailed Human Scale Design
- Environmental Stewardship

Thalia Creek waterfront area promenade concept

PLAN RECOMMENDATIONS

The following summarizes the general recommendations of the *Pembroke SGA Master Plan*:

- Implement transit-oriented development around planned transit stations
- Establish policies for developing affordable housing/workforce housing
- Tailor a Form-Based Code for each district
- Establish a Cultural Arts District in the Core Area
- Expand the Pembroke SGA to include Mount Trashmore Park and the South Independence Commercial corridor

- Design and build the entire length of Cleveland Street to Greenwich Road as a 'Complete Street' to be an attractive and efficient thoroughfare serving many modes of travel
- Develop a public facilities strategy for City-owned lands, considering recreation, library, museum, theatres, education, smaller spaces for visual and performing artists, and other uses

PLAN IMPLEMENTATION STRATEGIES

The Pembroke SGA is located at the major intersection of the primary transportation corridors at a central position of the City's developed area, which presents a unique opportunity for the creation of a world class regional downtown. As the City moves forward and the Pembroke SGA's 1,200 acres continue to redevelop, future planning efforts will need to consider the proposed urban systems on a site-specific level to ensure that the larger goals of the plan will produce a modern metropolitan center.

Western District urban open space concept

Recommended Action Plan

- Implement EMS, fire, and police urban policies and strategies
- Install district directional signs on Expressway and other major roads leading into the planning areas. Install signs or community logo in strategic entry locations in order to develop a distinct sense of arrival to the district.
- Develop a utility framework and urban policies for development of the utilities
- Develop a parking strategy/structured parking
- Develop a public facilities strategy within City owned lands, recreation, and libraries
- Develop an open space/park policy
- Develop an urban plan with Virginia Beach Public Schools for Princess Anne High School
- Build an additional crossing of the I-264 east of the Independence Boulevard interchange at Sentara Way
- Improve Cleveland Street
- Extend Market Street
- Implement the Thalia Creek open space plan – bike paths, walking paths and parks
- Develop designs for Cleveland Street improvements and a connection to Greenwich Road
- Start land acquisitions for City properties to be used as parks and open space
- Pursue the creation of Lynnhaven Landing in coordination with the Lynnhaven Ecosystem Project
- Develop a "Brand Name" for the SGA District

Since the adoption of the *Pembroke SGA 4 Master Plan* City Council has taken actions in support of light rail which significantly impact the *Pembroke SGA Master Plan*:

- Adopted a resolution favoring the extension of light rail 3.2 miles from the Newtown Road Station in Norfolk to Virginia Beach Town Center. The extension would include a new station at Witchduck Road and two stations in the Town Center area – one near Kellam Road and one at Constitution Drive. This is called the Locally Preferred Alternative.
- Adopted the below-listed CIP projects, including the light rail corridor shared-use pathway to provide opportunities for enhanced multi-modal mobility throughout the east-west corridors of the Newtown and Pembroke SGAs as well as nearby established neighborhoods.
- Adopted a budget that includes plans to extend light rail to Town Center, with plans to double the city's bus service, build a walking-biking trail alongside the light rail, and build over 20 new bus shelters.

Based on these actions, a Transit-Oriented Development (TOD) implementation strategy should be developed through a public process for an implementation focus on development and redevelopment areas within one-half mile of the planned light rail stations.

Programmed and Funded Capital Improvement Projects (CIPs)

- 1-107000 - Princess Anne High School Replacement. Originally built in 1954, the high school can no longer adequately house the required instructional programs, and the facility needs replacement.
- 2-025000 – Witchduck Road - Phase II. This project will provide a six-lane divided roadway on a 143-foot to 165-foot variable width right-of-way from I-264 to Virginia Beach Boulevard. The project will include improvements and modifications to Pennsylvania Avenue, Mac Street, Southern Boulevard, Cleveland Street, and Admiral Wright Road at Den Lane. Aesthetic improvements include 16-foot benches comprised of 8-foot wide concrete sidewalks and 8-foot wide brick pavers

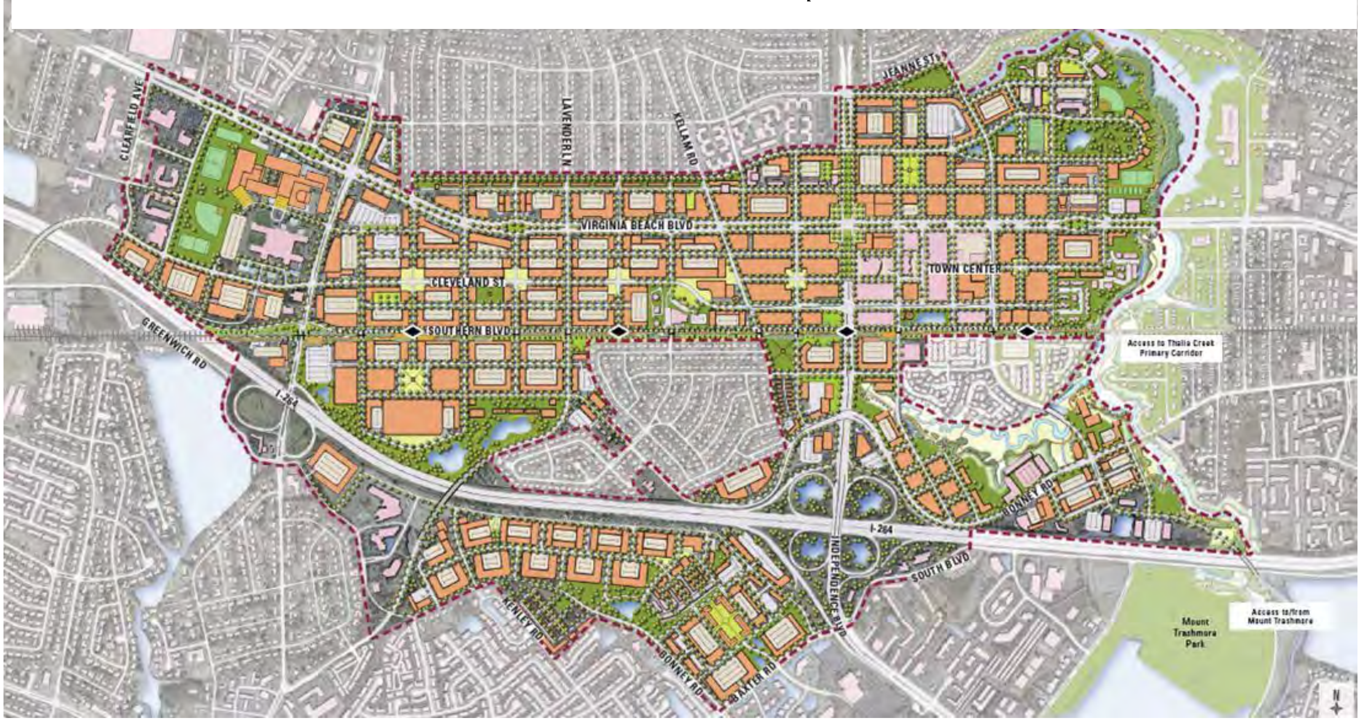
- 2—092000 – Virginia Beach Transit Extension Project. This is a design-build project to extend light rail fixed guideway transit, "The Tide", from its terminus at the Newtown Station/Norfolk-Virginia Beach City line, east to Town Center at Constitution Drive.
- 2-093000 – Buses for Virginia Beach Transit Extension. This project funds 12 transit buses to support enhanced public transportation throughout the City in addition to feeding "The Tide" light rail system. The Constitution Drive Light Rail Station will serve as a major transfer point for both bus transit, park and ride for motor vehicles and on-demand shared transportation (i.e. taxis, Uber, etc.) and pedestrians and bicyclists.
- 2-108000 – Light Rail Corridor Shared Use Pathway. This project will fund the design, construction, right-of-way acquisition and site furnishings required to create a shared-use pathway within and /or along the former Norfolk-Southern right-of-way in conjunction with the light rail extension project to provide additional modes of transportation.
- 2-401000 – Greenwich Rd Crossover & Cleveland St. Improvements. This project is part of the overall eastbound VDOT I-264 interstate improvement projects between I-64 and the Witchduck Rd. interchange. This project will be designed and constructed in three phases.
- 3-503000 – Housing Resource Center. This project is to construct an approximately 62,000 square foot Housing Resource Center that will provide shelter and services to homeless persons and those at risk of homelessness. It will include a central intake and assessment function that will be critical to achieving the goals of the Strategic Plan to End Homelessness.
- 4-079000 – Thalia Creek Greenway I. This project will fund the design and construction of the boardwalk and trail facilities outlined in the greenway corridor of the Thalia Creek Greenway Master Plan. This project is a unique initiative to develop an urban greenway that will provide access to natural open space and recreational activities in the Town Center area, while also providing an alternative transportation route.
- 4-522000 – Thalia Creek Greenway Trail Grant. A master plan for Thalia Creek greenway was completed in April 2007. Phase 1 of the greenway runs from Independence Boulevard around Town Center to Virginia Beach Boulevard with another leg running toward I-264. Phase 1 is divided into four sections 1A, 1B, 1C, and 1D. This project was selected by VDOT to receive Transportation Enhancements Program funds, June 2012. This project is for the construction of a portion of Phase 1A, approximately 1,200 linear feet of paved trail and raised boardwalk to connect from Independence Boulevard to the City-owned property at 4560 Bonney Road.
- 5-028000 – Witchduck Road Phase II Water Improvements. This project provides funds to improve existing water facilities along Witchduck Road from the Cleveland Street intersection to Virginia Beach Boulevard.
- 6-604000 – Witchduck Road Phase II Sewer. This project provides funding to improve existing sewer facilities along Witchduck Road from the I-264 intersection to Virginia Beach Boulevard.
- 9-083000 – Town Center Garage and Plaza Capital Maintenance. This project provides funding necessary for the equipment, capital maintenance, repairs, replacements, improvements, as well as planning, design, and engineering services for the five Town Center garages and the fountain plaza.
- 9-081000 – Strategic Growth Area Projects. This project will provide planning and design services, build or replace public infrastructure improvements, and acquire property as needed in order to support implementation of the eights SGAs.

AGENDA FOR FUTURE ACTION RECOMMENDATIONS: Pembroke SGA 4

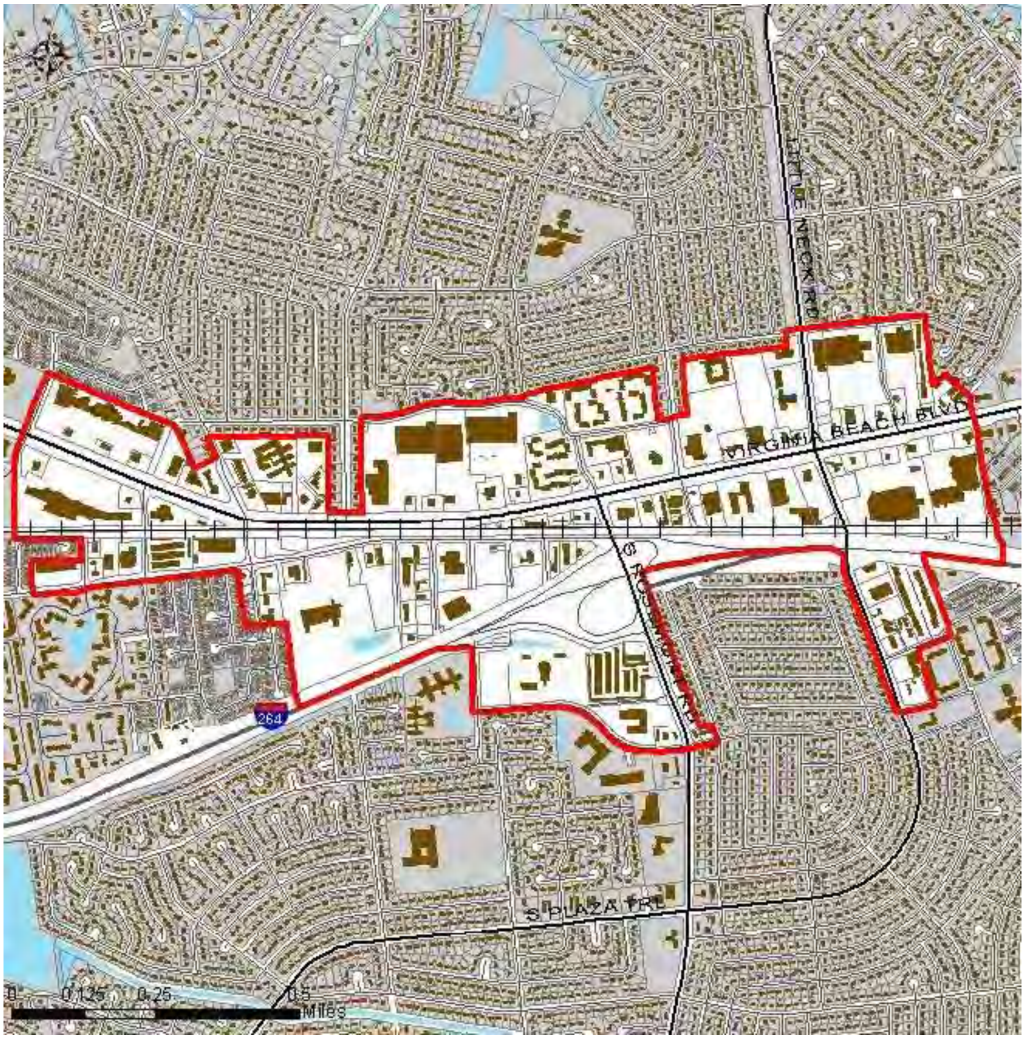
- Prepare a Master Transportation Plan for the Pembroke SGA using a public process that involves the adjacent neighborhoods.

For detailed *Pembroke SGA Master Plan* recommendations and information visit the online document library at www.vbgov.com/Planning.

Pembroke SGA Master Plan - Conceptual Plan



ROSEMONT STRATEGIC GROWTH AREA



DESCRIPTION

The Rosemont Strategic Growth Area is a 158-acre area located in the center of the city, east of the Pembroke SGA along the I-264/Virginia Beach Boulevard corridor. It is defined by a heavily used roadway system that is further complicated by the confluence of a railroad crossing and an interchange ramp system in proximity to one another. The land use of this area is characterized by suburban strip commercial and multifamily residential uses along Virginia Beach Boulevard and generally encompassed by established single family neighborhoods. However, like Newtown, Rosemont's future growth patterns are deemed to compliment the Pembroke land use.

The Rosemont SGA, which lies immediately east of Pembroke SGA and the Town Center is planned to be a transit-oriented residential community for those who desire to live near Town Center but not in it. Transit extension is necessary for this vision to be fully realized, but commercial property owners already see that potential and have begun to make improvements to attract new shoppers and enhance the shopping experience for existing customers. The Rosemont Strategic Growth Area Master Plan was adopted by the City Council on September 13, 2011 and is available in the online document library at www.vbgov.com/Planning.

VISION

The vision for the Rosemont SGA is a mixed-use development with a neighborhood center and improved pedestrian and trail facilities, with a street and block structure created to accommodate development and mobility. The Rosemont SGA will be a leading example of sustainable development practices, integrating high quality well designed workforce housing with guidelines and standards for land use, streets and open spaces.

Rosemont SGA - Neighborhood Center "Village Green"

SGA DESIGN PRINCIPLES

- Transition from strip commercial uses to mixed-use, mixed-income development that emphasizes townhouses and multi-family residential
- Create a new neighborhood center for Rosemont
- Improve pedestrian and trail facilities to connect neighborhoods to future transit and neighborhood centers
- Create a new street and block structure to accommodate development and improve mobility
- Require sustainable development practices
- Develop a set of design guidelines and standards for development of proper land use, streets, open spaces, and stormwater management
- Integrate well designed and high quality workforce housing into mixed-use development

PLAN RECOMMENDATIONS

The following summarizes the general recommendations of the *Rosemont SGA Master Plan*:

- Create an implementable series of private and public projects that can be packaged together to transform, over time, the heart of the city.
- Install district directional signs on Expressway and other major roads leading into the panning area. Install signs or community logo in strategic entry locations in order to develop a distinct sense of arrival to the district.
- Design to a "transit ready" framework that permits adequate scale and density, coupled with successive phasing of public investment to unlock a corresponding return on investment.
- Promote redevelopment through building the Sentara Way fly-over and other new connections within the SGA, supporting potential development, and improvements along South Plaza Trail.
- No industrial uses are recommended for this area.
- Introduce the residential neighborhoods south of Virginia Beach Boulevard by realigning Bonney Road, creating more regular development blocks to allow for higher density development, organized around parking garages and liner buildings.
- Establish criteria to humanize Virginia Beach Boulevard. Along the boulevard will be the new development of a village core, with surrounding lower-density residential neighborhoods to support the commercial uses and transit options that are being introduced.

PLAN IMPLEMENTATION STRATEGIES

With improved connectivity and mobility, the Rosemont SGA will transition from an auto-oriented retail strip to a mixed-use transit-oriented neighborhood center at higher densities. Market potential created by the introduction of transit and human-scaling of infrastructure suggests the idea of commercial development to serve the needs of a growing population, and the introduction of multi-family housing within easy walking distance to transit and neighborhood amenities.

Recommended Action Plan

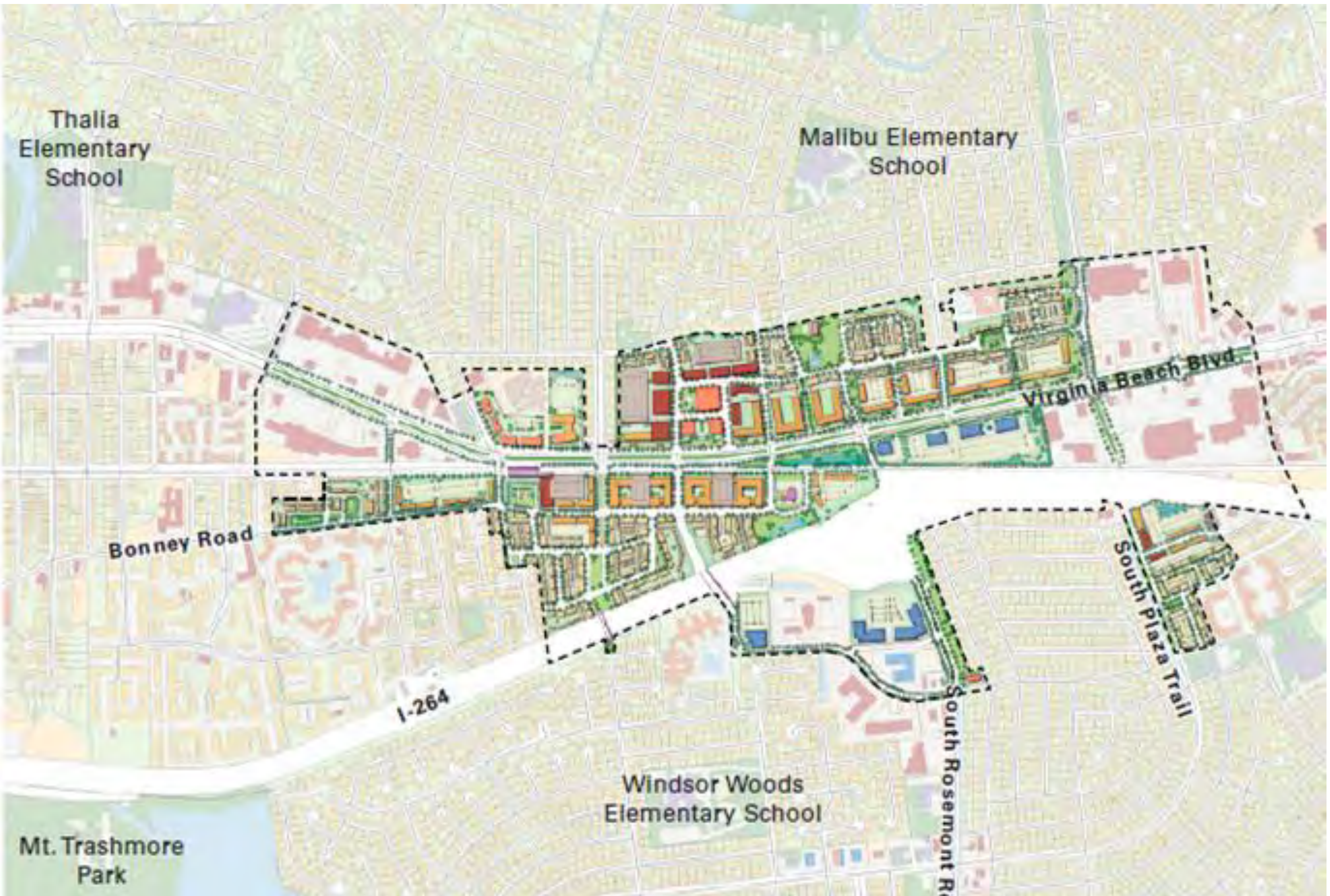
- Update zoning regulations based on the SGA plan recommendations.
- Develop a comprehensive stormwater management strategy.
- Develop a comprehensive open space/park policy strategy.
- Create a set of design standards for arterial and local streets within the SGA.
- Sentara Way Fly Over creates a secondary street and pedestrian network off of Rosemont and Virginia Beach Boulevard connecting Sentara Way south of I-264 to just west of Butternut Lane.
- South Plaza Trail north-south connection under I-264 will align with the rest of the Trail as it continues southbound. Discourages non-local traffic.
- Bonney Road Realignment is an incremental approach to realign Bonney Road to create full development sites between Virginia Beach Boulevard and Bonney Road.
- Rosemont Road Widening widens Rosemont Road from four to six lanes and incorporates sidewalks and on-street bike lanes.
- Virginia Beach Boulevard vision removes the outer lanes to widen for a planting strip and provides a dedicated bike lane.
- Palace Green Pedestrian Bridge
- East-West Trail along the transit corridor
- Thalia Station development
- Incorporate new connections to expand the existing Bikeways and Trail Network.

Future Rosemont Transit Station concept

Programmed and Funded Capital Improvement Projects (CIPs)

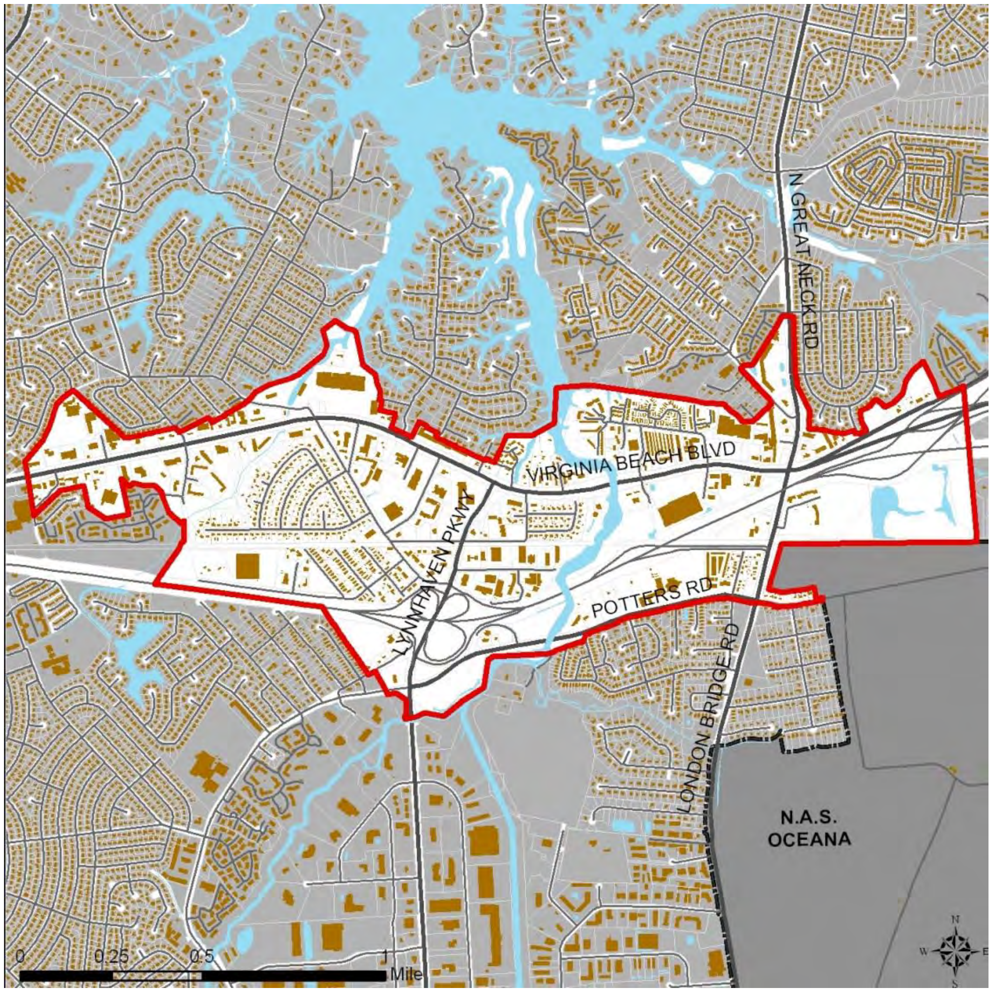
- 2-093000 – Buses for Virginia Beach Transit Extension. This project funds 12 transit buses to support enhanced public transportation throughout the City in addition to feeding "The Tide" light rail system.
- 9-081000 – Strategic Growth Area Projects. This project will provide planning and design services, build or replace public infrastructure improvements, and acquire property as needed in order to support implementation of the eight SGAs.

For detailed *Rosemont SGA Master Plan* recommendations and information visit the online document library at www.vbgov.com/Planning.



Rosemont SGA Master Plan - Conceptual Plan

LYNNHAVEN STRATEGIC GROWTH AREA



DESCRIPTION

The Lynnhaven Strategic Growth Area takes its name and heritage from the Lynnhaven River system that is a major presence throughout. It is generally bound by the Rosemont Strategic Growth Area to the west, the Hilltop Strategic Growth Area to the east, and NAS Oceana to the southeast. The entire area is heavily impacted by AICUZ restrictions associated with flight patterns at NAS Oceana, including noise zones and two accident potential zones. The area is characterized by a good contrast in type, intensity, and quality of land uses. This gateway to the Great Neck peninsula exhibits an excessive number of nonconforming signs, overhead utilities, and roadway access points. Much of this is due to the area being one of the oldest commercial areas in the City, and its retrofit with a modern roadway system has improved function more than appearance.

This SGA is attractive to businesses seeking easy access to transportation and serving the vast residential areas surrounding it. It offers an I-264 interchange, including new on-off ramps to London Bridge Road, three major crossing arterial connections, and a potential future transit stop.
The Lynnhaven SGA has the potential to serve the city as an innovative industrial and service industry zone, while maintaining existing affordable housing for first-time homebuyers and seniors in the established neighborhoods of Eureka Park and Pinewood Gardens. Rediscovering the waterways that meander through the Lynnhaven SGA by orienting our buildings toward them and creating more visual

and public water access points through an extensive public trail system is an underlying design principle. The *Lynnhaven Strategic Growth Area Master Plan* was adopted by the City Council on April 24, 2012 and is available in the online document library at www.vbgov.com/Planning.

VISION

The vision of the Lynnhaven SGA is a series of mixed-use and flexible developments along with targeted public infrastructure improvements. The under-performing commercial properties will have the opportunity to transform themselves into higher intensity uses to, in some cases, take advantage of the potential of transit, and, in other cases, to preserve and provide access to the Lynnhaven River. At the center of the redevelopment may be a new transit station that can provide park-and-ride, connection to nearby office uses, and transfer service to Lynnhaven Mall. The Lynnhaven SGA seeks to capitalize on existing adjacent assets such as the Lynnhaven River/London Bridge Creek system and healthy neighborhoods.

Rail-Trail concept overlooking London Bridge Creek - Lynnhaven SGA

SGA DESIGN PRINCIPLES

- Enable a clear and easy-to-access open space and recreation network
- Capitalize on the value of the water and marshlands
- Meet the Chesapeake Bay Act mandates to protect and restore the Lynnhaven River and its tributaries
- Locate compatible uses that are consistent with the APZ-1/Clear Zone Master Plan, APZ Zones, and AICUZ restrictions
- Strengthen existing neighborhoods through providing community services and convenient retail
- Improve multi-modal connections from the adjacent neighborhoods
- Connect future transit to employment, recreational destination, and park-and-ride
- Enable flexible development sites and building types to respond to ever-changing market needs and development programs
- Coordinate transportation planning and development

- Build on the existing good balance between homes, jobs, and services

PLAN RECOMMENDATIONS

The following summarizes the general recommendations of the *Lynnhaven SGA Master Plan*, which calls for six new distinct areas, each with its own quality and character of development:

- Non-Residential Mixed-Use Development Area located between Virginia Beach Boulevard and interstate 264. This area is a prime location for a range of non-residential uses. New development blocks created to accommodate new office development in an urban, pedestrian friendly neighborhood center with supporting retail. This district is well positioned as a transit-ready development.
- Innovation Zone Development Area provides opportunities for small start-up businesses and technology innovation in two areas in this SGA. The first zone along Dean Drive is a small complex of buildings that can accommodate a flexible range of working spaces and can house a variety of existing uses, to provide development opportunities for small start-up businesses and technology innovation.
- Riverfront Development Area showcases the Lynnhaven River/London Bridge Creek system as a major natural amenity that can create addresses for office space with spectacular views and allow commercial uses to capitalize on outdoor space. Turning development sites towards the river and the open space allows existing sites to better capitalize on the amenity, create new development opportunities, and organize the way redevelopment evolves.
- Residential Development Area utilizes small pockets of existing residential zoning that emerged as potential redevelopment sites with equal or lesser residential density than what currently exists on site. This new residential development may be lined with a mix of town houses and smaller multi-family buildings at a scale appropriate to adjacent residential.
- Lifestyle Center Development Area orients buildings to face along a secondary road network and central green space to better provide for a safe, accessible retail address. The central green space is the ideal place for passive recreation, outdoor café seating, and for visitors to congregate while shopping.
- Highway-Oriented Retail Development Area orients small retail buildings or office buildings with parking in the rear of lots along Virginia Beach Boulevard to provide a desirable scaled street frontage, while remaining easily accessible and visible to traffic along the boulevard.

Transit-oriented non-residential, mixed use district concept for Lynnhaven SGA

PLAN IMPLEMENTATION STRATEGIES

The Lynnhaven SGA Plan recognizes that, with public improvements in transit, local street networks, and open space, private property owners have an increased range of opportunities for development and utilization of their land to create new mixed-use districts.

Recommended Action Plan

- Update zoning regulations based on the SGA plan recommendations.
- Develop a comprehensive stormwater management strategy.
- Develop a comprehensive open space/park policy strategy.
- Develop an implementation strategy for access improvements and open space restoration along the Lynnhaven River and its tributaries.
- Implement the following key infrastructure improvements: Lynnhaven Parkway/I-264 Interchange Improvements; Norfolk Southern Trail; Potter's Road Bridge Restoration; Wesley Drive; Redevelopment; Transit Station and Park & Ride Lot; Virginia Beach Boulevard Improvements; North Lynnhaven Road Improvements; Southern Boulevard Improvements; London Bridge Improvements; Great Neck Road Improvements; Potters Road Improvements; Dean Drive Improvements; Lynnhaven Parkway Twin Bridges; and Virginia Beach Boulevard Bridge.
- Prepare a corridor plan for Virginia Beach Boulevard from Newtown Road to First Colonial Road

Programmed and Funded Capital Improvement Projects (CIPs)

- 2-093000 – Buses for Virginia Beach Transit Extension – This project funds 12 transit buses to support enhanced public transportation throughout the City in addition to feeding "The Tide" light rail system.
- 9-081000 – Strategic Growth Area Projects – This project will provide planning and design services, build or replace public infrastructure improvements, and acquire property as needed in order to support implementation of the eight SGAs.

For detailed Lynnhaven SGA Master Plan recommendations and information visit the online document library at www.vbgov.com/Planning.

Lynnhaven SGA Master Plan - Conceptual Plan

HILLTOP STRATEGIC GROWTH AREA

DESCRIPTION

Hilltop Strategic Growth Area (SGA) is home to a wealth of local businesses with a variety of retail, restaurant, office, health, and recreational uses. The SGA is generally bound by a diverse mix of retail located north of Laskin Road, the Lynnhaven Strategic Growth Area to the west, and Linkhorn Bay to the east, and Potters Road to the south.

Although this area is located within a high noise zone, it is a good candidate for redevelopment and reinvestment because of its existing commercial strength and its proximity to the Oceanfront Resort Area, NAS Oceana, and I-264 interchange. The area south of I-264 is subject to greater AICUZ restrictions due to the presence of accident potential zones and the clear zone.

The long-range vision for Hilltop SGA, which is already a regional retail destination featuring home-grown restaurants, a plethora of grocery stores, and a variety of shops, builds on the area's strengths, yet introduces more greenspace. Doing so through redevelopment opportunities can address stormwater management needs and, in turn, create a healthier environment and shopping/dining experience that welcomes more people out of their cars and outdoors as they move from place to place within the SGA. Industrial and commercial uses compatible with being in a military aircraft high noise zone have been relocated into this SGA through the City's YesOceana Program at its southern end. The historic neighborhood of Oceana Gardens, which has a concentration of early 20th Century Sears Kit Homes, is evolving with a new residential lot and density pattern that is more compatible with being located in a military aircraft Accident Potential Zone and high noise zone, while still trying to retain its character. The Hilltop Strategic Growth Area Master Plan was adopted by the City Council on August 28, 2012 and is available in the online document library at www.vbgov.com/Planning.

VISION

The vision for the Hilltop SGA expands the develop opportunities of many of the local businesses by transforming land areas devoted to parking and under-utilized commercial property into a mix of retail and office opportunities. Targeted public infrastructure improvements and enhanced transit service will help evolve the Hilltop SGA as a convenient, regional retail destination that's within close proximity to the beach.

Hilltop Shopping Center infill development concept

SGA DESIGN PRINCIPLES

- Build a network of streets to improve traffic flow
- Provide trails and sidewalks for pedestrians and cyclists
- Provide a mix of retail, restaurants, and office uses
- Build on existing healthcare, food and adjacent recreational assets
- Match quality of local businesses with an equally memorable built setting
- Provide additional transit connections to Hilltop
- Comply with AICUZ land use zoning requirements
- Reduce land areas devoted to parking and replace with more productive uses
- Revisit and update old plans for roads and infrastructure
- Incorporate an Urban Tree Canopy Program

PLAN RECOMMENDATIONS

The *Hilltop SGA Master Plan* represents a unique opportunity to enhance an established retail market area with a distinct identity within the City. With improved streets will be sidewalks, crosswalks, landscaping and lighting that will transform Hilltop into a walkable district. Over time, existing retail buildings will be replaced with new retail buildings built facing the new streets. The suburban pattern of highways lined with parking lots and strip centers will gradually give way to a new pedestrian friendly mixed-use district. The following summarizes the key recommendations of the *Hilltop SGA Master Plan*:

- Incorporate an Urban Tree Canopy Program within the Hilltop SGA to create a pedestrian environment and aid stormwater management.
- Define a clear hierarchy of streets to establish a structure of development blocks and reconnect places. Major street improvements should support urban, walkable environments that are positioned to service growth.
- Build upon the existing natural resources to expand access to public open space through an interconnected system of parks and trails.
- Evaluate repositioning the proposed transit station to the core of the Hilltop SGA with street and trail improvements to promote transit-oriented economic development.
- Encourage redevelopment of obsolete commercial structures with new buildings placed according to new urban planning standards for the district.

PLAN IMPLEMENTATION STRATEGIES

The *Hilltop SGA Master Plan* transitions under-utilized commercial property into a transit-ready retail and office mixed-use urban environment by building a network of streets to improve traffic flow, trails and sidewalks for pedestrians and cyclists, and matching the quality of local business with an equally memorable setting.

Recommended Action Plan

- Update zoning regulations based on the SGA Plan recommendations.
- Consider tools for redevelopment such as those identified in the "Guidelines for Evaluation of Investment Partnerships for Economic Development" Policy. For information about this policy visit www.vbgov.com/government/departments/sga/Pages/default.aspx.
- Develop a comprehensive stormwater management strategy.
- Update the Sanitary Sewer Master Plan based on projected future densities to adequately serve the redeveloped Hilltop SGA.
- Develop a district parking strategy for Hilltop and introduce structured parking through public/private ventures in order to increase open space and tree canopy throughout SGA.
- Build upon existing natural resources by creating a new parks and open space network
- Implement the following key infrastructure improvements to establish a structure of development blocks and reconnect places: Laskin Road Redesign and Implementation to eliminate frontage roads and improve traffic flow and safety; First Colonial Road – six through lanes with consolidated turn lane and median with on street bike lanes; Virginia Beach Boulevard - redesign to an urban pedestrian friendly environment; Republic Road – incorporate pedestrian accommodations and on-street parking; Nevan Road – four through lanes with on-street bike lanes and improved pedestrian accommodations; and Donna Drive – two through lanes with on-street bike lanes and improved pedestrian accommodations.
- Introduce a transit station and transit park in Hilltop as part of a new citywide transit system and open space network.
- District streetscaping improvements to include landscaping, trees, lighting, trails, sidewalks, crosswalks, and way finding signage

Improved Laskin Road - First Colonial Road intersection with transit station concept

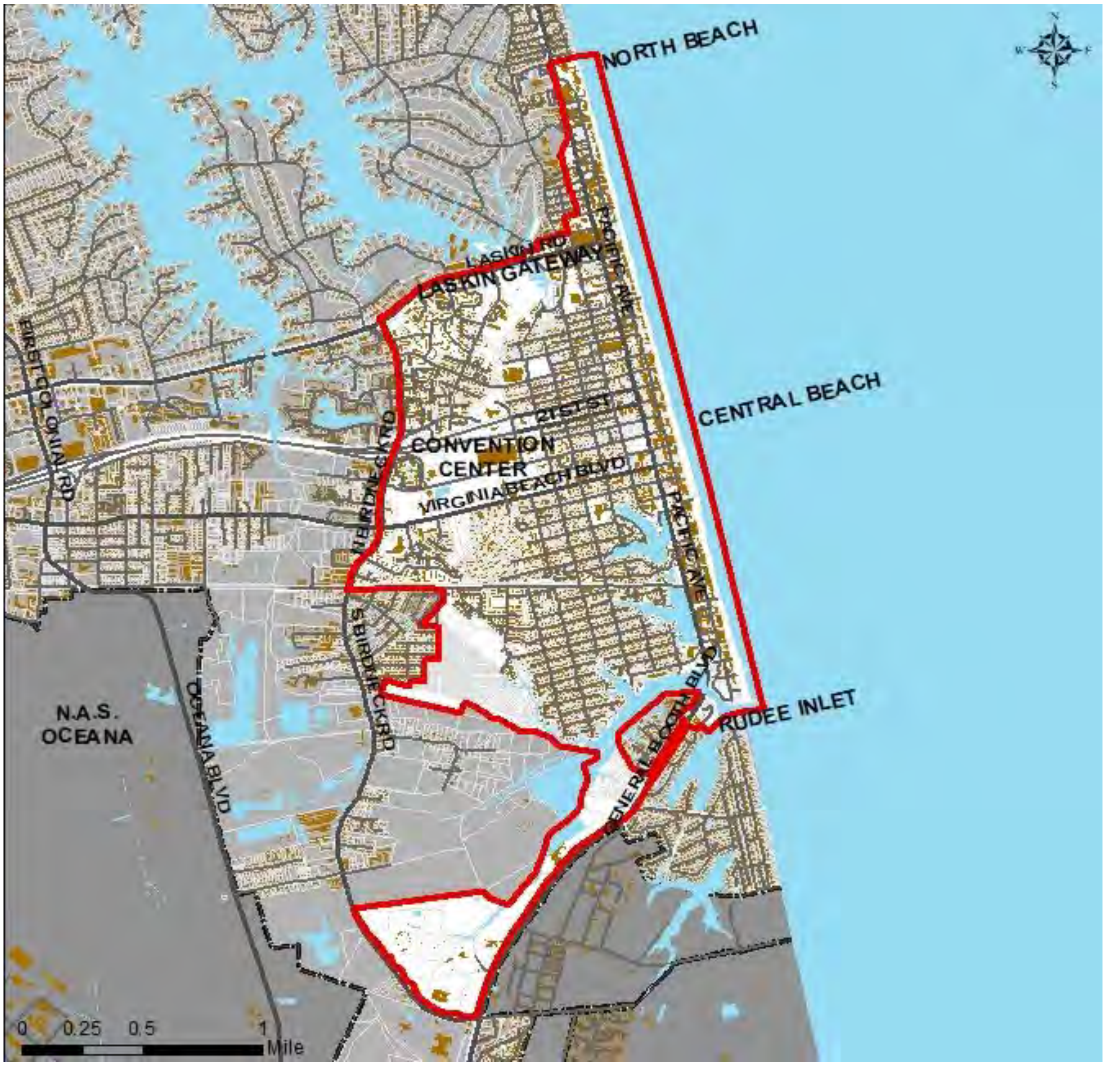
Programmed and Funded Capital Improvement Projects (CIPS)

- 2-093000 – Buses for Virginia Beach Transit Extension – This project funds 12 transit buses to support enhanced public transportation throughout the City in addition to feeding "The Tide" light rail system.
- 9-081000 – Strategic Growth Area Projects – This project will provide planning and design services, build or replace public infrastructure improvements, and acquire property as needed in order to support implementation of the eight SGAs.

For detailed *Hilltop SGA Master Plan* recommendations and information visit the online document library at www.vbgov.com/Planning.

Hilltop SGA Master Plan - Conceptual Plan

RESORT STRATEGIC GROWTH AREA



DESCRIPTION

The Resort area is generally bound by 42nd Street, the Atlantic Ocean, Rudee Inlet, General Booth Boulevard to the Virginia Aquarium and Owl's Creek Area, and Birdneck Road. Revitalization efforts have transformed the Resort area into a major activity center, with strengthened neighborhoods, and increased economic growth.

The Resort Area SGA has received much capital investment in streetscape and utilities improvements, including Rudee Walk, Pacific Avenue, and a new public parking structure on 25th St. An innovative, flexible Form-Based Code is enabling new private development that provides a variety of housing types and a greater range of year-round retail and entertainment for both residents and visitors alike. An arts community has emerged in the Resort's Central Beach District, called the Vibe Creative District and, as a result, more opportunities and choices are enabled in creative expression. The *Resort Area Strategic Action Plan* 2030 was adopted by the City Council on June 2, 2020 and is available in the online document library at www.vbgov.com/Planning.

VISION

With a vision supported by the community, the Virginia Beach *Resort Area Strategic Action Plan (RASAP)* 2030 identifies the potential for four distinct, yet complementary, districts/corridors at Laskin Gateway, Central Beach, Marina, and Oceanfront (Atlantic and Pacific Avenues). The plan is a vision for enhancing the area by extending the energy at the beach into these areas. This plan develops synergies between the cultural and commercial life, the recreational and natural life, and an overall focus on drawing residents and visitors into the area.

2030 VISION

- Create a unique sense of arrival
- Provide safe and comfortable places for residents and visitors
- Retain the feel of an oceanside resort with a sense of community
- Preserve the feeling of Virginia Beach identity, culture, and history through art and design
- Provide a simultaneous sense of calm and renewed energy for residents and visitors
- Address sea level rise and coastal resilience
- Rehabilitate and preserve historic structures and properties

Future 17th Street Corridor Concept

PLAN RECOMMENDATIONS

The Resort Area Strategic Plan 2030 boundary includes multiple sub-districts. Each of these districts has its own distinct character which, through additional placemaking efforts, will be a key to a diverse resort area that has something for everyone to enjoy year-round.

- *Central Beach* encompasses the 21st Street Gateway, the ViBe Creative District, the Virginia Museum of Contemporary Art (MOCA) and 19th Street, which is planned to be a key multimodal corridor.

- *Marina* showcases the working waterfront. There is great opportunity for mixed-use redevelopment that includes hotels, retail, restaurants, business and residential uses that are compatible with the adjacent Seatack and Shadowlawn neighborhoods. All development should be connected with a public walk that offers recreational connections to Rudee Inlet and is integrated with future flood gates and barriers.

- *Laskin Gateway* is a key connection point for North End businesses and neighborhoods and the Hilltop commercial area to the west. Linkhorn Bay is a beautiful tidal backdrop to this gateway.

- *Oceanfront Corridor* includes Atlantic and Pacific avenues. This is the main north-south connector in the Resort Area and is where the majority of visitors stay and gather. This corridor welcomes the millions of people to Virginia Beach and must be a beautiful and inviting place for pedestrians to shop and dine, as well as carry a significant amount of traffic. A mobility plan and streetscape improvements are needed to accomplish these goals.

PLAN IMPLEMENTATION STRATEGIES

- Recognize the all elements of the Resort Area are connected and should be connected
- Provide the highest quality spaces and experiences for locals and visitor to achieve a "Year Round Resort"
- Create great districts with distinctive character through placemaking
- Comprehensively address mobility
- Promote environmental stewardship
- Develop passive green/open spaces that connect inland neighborhoods to the oceanfront
- Improve existing connector parks by adding new amenities such as event and performance spaces, bathrooms and day-use showers
- Establish a committee to oversee the design of proposed gateways
- Preserve historic properties and the history of the Resort area through adaptive reuse projects
- New residential should be located west of Atlantic Avenue

Recommended Action Plan

- Adopt the best practices of a Central Management Entity
- Develop a comprehensive Mobility Plan
- Design and implement Streetscape Improvements
- Enhance and develop connected Green/Open Spaces
- Design and construct a Gateway at 21st Street that provides a sense of welcome and arrival
- Support Impact Projects that benefit the Resort Area and the City of Virginia Beach
- Support Residential and Mixed-use Developments in the Resort Area

Programmed and Funded Capital Improvement Projects (CIP's)

- 2-138000 – Atlantic Avenue reconfiguration. This project will reconfigure Atlantic Avenue from 40th Street to Pacific Avenue, removing the Atlantic Avenue/Pacific Avenue intersection and providing a cul-de-sac of Atlantic Avenue at the Cavalier property. The project includes new left turn lanes and two new traffic signals.
- 2-154000 – General Booth Boulevard/Camp Pendleton Intersection Improvements.
- 2-156000 – Laskin Road Phase 1-B (VDOT). This project is for construction of an eight-lane divided highway, including bike path and sidewalk, from Republic to Winwood Drive, and a six-lane divided highway from Winwood Drive to South Oriole Road.
- 2-165000 – Laskin Road Phase II. This project is for construction of a six-lane divided highway with a bikeway from the eastern terminus of Laskin Road Phase I (Oriole Drive) to the 30th/31st Street split. A transportation corridor analysis is included along with undergrounding of utilities.
- 3-028000 – Aquarium Marsh Pavilion Enhancements. This project will enhance the Aquarium Marsh Pavilion and include the creation of exhibit play area for children, renovation of the existing exhibit areas, modifications to the trail to the outdoor theatre, a more welcoming entrance, landscape enhancements, visitor amenities such as the small café, and refurbishment of the Pavilion's gif store, support areas and theatre.
- 3-074000 – Aquarium Marsh Pavilion Phase II (Veterinary Care Center). This project will support the existing Virginia Aquarium by adding an entirely new building, a Vet Clinic, to the side of the existing Marsh Pavilion.
- 3-161000 – Aquarium Seal Exhibit. This project funds the studies related to architectural and engineering needs of the Virginia Aquarium's seal exhibit and improvements to the front entrance.
- 3-162000 – Veterans Memorial Sustainment. This project will provide funding necessary to address identified and discussed maintenance issues and deficiencies.
- 3-171000 – Virginia Aquarium Enhancement Study. This project funds the study related to the architectural and engineering needs of the Virginia Aquarium Imax theatre.

- 3-518000 – Convention Center Capital Maintenance. This project provides funding for capital replacements of vital infrastructure for the Virginia Beach Convention Center.
- 3-519000 – Chesapeake Bay Aquarium Renovation. This project is to refurbish, repair, and/or replace the aquarium systems that make up the Chesapeake Bay aquarium.
- 3-610000 – Police Oceanfront cameras. The Virginia Beach Police Department is seeking to replace and expand the security camera system at the oceanfront and increase the number of cameras and video management capabilities provided.
- 4-041000 – Owl Creek Municipal Tennis Center Repairs and Renovations. This project funds capital equipment replacements for the Owl Creek Tennis Center and infrastructure repairs and replacements as required.
- 5-101000 – ViBe District Water Improvements. This project provides funding for the replacement of aging water lines within the ViBe District on 17th, 18th, and 19th Streets between Cypress Avenue and Pacific Avenue.
- 5-207000 – Laskin Road Water Improvements Phase I- This project provides funding to improve the existing water distribution facilities on Laskin Road from Republic Road to Oriole Drive, and along portions of First Colonial Road.
- 5-708000 – Resort Area Neighborhood Revitalization. This project provides funding for the design and construction of water mains within the oceanfront resort neighborhoods of Old Beach, Lakewood, and Shadowlawn.
- 6-019000 – Resort Area Neighborhood Revitalization. This project provides funding for the design and construction of gravity sewer within the oceanfront resort area neighborhoods of Old Beach, Lakewood, and Shadowlawn.
- 6-075000 – Laskin Road Sewer Improvements Phase I (VDOT). This project provides funding to improve existing sewer facilities on Laskin Road, from Republic Road to Oriole Drive, and along portions of First Colonial Road.
- 6-101000 – ViBe District Sewer Improvements. This project provides funding for the replacement of aging sewer lines within the ViBe District on 17th, 18th and 19th Streets between Cypress Avenue and Pacific Avenue.
- 7-005000 – North Lake Holly Watershed – This project will provide for the study, design, and construction of an adequate drainage system to serve the Beach Borough neighborhoods which generally lie with the area bounded by Virginia Beach Boulevard, Parks Avenue, Norfolk Avenue, and Pacific Avenue.
- 7-016000 – South Lake Holly Watershed – This project will provide for the study, design, and construction on an adequate drainage system to serve the Beach Borough neighborhoods, which generally lie with the area bounded by Norfolk Avenue, Rudee Avenue, Pacific Avenue, and Rudee Inlet.
- 7-041000 – Central Resort District Drainage Improvements. This project will provide for the study design, and construction of storm drain improvements to address drainage in adequacies in the Northwest Dome Sub watershed, the Southeast Dome Sub watershed, the Virginia Beach Convention Center Sub watershed, and the 2nd Precinct Sub watershed.
- 7-054000 – Lynnhaven River Watershed II. This project is for the implementation of water quality improvement projects and programs within the Lynnhaven River Watershed.
- 7-059000 – Lynnhaven River Basin Ecosystem Restoration Project. This project is intended to restore approximately 38 acres of wetlands, 94 acres of submerged aquatic vegetation, and 31 acres of reef habitat within the Lynnhaven River.
- 7-064000 – Central Resort District – 24th Street Culvert. This project is for property acquisition and construction of stormwater and roadway improvements at three existing culverts.
- 7-072000 – Lynnhaven River Watershed Stormwater Projects. This project will identify and prioritize smaller stormwater management projects in the Lynnhaven River Watershed.
- 9-039000 – 17th Street Improvements II. This project provides funding to improve 17th Street from Cypress Avenue to Birdneck Road and provides a rehabilitated streetscape through the

undergrounding of overhead utilities, traffic safety improvements, better bicycle and pedestrian accommodations, utility and stormwater upgrades, and aesthetic improvements such as street trees and pedestrian lights.

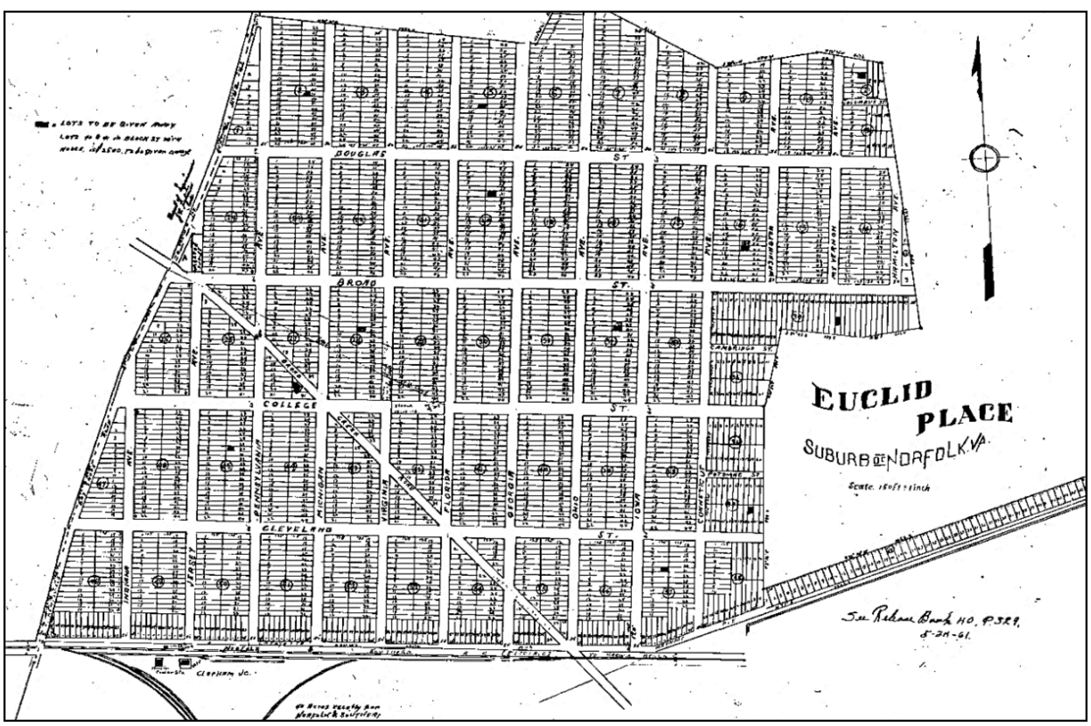
- 9-045000 – Central Beach and Convention Districts Parking. This project provides funding for public parking spaces in the Convention Center District and the Central Beach District between 14th and 23rd Streets and Atlantic Avenue and Birdneck Road.
- 9-050000 – Dome Site Streetscapes. This project will fund streetscape improvements to support the development of the former Dome site into a mixed-use, high density development including space for residence, offices, retail, restaurants, a surf park, an entertainment venue, and parking.
- 9-053000 – Dome Site Entertainment Venue. This project will fund the construction of an entertainment venue as part of the redevelopment of the former Dome site.
- 9-056000 – Oceanfront Parking Facilities Capital Maintenance/Development II. This project provides funding necessary for the acquisition, development, equipment, capital maintenance, repairs, rehabilitation, improvements, design, planning and engineering services for the Oceanfront, Resort, and Sandbridge parking garages and parking lots.
- 9-063000 – 17th St. Improvements II. This provides funding to improve 17th Street from Cypress Avenue to Birdneck Road and provides a rehabilitated streetscape through the undergrounding of overhead utilities, traffic safety improvements, better bicycle and pedestrian accommodations, utility and stormwater upgrades, and aesthetic improvements.
- 9-065000 – Dome Site Parking. This project provides funding for public parking spaces at the former Dome Site.
- 9-069000 – 19th Street Corridor Improvements. This project provides ongoing funding to reinvest in various high impact capital projects at the oceanfront.
- 9-100000 19th Street Infrastructure Improvements. This project provides for streetscape improvements including wider sidewalks, street trees, and undergrounding of overhead utilities; a new street section; and associated stormwater and traffic improvements.

1.3 - SUBURBAN AREA

INTRODUCTION

Much of the area located north of the Green Line possesses a suburban land use pattern, meaning the area primarily consists of low- to medium-density residential land use with commercial retail, office, and service uses interspersed throughout the area. This land use pattern is the result of more than a century of the development of communities created by subdividing all or portions of the farms that defined Princess Anne County (now the City of Virginia Beach) since the 17th century. The earliest subdivisions were established in the late-19th and early-20th centuries, located adjacent to the railroad line that connected the City of Norfolk to the Town of Virginia Beach. Since the automobile was largely a novelty during these years, movement outside of the urban core cities of Norfolk and Portsmouth was either via the railroad or a poorly maintained roadway system using horse and wagon. The railroad line offered developers the opportunity to establish communities outside the urban core of Norfolk for those who desired to choose a lifestyle less intense than that of Norfolk. This trend of creating communities outside the urban core cities occurred not only here, but throughout the United States, and England as well. Eventually, the area outside the core urban cities was designated as being 'suburban.'

Vestiges of the early suburban communities in Virginia Beach can be seen in the existing street layout of Pembroke, south of Virginia Beach Boulevard, which were established as Euclid Place (1910) and Sunny Brook (1916). Other early suburban communities located on the railroad line still partially exist as Thalia Village (1893), Rosemont (1902), Lynnhaven (1895), and Oceana Gardens (1906). The same type of early suburban development occurred along the railroad line between Norfolk and Cape Henry where suburban subdivisions such as Ocean Park (1916) were established.
The development of the city's Suburban Area began in earnest during the 1950s after the Second



1910 Subdivision Plan for Euclid Place

World War. It was this initial phase of suburban development that placed the automobile at the core of the design of the Suburban Area. Instead of the small rectangular lots of the early part of the 20th century, lots were of various shapes, larger, and served by a system of local, collector, and arterial roadways. Development slowly increased during the 1960s, followed by exponential increases during the 1970s and 1980s, during which Virginia Beach was one of the fastest growing cities in the United States.

Characteristic Suburban Area Land Use Pattern

Movement through the area and to destinations outside the area is heavily dependent on the automobile, which in turn is dependent on a network of roadways that has traditionally been designed to move automobiles from one place to another in the fastest and safest manner. The Master Transportation Plan (Chapter 2, Section 2.1) describes this transportation system in detail, explains the issues we face, and provides recommended policies and capital improvements to create a system that, over time, will reduce our dependence on the automobile.

The need to diversify the means by which we move through the Suburban Area and, thereby, reduce our dependence on the automobile, combined with a reduction in the number of acres of land available for new development, has increased the importance of our Strategic Growth Areas, as explained in Section 1.2 – Urban Areas. Accordingly, portions of the City's Suburban Area are undergoing a transformation to an urban land use pattern, guided by the master plans for eight Strategic Growth Areas as well as the policies and guiding principles for the City's Urban Areas, as presented in Section 1.2.

The guiding planning principles for the Suburban Area recognize this transformation as part of a maturing city, offering new types of land use and lifestyle choices. These guiding principles also emphasize the importance of the 'edges' or boundaries where the land use intensity and density of the Suburban Area transitions to that of the Urban Areas. Equally, the guiding principles for the Suburban Area recognize the city's original rural land use pattern and lifestyle by ensuring that development along the southern edge of the Suburban Area has a lower density and intensity and possesses site and building designs that ensure an appropriate change from the Suburban Area to Princess Anne Commons and the Transition Area, and ultimately, to the Rural Area. The guiding principles presented below work in concert with this Plan's guiding principles for the Urban and Rural Areas, as well as Princess Anne Commons and the Transition Area, to ensure that the diversification in land use and lifestyle choices is acknowledged, while also ensuring the Suburban Area continues to be an area of stability, sustainability, and quality.

GUIDING PRINCIPLES FOR THE SUBURBAN AREA

- Create and maintain neighborhood stability and sustainability – create "Great Neighborhoods."
- Protect and enhance natural open spaces and places and buildings of cultural and historic significance and integrate into development as appropriate.
- Create and maintain a transportation system that provides connectivity and enhances mobility regardless of transportation mode.

GUIDING PLANNING PRINCIPLES

Three guiding planning principles have been established to guard against possible threats to the stability of Suburban Area and to provide a framework for neighborhoods and places that are increasingly vibrant and distinctive. This is accomplished by providing planning guidance that ensures appropriate and sustainable use of land, the protection of natural and designed open spaces as well as places and buildings or cultural and historic significance, and the provisions of utilities, transportation, and services adequate to meet existing and future needs.

Create and Maintain Neighborhood Stability and Sustainability – create "Great Neighborhoods"

"Neighborhoods" may be defined as a cohesive arrangement of properties, structures, streets, and uses, within an area most or all of which is residential, that shares distinct physical, social, and economic characteristics.

Creating and maintaining a stable and sustainable neighborhood is difficult. We are fortunate, however, that the majority of the neighborhoods in the City of Virginia Beach are stable, even though much of the city's housing is aging, some in excess of 50 years of age. The majority of the city's neighborhoods also possess a high degree of social connectivity and civic activism, which are vital for maintaining stability.

Our primary guiding principle for the Suburban Area is to create "Great Neighborhoods," and to support those neighborhoods with complementary non-residential uses in such a way that working together the stability and sustainability of the Suburban Area is ensured for now and the future.

To achieve this objective, the following are to be sought in the development of new residential areas and used in the assessment of their compatibility with surrounding areas:


Stable suburban neighborhood

- Careful mix of land uses that contributes to the day-today life of our residents
- Site and building design that is visually interesting, encourages greater social interaction, and provides a memorable character
- Compatible infill development
- Accommodate multiple modes of transportation (e.g., pedestrians, bicyclists, and drivers)
- Promote sustainability and responsive to changes in our environment (e.g., sea level rise)

Well-designed multi-family residential development with amenities

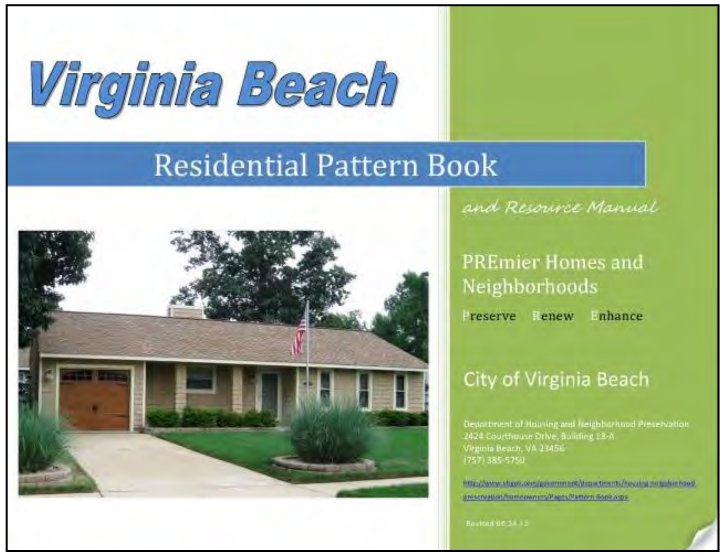
Several of the items above are based on 'Characteristics of a Great Neighborhood' as defined by the American Planning Association, as part of its "Great Places in America" program. Among them is a predominant emphasis on design of both the neighborhood and the dwellings; therefore, the *Special Area Development Guidelines: Suburban Area* found in the *Reference Handbook* are to be extensively used to guide and evaluate existing and new development within the Suburban Area. For example, new residential development on larger parcels should be consistent with the character of any residential uses in the surrounding area, as well as consistent with the guiding planning principles for the Suburban Area. Residential density in the Suburban Area should be low to medium where the surrounding land use patterns and densities are appropriate for such. Higher densities are appropriate for development in the Urban Areas.

Design plays an important role in the encouragement of social interaction and providing for a quality day-to-day experience. Equally important, however, are the institutions that support residents, such as religious uses, community centers, and schools. In particular, schools have always played a significant role in the lives of Virginia Beach residents through not only the education provided, but also by acting as centers of community activity. The quality of the educational experience and the community focus of our schools have been, and continue to be, a primary contributor to the desire of people to live in Virginia Beach, and accordingly, a driver of the City's growth. Further discussion of this aspect of the Suburban Area can be found in

Floyd E. Kellam High School

the Virginia Beach Public Schools' *Compass to 2020 Strategic Plan*, which is available online at http://www.vbschools.com/compass.

Infill development on small vacant parcels within an existing neighborhood or on parcels being redeveloped should be compatible to the existing development around it. Designing a structure *that is scaled and proportioned with* surrounding development is typically more difficult than utilizing a design that simply fits the site and meets zoning regulations. The result, however, is a structure compatible with the neighborhood with respect to land use and design and will give the impression to those who pass by that it has always been part of the original development. There is a limited amount of design guidance for infill development in the Special Area Development Guidelines: Suburban Area. Though it is focused on infill development in the Oceanfront neighborhood of Shadowlawn, the Shadowlawn Infill Development Guidelines, which are part of the Reference Handbook, provides insight into principles of developing small infill lots. Finally, development on smaller parcels, whether infill or renovation of existing dwellings should be guided by the Virginia Beach Residential Pattern Book and Resource Manual, which is available online at http://www.vbgov.com/government/departments/housing-neighborhood-preservation/homeowners/Pages/vb-pattern-book.aspx. Further discussion of infill development is found in Chapter 2, Section 2.3 - Housing and Neighborhoods Plan.



The Residential Pattern Book provides guidance for renovation of existing houses and construction of infill housing

Land use compatibility among uses within the Suburban Area is vital to the stability of the city's neighborhoods. Equally as vital, however, is the compatibility of land uses within the Suburban Area with those of the Urban Area, Princess Anne Commons, Transition Area, and Rural Area. At these transitional 'edges' from Suburban Area to Urban Areas and Suburban Area to Transition Area to Rural Area, it is critical that the *Special Area Development Guidelines: Suburban Area* be used in concert with the *Special Area Development Guidelines: Urban Areas* and the *Rural Development Guidelines* dependent on which 'edge' is involved. Moreover, additional guidance pertaining to these edges is provided in the planning documents for each of the Strategic Growth Areas.

Underutilized neighborhood shopping center

To create and maintain "Great Neighborhoods," emphasis on the residential component must be balanced by an emphasis on the commercial component. Each land use is dependent on the other, and accordingly, the quality and vitality of one affects that of the other. Just as the City's housing is aging, many of our neighborhood commercial centers are aging and showing deteriorated through years of neglect by the owners. We cannot afford to allow such deterioration to continue, as there will be a corresponding effect on our neighborhoods until eventually, a cycle of decline of both occurs. Many of the centers serve as the core of the community. The demise of neighborhoods is quickened when they are in the vicinity of abandoned aging centers, while, at the same time, development of new centers elsewhere is allowed. It is vital, therefore, that we encourage the renewal of such centers with regard to both design and the products and services provided to the neighborhoods where they are located. We must be innovative using financial, zoning, and other tools yet to be determined to encourage owners to renew these commercial centers. For example, allowing dwelling units to be added to such centers will mix land uses in a way that new customers located in close proximity are provided to businesses and additional income is provided to the property owner that can be used to renew the center. Another example is use of underutilized areas of parking lots for markets of various types (e.g., farm produce; home gardening plants and supplies, etc.).

Example of food truck bringing vitality to vacant neighborhood shopping center parking lot as part of a farm market

Of importance to our neighborhoods as well is ensuring that principles of sustainability are incorporated into our neighborhoods to make sure that future residents of our neighborhoods can enjoy the same, and potentially even better, quality of life than current residents do. Chapter 2, Section 2.2 - Environmental Stewardship Framework, as well as the City's *A Community Plan for a Sustainable Future* (commonly referred to as *The Sustainability Plan)* provide policies and strategies to that end.

Protect and Enhance Natural Open Spaces, Places and Building of Cultural and Historical Significance and Integrate into Development as Appropriate

Over the long term, the quality of the physical environment within the Suburban Area will be impacted by how well we protect and enhance its physical assets including open spaces. Carefully planned open space areas also add to the attractiveness and livability of our suburban neighborhoods. They also have a positive effect on the market value of surrounding properties and, thus, help to advance our City's economic vitality. Significant multiple benefits are derived from this amenity and, as such, it is important for the City to continue providing sufficient resources to ensure an effective, on-going open space preservation and acquisition program as identified in the *Virginia Beach Outdoors Plan* and within other areas of the City, as deemed appropriate.

Attractive park and open space design provides amenities for neighborhood residents

The following should guide the protection and enhancement of our open spaces as well as the buildings and places of cultural and historic significance within the City:

- *Maintain Existing open Spaces and Parks*

We must ensure that sufficient resources are available to adequately maintain existing public open space, parks, and recreation areas. We must also develop tools that assist neighborhoods developed with open space areas and parks, but which are now difficult to maintain due to declining revenues of property owners' associations.

- *Create New Open Spaces with Development, including City Capital Improvement Program Projects*

Continue adding new publicly owned and/or accessible open space areas and viewsheds, especially in areas of need in accordance with the *Virginia Beach Outdoors Plan*. In addition, explore reasonable alternatives to achieve these objectives including the purchase of easements, land swaps, or long term lease agreements to protect open space areas within or adjacent to defined areas of need.

Public road project with well-integrated open space and streetscape landscaping

Where appropriate, carefully planned open space areas should be included as an important element of Capital Improvement Program projects. This is particularly vital when such actions reinforce the character and quality of the physical environment of stable neighborhood areas or complement open space being included with new development.

As part of proposals for new development or redevelopment, carefully consider the location of proposed open space areas and trails to create a physical link and complement other similar features that exist or may be planned on adjacent or nearby properties.

- *Apply Natural Resource Planning Principles in Development*

Ensure that all new development and redevelopment preserves the quality of our natural environment by adhering to established natural resource planning principles. These include, among others, the clustering of lots, where appropriate, to increase areas of preserved natural resources, maintaining natural buffers adjacent to shorelines, minimizing impervious cover of such features as buildings, roads and parking areas, following innovative stormwater management practices, and utilizing drought tolerant plant material.

We should also ensure that new development responds to the effects of projected sea level rise as well as the recurrent flooding that occurs in areas of the City.

Southern Watershed Subject to "Special Drainage Considerations"

In addition, the Southern Watershed portion of the Suburban Area is subject to "special drainage considerations." Drainage in the Southern Watershed is highly impacted by the presence of high ground water, poorly draining soils, and high water surface elevations in downstream receiving waters. Therefore, it is incumbent upon the developer of any property in the Southern Watershed to understand and evaluate these factors prior to undertaking the project and to properly account for these factors in the project design. Receiving waters in the Southern Watershed are subject to tidal influences which can be exacerbated by winds. High ground water elevations and poorly draining soils can result in increased runoff, can limit the capacity of the stormwater conveyance systems, and can counter indicate the use of certain Best Management Practices, such as infiltration.

All of these effects must be fully considered and evaluated in the analysis and design of drainage systems in the Southern Watershed. Accordingly, it is strongly recommended that the developer has a preliminary drainage study prepared by a qualified professional engineer in advance of any request to approve a discretionary (versus by-right) development application that involves land disturbance in the Southern Watershed. The drainage study should fully and accurately evaluate the effects of the foregoing factors on the planned development and on upstream and downstream areas. The proposed drainage system for the planned development would provide positive drainage that meets City standards and does not result in flooding within the planned development or to upstream or downstream areas.

- *Protect Resources of Historic and Cultural Significance*

Coupled with protecting open space is the importance of protecting our resources of historic and cultural significance. It is the policy of the City to use all available resources, including those provided by the City's Historic Review Board, Historic Preservation Commission, as well as the Princess Anne County/Virginia Beach Historical Society, to preserve such resources. Efforts to retain these historic resources should be accomplished in a responsible and innovative manner. The efforts include providing land use planning guidance and tax credit assistance to owners of historic properties in order to help protect and preserve the City's limited number of valuable historic resources and surrounding open space areas. Owners of qualified properties should be encouraged to participate in the Virginia Beach Historical Register program and receive recognition for their contributions to our City's heritage.

Historic Adam Thoroughgood House

Create and Maintain a Transportation System that Provides Connectivity and Enhances Mobility Regardless of Transportation Mode

Movement through the Suburban Area and to destinations outside the Suburban Area is heavily dependent on the automobile, which in turn is dependent on a network of roadways that has traditionally been designed to move automobiles from one place to another in the fastest and safest manner. Currently, a conflict exists between the goal of encouraging the public to use transit service and other modes of travel and the limited demand for such services in a typical suburban setting. A disproportionate reliance on the automobile, often with only a single occupant, creates these negative results:

Construction of new Lesner Bridge Replacement over Lynnhaven Inlet

- Declining environmental quality;
- Inefficient use of energy resources;
- Stress on the economy due to increased costs to residents to maintain vehicles and help pay for system improvements;
- Stress on the public sector due to the need to find innovative means to fund improvements to the existing system, the development of new systems, and the maintenance of the complete transportation system;
- Time lost due to congestion; and,
- A reduction in quality of life due to all of the above.

Chapter 2, Section 2.1 - Master Transportation Plan describes this transportation system in detail, explains the issues we face, and provides recommended policies and capital improvements to create a system that, over time, will reduce our dependence on the automobile.

NEIGHBORHOOD TRAFFIC CALMING

There are ways to slow vehicular movement inside residential areas and reduce 'cut through' traffic. Often called 'Traffic Calming', these techniques include assessing the neighborhood traffic condition and, if warranted, providing greater police enforcement, limiting direct access to neighborhoods from adjoining roadways, adding traffic circles, narrowing street widths in certain areas and the use of other methods to reduce traffic volume and speed.
The City has instituted a multi-step 'Traffic Calming' program to accomplish these objectives and this program should be used, where necessary, to increase public safety within neighborhoods.

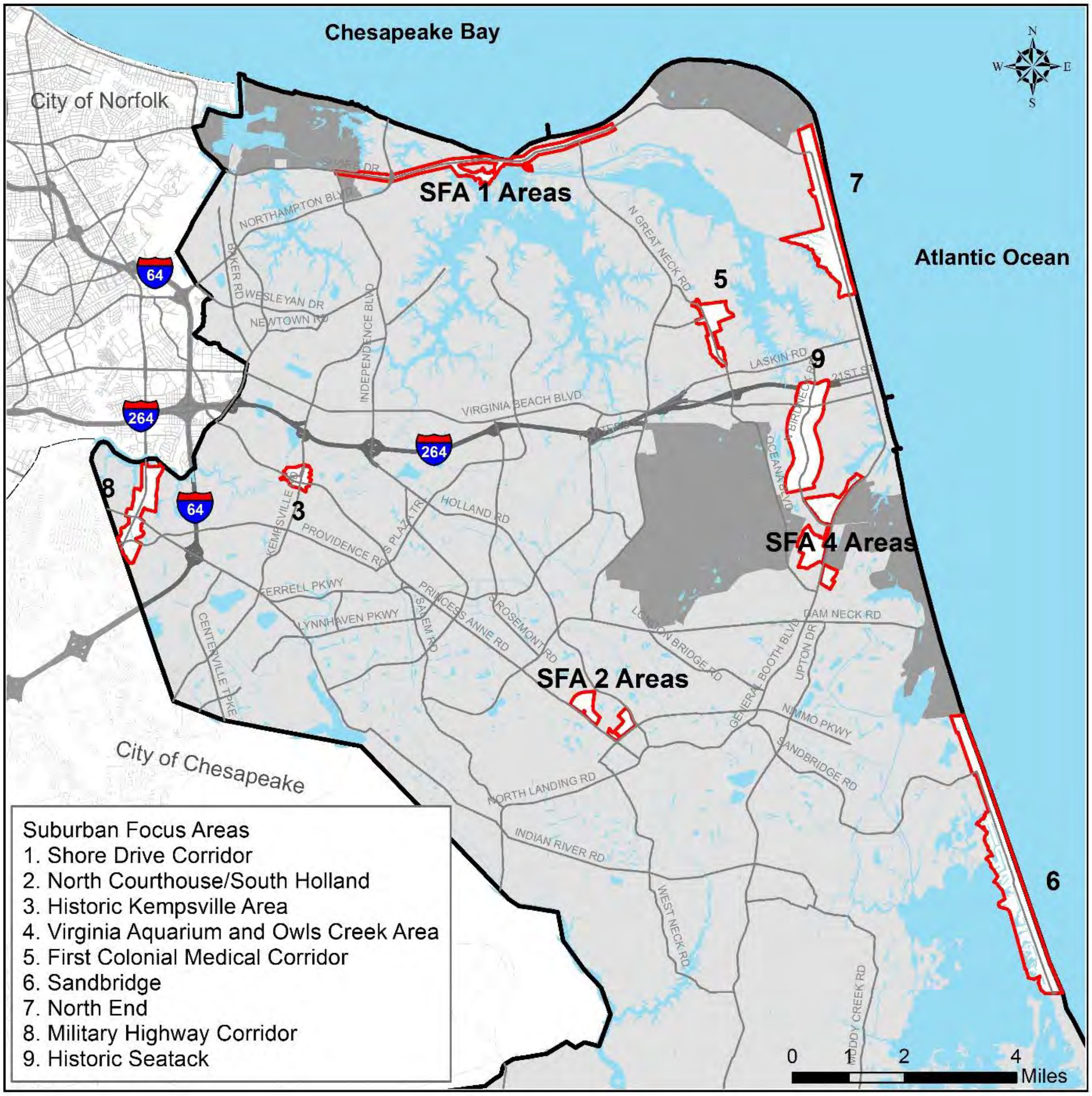
Traffic calming technique - traffic circle or roundabout

AREA-SPECIFIC PLANNING RECOMMENDATIONS FOR SITES IN THE SUBURBAN AREA – SUBURBAN FOCUS AREAS (SFAs)

The following section of this chapter provides more refined planning guidance for designated Suburban Focus Areas (SFAs) throughout the Suburban Area. Much of the Suburban Area comprises well-established neighborhood and commercial areas that define the land use character in the northern portion of the City and should remain that way into the foreseeable future. However, opportunities to reinforce or revitalize certain areas by providing compatible land use guidance or recommendations to improve the quality of land use exists on certain suburban tracts. The purpose of Suburban Focus Areas is to offer guidance to advance these objectives. In some cases, area master plans have been developed for designated SFAs (e.g., Historic Kempsville Area, Shore Drive Corridor, and the Virginia Aquarium & Owls Creek Area).

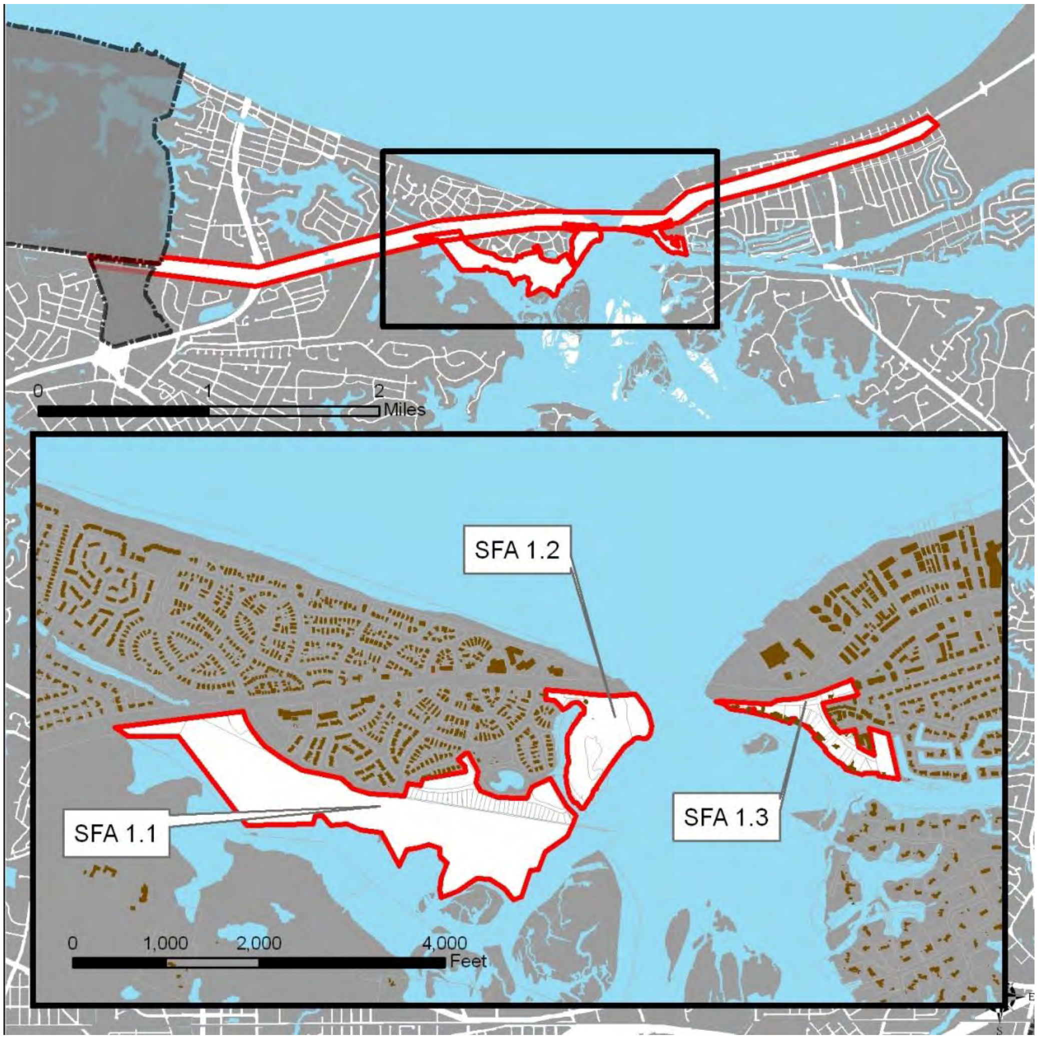
There are 9 SFAs designated in the Comprehensive Plan, which can be found on the locator map on p. 1-69:

1. Shore Drive Corridor
2. North Courthouse/South Holland Road
3. Historic Kempsville Area
4. Virginia Aquarium & Owls Creek Area
5. First Colonial Medical Corridor
6. Sandbridge
7. North End
8. Military Highway Corridor
9. Historic Seatack



SUBURBAN FOCUS AREAS LOCATOR MAP

SFA 1 - SHORE DRIVE CORRIDOR



DESCRIPTION

This corridor is characterized by:

- many well-established neighborhoods
- newer high density residential development
- neighborhood and resort commercial uses
- significant parks and open spaces
- proximity to Chesapeake Bay and Lynnhaven River

The Shore Drive Corridor is an integral part of the Bayfront Community, extending from North Independence Boulevard to First Landing State Park. While primarily a residential community, the corridor shares the responsibility of being one of Virginia Beach's primary east-west connectors, creating unique and sometimes problematic challenges. The area is considered a resort neighborhood and not a resort destination. This means that the Shore Drive Corridor:

- while the most densely populated area of the City, is primarily a neighborhood residential area;

- comprises commercial uses to support the neighborhoods;
- accommodates Shore Drive, a primary circulation corridor for the City; and,
- affords more passive recreational and tourism amenities.

The Bayfront Advisory Commission (originally established as the Shore Drive Advisory Committee and then the Bayfront Advisory Committee) was established by City Council in 1998. The mission given by City Council to the Bayfront Advisory Commission is:

> . . . to review and make recommendations to the City Council regarding public and private projects and issues associated with the Bayfront area, and projects or issues associated with the Bayfront area that the City Council may refer to the Commission.

More information is provided in the *Shore Drive Corridor Plan*, adopted by the City Council in 2000. The *Shore Drive Corridor Design Guidelines* provide direction for the form and function of land use and development in this area. Both of these documents are available in the Planning Department's online Document Library at www.vbgov.com/Planning.

The planning policies that apply to the entire Shore Drive Corridor and Bayfront Communities are:

- Completion of the remaining roadway improvements (all identified Phases) along Shore Drive to enhance the safety, access, and character of the Corridor;
- Retain the majority of Shore Drive, particularly east of the bridge, as a four-lane road for as long as is practical but protect the necessary right-of-way for an expansion to a six-lane facility, if necessary. Any increase in the number of lanes on Shore Drive could negatively impact the community by further separating the northern and southern parts of the Corridor;
- Ensure safe passage by pedestrians from one side of Shore Drive to the other side through reduced speed limits and well-identified pedestrian crossings;
- Ensure the safety of bicyclists using Shore Drive;
- Preserve and protect the character of the established neighborhoods;
- Improve land use compatibilities and avoid over-commercialization to ensure that resort-based uses complement rather than dominate this corridor;
- Encourage reuse and revitalization of existing commercial properties;
- Achieve the lowest reasonable density for future residential uses;
- Implement the recommendations of the Sea Level Wise Adaptation strategy to address projected sea level rise and recurrent flooding that occurs in this area.
- Update the *Shore Drive Corridor Design Guidelines*, and in particular, develop design guidance for residential development within the Corridor and its established neighborhoods;
- Improve public parking and public access to the beachfronts;
- Provide a continuous multipurpose trail through this corridor (reference the *Virginia Beach Outdoors Plan* for recommendations); and,
- Provide continued support for restoring the health of the Chesapeake Bay and Lynnhaven River.

This Suburban Focus Area has three sub-areas that, due to unique issues and/or opportunities, require further guidance. The following sections provide specific planning guidance for each.

SFA 1.1 – PLEASURE HOUSE POINT

- Maintain and protect the significant investment that has been made to preserve Pleasure House Point for open space, limited recreation, natural resource preservation, and natural resource education.
- Ensure that any development in the surrounding area is complementary with regard to both design and land use to the natural resource and open space amenity provided by Pleasure House Point.

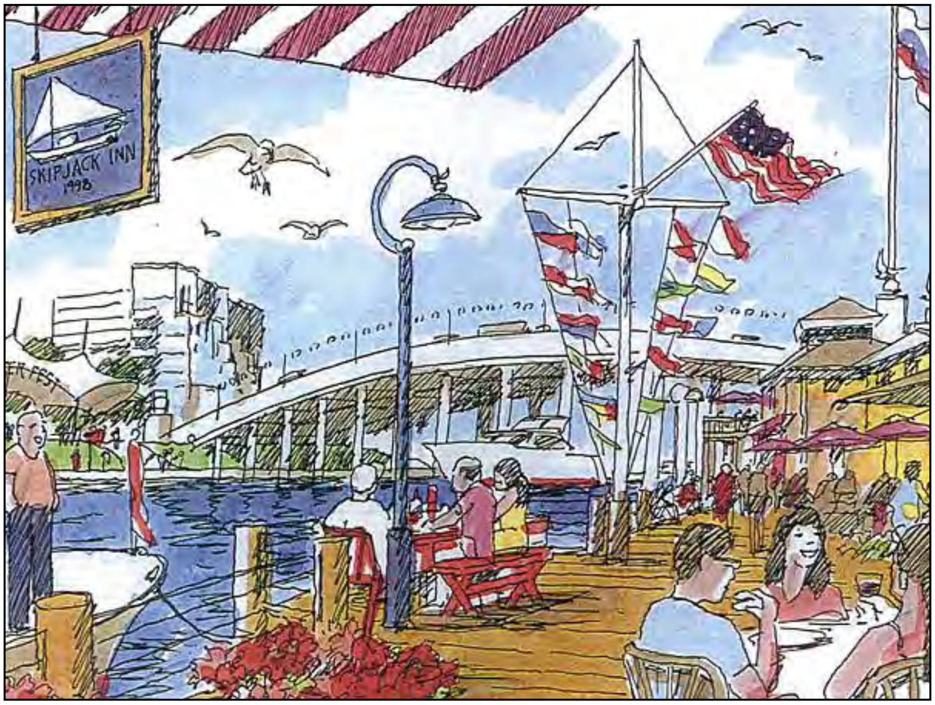
Pleasure House Point

SFA 1.2 – LYNNHAVEN BOAT AND BEACH FACILITY

- Continue as a public waterway access for motorized and non-motorized watercraft;
- Add appropriately scaled public park and recreational facilities; and,
- Provide linkage to Shore Drive trail system and Chesapeake Bay beaches.

SFA 1.3 – WATERMAN'S WALK

- Coordinate with property owners to create a thematic waterfront concourse overlooking the Lynnhaven Inlet;
- Create a special place for people to shop, work, live, and enjoy the exceptional waterfront amenities;
- Consider establishing a public-private partnership to achieve this vision; and,
- Integrate a variety of appropriately scaled mixed uses including marinas, restaurants, residential units, specialty retail shops, and offices.



Concept sketch of Waterman's Walk

SFA 2 – NORTH COURTHOUSE/SOUTH HOLLAND ROAD

DESCRIPTION

This area has the following characteristics:

- Location within the 70 to 75 dB DNL AICUZ and the 65 to 70 dB DNL (Sub-Area 2) AICUZ
- Location north of the Green Line at the edge of the Suburban Area and adjacent to SEGA 4 - Princess Anne Commons, as well as the Municipal Center and Courthouse
- Stable and well-established neighborhoods
- Proximity to new roadways: Princess Anne Road, Nimmo Parkway, and Holland Road
- Undeveloped areas, with some consisting of one or two parcels and property owners and others consisting of multiple parcels and multiple (and in some cases, undetermined) property owners
- Historical, architectural, and archaeological resources

Aerial photograph of SFA 2 and surrounding area

With the improvement of Princess Anne Road from a two-lane roadway to its current four-lane parkway, the improvement of Holland Road from a two-lane roadway to a four-lane arterial, and the completion of Nimmo Parkway from the Courthouse to General Booth Boulevard, this area is now well-served by the transportation system and strategically located for appropriate development. Princess Anne Road, a major north to south roadway, has been widened and improved with its own special unifying 'brand' of significant attractive landscaping, open space, multi-use paths, and pedestrian lighting. Nimmo Parkway is now a major east to west arterial roadway with multi-use paths, providing a connection from this area to General Booth Boulevard and the trail adjacent to it. Scheduled for completion in 2017, construction has begun to widen and improve Holland Road with sidewalks, aesthetic treatments, and landscaping from Dam Neck Road to Nimmo Parkway. Commercial and residential development continues to be attracted to the area as evidenced by the 240-unit multifamily complex developing behind the shopping center on Nimmo Parkway and the numerous businesses located nearby. Additionally, several large tracts of undeveloped land provide exceptional development opportunities for a variety of uses ranging from residential to commercial projects, all dependent, however, on the compatibility of any proposed use to the AICUZ of the site.

Hampton Roads Joint Land Use Study

The City of Virginia Beach has adopted a series of policies and ordinances to achieve objectives outlined in the *Hampton Roads Joint Land Use Study* and the City's Oceana Land Use Conformity Program. These provisions apply to most of the North Courthouse / South Holland Area. For areas within the 70 and higher dB DNL AICUZ, development of property for residential use is limited to what is already zoned for such use. Other properties, located within the 65 to 70 dB DNL AICUZ, may be developed through a change of zoning consistent with Article 18 of the City Zoning Ordinance.

Access Controlled Roadways Policy - Nimmo Parkway and Princess Anne Road

Nimmo Parkway and this section of Princess Anne Road are designated by the Master Transportation Plan (Chapter 2, Section 2.1) as "Access Controlled" roadways, which means private direct access to Nimmo Parkway and Princess Anne Road is not permitted, except when a property has no other reasonable access to the roadway system. In such cases, direct access is allowed until such time that access can be gained from the back of the lot by some means, such as a new roadway. Many times, these roadways are purposefully planned and constructed as part of a large development and are referred to a 'reverse frontage' roads.

SFA 2 - GENERAL RECOMMENDATIONS

With regard to residential development, when found to be an appropriate land use, the following recommendations focus on providing a density range between 'baseline' and 'incentive.' The incentive level relies on development options and performance guidelines to help achieve the objectives of creating well-planned developments, protecting existing neighborhoods, and implementing the policies of the Master Transportation Plan with respect to roadway access. Baseline options apply to development proposals that are limited in achievement of meeting the planning objectives for the North Courthouse/South Holland Area. Incentive options apply to development proposals that meet or exceed these planning objectives. The level of density recommended within each Subarea will be commensurate with the degree to which the development integrates the general and Subarea-specific recommendations, but more importantly to what is appropriate under the provisions of Section 1804 of the Zoning Ordinance.

The following recommendations should be applied to the North Courthouse/South Holland Road Suburban Focus Area:

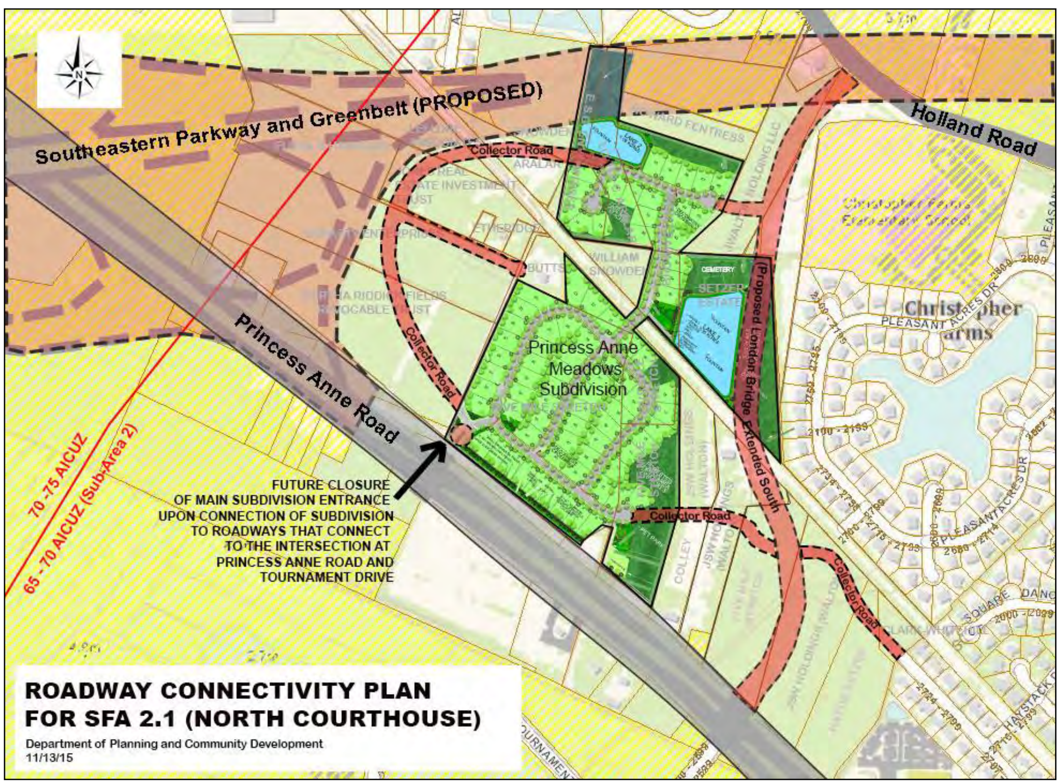
- As many parcels as possible within SFAs 2.1, 2.2, and 2.3 should be consolidated into a single, well-configured tract of land that enables a safe, coordinated, and attractively designed development plan.
- Proposed uses should reinforce and emphasize the character of the area and should be compatible with the adjacent neighborhoods.
- Significant landscape buffers should be established between existing residential areas and proposed developments and roadways to mitigate adverse visual and noise concerns.
- Site designs and buildings should complement the Municipal Center to the south.
- Integrate adjacent land uses such that each complements the other visually, functionally, and spatially with attractive landscaped vistas, open space areas and multipurpose trails, and other amenities to enhance the quality of the physical environment and provide connectivity.
- Open space areas and vistas should include preservation of mature tree stands and have significant landscaping.

- Design streets and stormwater management facilities using aesthetic and environmental design techniques to enhance scenic and open space opportunities.

SFA 2.1 – NORTH COURTHOUSE

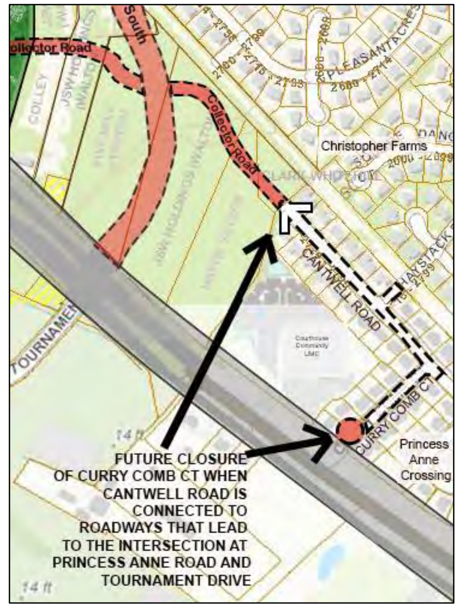
Bounded on the north by the proposed Southeastern Parkway interchange, on the south and east by the Christopher Farms subdivision, and to the west by Princess Anne Road, the North Courthouse SFA consists of approximately 100 acres and includes numerous privately-owned parcels with a few single-family residences. It is located within the 65 to 70 dB DNL AICUZ (Sub-Area 2), and thus, residential development is subject to the AICUZ Overlay Ordinance, Section 1804. One of the goals for SFA 2.1 is that properties will be accessed by a proposed connector road (London Bridge Extended) that would cross through this area to link Holland Road with Princess Anne Road, aligning with the entrance to the Virginia Beach National Golf Course. The City Council has identified the roadway system as shown on the connectivity plan below as guidance for properties as SFA 2.1 develops. These connections will ensure that all of the properties have access to Princess Anne Road at one location, consistent with the Controlled Access designation for Princess Anne Road.

Furthermore, one of the conditions of approval for the Princess Anne Crossing subdivision was that the intersection at Curry Comb Court and Princess Anne Road was temporary, and, following the widening of Princess Anne Road, Curry Comb Court would be closed, and an alternative roadway access would be provided. This alternative new roadway access would be provided via a portion of the proposed connector road [London Bridge Road Extended] and a new roadway link connecting the



proposed connector road [London Bridge Road Extended] to Cantwell Drive and Courthouse Community United Methodist Church, which is to lose its access to Princess Anne Road as well. The plan drawings above and to the right depict this proposed access route.

RECOMMENDATIONS



Roadway access recommendation for southern part of SFA 2.1

- Non-Residential
  - Based on the AICUZ, non-residential use may be preferable. In this case, the development of the property should be consistent with that located in Princess Anne Commons on the south side of Princess Anne Road. High quality, low-rise offices are encouraged.
  - A limited range of residentially compatible, non-intrusive service uses, such as day care centers and medical offices are appropriate.
  - Non-residential development should be carefully planned and integrated into the development.

- "Baseline" Density
  - In addition to the 'General Recommendations' above:
    Single-family residential development with an overall maximum density of two dwelling units per acre.
  - Variety of housing unit types is encouraged.

- "Incentive" Density

  In addition to the 'General Recommendations' above:

  - The development site should consist of the consolidation of as many contiguous parcels of land to ensure the recommendations for the area can be satisfied.
  - Consistent with the provisions of Section 1804 of the Zoning Ordinance, single-family residential development with an overall maximum density of 3.3 dwelling units per acre.
  - Exceptional open space areas and vistas should be provided.
  - Stormwater management facilities should be designed as an amenity.
  - Access to Princess Anne Road should be exclusively by a system of collector roads connecting Holland Road to Princess Anne Road at an intersection aligned with the Virginia Beach National Golf Course entrance (as shown on the Roadway Connectivity Plan above).
  - Every effort should be made to save any areas of undisturbed mature trees located adjacent to the Christopher Farms neighborhood and elementary school.
  - Where possible, a berm and heavily landscaped buffer approximately 100 feet in width should be located between Christopher Farms and any roadway constructed between Holland Road and Princess Anne Road. Buffer plantings should incorporate evergreen plantings of trees and shrubs.

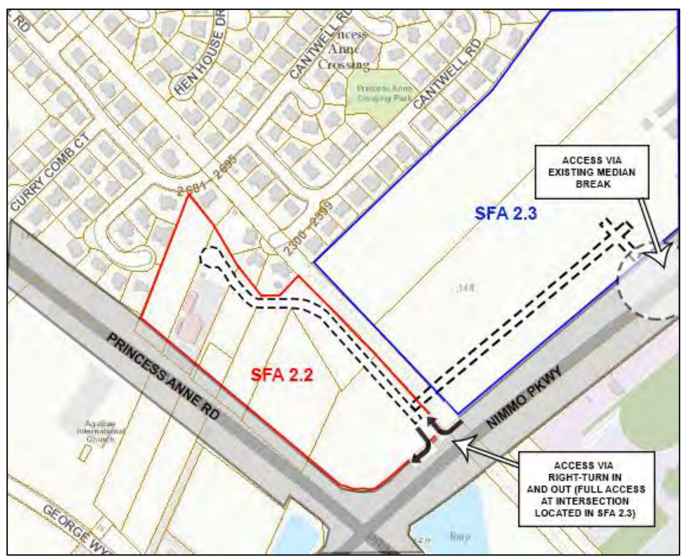
- Combination of Residential and Non-Residential
  - A combination of single-family residential with non-residential use of the type described above are possible within SFA 2.1 should the recommendations for each be achieved.

SFA 2.2 – COURTHOUSE CORNER

Courthouse Corner is comprised of seven parcels totaling approximately 13 acres. Located on the northeast corner of the Nimmo Parkway and Princess Anne Road intersection, it is situated within the Less than 65 dB DNL AICUZ.

RECOMMENDATIONS

- Efforts should be made to encourage parcel consolidation.
- Significant landscape buffer adjacent to the existing residential area should be included.
- Recommended uses include low-rise, low-intensity office and service uses that are attractively designed with reverse frontage access. Residential dwellings mixed with such uses is appropriate.
- Roadway and driveway accesses should be in keeping with the Access Controlled designation for Princess Anne Road and Nimmo Parkway. Those properties fronting on those roadways should be provided access from a connecting roadway located to the rear of these properties - otherwise known as "reverse frontage" access. At the time such access is provided, all direct access to Princess Anne Road from development within Courthouse Corner should be completely closed. The plan drawing to the right depicts this concept.
- This proposed reverse frontage road should not connect to the existing adjacent residential area.
- As shown on the plan drawing to the right, efforts should be made to provide a single, common access road from Nimmo Parkway that would serve the Courthouse Corner and the South Holland areas.



Roadway access recommendation SFA 2.2 and SFA 2.3

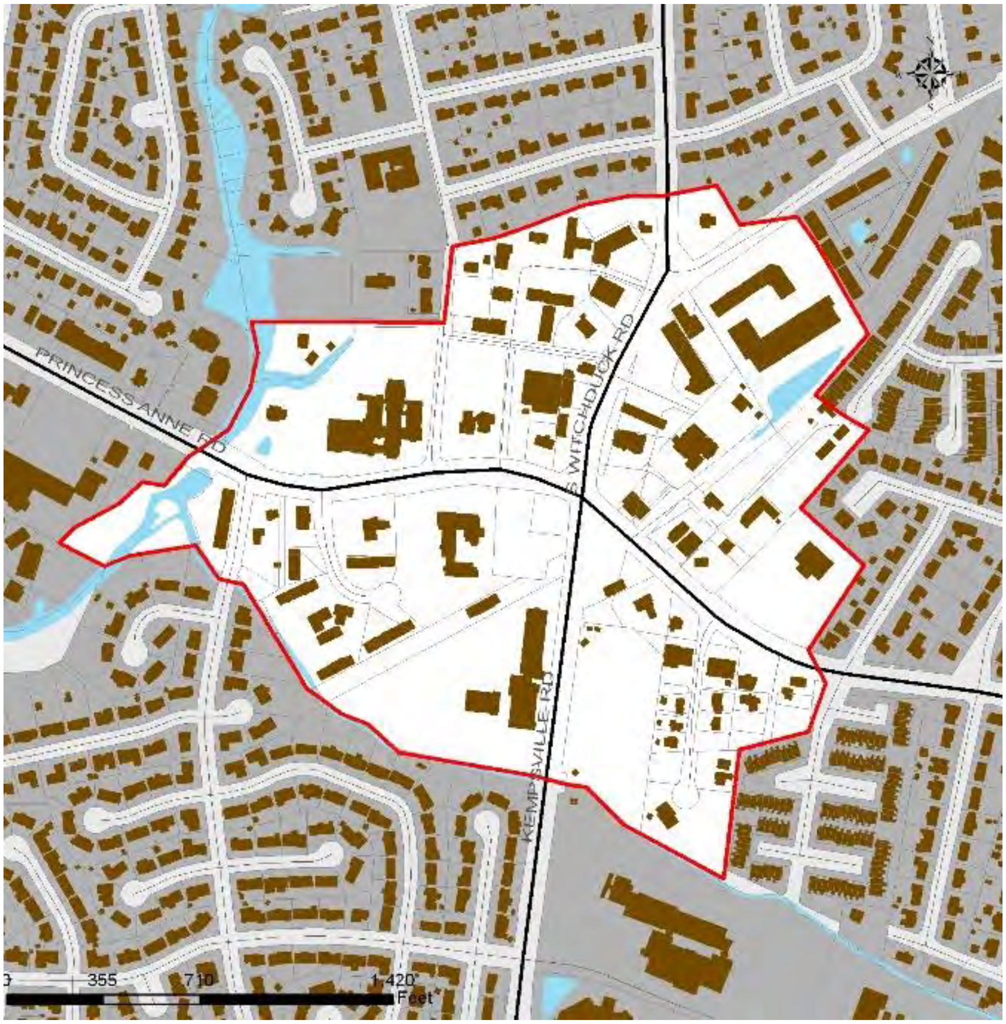
SFA 2.3 – SOUTH HOLLAND

The South Holland Subarea is located on the northwest corner of the Nimmo Parkway and Holland Road intersection and stretches southwest toward Princess Anne Road. It includes six properties totaling approximately 65 acres and contains a historic resource known as Buyrn Farm. A majority of South Holland is located within the 65 to 70 dB DNL AICUZ (Sub-Area 2) while the southwest section is located within the Less than 65 dB DNL AICUZ.

RECOMMENDATIONS

- Single-family residential development with an overall maximum density consistent with the AICUZ Overlay Ordinance, but not to exceed four units per acre.
- A limited range of residentially compatible neighborhood-serving specialty retail shops, office, and service uses may be allowed. Examples of limited neighborhood service uses are day care centers, medical offices, pharmacies, and similar non-intrusive uses.
- Efforts should be made to create a single, common access road from Nimmo Parkway to serve Courthouse Corner and South Holland (as shown on map above).
- No roadway access should be provided to the existing adjacent residential area, Princess Anne Crossing, from the South Holland Subarea.

SFA 3 – HISTORIC KEMPSVILLE AREA



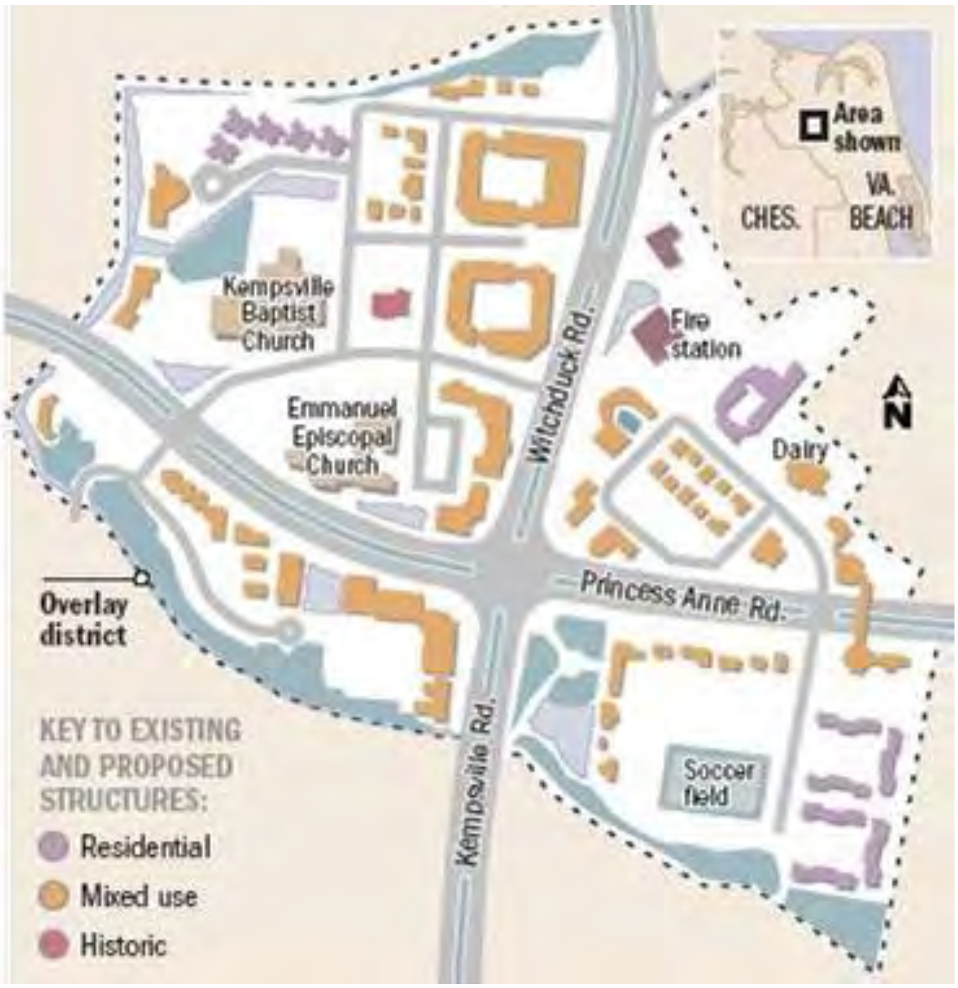
DESCRIPTION

Following considerable public involvement, the City Council adopted the Historic Kempsville Area Master Plan in January of 2006. This plan outlines the methods needed to implement land use, environmental, transportation and design improvements to accomplish the desired revitalization of this area. It also provides guidance to leverage public investments to achieve multiple outcomes and create a high quality 'village' center. The Historic Kempsville Area Master Plan is available in the online document library at www.vbgov.com/Planning.

RECOMMENDATIONS

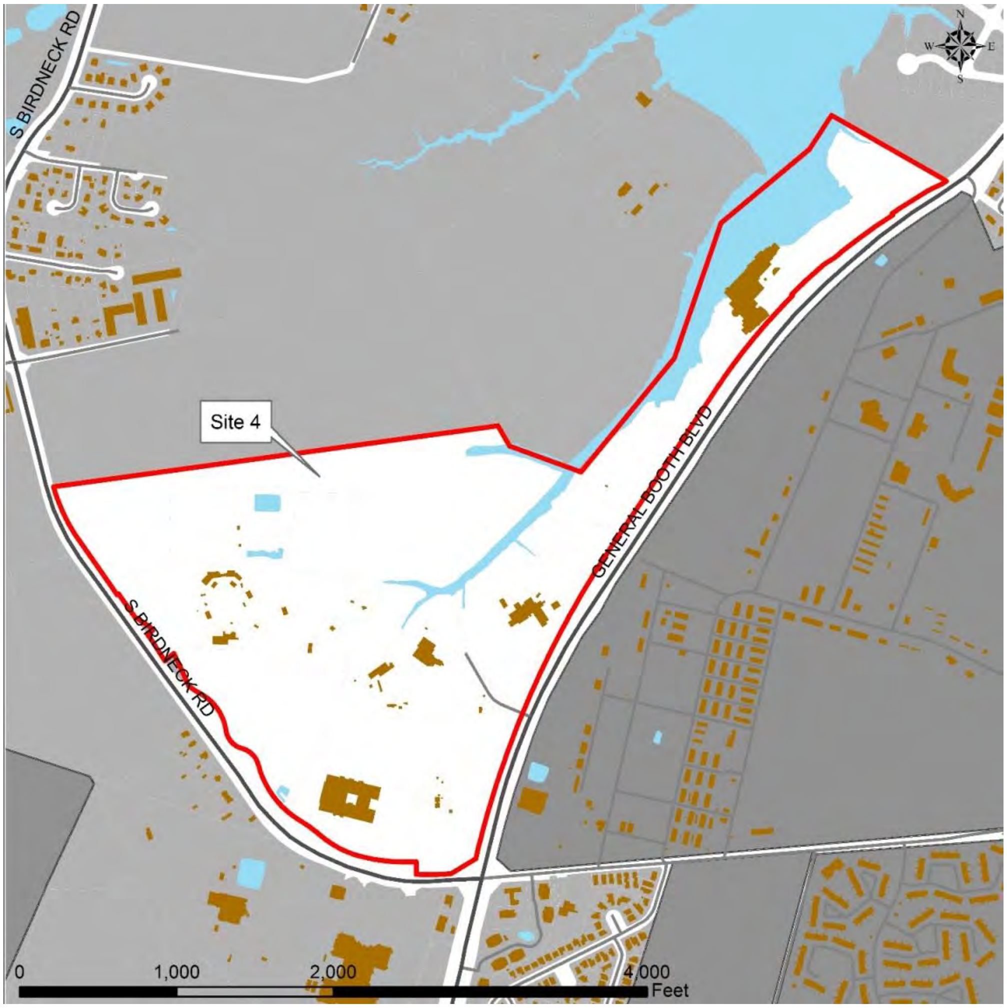
Adhere to the Vision and Goals cited in the Historic Kempsville Area Master Plan especially as they relate to the protection of adjoining stable neighborhoods. The following summarizes the master plan's provisions for each of the quadrants around the realigned Princess Anne/ Witchduck Road intersection:

- *Northeast Quadrant:* Implement the colonial village core to include medical services, senior housing, and public safety and support activities.
- *Southeast Quadrant:* Implement residential uses with a village green and secondary non-residential uses.
- *Southwest Quadrant:* Implement a mixed use development to include residential and compatible non-residential with waterfront access to include an historic interpretive area.
- *Northwest Quadrant:* The future use of Pleasant Hall, a house built in 1769, should respect its historic heritage, as should the form and function of other uses within this quadrant.



Historic Kempsville Area Master Plan, 2005

SFA 4 - VIRGINIA AQUARIUM AND OWLS CREEK AREA



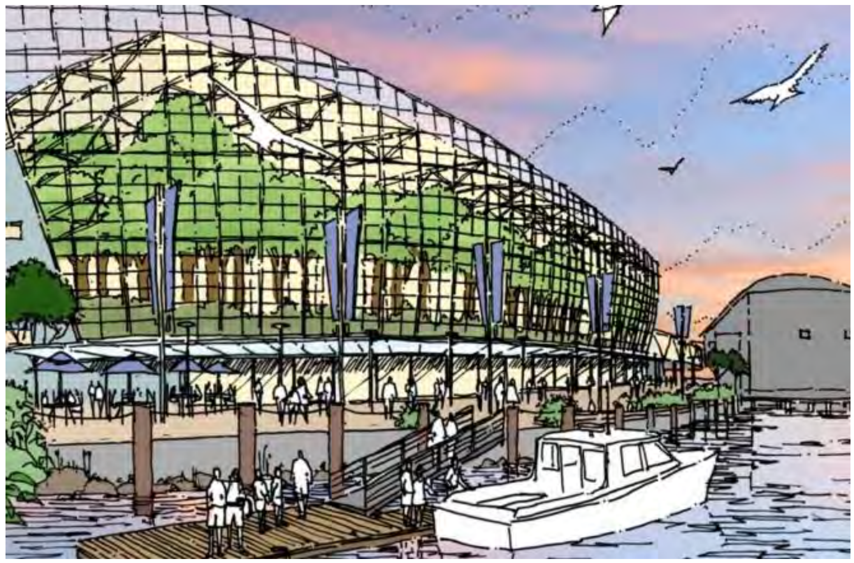
DESCRIPTION

The Virginia Aquarium and Owls Creek area is generally bound by General Booth Boulevard and South Birdneck Road on the south and east and by property owned by the United States to the north. This area has great potential to be a national example of sustainable growth and economic development geared towards environmental preservation. With a vision supported by the community, the *Virginia Aquarium and Owls Creek Area Master Plan* (https://www.vbgov.com/government/departments/sga/projects/oc/oc-masterPlanNov2011.pdf) encourages development or redevelopment of regional significance by protecting the natural environment, facilitating a mix of connectivity, enhancing the character, and providing incentives for quality development.

RECOMMENDATIONS FOR VIRGINIA AQUARIUM AND RESEARCH CENTER AREA

The Virginia Aquarium and Research Area is planned to create expansion opportunities focusing on environmental education, stewardship, and research. The master plan for the aquarium area includes:

- New aquarium exhibit building linked to the existing aquarium to provide additional space for exhibits, banquet facilities, and meeting rooms to position the Virginia Aquarium alongside the top tier aquariums in the world.
- A research aquarium serving multiple functions diversifying the base of economic activity in the aquarium area, creating a hub of marine science and "green" research and innovation.
- The existing boat ramp will remain serving the public, the aquarium, and the green research building.
- A green research building will provide space for environmental and energy related research.



Virginia Aquarium and Research Area Concept

RECOMMENDATIONS FOR THE RESEARCH CENTER AT OWLS CREEK POINT AND MARSHVIEW PROPERTY

The Research Center at Owls Creek Point and Marshview Property is a low-impact development that is a supportive extension of the research complex located primarily in the Aquarium area. This development includes additional research space and research-oriented conferencing and symposia space such as:

- A natural setting for research, learning laboratories, and small research-oriented meetings and events to attract a niche audience.
- The trail system links to the overall trail system throughout the nature park on the Marshview property.
- The property will offer to nearby residents, amenities including open nature trails, lookout-towers, boardwalks, open play recreational fields, and possibly a dog park.

Concept for the Research Center

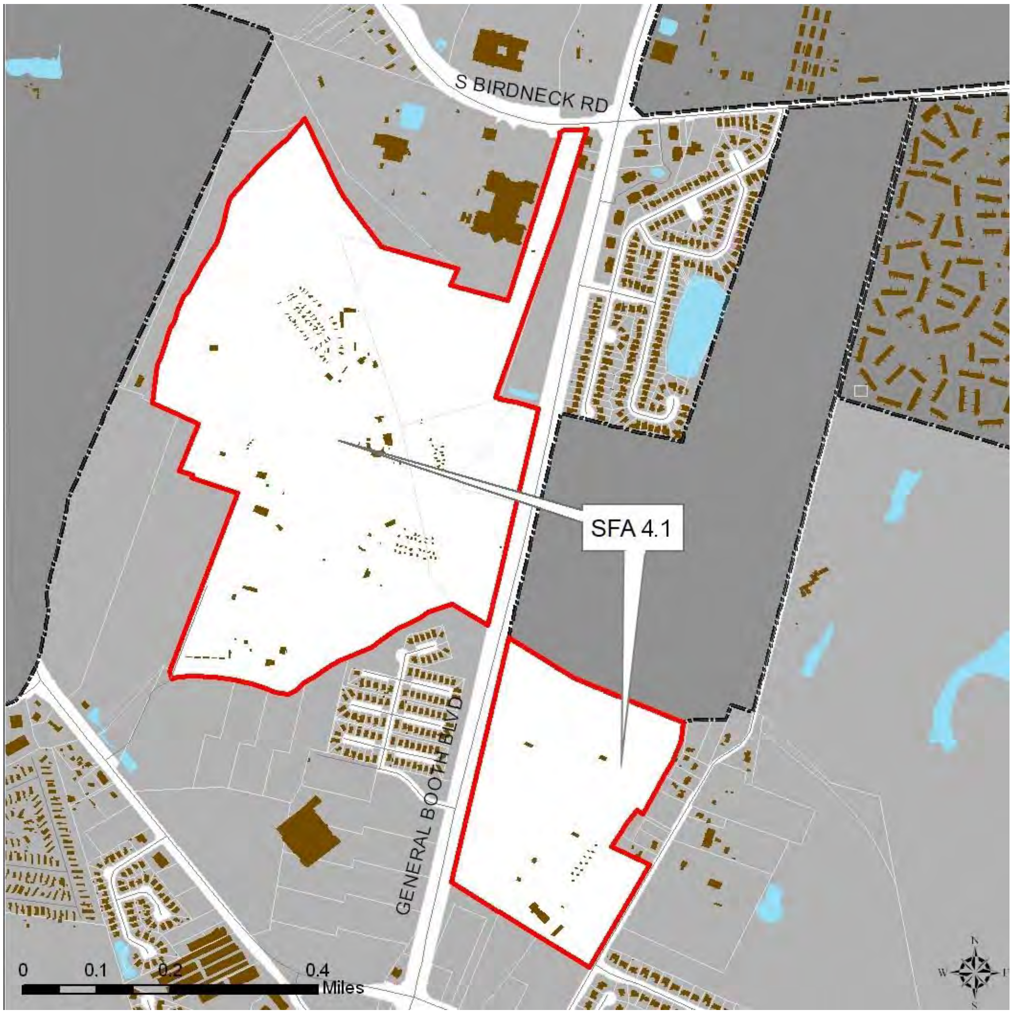
RECOMMENDATIONS FOR THE ENTERTAINMENT AND EDUCATION CENTER

The Entertainment and Education Center includes expansion space for existing attractions, creates new indoor and outdoor attractions, and introduces retail, restaurant, and entertainment space to comprise a mixed-use leisure and entertainment destination.

- The Entertainment Village expands the existing Motor World and Ocean Breeze areas to offer additional rides and one continuous entertainment village at the core of the area with retail and restaurants.
- The prominent corner of General Booth Boulevard and South Birdneck Road will be a continuation of the retail, restaurant, and entertainment with high exposure.
- An outdoor adventure park geared toward the adrenalin seeking visitors is located in this area. First steps to this end began in 2014 with a zip line and high ropes course, creating a unique opportunity through the Aquarium to get visitors immersed in the natural beauty of the area.
- The Coastal Pavilion expansion offers more exhibits relating to the coastal environment.
- Seatack Elementary will remain with an increased natural buffer and a dedicated pathway connecting the school to the Coastal Pavilion for possible joint learning programs.

Entertainment and Education Center concept

SFA 4.1 - GENERAL BOOTH CAMPGROUNDS



DESCRIPTION

The Holiday Trav-L Park is located on the west side of General Booth Boulevard and the KOA Campground on the east side. Both offer outdoor recreational activities for citizens and visitors of Virginia Beach and complement our City's recreational programs and the resort hospitality industry.

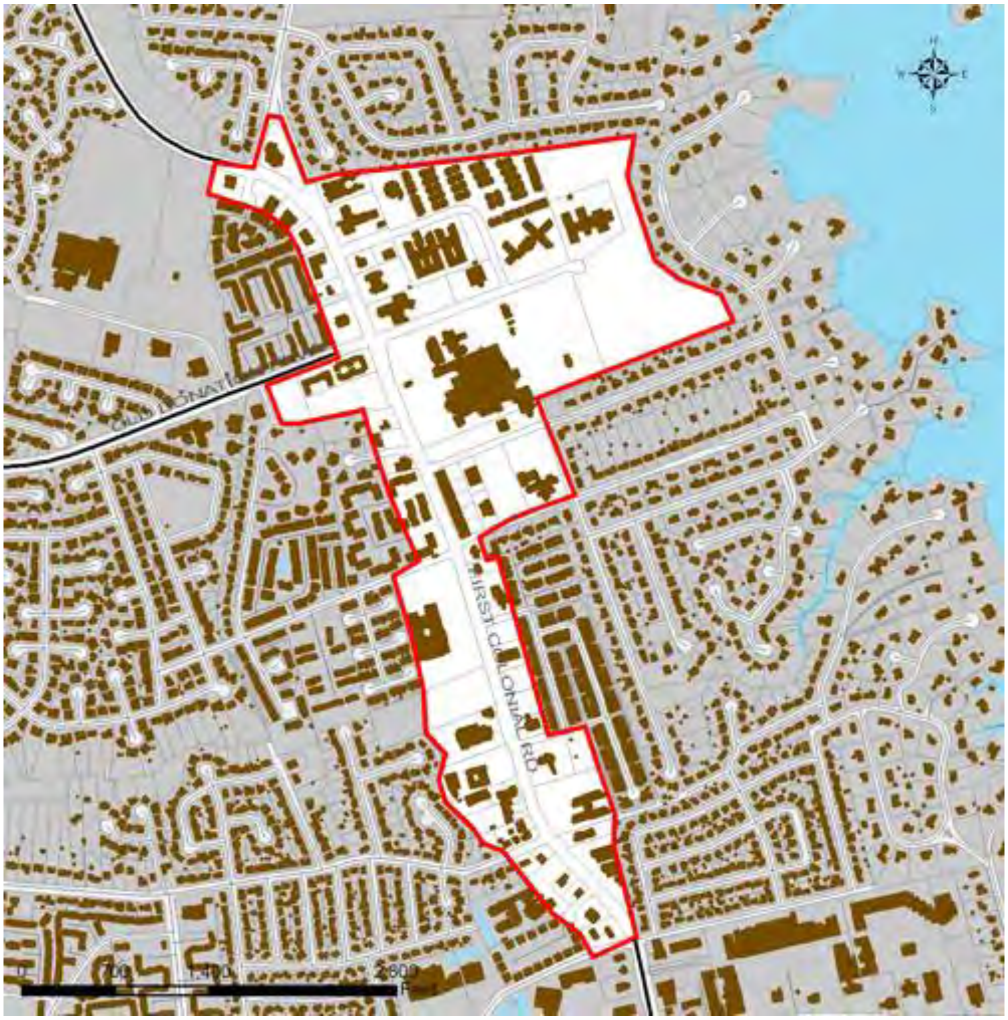
RECOMMENDATIONS

- The existing campgrounds offer outdoor recreational activities for both citizens and visitors of Virginia Beach and are appropriate uses for these sites.
- Where consistent with AICUZ policy, alternate uses may include attractive, high quality, and low intensity:

- Offices;
- Resort oriented retail;
- Resort oriented recreational; or
- Other AICUZ compatible uses

Residential or hotel uses are not recommended for either campground site.

SFA 5 - FIRST COLONIAL MEDICAL CORRIDOR



DESCRIPTION

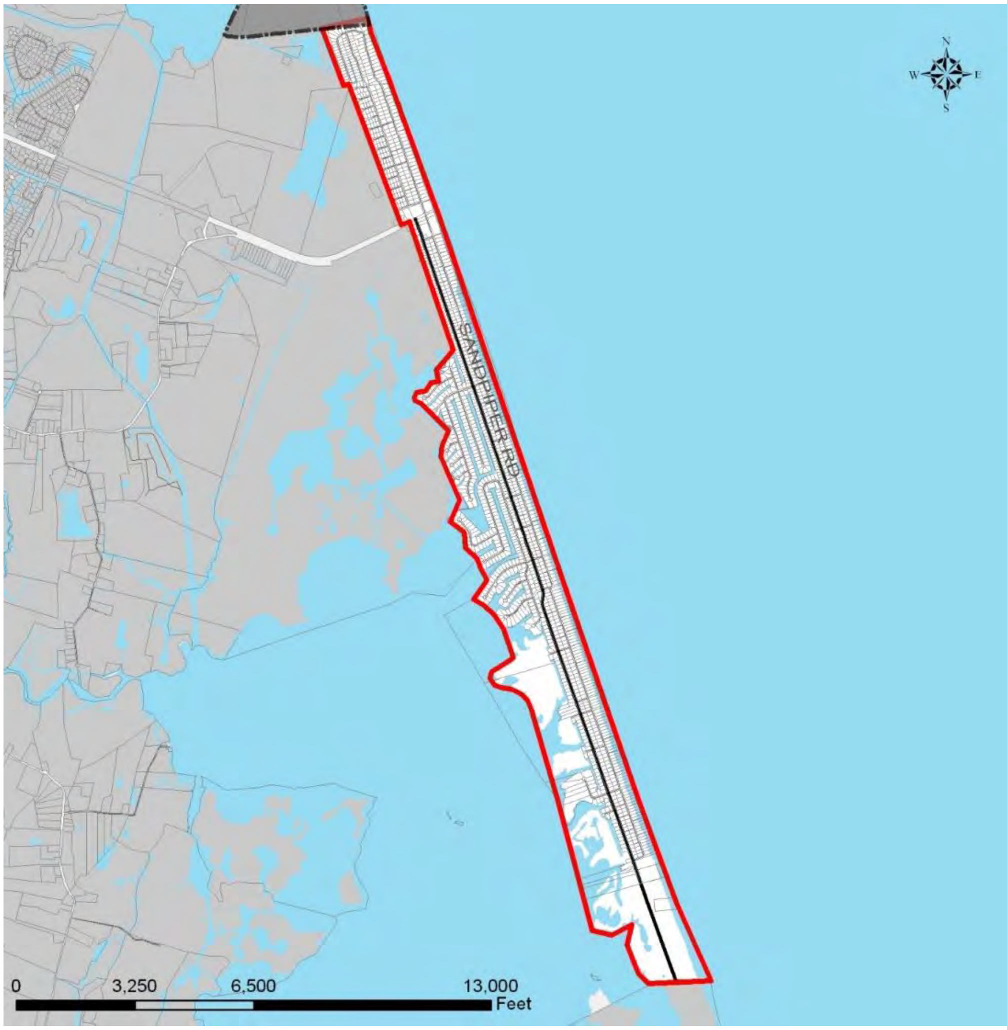
The Sentara Virginia Beach General Hospital anchors a major medical complex along First Colonial Road from Mill Dam Road south to Republic Road. The area includes medical offices, rehabilitation centers, senior housing, and a good mix of non-medical uses such as banks, general offices, places of worship and other neighborhood based services. Hampton Roads Transit service is also provided to this area.

RECOMMENDATIONS

- Priority should be given to infill or redevelopment proposals that complement the area's medical and health care activities.
- Because of the supportive land use and transportation services, residential and support uses that serve the needs of older adults are appropriate for this area.
- New development should include access management and cross-access between parcels to minimize impacts to First Colonial Road.

Sentara Virginia Beach General Hospital

SFA 6 - SANDBRIDGE



DESCRIPTION

The Sandbridge community is a stable, low-density, single-family community with about 1,200 dwelling units. It is located on a barrier island and sandbar between the Atlantic Ocean and Back Bay that extends from the Navy's Dam Neck Fleet Combat Training Base on the north to False Cape State Park to the south. A mid-rise condominium complex is located in southern Sandbridge and similar uses have recently been added as part of the neighborhood commercial center at the northern entrance to this area. Many of the dwellings are rented to visitors who prefer a slower, quieter atmosphere than that experienced at the Oceanfront Resort Area. A trend of large single-family houses being used for large family or friend vacation gatherings has become an issue in recent years and could become a destabilizing influence.

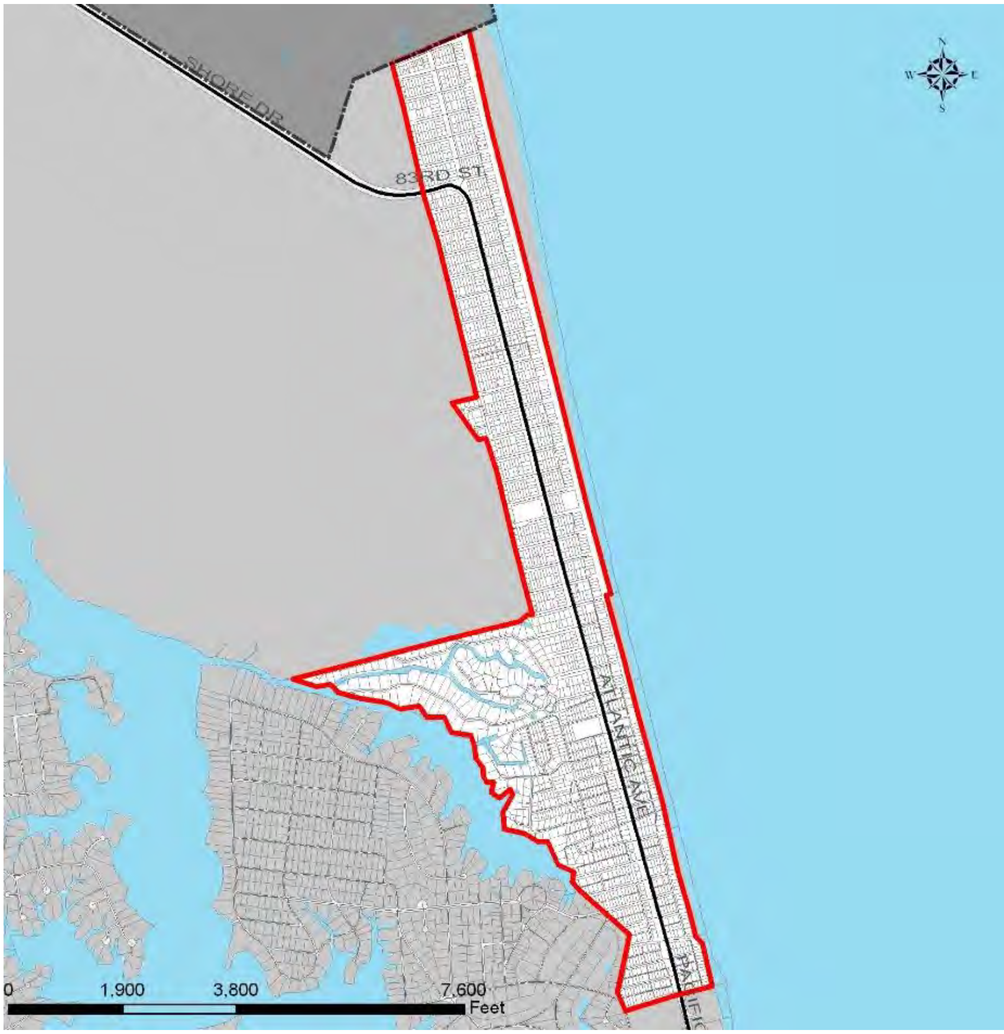
RECOMMENDATIONS

It is the policy of the City to retain the existing, low density neighborhood character of Sandbridge. The following land use recommendations apply to this area:

- Limited commercial uses may be added provided the type and extent of such uses are scaled to serve only the Sandbridge neighborhood and that the site and building designs are of high quality and consistent with physical characteristics of the neighborhood.
- Where opportunities present themselves, consider placing overhead utilities underground.
- Additional public parking and day use facilities should be provided to serve day visitors.
- Land uses in the Sandbridge community should be compatible with the environmental objectives of the Back Bay National Wildlife Refuge.
- The City and US Navy should continue their long-standing arrangement of providing, when necessary, an emergency public evacuation route from Sandpiper Road north through NAS Oceana Dam Neck Annex to Dam Neck Road.

Gateway to Sandbridge Beach resort community

SFA 7 - NORTH END



DESCRIPTION

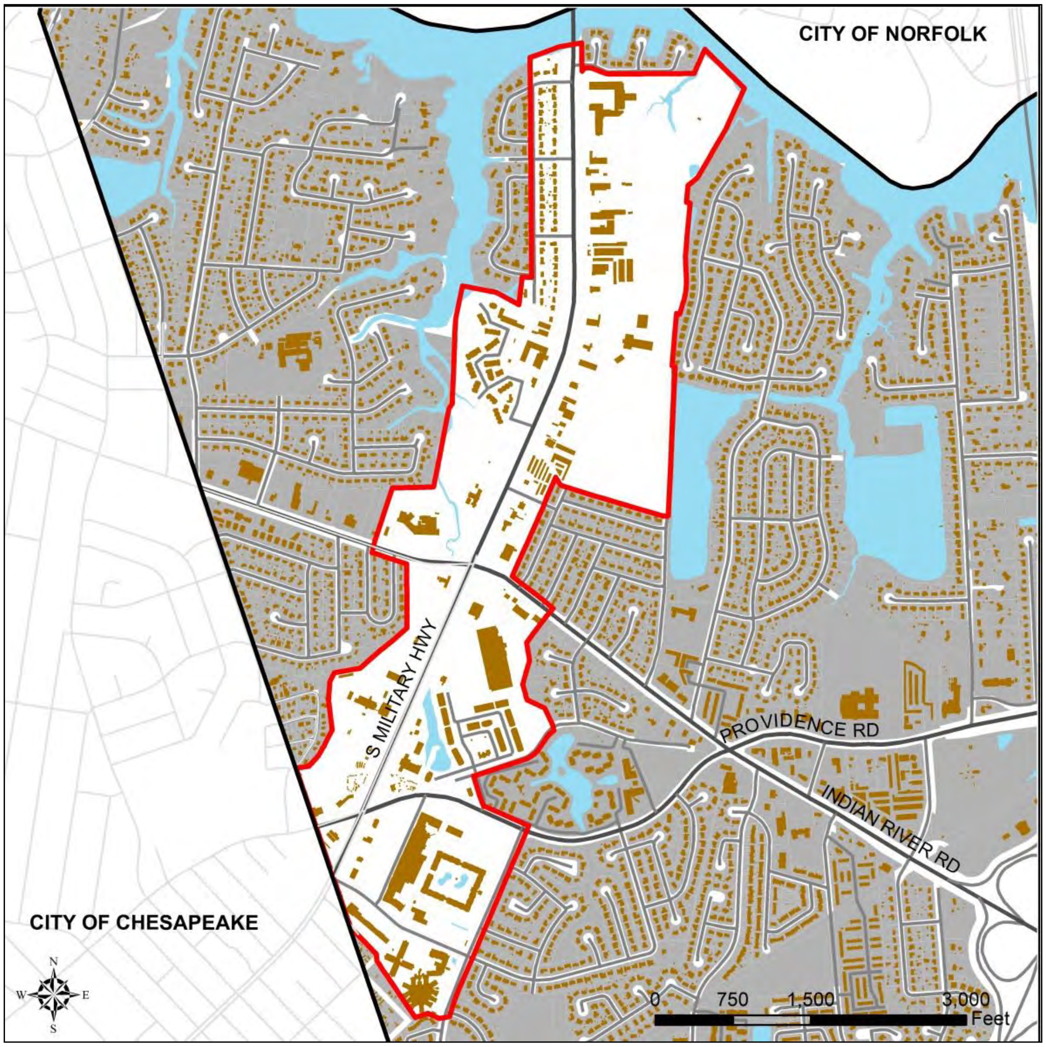
The North End, located on both sides of Atlantic Avenue from 42nd Street to 89th Street, is characterized by a compact arrangement of single-family and duplex dwelling units with much of the land zoned Residential Resort District (R-5R). The headquarters of Edgar Cayce's Association for Research and Enlightenment is a renowned landmark located at 67th and Atlantic Avenue. Another prominent building is the Wyndham Hotel located on the oceanfront at 57th Street. Moreover, the North End area is characterized by a relatively high density of single-family/duplex housing, high impervious surface coverage and problematic topographic conditions, all of which combine to create recurring stormwater drainage problems. The City has implemented drainage improvements in the North End area to help alleviate these situations. The neighborhoods in this area also experience parking and circulation problems. This area contains some significant historic structures.

Edgar Cayce's Association for Research and Enlightenment and adjacent private homes

RECOMMENDATIONS

- Parcel consolidation, density stabilization and the use of 'Best Management Practices' for stormwater control should be part of reconstruction efforts.
- Improvement and reconstruction should use porous materials for driveways, walkways and other similar surfaces, wherever feasible, to achieve a net reduction of impervious coverage.
- Attractive and high quality materials capable of withstanding severe weather events should be used.
- It is the policy of the city to preserve designated historic structures and efforts to retain these resources should be accomplished in a responsible and innovative manner.

SFA 8 - MILITARY HIGHWAY CORRIDOR



DESCRIPTION

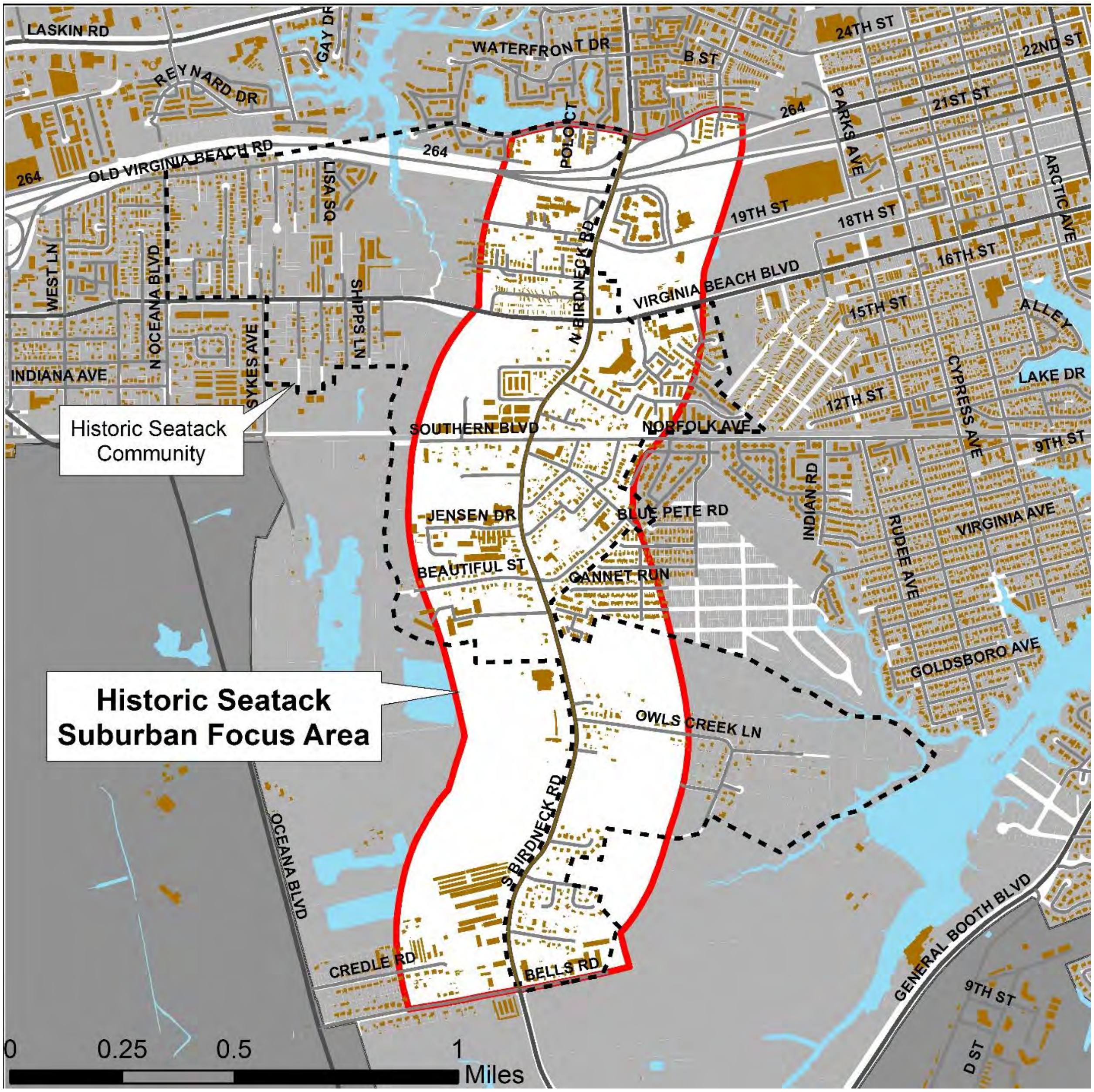
The general pattern of land uses along this one and one half mile corridor has remained essentially unchanged for decades. To the west is a low to medium density residential area and to the east are light industrial uses including auto and truck sales, rentals, and repairs, outdoor storage, and warehousing. Behind this industrial strip of land are Riverton and Lakeville Estates, both low-density, single-family residential neighborhoods. The Jonathan Cove neighborhood is located on the Elizabeth River north of the industrial area. An established neighborhood, West View Village, is located north of Indian River Road and west of the industrial uses on Military Highway. The land along Military Highway south of Indian River Road is used and zoned for commercial purposes.

RECOMMENDATIONS

- Replace the industrial activities with more compatible uses such as medium density residential, office, hotel, and institutional uses.
- Any change of land use in this corridor located near or adjacent to existing stable neighborhoods must be compatible uses and employ appropriate buffering features to protect the quality of life of those residential areas.
- The number of access points along Military Highway should be significantly reduced. Greater reliance on access management, inter-parcel access, and shared parking between uses is strongly recommended.
- New and redeveloped uses should improve the aesthetic of this corridor through high quality building design, signage and landscaping.
- All major land use changes considered for this area should be coordinated with the Cities of Chesapeake and Norfolk.

Intersection of Military Highway and Providence Road (looking north) [photo ©2016 Google Earth]

SFA 9 - HISTORIC SEATACK SFA & HISTORIC SEATACK COMMUNITY



DESCRIPTION

The Historic Seatack community, located in the City's Oceanfront Resort Area, is thought to be the oldest African-American settlement in Virginia and possibly in the United States. Outlined by the dashed black line on the above map, it is generally centered on the Birdneck Road corridor between Old Virginia Beach Road and Bells Road, on Virginia Beach Boulevard between West Lane and the convention center area, and along Southern Boulevard/Norfolk Avenue, and includes the area of Atlantic Park. It is bounded on the east by Lake Rudee, Owls Creek, and the Marshview Park area and on the west by the Oceana Gardens Neighborhood and the industrial and residential areas just east of NAS Oceana. The original settlement, which was once much larger extending to the present day Virginia Beach oceanfront, was formed by free men and dates back to the late 1700s to early 1800s. The area eventually took its name from the words "Sea Attack," based on British warship cannons positioned off the Virginia Beach shoreline that fired inland during the War of 1812. A more detailed accounting of the Seatack community's history is located in the Technical Report.

Seatack is an integral part of the Resort Area and, while primarily a residential community with supporting religious institutions and public facilities, such as a neighborhood park and recreation center, it also includes some businesses and light industry. With the improvement of Birdneck Road, this area is now well-served by a strategically located transportation corridor.

Much of the SFA is constrained by the Special Flood Hazard Area, is owned by the Federal Government or has Navy restrictive easements, is impacted by military aircraft accident potential zones (APZ-1 and APZ-2) and the highest noise zones (70 – 75 dB DNL and greater than 75 dB DNL). Per market trends and the requirements of Article 18, Special Regulations in Air Installations Compatible Use Zones (AICUZ) Overlay, new development and redevelopment of property within the SFA has occurred with uses compatible with flight operations at nearby NAS Oceana. In some cases, this development activity has altered the character of this historic community.

The SFA is in a flat, low-lying area in proximity to waterways and wetland areas in the Lynnhaven River system and the Owls Creek watershed. Drainage issues and recurrent flooding, especially associated with new development, have been observed which has, in some cases, negatively impacted existing residential areas.

There are several significant historic and cultural landmarks in this SFA that are important to the history and progress of the community. They should be recognized and/or protected as local historic or cultural landmarks. There may be opportunities to place historical markers at some of these sites and/or have them included on the Virginia Beach Historic Register through nomination by the property owners.

The recommendations for the Historic Seatack SFA are found below and are focused on the properties encompassed by the solid red line on the above map.

RECOMMENDATIONS

1. All new development, redevelopment and additions to structures should adhere to the City Zoning Ordinance requirements established in Article 18, Special Regulations in Air Installations Compatible Use Zones (AICUZ) Overlay.

2. All new development, redevelopment and additions to structures, will, as required, adhere to the requirements of Code of Virginia Beach, Appendix I, Airport Noise Attenuation and Safety Ordinance.

3. New development should respect the historic settlement of this area and should be compatible with the neighborhood. Significant landscape screening buffers should be established between existing residential areas and new non-residential development to mitigate adverse visual and noise impacts.

4. A careful mix of compatible land uses should be maintained where they currently exist and should be encouraged as new land uses are proposed so as to contribute to the day-to-day life of community residents.

5. Uses incompatible with existing residential should be discouraged to minimize impact to adjacent residential neighborhoods.

6. Building design should be visually interesting, encourage greater social interaction, and provide a memorable character.

7. Neighborhood identification signs should be installed at neighborhood entrances/gateways.

8. Recognition of historic and cultural landmarks and sites should be encouraged by nomination to the Virginia Beach Historical Register or and/or by the installation of interpretive historic site markers.

9. In partnership with and guidance from the Seatack Community, explore the potential benefits and regulatory impacts of delineation and adoption of a local Historic and Cultural District, if desired by the community and property owners.

10. All new development should be designed such that site drainage and stormwater management does not negatively impact adjacent parcels.

11. Maintain stormwater facilities and encourage the retrofit of existing drainage system problem areas.

12. New development, redevelopment, and site improvements should be encouraged to use porous materials for driveways, walkways and other similar surfaces, wherever feasible, to achieve a net reduction in impervious coverage.

13. Enhance landscaping in the Birdneck Road medians where there are opportunities to do so.

14. The Virginia Aquarium and City's Marshview Park improvement projects should provide education and recreation opportunities for Seatack residents through neighborhood outreach programs.

15. New development and public facilities improvements should accommodate multiple modes of transportation (e.g. pedestrians, bicyclists, and drivers) and accessibility needs.

AGENDA FOR FUTURE ACTION RECOMMENDATIONS: Suburban Area

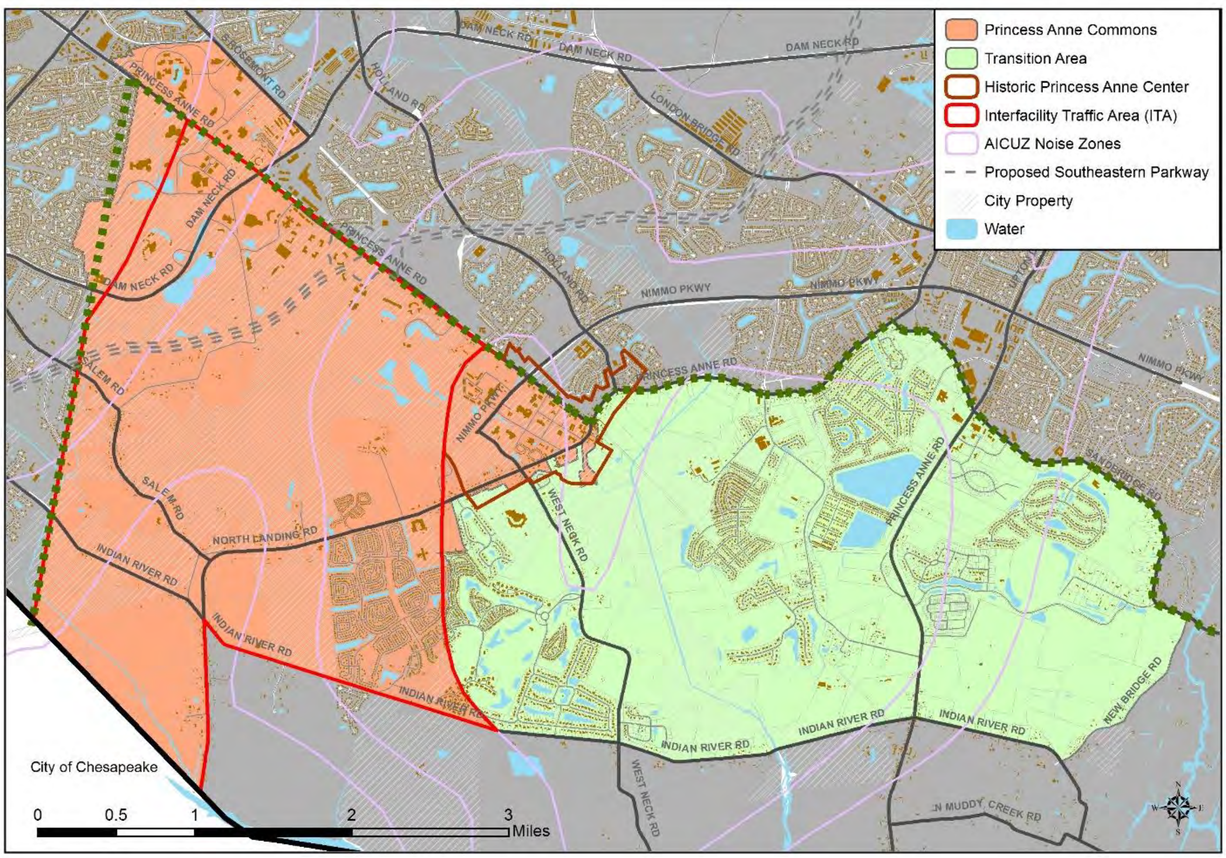
- Develop infill development guidelines as a component of the "Special Area Development Guidelines: Suburban Area" in the Reference Handbook.
- Develop tools to encourage new investment in declining commercial centers.
- Develop tools to assist distressed property owner associations with the preservation and maintenance of neighborhood parks and open spaces.
- Revise the Suburban Area section of the Comprehensive Plan as appropriate when sea level rise and recurrent flooding policies are developed and/or adopted by the City Council.
- To ensure that the function of Princess Anne Road is not reduced due to numerous access points within Suburban Focus Area 2.1 (North Courthouse), the City should construct all or a portion of at least two lanes of London Bridge/Drakesmile Extended.
- Study the area between Holly Road and Pacific Avenue, north of 32nd Street to 42nd Street (the southern boundary of North End SFA) to determine need for infill development and redevelopment policies and design guidelines.

1.4 - PRINCESS ANNE COMMONS & TRANSITION AREA

INTRODUCTION

Princess Anne Commons and the Transition Area are strategically located below the "Green Line," between the Suburban Area of the City to the north and the Rural Area to the south. This area is an important component of the City's overall smart growth land use planning strategy. The "Green Line" is the boundary between the more densely populated and higher intensity urban and suburban land use areas of the City, which are intended to be served by a full range of public infrastructure and services, and the less-populated lower density, recreational, and rural areas, which are characterized by an abundance of natural resources, larger open spaces (including federal, state, and local parks), and the City's prime agricultural lands.

It is not the intent of the Comprehensive Plan that Princess Anne Commons or the Transition Area become part of the urbanized area north of the Green Line. It is also not intended that Princess Anne Commons, or the Transition Area be limited to the very low densities appropriate for Rural Area preservation.



PRINCESS ANNE COMMONS & TRANSITION AREA MAP

Natural Resources Planning and Protection

Princess Anne Commons and the Transition Area include natural resources and environmentally sensitive expanses that are designated as not only part of the Southern Watershed, but also are included in the *Green Sea Blueway and Greenway Management Plan*. The principal effects of this designation are presented below:

- *Southern Watershed Management Plan and Ordinance*

The Southern Watershed Management Plan was adopted as a part of this Comprehensive Plan in 2001 (www.vbgov.com/Planning) and is implemented by the Southern Rivers Watershed Management Ordinance. The ordinance is intended to protect, enhance, and restore the quality of waters within the Southern Watershed of the city. The ordinance applies to development of any lands within the Southern Watershed (North Landing River Watershed, Northwest River Watershed, the Small Coastal South Watershed, and the Back Bay Watershed) and any artificial alteration of the level or flow of any watercourse or impoundment of water, with exceptions as noted in Section 6 of the ordinance; and, agricultural lands/agricultural activities to the extent set forth in Section 10 of the ordinance. The ordinance establishes development performance standards. Furthermore, the developer of any land within the Southern Watershed shall, prior to undertaking any land-disturbing activity, submit a Southern Watershed Management Plan if such development is subject to the additional performance standards set forth in Section 7(e), which excludes single-family dwellings or duplexes separately built and not part of a subdivision.

- *Green Sea Blueway and Greenway Management Plan*

The *Green Sea Blueway and Greenway Management Plan (*www.vbgov.com/Planning), adopted in 2015, is a regional plan collaborated on by the City of Chesapeake and Currituck County, North Carolina. It is a conservation and management plan to protect the abundance of unique and diverse natural resources, open space lands, and potential recreational opportunities existing along three connected rivers – the North Landing River in Virginia Beach, the Albemarle and Chesapeake Canal in Chesapeake, and the Currituck Sound in Currituck County, North Carolina. The purpose of the plan is to develop a long-term management strategy that protects, conserves, and manages a unique system of natural resources, open space areas, and carefully-selected recreational uses that are sustainable. The primary focus of the plan is on the waterway as a regional resource with unlimited opportunities for stewardship and enjoyment that can be shared for future generations. The *Green Sea Blueway and Greenway Management Plan* is important to the context of the Princess Anne Commons Area because of its alignment with the Comprehensive Plan policies and similar plans adopted by reference established to accomplish the following: preserve cultural heritage; sustain agricultural production; preserve, protect, and promote the area's unique natural resources in a sustainable manner; improve stormwater management and floodplain protection; protect undisturbed open space land; provide low-impact recreational uses where opportunities exist; identify and protect wildlife corridors; manage invasive plant and animal species; and encourage and promote reasonable uses and activities that are complimentary to the character and integrity of the rural area for the use and enjoyment of future generations. The plan advocates the importance of the Princess Anne Commons Area and the need to retain its distinction and attributes not found in the City's Urban and Suburban Areas.

Southern Watershed Subject to "Special Drainage Considerations"

The Southern Watershed portion of the Princess Anne Commons and the Transition Area is subject to "special drainage considerations" (see Southern Watershed map, Chapter 1, Section 1.5 - Rural Area). Drainage in the Southern Watershed is highly impacted by the presence of high ground water, poorly draining soils, and high water surface elevations in downstream receiving waters. Therefore, it is incumbent upon the developer of any property in the Southern Watersheds to understand and evaluate these factors prior to undertaking the project and to properly account for these factors in the project design. Receiving waters in the Southern Watersheds are subject to tidal influences which can be exacerbated by winds. High ground water elevations and poorly draining soils can result in increased runoff, can limit the capacity of the stormwater conveyance systems, and can counter indicate the use of certain Best Management Practices, such as infiltration.

All of these effects must be fully considered and evaluated in the analysis and design of drainage systems in the Southern Watersheds. Accordingly, it is recommended that the developer has a preliminary drainage study prepared by a qualified professional engineer in advance of any request to approve a discretionary (versus by right) development that involves land disturbance in the Southern Watershed. The drainage study should fully and accurately evaluate the effects of the foregoing factors on the planned development and on upstream and downstream areas. The proposed drainage system for the planned development would provide positive drainage that meets City standards and does not result in flooding within the planned development or to upstream or downstream areas.

Indian River Road State Scenic Byway Designation

Indian River Road, which forms the southern boundary of both Princess Anne Commons and the Transition Area, is designated as a Virginia Byway as a part of the Virginia Byways program. The Byways program is managed by Virginia Department of Transportation (VDOT) in partnership with the Department of Conservation and Recreation (DCR). The Virginia Byways program recognizes roads that border areas of historical, natural, and recreational significance as a way to encourage exploration of interesting destinations in less traveled corridors.

The following subsections present general and specific-area policy recommendations for Princess Anne Commons and the Transition Area.

PRINCESS ANNE COMMONS

DESCRIPTION

Princess Anne Commons includes the Interfacility Traffic Area (ITA), as well as additional surrounding areas including the area north of the Green Line where Tidewater Community College, the Higher Education Center, and LifeNet are located, as well as most of the Princess Anne Historic and Cultural District to the east. Also, part of Princess Anne Commons and the ITA is the property owned by the City south of Indian River Road, formerly owned by Rock Church.

VISION

The Princess Anne Commons area of the City offers unique education, entertainment, recreation, habitat preservation, and quality economic development opportunities. It is a true jewel within Virginia Beach. The policies of this Comprehensive Plan have been designed to ensure that Princess Anne Commons continues to be a well-planned area.

City Hall located in the Municipal Center portion of the Princess Anne Commons Area

Amphitheater in North Princess Anne Commons Area

The vast majority of Princess Anne Commons is included in the Interfacility Traffic Area (ITA). The ITA is a product of the *Hampton Roads Joint Land Use Study* and the City's Oceana Land Use Conformity program. The ITA was created in 2005 to address land use compatibility issues associated with frequent overflights of military jets in this part of the City. The boundary of the ITA generally overlaps the area of Princess Anne Commons impacted by noise zones at or greater than 65 dB DNL. The planning policies affecting the ITA have been carefully written to achieve compliance with the provisions of the City's adopted Oceana Land Use Conformity program.

The entire ITA is subject to certain development limitations due to jet noise restrictions; therefore, the area has been carefully planned to achieve a coherent and compatible land use pattern. Of the roughly 6000 acres within this special area, less than half are developable due to the presence of water, wetlands, existing development or other constraints. The alignment for the Southeastern Parkway & Greenbelt traverses the northern portion of the ITA in a northeast to southwest direction.

Due to the incompatibility of residential uses in these high noise zones as well as it being undesirable to have new residential dwellings within the ITA, one of the principal effects of this is a reduction in residential density to what could be achieved by right with Agricultural zoning (one unit per 15 acres). A second effect was an increase in the area owned by the City of Virginia Beach, as the City and U.S.

Navy began a program of purchasing property voluntarily offered to the City. This program has led to ownership by the City of Virginia Beach of approximately half of the area. The City Council adopted the *Interfacility Traffic Area (ITA) and Vicinity* Plan as a component of this Comprehensive Plan to establish a vision for the use of the ITA as well as to ensure the ITA develops only with those uses compatible with the purposes of the Interfacility Traffic Area.

Interfacility Traffic Area (ITA) & Vicinity Master Plan

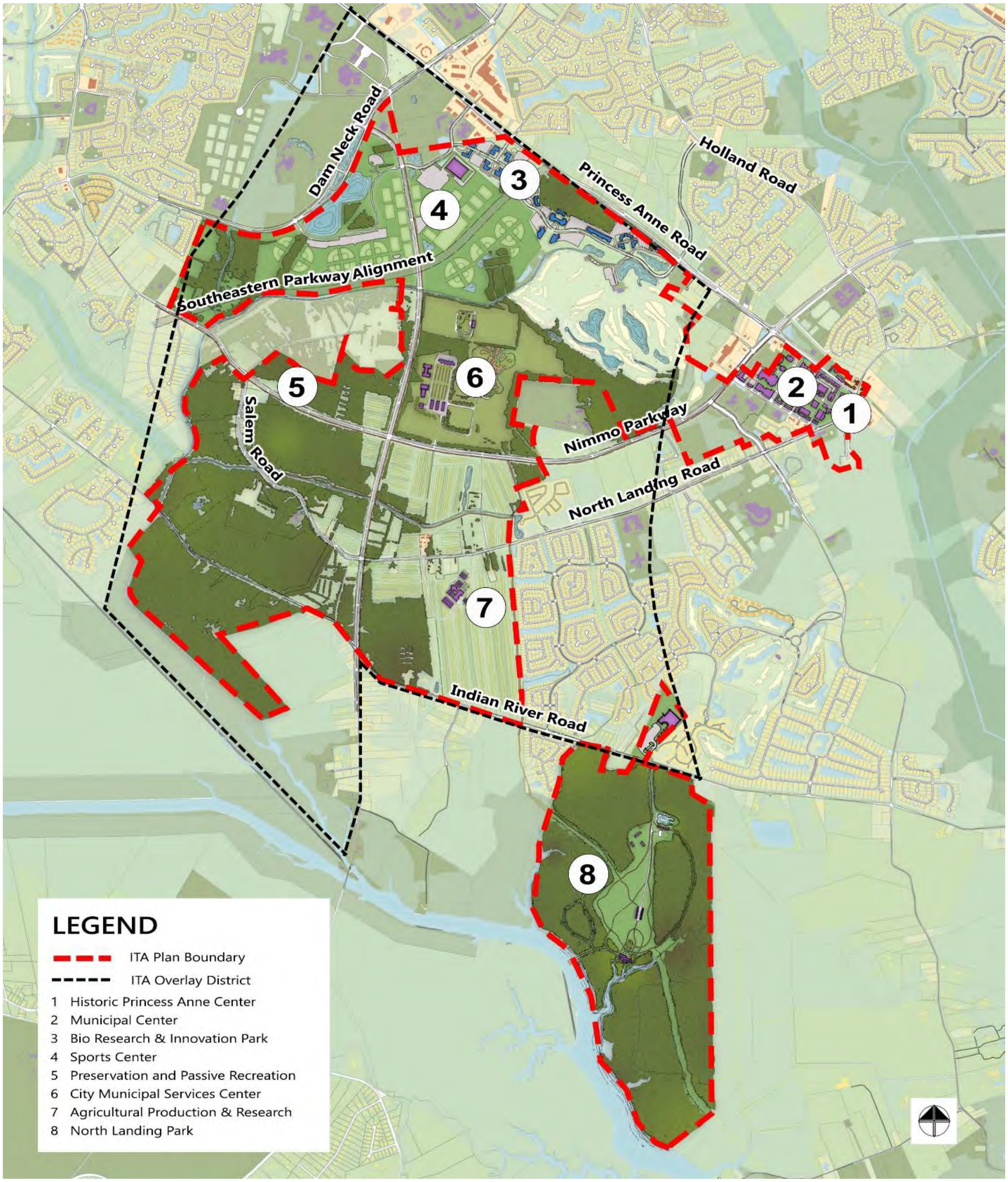
The vision for the ITA was established in 2011 with the adoption of the *ITA and Vicinity Master Plan*. The ITA Plan was prepared with effective community involvement to provide planning policy guidance in the areas of land use, transportation, environmental stewardship, infrastructure, public service delivery, economic vitality, AICUZ compatibility, and community design. During the five years after the adoption of the 2011 ITA Plan, there were changes in the area's characteristics that pointed to a need to update the plan to insure it continued to provide a realistic vision. In particular, the transition in the property ownership from private to public, with the resulting increase in the percentage of the ITA controlled by the City, offered opportunities that were not available in 2011. In 2016, work began to update the 2011 ITA Plan, and in 2017, the City Council adopted a revised version of the plan that sets out a vision based on realities and opportunities not available in 2011. Specific policies from this plan are provided later in this section.

The ITA Plan's vision framework continues to move the Princess Anne Commons area forward in a direction that reflects the area's history, is sensitive to the environment, and acknowledges existing assets already in place for those portions of this special area. Adopted land use patterns have now made this area more compatible with the operations of the airfields in the region.

The *Interfacility Traffic Area & Vicinity Master Plan* focuses on conservation and preservation of sensitive uses, amenities for residents, employment, municipal services, and recreation. Employment and research will be focused in the VBBio Innovation Park adjacent to the Virginia Beach National Golf Course. More dense development remains clustered along Princess Anne Road at the Municipal Center and North Princess Anne Commons. At the Municipal Center and Historic Princess Anne areas, as designated by the ITA Plan, residential uses outside of the AICUZ can be provided to create vibrant mixed-use districts where people can live, work, and recreate within walking distance to services and gathering spaces. The active recreation around Dam Neck Road can be expanded to include new types of recreation and sports not currently offered. Existing farmland provides opportunities for the conservation of valuable productive land in Virginia Beach, possibly evolving into a research farm. Special destinations could be developed that fit with the natural environment, including an agricultural research center, Wildlife Rehabilitation Center, environmental conservation center, and Municipal Services Facility. Enhancing natural features will allow improved stormwater management and flood controls. Throughout the area, trail and open space would connect the uses. Thoughtful implementation of this vision will position Princess Anne Commons and, thus, Virginia Beach as a leader in sustainable urban edge economic development.

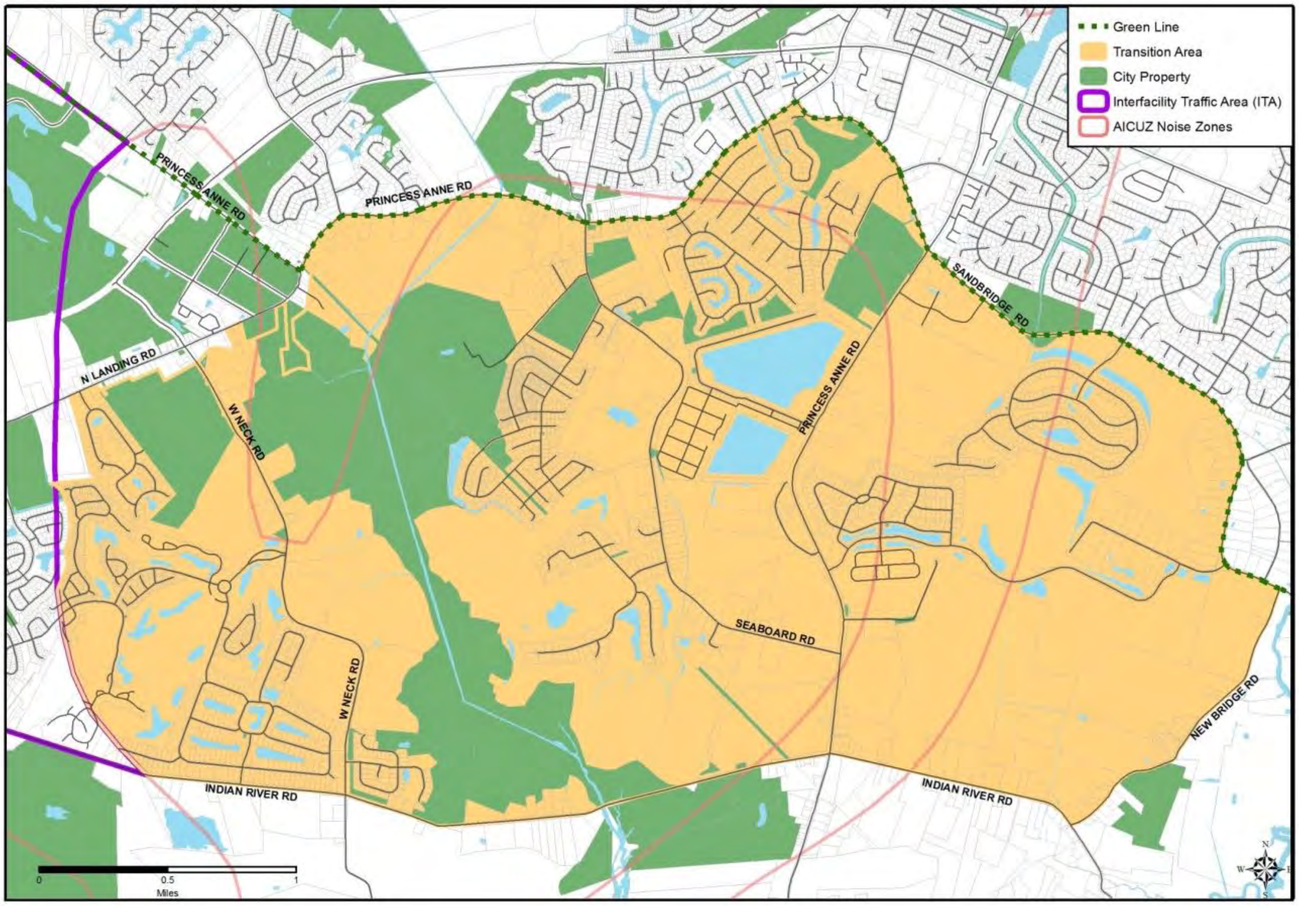
The northern portion of the area addressed in the *ITA and Vicinity Master Plan* has also been designated as "Special Economic Growth Area 4 (SEGA 4) - Princess Anne," recognizing the land development constraints and economic development opportunities associated with this area's location within a military aircraft overfly zone. Specific information and recommendations for SEGA 4 are provided in Chapter 2, Section 2.4 – Economic Vitality.

The recommendations of the *ITA and Vicinity Master Plan* are to be followed for the remaining portion of Princess Anne Commons south of SEGA 4. For those areas outside the boundary of the *ITA and Vicinity Master Plan* (see map below), land use will be as allowed by the existing zoning, as well as being consistent with the Interfacility Traffic Area (ITA) Overlay District regulations.



Interfacility Traffic Area & Vicinity Master Plan - Vision Concept (2017)

TRANSITION AREA



TRANSITION AREA LOCATOR MAP

DESCRIPTION

The Transition Area lies to the east of Princess Anne Commons. It consists of approximately 5,900 acres, bounded by Princess Anne and Sandbridge Roads along the 'Green Line' to the north, North Landing Road and the Princess Anne Commons area border to the west, Indian River Road to the south, and New Bridge Road to the east. The Transition Area is impacted by high noise AICUZ to a lesser extent than Princess Anne Commons and the ITA and, therefore, is more suitable for a limited amount of residential development. It is characterized by several high quality neighborhoods that include significant open space and recreational areas, including City park facilities, golf courses, public trails in roadside buffers, and equestrian centers. Commercial development is primarily located at major intersections. Some lands remain under cultivation or in minerals extraction. Approximately 30% of the Transition Area is City-owned parkland or contains soils that are defined by the City Zoning Ordinance as being undevelopable. The area is served primarily by rural roads, some of which are proposed to be improved over time, as indicated in the Master Transportation Plan. Indian River Road is designated as a "State Scenic Byway." Public utilities are intended to be extended through private development in a phased, orderly manner on a cost-participation basis. The western part of the Transition Area is bisected by the City-owned West Neck Creek Park corridor, a major natural corridor. The eastern part of the Transition Area, east of Princess Anne

Road, is prone to flooding from sheet flow, wind-driven tides, increasingly rising waters, and limited drainage infrastructure, according to farmers who cultivate the area. This is due, in part, to the existence of a topographic feature known as the "Pungo Ridge," one of the City's three primary north-south ridges of land suitable for cultivation that are separated by low-lying flats. The Pungo Ridge has elevations of 18-20 feet above mean sea level. In the Transition Area, the Pungo Ridge resembles a large "turtle back" with changes in elevations from 10-14 feet down to 2-4 feet. This change in elevation results in changes in soil types, including the presence of hydric soils, sometimes in just a very short distance. This natural landscape feature, coupled with the occurrence of a high water table, can severely limit development opportunities in this area. The eastern edge of the Transition Area is close to the headwaters of Back Bay and the Back Bay National Wildlife Refuge. Both the West Neck Creek Park corridor and Back Bay help define the Transition Area and provide unparalleled amenities for those who reside in or visit the area for recreational purposes.

VISION

Paddling along West Neck Creek Natural Area

The vision framework for the Transition Area is as a distinct place with inherently unique environmental characteristics and constraints that must be carefully considered when designing for development. Development policies for the Transition Area are not intended to be a continuation of the higher density development patterns and form found in the Suburban and Urban Areas to the north. Rather, they enable a more limited type of development, with its own development standards suitable to the character of the Transition Area, where greater integration of natural resources and more open space is planned to respect and protect the unique natural character of the area and to enable a true transition into the Rural Area to the south.

Since the Transition Area is meant to serve as a buffer between the City's Suburban and Rural Areas, it should provide an apparent visual shift from suburban development character and form to rural development character and form as one travels from north to south. Therefore, development in the Transition Area should reflect a noticeable transitional pattern with contiguous and unified open space throughout, also in keeping with the accompanying *Transition Area Design Guidelines*, which are adopted by reference as part of this Comprehensive Plan and are available in the online document library at www.vbgov.com/Planning. These guidelines articulate a high quality, 'Rural Transitional' design theme, unique to the Transition Area vision.

The Transition Area policies and *Transition Area Design Guidelines* also support the *Virginia Beach Outdoors Plan* by emphasizing trail connectivity and preservation of open space, waterways, and other natural resources. The policies for the Transition Area support the Urban and Suburban Areas growth pattern goals and redevelopment opportunities in the area to the north above the Green Line, and the Rural Area preservation goals affecting the area to the south, below Indian River Road.

The Transition Area policies also support the goals of the *Southern Watershed Area Management Plan,* and the City's AICUZ zoning regulations. Furthermore, the policies support an appropriate mix, intensity, and scale of high quality, residential and non-residential development, while sustaining our agricultural industry in this area and to the south. All open space areas should be connected by trails to provide for a continuous open space system throughout the Transition Area. All development in the Transition Area should be considered relative to its impact on current and planned infrastructure and to other discretionary development proposals.

RECOMMENDATIONS

To enable the vision framework and policies for the Transition Area, all new development and redevelopment in the Transition Area should adhere to the following general recommendations and the *Transition Area Design Guidelines*.

Development & Uses:

- Development should be creative and of high quality.
- Uses should be limited to low-impact, low-density residential, low-intensity non-residential, open space and recreational, and agricultural, including row-crop farming and equestrian uses.
- Uses should necessitate limited roadway improvements (e.g., turn lanes).
- For residential development, a maximum average calculated density of up to and no more than one unit per developable acre can be earned through demonstrated conformance with the *Transition Area Design Guidelines*.
- Minimum lot sizes of 15,000 square feet are preferred. Lot sizes less than 15,000 square feet are appropriate if additional active open space location recommendations as set forth in the *Transition Area Design Guidelines* are incorporated into the site design.
- Non-residential uses should be "neighborhood-serving." These are uses that are scaled to support the needs of nearby residential neighborhoods, users of the Transition Area's open space and recreational areas, and agricultural users.
- Non-residential uses should be located at major roadway intersections or, if as part of a mixed use plan of development, located at the entrance to the neighborhood or interior to the neighborhood around a central green or open space.
- Development within floodplains is strongly discouraged.
- Ensure all development proposals conform to the provisions of the Oceana Land Use Conformity Program and AICUZ provisions in the Zoning Ordinance, the Southern Watersheds Area Management Plan and Ordinance, and all other applicable development regulations.

Design Principles:

- Design with nature using low-impact development techniques and creative design to minimize impervious surfaces, protect natural resource areas and open spaces, address stormwater management requirements, and optimize site amenities.
- Open space should be deliberately included and designed as a site amenity in all development.
- Stormwater management techniques should be designed as site amenities and retention areas and should not be isolated behind buildings.
- Protect historic structures and sites and incorporate them into site design either through preservation or adaptive reuse. Such extant structures and sites are reminders of the rural heritage and character of this part of the City.
- Residential and non-residential use design should reflect a "Rural Transitional" architectural theme (refer to the *Transition Area Design Guidelines* for examples).
- When developing in proximity to a designated "Special Place" (e.g., Municipal Center, Historic Nimmo Church, Pungo Village, and the Ecological Awareness Center at Back Bay), incorporate design elements that are contextually relevant to that Place to ensure compatibility (refer to *Transition Area Design Guidelines* for "Special Place" locations and descriptions).
- For residential development, parcel consolidation is encouraged to enable larger development sites that can be designed creatively.
- Non-residential site design should focus on providing an attractive streetscape view into the site from the roadway.
- Parking areas should be situated behind or on the side of buildings and should incorporate landscaping throughout the parking areas to enable bio-retention of stormwater runoff.
- Signage should be complementary in scale and style to the use, constructed of high quality and long-lasting materials, and externally-illuminated.
- Fencing should be of an open style to create or maintain a sense of open space throughout the Transition Area.

Example of residential development in the Transition Area – Matthews Green Neighborhood

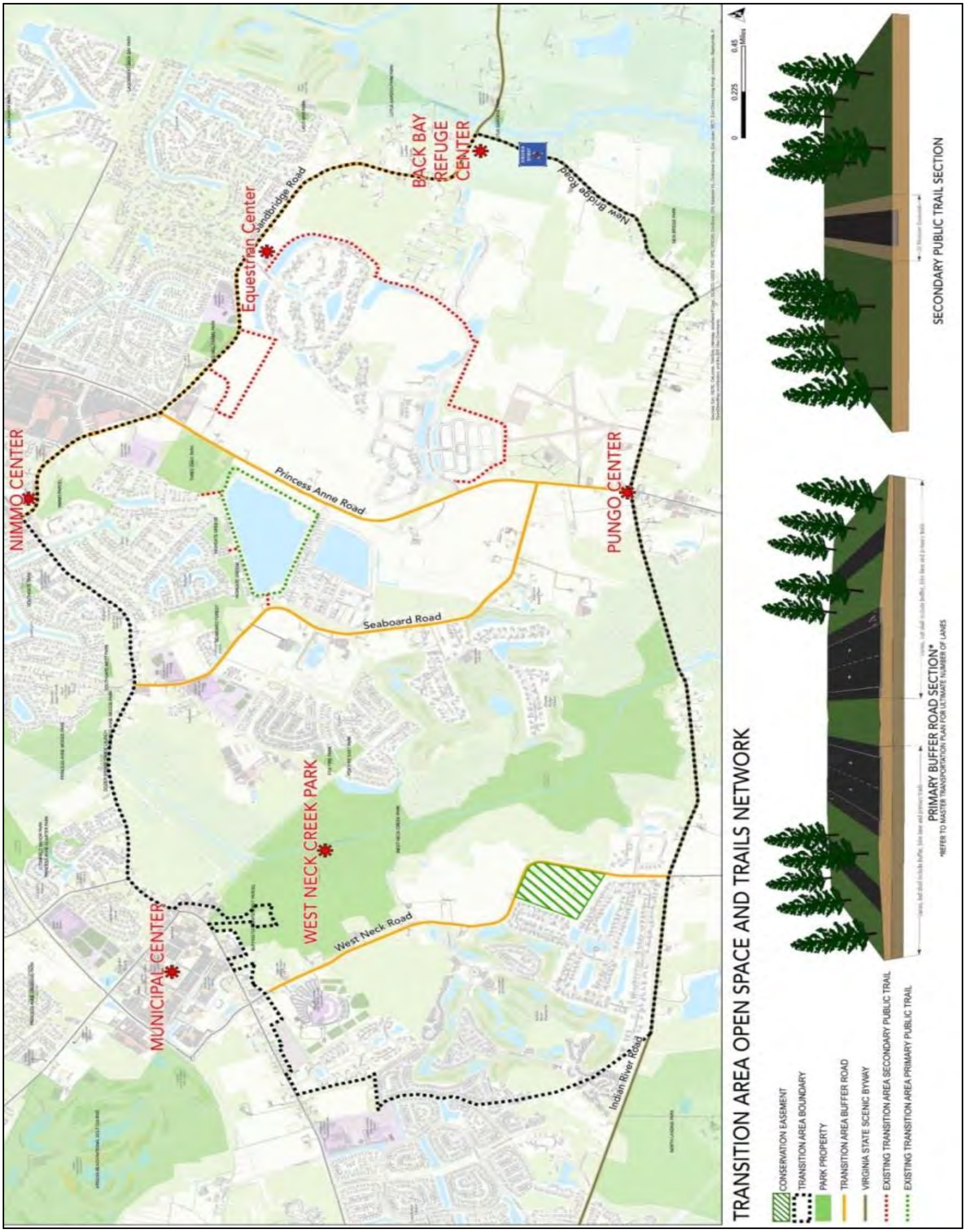
Context-sensitive neighborhood commercial use near Nimmo Church

Open Space and Recreation:

Open space in Heritage Park Neighborhood

- For residential development, 50% of the developable area should be designed to provide a balance of both "active" and "passive" open space areas, which should be clearly designated, respectively, on the development plan.
- For non-residential development, 30% of the developable area of the subject property should be designed as open space and clearly designated on the development plan. Such open space should not be limited to stormwater management facilities.
- A well-planned system of multi-purpose public trails should be included in all development to provide non-vehicular mobility, recreational opportunities, and connectivity to the larger Transition Area Open Space and Trails Network. A balance of both "primary" and "secondary" trails should be provided and clearly designated on the development plan.
- Open space and recreational areas, trailway design, and connections should be designed to help implement the Transition Area Open Space and Trails Network and the goals of the *City of Virginia Beach Outdoors Plan.* Roadway buffers should be designated along selected roadways (as shown on the "Transition Area Open Space and Trails Network" plan/map below and in the *Transition Area Design Guidelines)*, containing both landscaping and a primary public multi-purpose trail within a public access easement, to provide for screening of development and to promote trail connectivity throughout the Transition Area. These buffers may be used for open space and residential density calculations.

Roadway buffer with primary trail along Seaboard Road


TRANSITION AREA OPEN SPACE AND TRAILS NETWORK
NIMMO CENTER
MUNICIPAL CENTER
WEST NECK CREEK PARK
Equestrian Center
BACK BAY REFUGE CENTER
PUNGO CENTER
Princess Anne Road
Seaboard Road
West Neck Road
Indian River Road
New Bridge Road
Sandbridge Road
CONSERVATION EASEMENT
TRANSITION AREA BOUNDARY
PARK PROPERTY
TRANSITION AREA BUFFER ROAD
VIRGINIA STATE SCENIC BYWAY
EXISTING TRANSITION AREA SECONDARY PUBLIC TRAIL
EXISTING TRANSITION AREA PRIMARY PUBLIC TRAIL
PRIMARY BUFFER ROAD SECTION*
*REFER TO MASTER TRANSPORTATION PLAN FOR ULTIMATE NUMBER OF LANES
SECONDARY PUBLIC TRAIL SECTION

Infrastructure:

- All development in the Transition Area should be considered relative to its impact on current and planned public infrastructure. Connectivity to existing public facilities infrastructure, also known as "Public Infrastructure," should be required for all discretionary development.
- Many roads in the Transition Area are presently 2-lane rural roads. Improvements are contingent on necessity and sufficient capital funding." Likewise, consideration should include roadway design safety and capacity for future relevant Capital Improvements Plan (CIP) projects.
- Connection to public sanitary sewer and water is preferred. However, if a parcel is proposed to be served by a private septic system or an alternative on-site sewage system (AOSS), ensure that the lot area is of sufficient size and soil suitability to install a replacement system in case of original system failure.
- Public utilities service extension should be incremental and in an orderly fashion.
- Development should respect the Master Transportation Plan by providing reservations or dedications for planned road improvements.
- Incorporate stormwater management into project design according to state stormwater management regulations. Use a systems approach to stormwater management, incorporating a range of stormwater management techniques. Wherever feasible, consider multi-site or regional stormwater management facilities and design them as site amenities.

AGENDA FOR FUTURE ACTION RECOMMENDATIONS: Transition Area

- Explore the feasibility of expanding the Agricultural Reserve Program to include properties located in the Transition Area. This could better enable the desired "transition" along the border of the Transition Area immediately adjacent to the City's Rural Area, as per the above vision statement for the Transition Area.

1.5 - RURAL AREA

INTRODUCTION

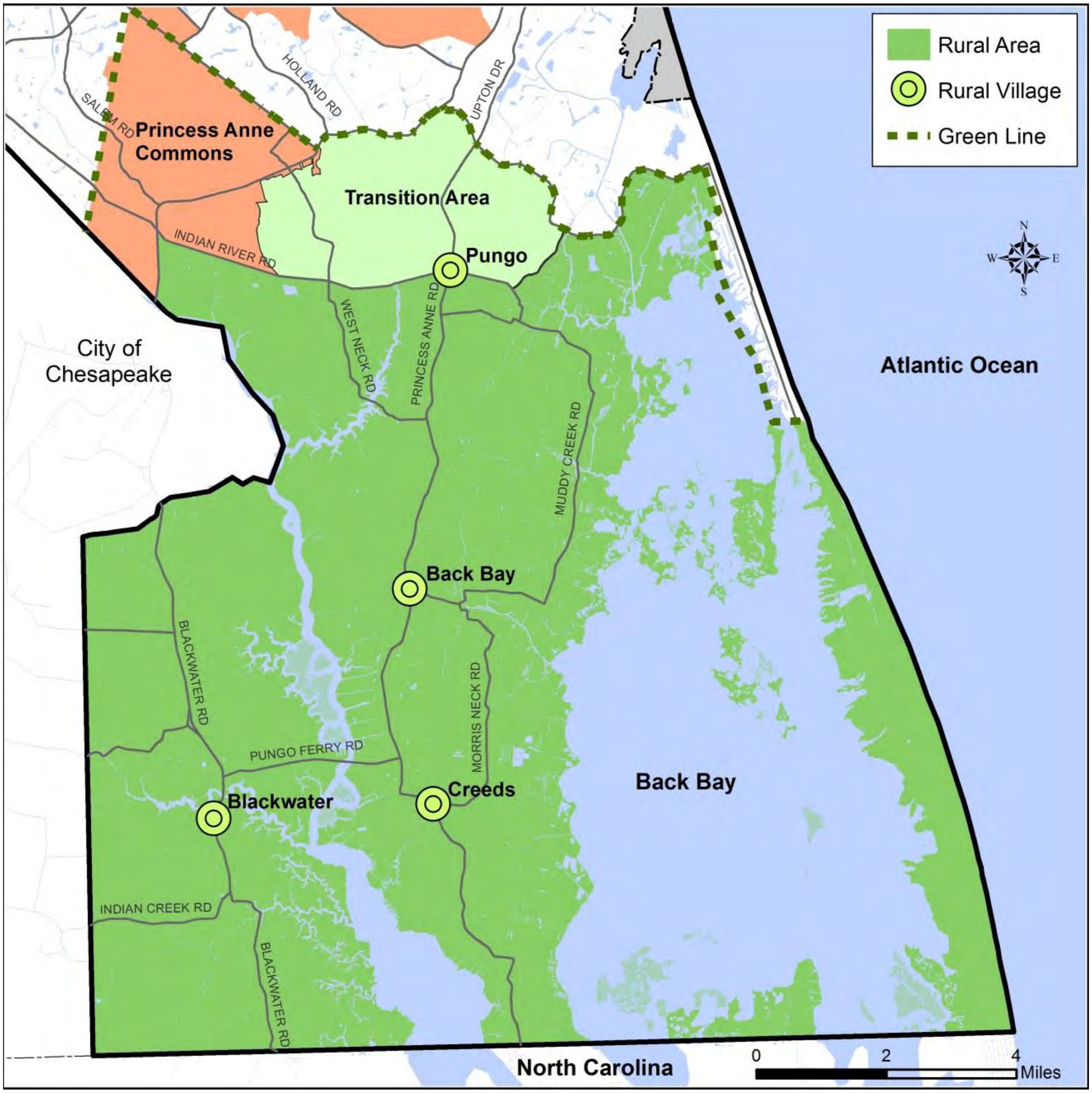

Transplanting strawberry plants (courtesy Cromwell's Produce)

The Rural Area comprises nearly 145 square miles of land, wetlands and water-- close to half of the City's total area. It lies south of Indian River Road, from North Landing Road and the City of Chesapeake on the west, to the area east of New Bridge Road and south of Sandbridge Road to, but not including, Sandbridge, and extends south to the North Carolina border. It is a treasure in agricultural industry and economic vitality, rural heritage, and wildlife habitat. In its current state, it functions as critical part of our city today. The Rural Area land use policies assist in keeping taxes low and assuring continued local, state, and national food production. Furthermore, the Rural Area adds to the diversity of the City's character. It provides a unique component to the City's tourist industry, while maintaining the rural community so essential to the overall quality of life for Virginia Beach residents.

The physical character of the Rural Area is low, flat land with wide floodplains, ditch drainage, and a high water table. The area east of Princess Anne Road is prone to flooding from sheet flow, increasingly rising waters, and limited drainage infrastructure. This is due, in part, to the existence of a topographic feature known as the "Pungo Ridge," one of the City's three primary north-south ridges of land suitable for cultivation that are separated by low-lying flats. The Pungo Ridge resembles a large "turtle back" with changes in elevations from 10-20 feet above mean sea level down to 2-4 feet. According to farmers who cultivate the area, this change in elevation results in changes in soil types, including the presence of hydric soils, sometimes in just a very short distance. This natural landscape feature, coupled with the occurrence of a high water table, can severely limit development opportunities in this area. The vast water bodies found here—the Northwest River, the North Landing River, and Back Bay— often produce wind-driven tidal flooding.

Typical rural roadway with ditch in Virginia Beach

Approximately 28,000 acres of land, or nearly 44 square miles, of the Rural Area is devoted to production agriculture, upland forest, and pasture. Wetland and water cover about 48,700 acres and an additional 9,700 acres is either privately owned or federal and state owned property used for environmental conservation purposes. Only about 3,200 acres of land in Rural Area is actually developed, comprised mostly of rural dwellings and a small amount of rural commercial uses. Roads serving the area are predominantly two-lane rural roadways with little to no shoulders and can be heavily traveled by large agricultural vehicles.



RURAL AREA LOCATOR MAP

There are several roadways in the Rural Area designated by the Commonwealth of Virginia as "Scenic Byways". The purpose of being designated a Virginia Byway is to offer travelers a side of the Commonwealth that is uncommon and revealing. Each byway leads to scenes of natural beauty and places of historical and social significance. The following roadways in the Rural Area can be found on the State Scenic Byways Map:

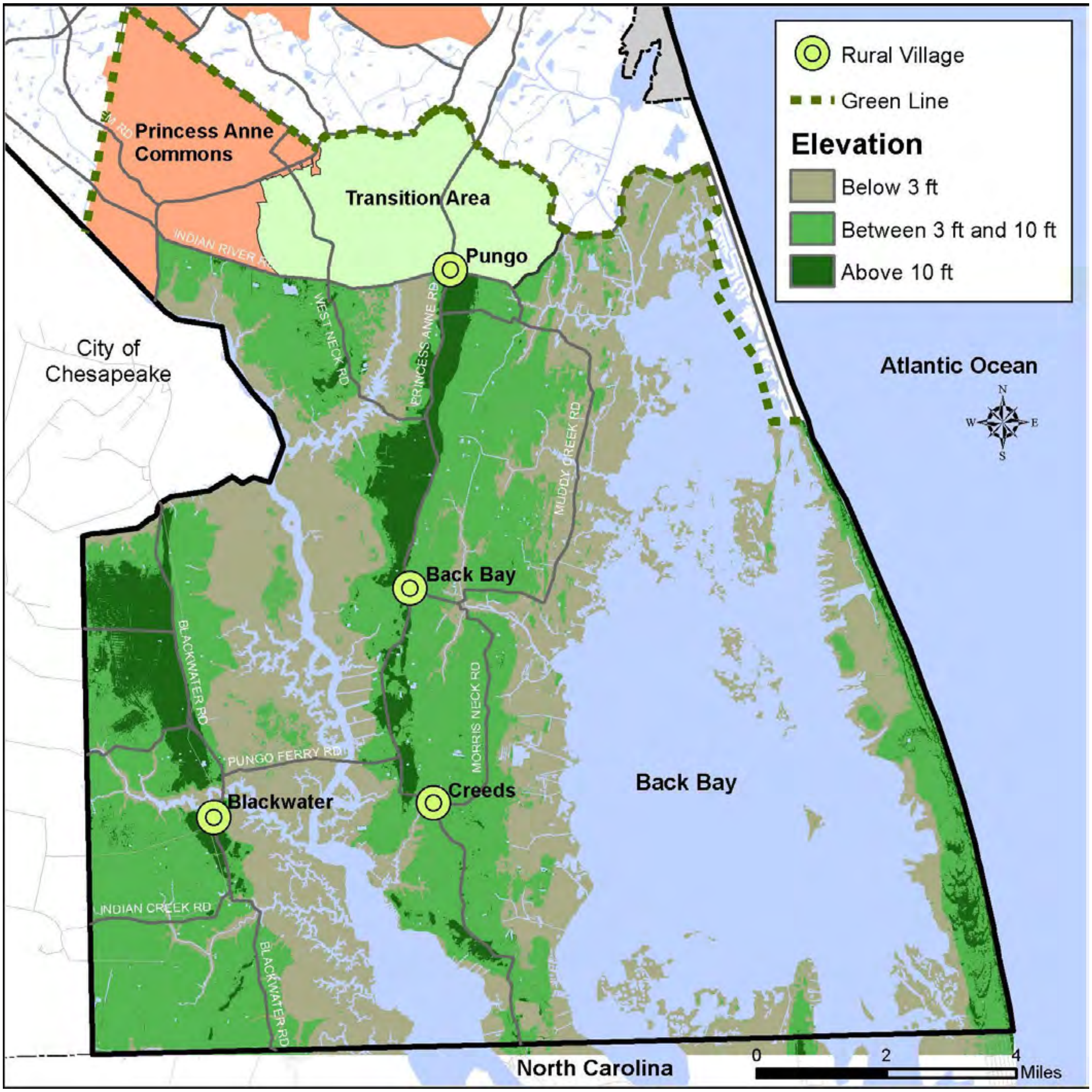
Scenic Byway Sign

- Indian River Road;
- New Bridge Road;
- Sandbridge Road;
- Muddy Creek Road;
- Nanney's Creek Road;
- Morris Neck Road;
- Princess Anne Road between Pungo Ferry Road and Morris Neck Road;
- Princess Anne Road between Morris Neck Road and the North Carolina border, and;
- Blackwater Road between Pungo Ferry Road and the North Carolina border.

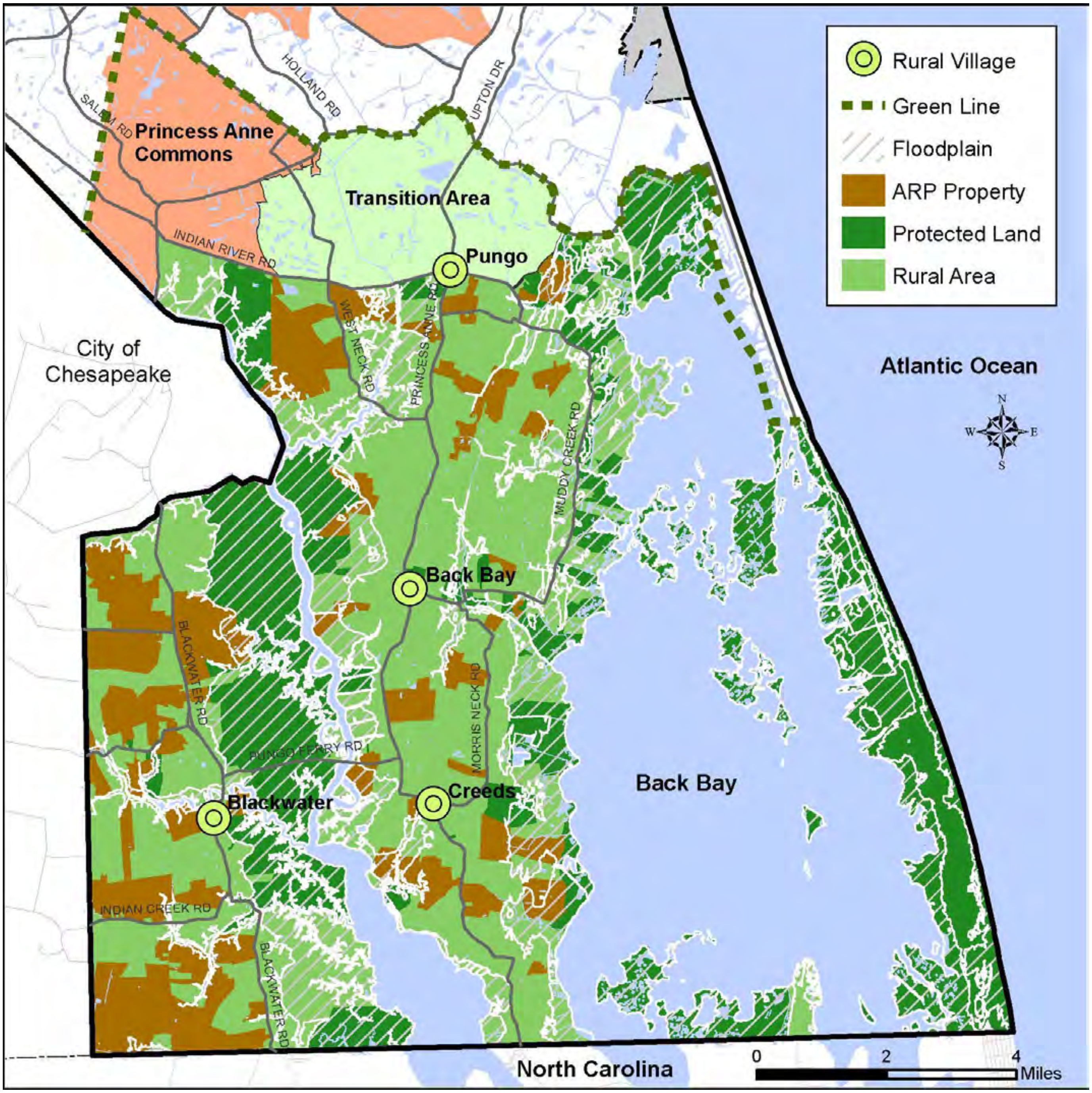
Most of the city's agricultural activity occurs in the Rural Area. Agriculture is the third leg in the City's predominantly three-legged local economy, accompanied by tourism and the military/defense-related industry. Agriculture has an annual economic impact of over 121 million dollars. As an engine helping to power the success of our local economy, the Rural Area is vital to the overall vision of Virginia Beach and Hampton Roads.

Hay bales ready for market (courtesy Cromwell's Produce)

The maps on pp. 1-123 and 1-125 illustrate land elevation in the Rural Area and the extent to which Rural Area lands are protected as conservation lands (federal, state, local or private), are enrolled in the City's Agricultural Reserve Program (ARP) or are located in floodplains.



RURAL LAND AREA ELEVATION MAP



RURAL AREA CONSERVATION AND PROTECTED LANDS MAP (INCLUDING FLOODPLAIN AREAS)

Rural Villages

Small Rural Villages-- Pungo, Back Bay, Creeds, and Blackwater-- have served as the Rural Area's historical business and community core areas. They range in size, character, and physical cohesiveness. They provide basic support retail and municipal facilities (e.g., fire/EMS stations, schools, libraries, and community centers) to the local community and greater Rural Area. The Rural Villages are described in more detail later in this chapter.

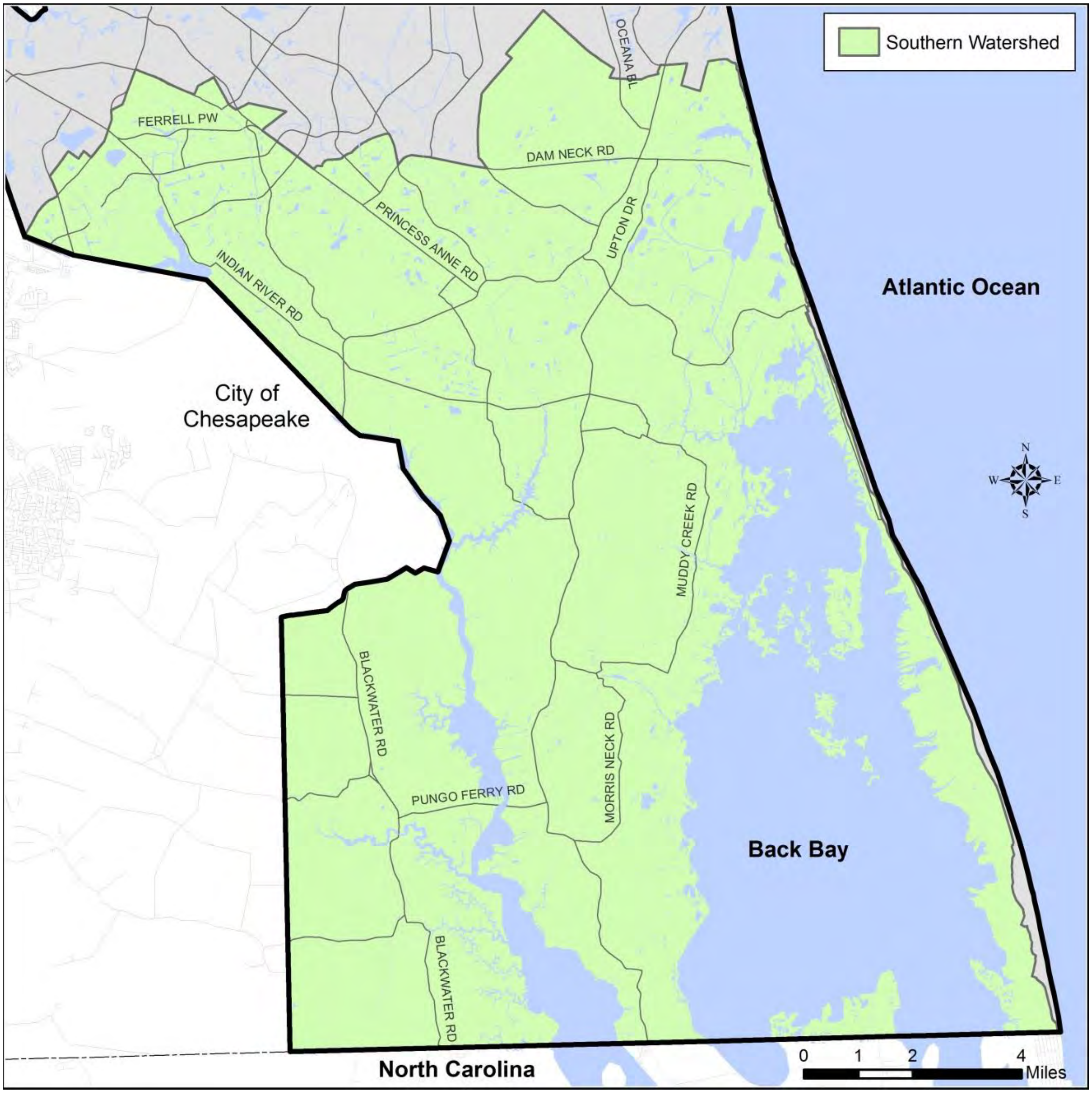
Natural Resources, State/Federal Lands, and Parks

The watersheds of the North Landing River, the Northwest River, the Small Coastal South Watershed, and Back Bay, are collectively referred to as the Southern Watershed *(see Southern Watershed map on the next page)*. This watershed constitutes a unique and sensitive environment, inclusive of coastal primary sand dunes, tidal wetlands, nontidal wetlands, and hydric soils. Extensive floodplains and marsh fringes bordering the waterways within the Southern Watershed provide a unique and valuable habitat. Lands adjacent to the waterways have an intrinsic water quality value due to the ecological and biological processes they perform. Much of the area within the Southern Watershed lies within natural areas identified in the Virginia Beach Natural Areas Inventory and it contains significant natural heritage resources.

Mill Dam Creek, a Tributary of the North Landing River

The North Landing River Watershed is the largest secondary watershed located in southern Virginia Beach. This watershed covers much of the western and southwestern portions of the City and the eastern portions of the City of Chesapeake, comprising an area of roughly 105,600 acres. The North Landing River and its tributaries support a large concentration of rare plant and animal species and natural communities, many of which have global significance, thus making this an extremely important area for biodiversity conservation in the mid-Atlantic region. The North Landing River is part of the Intracoastal Waterway, a major inland waterway running along the Atlantic and Gulf Coasts of the United States. Much of the land surrounding the river is owned and protected by various public, private, and nonprofit conservation organizations, comprising roughly 15,700 acres under easements held by federal, state, local, and nonprofit partnerships. The North Landing River is a major recreational resource that is used extensively for boating, hunting, and fishing. The river and its tributaries have been designated by the State and City as a Scenic River.

Most of the Rural Area is comprised of Land Management Soils, which are not suitable for major residential subdivision development. These are Somewhat Poorly, Poorly or Very Poorly drained soils, as defined by the 1985 issue of the *U.S. Soil Survey for Virginia Beach*. As a result, extension of public water and sewer services to this area is not intended. Rural residential development has historically been limited to areas consisting of well-drained soils and deeper water tables that are capable of handling septic systems. However, recent changes in state legislation enable the design and use of alternative septic systems. This may begin to place development density pressure on the Rural Area in ways not previously expected.



SOUTHERN WATERSHED AREA MAP

Rich in natural and recreational amenities, the Rural Area is home to multiple state and national parks, refuges, natural areas, and wildlife management areas. Back Bay National Wildlife Refuge (NWR) was established on June 6, 1938 as a 4,589-acre refuge to provide feeding and resting habitat for migratory birds. It is a critical segment in the Atlantic Flyway. As Virginia Beach began to grow in the 1980's, the U.S. Fish and Wildlife Service pursued a land acquisition program to double the size of Back Bay NWR in order to protect the watershed from harmful development. Since 1988 the Refuge has grown to over 9,250 acres, protecting critical habitat for wildlife, which years ago had been zoned for residential and commercial use.

Back Bay looking south

Back Bay NWR includes a thin strip of barrier island coastline typical of the Atlantic and Gulf coasts, as well as upland areas on the west bank of Back Bay. Habitats include beach, dunes, woodlands, agricultural fields, and emergent freshwater marshes. The majority of refuge marshes are on islands within the waters of Back Bay. Thousands of tundra swans, snow and Canada geese, and a large variety of ducks visit the refuge during the fall/winter migration. Refuge waterfowl populations usually peak during December and January. The refuge also provides habitat for other wildlife, including such threatened and endangered species as the loggerhead sea turtle, piping plover, and recently recovered species like the brown pelican and bald eagle. Back Bay NWR is an "open" refuge with a vibrant visitor program that is both a tourist attraction and benefit to our citizens. It offers over 8 miles of scenic trails, a visitor contact station, and interpretive programming.

Located on Back Bay, the Princess Anne Wildlife Management Area, an area of 1,546 acres, serves as the Virginia Department of Game and Inland Fisheries' major waterfowl hunting area. Hunting opportunity is further enhanced by a long-standing cooperative agreement with the Virginia Department of Conservation and Recreation to provide limited access to False Cape State Park for visitors, including hunting waterfowl and deer. The Rural Area also serves as a buffer for Mackey Island National Wildlife Refuge in Knotts Island, North Carolina.

Munden Point Park, located on the North Landing River, is a city-owned, major multi-purpose recreational amenity in the Rural Area, offering public boat access, picnic areas, playgrounds, ballfields, a disk golf course, and a small amphitheater.

It is intended that land use adjacent to and affecting these local, state, and national natural and recreational amenities enhance the use and preservation of these valuable assets.

VISION

The vision for the Rural Area is for it to remain rural into the foreseeable future through a commitment to strong planning objectives that emphasize its agricultural and environmental economic value, in an effort to preserve the area for future generations. By maintaining the rural character of the area and the sustainability of the City's agriculture industry, the City is also providing a plan that will help offset impacts from issues inherent to being a coastal community: sea level rise, wind-driven flooding, and storm-related damage from hurricanes. Emphasizing the value and heritage of our agricultural industry, in order to optimize and preserve it, helps protect our environmentally sensitive lands and waterways, provides for the long term viability of the area's abundant wildlife, and maintains our quality of life. The extension of urban services (public water, public sanitary sewer, and major roadway improvements) is not envisioned for this area now or in the foreseeable future.

RURAL PRESERVATION PLAN

The City seeks to achieve the following four planning objectives for the Rural Area:

- Preserve and promote a vibrant agricultural economy
- Reinforce rural heritage and way of life
- Sustain natural resources for future generations
- Manage rural area development and design

The City's commitment to directing new growth into the Urban Area (Strategic Growth Areas or SGAs), Suburban Area, and Special Economic Growth Areas (SEGAs) is complementary to these Rural Preservation Plan objectives.

Preserve and Promote a Vibrant Agricultural Economy

Agricultural preservation is an important economic and land use issue. Today, the amount of actively cultivated land in the Rural Area is smaller than recorded in years past. This reduction illustrates the importance of effective and affirmative comprehensive planning strategies to the preservation of the City's agricultural land and rural heritage. Accordingly, land use and development in the Rural Area should be evaluated and encouraged in the general context of the overarching goals of preservation and optimization of this integral facet of our city.

The importance of agriculture to Virginia Beach's economy is evidenced by a spectrum of examples. The City's Rural Area is home to major grain handling facilities that utilize container export, thus supporting the Port of Hampton Roads. Virginia Beach is the largest strawberry producer in the state and ranks highly in grain production and equine population. Farm markets, roadside stands, and you-pick farms are not only important economically; they foster Virginia Beach's agricultural heritage, tourism, and quality of life.

Strawberries ready for picking

Local agriculture supports another of the City's long-term goals, as it is the ultimate sustainable industry. Through effective land use planning goals, Virginia Beach has an opportunity to remain at the forefront of the global initiative to meet the increasing need for healthy, varied agricultural products. This is becoming increasingly critical for communities to remain competitive. Virginia Beach's opportunity to maintain this component of its livability and sustainability enhances its appeal and desirability as a Community for a Lifetime. It also directly impacts economic development through industry and research. The City's vibrant and diverse agricultural economy is not only an asset to be preserved; it presents an opportunity for national renown.

Many of Virginia Beach's family-owned and operated agricultural businesses date back to when the City of Virginia Beach was Princess Anne County. The diversity of these businesses is not only a matter of size; it's a matter of what is planted, grown, and harvested such as fruits, vegetables, ornamentals, pasture land, Silviculture, corn, wheat, soybeans, aquaculture, livestock, as well as agritourism and equine uses. The annual impact of agriculture and agricultural uses to Virginia Beach, as well as to the region and state, demonstrates the value and need for sustainability of the industry for its long term growth and resiliency.

Dick Cockrell Arena - Creeds Ruritan Club

Virginia Beach's agricultural industry is supported by the City of Virginia Beach Agricultural Department, the Virginia Beach Cooperative Extension office, and the Hampton Roads Agricultural Research and Extension Center in Virginia Beach, which is supported by Virginia Tech's College of Agricultural and Life Sciences. Virginia Beach also has a strong 4-H program for its youth, with two dedicated facilities provided by the Creeds Ruritan Club: the Ralph Frost Livestock Building and the Dick Cockrell Arena. The 4-H program ensures that the youth of our area are educated about agriculture and prepared to serve as the next generation of stewards of the land.

Irrigating corn (courtesy Cromwell's Produce)

Agricultural Reserve Program

One effective strategy Virginia Beach employs to promote, sustain, and preserve agriculture is through the Agricultural Reserve Program (ARP). The ARP was established in 1995 with a goal of preserving 20,000 acres of agricultural land and open space. It is one of the most successful Purchase of Development Rights (PDR) programs in the nation, according to the American Farm Land Trust. The ARP is a non-development option available to property owners on a voluntary basis in the City Rural Area. It preserves land for farming, preserves the rural character and environmental resources, and minimizes the need for urban infrastructure. It works by voluntarily purchasing development rights from property owners at fair market value and instills fairness by offering market value compensation to property owners. This ensures that their land's development value will be realized while agricultural production is maintained. The ARP is an important long-range implementation tool for rural and agricultural preservation. ARP sites are not to be used for wetland mitigation. As of June 2015, 9,266 acres have been enrolled in the ARP.

Reinforce Rural Heritage and Way of Life

Rural heritage and way of life are essential components in the Rural Area's sense of place. The residents of the Rural Area, and the City as a whole, have enjoyed the rural lifestyle that has existed here for generations. Long stretches of two-lane roadways connect small and large farms, horse boarding facilities and equestrian-related businesses, campgrounds, wineries, and open space activities. The Rural Villages are small in scale but serve the commercial needs of a comparatively large geographic area. Industrial uses will generally be those that are related to, and dependent on, natural resources such as agriculture, timber, or minerals. All of these uses contribute to the economic health of the city and overall well-being of its inhabitants.


Future farmers (courtesy Cullipher Farm)

<u>Historic Preservation Program</u>

Many of the City's historic resources and sites can be found in the Rural Area. It is the City's policy to use all available resources to preserve designated historic resources, including those provided by the City's Historical Review Board, Historic Preservation Commission, and the Princess Anne County/Virginia Beach Historical Society, as well as those provided by the Commonwealth of Virginia. Retaining these historic resources can be accomplished via sound land use planning guidance and tax credit or abatement assistance to property owners. Additionally, property owners can seek inclusion into the Virginia Century Farm Program, a program dedicated to honoring the Commonwealth's rich legacy of generational farming. For a full listing of historic preservation programs, refer to the "Historical and Cultural Resources" chapter of the Comprehensive Plan's *Technical Document*.

Sustain Natural Resources for Future Generations

It is an important planning objective to protect and sustain the valuable environmental, scenic, and agricultural resources in the Rural Area against inappropriate activities and intense growth pressures.

The prevalence of water, wetlands, and low lying land in the Rural Area is highlighted by the fact that 64% of the City's regulatory floodplain is located here. These floodplains are characterized by wind driven tides and have a limited flood storage capacity, making them extremely sensitive to development and fill. In addition, and as evidenced in anecdotal information provided by the area's farmers, the Rural Area is already experiencing and is anticipated to continue to experience impacts from sea level rise over time. To preserve these unique aspects of the Rural Area, Section 4.10 of the

City's Floodplain Ordinance (Appendix K) limits the use of fill and prohibits new residential dwelling units on newly created lots in the regulatory floodplain.

Natural Resource Management

- *Southern Watershed Management Plan and Ordinance*

  The *Southern Watershed Management Plan* was adopted as a part of this Comprehensive Plan in 2001 (www.vbgov.com/Planning). It is implemented by the *Southern Rivers Watershed Management Ordinance*. The ordinance is intended to protect, enhance, and restore the quality of waters within the Southern Watershed of the city. The ordinance applies to development of any lands within the Southern Watershed (North Landing River Watershed, Northwest River Watershed, the Small Coastal South Watershed, and the Back Bay Watershed) and any artificial alteration of the level or flow of any watercourse or impoundment of water, with exceptions as noted in ordinance Section 6; and, agricultural lands/agricultural activities to the extent set forth in ordinance Section 10. The ordinance establishes development performance standards. The ordinance requires the developer of any land within the Southern Watershed to submit a "Southern Watershed Management Plan," prior to the undertaking of any land-disturbing activity, if such development is subject to the additional performance standards set forth in ordinance Section 7(e), which excludes single-family dwellings or duplexes separately built and not part of a subdivision.

- *Green Sea Blueway and Greenway Management Plan*

  The Green Sea Blueway and Greenway Management Plan (www.vbgov.com/Planning), adopted in 2015, is a regional plan that was developed with collaboration by the City of Chesapeake and Currituck County, North Carolina. This conservation and management plan seeks to protect the abundance of unique and diverse natural resources, open space lands, and potential recreational opportunities existing along three connected waterbodies – the North Landing River in Virginia Beach, the Albemarle and Chesapeake Canal in Chesapeake, and the Currituck Sound in Currituck County, North Carolina. The purpose of the plan is to develop a long-term management strategy that protects, conserves, and manages a unique system of natural resources, open space areas, and carefully-selected recreational uses in a sustainable manner. The plan focuses on each of these waterways as a regional resource with unlimited opportunities for stewardship and enjoyment that can be shared for future generations. The *Green Sea Blueway and Greenway Management Plan* is important to the Rural Area context because of its alignment with the Comprehensive Plan policies and similar plans adopted by reference that have been established to accomplish the following:

  Ibises feeding in the Green Sea

  - sustain agricultural production;
  - preserve rural heritage;

- preserve, protect, and promote the area's unique natural resources in a sustainable manner;
- improve stormwater management and floodplain protection;
- protect undisturbed open space land;
- provide low-impact recreational uses where opportunities exist;
- identify and protect wildlife corridors;
- manage invasive plant and animal species; and,
- encourage and promote reasonable uses and activities that are complimentary to the character and integrity of the rural area for the use and enjoyment of future generations.

The plan advocates for the importance of the Rural Area and the need to retain its distinction and attributes not found in the City's Urban and Suburban Areas. These initiatives, coupled with the objective of maintaining a reasonable overall level of rural development potential, establish sound planning policies that balance the need for limited rural growth.

Manage Rural Area Development and Design

Sunflower crop (courtesy Cullipher Farm)

We should continue to pay careful attention to managing the density, intensity, and design of rural residential and non-farm related, non-residential development that occurs in the Rural Area in the future in order to achieve the goals of the Rural Preservation Plan.

Eliminate Need for Urban Infrastructure

It is the City's policy to eliminate the need and cost associated with providing and maintaining urban infrastructure by not allowing the extension of urban infrastructure into the Rural Area. The Rural Preservation Plan does allow reasonable levels of rural development to continue into the foreseeable future, by affording equity for property owners and ensuring that demand placed on public facilities will remain at or below what is deemed acceptable for rural communities. The City also recognizes its responsibility to provide programmed improvements and ongoing public facility and infrastructure maintenance projects in this area.

Rural Area Development

Rural residential development potential in Virginia Beach has historically been based on land area and soil quality, as opposed to lot frontage. Property owners may choose to sell their development rights by participating in the Agricultural Reserve Program or to develop their land either 'by-right,' which yields a maximum density, or through a Conditional Use Permit, which may yield a slightly higher rural density while preserving large tracts of farmland and open space areas. The by-right option has a calculated density of no more than one dwelling unit per 15 acres. The Conditional Use Permit option allows a calculated density of one dwelling unit per 5 to 10 acres, depending on soil quality (Soil Area #1: 5 acres; Soil Area #2: 10 acres). Refer to the "Southern Rural Area Soils List and Map" in the *Technical Report*.

State law now requires local governments to approve single-family residential development plans on parcels where the Virginia Department of Health has approved the design of an Alternative On-Site Septic System (AOSS), regardless of soil quality. *Nonetheless, the City maintains its Rural Area density policies for calculating allowable density*. However, the discretionary determination by City Council to issue a Conditional Use Permit for residential development should take a number of factors into consideration to determine density in addition to soil suitability, including but not limited to: adverse impact on agriculture; the presence of floodplains; groundwater table elevation; and, drainage, roadway, and other infrastructure conditions.

<u>Southern Watershed Subject to "Special Drainage Considerations"</u>

In addition, the Southern Watershed (see Southern Watershed map) is subject to "special drainage considerations." Drainage in the Southern Watershed is highly impacted by the presence of high ground water, poorly draining soils, and high water surface elevations in downstream receiving waters. Therefore, it is incumbent upon the developer of any property in the Southern Watershed to understand and evaluate these factors prior to undertaking the project and to properly account for these factors in the project design. Receiving waters in the Southern Watershed are subject to tidal influences which can be exacerbated by winds. High ground water elevations and poorly draining soils can result in increased runoff, can limit the capacity of the stormwater conveyance systems, and can counter indicate the use of certain Best Management Practices, such as infiltration.

All of these effects must be fully considered and evaluated in the analysis and design of drainage systems in the Southern Watershed. Accordingly, it is strongly recommended that the developer has a preliminary drainage study prepared by a qualified professional engineer in advance of any request to approve a discretionary (versus by right) development that involves land disturbance in the Southern Watershed. The drainage study should fully and accurately evaluate the effects of the foregoing factors on the planned development and on upstream and downstream areas. The proposed drainage system for the planned development would provide positive drainage that meets City standards and does not result in flooding within the planned development or to upstream or downstream areas.

<u>Rural Area Development Design</u>

Rural Area residential development design

Successful rural residential developments do not dominate, but rather, complement the setting and showcase the attractiveness of the natural surrounding countryside. They may include large open space areas that are retained in their natural state, used as farmland, gardens, equestrian centers or other rurally compatible uses. Houses are arranged and streets are aligned in ways that create or adapt to the natural rural setting and do not follow a typical suburban pattern of regimentation, enabling larger, continuous open space areas. It applies such building design techniques as large, open wrap-around porches, pitched roof lines, and detached or side-loading garages. It incorporates architectural details that take cues from local farm buildings, hunting clubhouses, and other examples which reflect the architectural heritage and agrarian character of southern Virginia Beach.

Rural residential and non-residential guidelines should be met, as appropriate, whenever a rural development proposal request is submitted for review. See *City Zoning Ordinance* Article 4, Agricultural Districts for further information regarding the development of rural properties. Related design guidelines for the Rural Area may be found in the Comprehensive Plan's *Reference Handbook*.

RURAL VILLAGES


Blackwater Trading Post

The Rural Villages of Pungo, Back Bay, Creeds, and Blackwater should be thought of as core areas and focal points for existing and future development in the Rural Area. Creeds Village has two nodes, with the main node being the northernmost and which includes Creeds Elementary School and the southernmost node containing small retail and commercial uses and a community Fire/EMS Station. Development in these villages can include a mix of locally- oriented retail or services and community facilities designed to be compatible with the area context. Non-residential development should be located within a Rural Village, unless the non-residential is agricultural in nature or a farm, part of a farm, stable or a mill.

Planning Guidelines for Pungo Rural Village

Pungo Strawberry Festival blanket souvenir

The most recognizable gateway to the southern Rural Area of Virginia Beach and the largest Rural Village is Pungo, located at the crossroads of Indian River and Princess Anne Roads. A traditional rural village and business district comprised of small and varied clusters of commercial, residential, and public uses, Pungo's character is defined by the presence of small retail businesses, an equestrian center, privately-owned land and residences, the City's mounted patrol facility, and conservation areas. Rural Area residents, business owners, and visitors appreciate and value this active commercial node for its rural character and local convenience. Pungo's annual Strawberry Festival welcomes the summer during Memorial Day Weekend and has become increasingly popular with tourists.

Pungo's importance as the Rural Area's main commercial center has declined in recent years with the emergence of the larger destination retail center at Red Mill Commons and Sandbridge Marketplace to the north. As a result, more pass through traffic from and to the more southern reaches of the Rural Area and North Carolina, is impacting Pungo by causing traffic congestion. As traffic congestion increases during the resort tourist season along the Princess Anne Road segment to the north and Sandbridge Road, more and more travelers are using Indian River Road and New

Bridge Road to reach their destination in Sandbridge, resulting in longer traffic delays at the Pungo intersection.

Currently, Pungo is served by various on-site septic systems. These can range from traditional septic systems to AOSS technology systems. There are no reports of any sewer problems currently being experienced in Pungo; therefore, at this time, it is unknown if there is a need for either public sewer or a small alternative public treatment facility to service this Rural Village. A study is needed to determine if any of the existing septic systems are failing or if a desired future development density for the village cannot be accommodated by onsite systems.

To help retain its village character and avoid its giving way to uses and building/site design that is not in keeping with its history as the City's primary gateway into the Rural Area, it is important to use general planning guidelines for future infill development and redevelopment in Pungo. The following planning guidelines should be applied to development proposals within the Pungo Rural Village:

- Development proposals should reflect the existing rural character.
- Older buildings should be considered for adaptive reuse redevelopment opportunities first, and demolition should be considered a method of last resort. Owners of historic properties (buildings 50 years of age or more) should consider nomination for listing on the local, state and national historic registers in order to take advantage of the historic preservation tax incentive programs, as noted earlier in this chapter, to assist with historic building renovation.
- Urban and suburban patterns of development and building design should be avoided. Protect existing public rights-of-way and provide additional pavement width on Princess Anne and Indian River Roads in Pungo to accommodate safer movement of farm equipment and bicyclists.
- Consolidate scattered vehicular access points to property into clearly defined entrances off the road.
- Provide a safe, attractive and continuous pedestrian network to enable greater pedestrian mobility in the village.
- Public water and sewer is recommended to serve the area north of Indian River Road with no public water and sewer or alternate centralized sewer system serving the area south of this road.

Related design guidelines for Pungo Rural Village may be found in the Comprehensive Plan's *Reference Handbook*.

AGENDA FOR FUTURE ACTION RECOMMENDATIONS: Rural Area

- Review Section 402(b) of the Zoning Ordinance (Agricultural Districts) for possible amendment to address Code of Virginia Section 15.2-2157(c) and because it limits density by reference to how well different soil types can accommodate a traditional on-site septic system. The City should consider factors other than soil types to limit density including, but not limited to, adverse impact on agriculture, the presence of floodplains, groundwater table elevation and drainage, roadway, and other infrastructure conditions.
- Using GIS, analyze floodplains to determine where future rural residential development should be avoided.

- Use GIS analysis to determine how many platted lots of 5 acres or less along rural roadways that were not considered buildable due to soil constraints are now potentially buildable under state AOSS regulations. Assess the extent to which rural roadways may be impacted.
- Formally delineate the Pungo Rural Village boundary using stakeholder input and community consensus-building.
- Using stakeholder input and community consensus-building, prepare a Master Plan for the Pungo Rural Village to determine the type and form of future desired growth. An important aspect of this planning process should be to anticipate when that growth might reasonably be expected to occur.
    - Conduct a study for Pungo Rural Village to determine if the existing on-site systems should be used if Rural Area development policies remain at the current density limit, or if such systems cannot be repaired or rehabilitated using AOSS technology if they are found to be failing. If it is found that existing onsite systems are failing and cannot be repaired, or if development with increased density is anticipated (or desired) to such an extent that onsite technology will not work, a study should be conducted to determine the need for technology options and feasibility for providing public sanitary sewer treatment systems for the Pungo Rural Village. The study should also investigate and evaluate the feasibility and cost of various alternatives.
- Enhance the "Pungo Village Design Guidelines" in the Comprehensive Plan's *Reference Handbook* with illustrations.

1.6 - MILITARY INSTALLATIONS AND SUPPORT

Virginia Beach proudly hosts three military installations, including the U.S. Navy's East Coast Master Jet Base. These include:

- Joint Expeditionary Base Little Creek-Ft. Story (U.S. Navy – U.S. Army)
- NAS Oceana and Dam Neck Annex (U.S. Navy)
- Camp Pendleton (VA National Guard)

U.S. Navy Blue Angels in formation

This military presence dates back to the early 20th Century and has come to be a defining character of our city, influencing its growth, economy, and land use patterns through the years. The City supports a continued strong military presence, both now and in the years to come. Our commitment to ensure this includes:

- adopted land use plans as part of this Comprehensive Plan;
- Air Installations Compactible Use Zones (AICUZ) zoning regulations;
- a land acquisition program to reduce incompatible residential density and use encroachment and annual reporting;
- a business relocation incentive program; and,
- advocacy and advisory partnership committees.

We work closely with local and regional military leaders, the United States Congress, the Commonwealth of Virginia, and neighboring municipalities to reduce incompatible land use encroachment, and to prevent future incompatible land use, i.e., encroachment, from occurring adjacent to our military installations. We absolutely recognize the value and importance that the Department of Defense places on its unique training facilities in our city. We desire to work in continued partnership to play host to their mission and their families, who are such an integral part of our diverse community. We desire to be a home to military veterans exiting their distinguished service to our nation and to fully assimilate them into our community through workforce development training to transition and apply their special skills in the civilian sector and through veterans' care programs.

Virginia Beach and the Hampton Roads region have long relied on the military industry as a major thrust of our local and regional economy. Our military presence has enabled us to remain relatively resilient in times of economic recessions. However, as discussed further in Chapter 2, Section 2.4 – Economic Vitality, the region understands fully that in addition to supporting the military presence and benefitting from it, it is imperative that we also have a diverse and sustainable regional and local economy. For example, the *Navy Region Mid-Atlantic Hampton Roads Area FY 2013 Economic Impact Report* indicated that the Navy's direct economic impact on the Hampton Roads area was approximately $9.2 billion, a decrease of approximately $1.8 billion or 16.4% over FY 12's total of $11 billion. Procurement expenditures decreased from approximately $2.8 billion in FY12 to about $1.3 billion. The Hampton Roads area had an overall decrease of about $1.5 billion in procurement expenditures. Active duty military pay decreased by $306 million; retired and survivors pay increased by $76 million; civilian pay decreased by $54 million; NAF increased by $0.5milllion and contractor pay decreased by $55 million. This reduction in military spending as part of a defense budget reduction has affected Hampton Roads localities and many, if not all, localities in the nation with a military presence. In many cases, just as we are experiencing here locally, this trend is being supplanted by growth in other industries.

THE MILITARY PRESENCE TODAY

Joint Expeditionary Base Little Creek – Ft. Story (JEBLCFS) (U.S. Navy – U.S. Army)[ii]

JEBLCFS is the largest military employer in the city of Virginia Beach. It is the major East Coast base supporting overseas contingency operations (OCO), with 130 resident commands, including 3 flag officers. The installation consists of 3,947 acres of land and includes 61 piers and 7.6 miles of beachfront, and a total of 126 training sites. As of January 31, 2015, JEBLCFS homeports 24 Navy Auxiliary Ships, the USCGC Vigorous, and 126 small craft. The total base population is 19,179 (Little Creek Base: 16,658; Ft. Story Base: 2,821). Base population growth since September 11, 2001 has been just under 10,000 persons or almost 100%. To accommodate the growing presence, there are now 1,155 base housing units, with 337 units located inside the fence line. Estimated payroll is $1.3B, making a substantial impact on the City's economy.

Aerial view of Amphibious Base at Joint Expeditionary Base Little Creek-Fort Story (JEBLCFS)

The character of the base has changed since September 11, 2001, becoming more expeditionary in nature. According to base planners, JEBLCFS is becoming the training site of choice for the joint community due to characteristics that are unique to the East Coast. It is recognized as an irreplaceable "National Joint Training Asset," offering joint logistics over the shore training and a nearly full mission profile for special operations training. Recent trends indicate that more units are conducting training locally, decreasing travel training dollars. Through strong community engagement with City of Virginia Beach leaders and city planners, encroachment is manageable with community support.

Transfers have occurred since the last Comprehensive Plan update in 2009. During 2013-2014, the following operations were relocated:

- Navy CYPERFOR and NETWAR Commands (relocated to Suffolk) – due to recurrent flooding associated with sea level rise impacts.
- PCRON/Coastal Patrol Craft (relocated 5th AOR/Mayport, FL)
- USS Fort McHenry (homeport shift to Mayport, FL)

LACVs at JEBLCFS

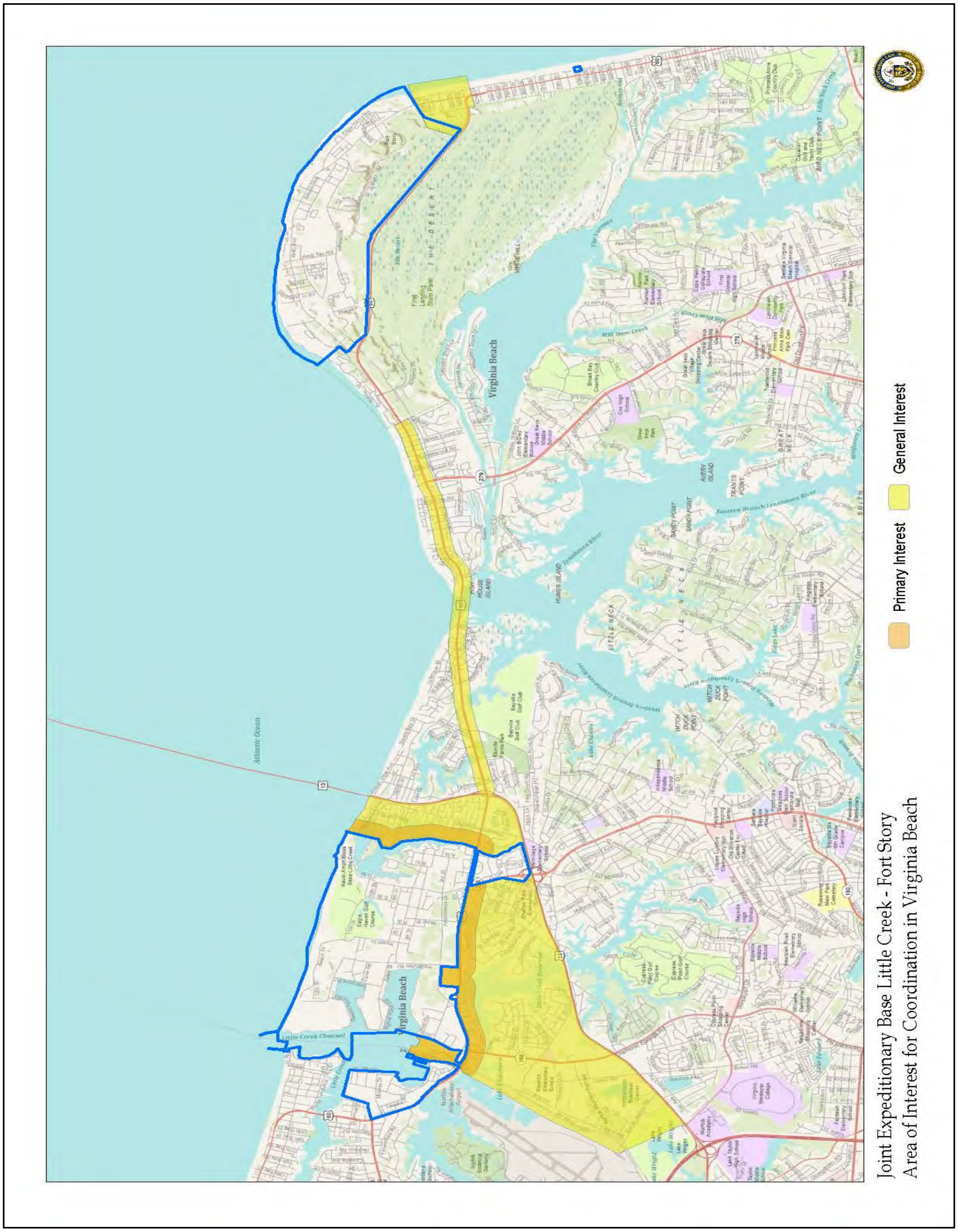
Base mission growth in the future is anticipated to consist of an increase in Explosive Ordinance Disposal Group 2 Operations; expansion of the Naval Special Warfare and Support Activity footprint; gains in training vessels and equipment; and an increase in training operations/capacity.

JEBLCFS is a committed steward of its cultural and natural resources, working closely with the City and non-profit organizations to inventory and protect these assets. Some of these include the Cape Henry lighthouses, the original base chapel, the First Landing site, and the various monuments documenting the strategic role that Cape Henry played during the American Revolution and the War of 1812.

JEBLCFS has a robust community engagement program, ensuring that it works in partnership in a variety of needs identified as mutually important. These include:

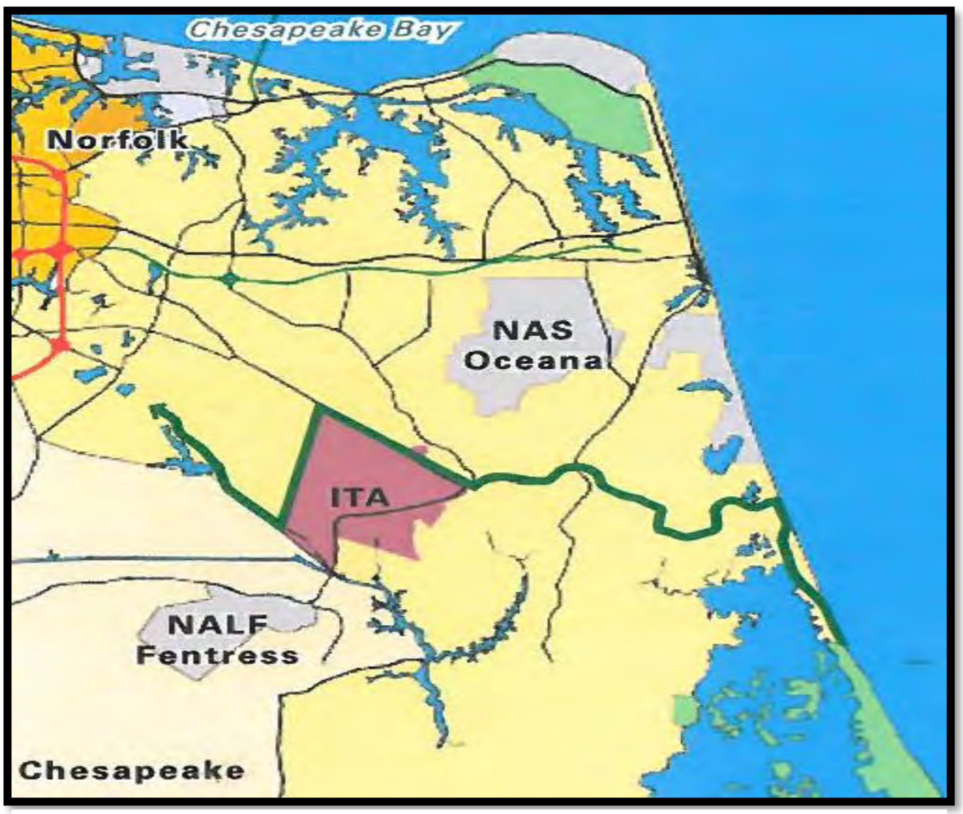
- Quarterly meetings with City of Virginia Beach leadership
- Virginia Beach City Public Schools
- Virginia Beach Education Association
- Partners in Reducing Sexual Assault
- Federal Aviation Administration
- Hampton Roads Chamber of Commerce
- Virginia Beach Bayfront Advisory Commission
- Military Economic Development Advisory Committee
- Joint Military Services School Liaison Committee
- Military Child Education Coalition
- Hampton Roads Planning District Commission
- Virginia Military Advisory Commission
- Central Virginia Food Bank
- USO of Hampton Roads and Central Virginia
- Armed Services YMCA

Since 2009, City and base planners have developed an "Areas of Interest" map (see next page) and list of land uses of particular interest to the base. These tools assist both parties in determining which proposed uses may be in potential conflict or encroachment with base mission and operations. The Department of Planning & Community Development provides the base Community Planning Liaison Officer (CPLO) an opportunity to review and comment on development applications located in the Areas of Interest, prior to Planning Commission or City Council public hearing. The City's Public Works and Public Utilities Departments are in routine communications with base planners to inform them about pending infrastructure construction projects (i.e., roadway repair, bridge maintenance, underground utilities work, etc.) in consideration of personnel mobility along the Shore Drive corridor between the two base areas at Little Creek and Fort Story.


Joint Expeditionary Base Little Creek - Fort Story
Area of Interest for Coordination in Virginia Beach
Primary Interest
General Interest
Atlantic Ocean
Virginia Beach

Naval Air Station Oceana and Dam Neck Annex (U.S. Navy)[iii]

Naval Air Station (NAS) Oceana is the Navy's only Master Jet Base on the East Coast and supports the training and deployment of the Navy's Atlantic and Pacific Fleet FA-18 C/D Hornet and FA-18 E/F Super Hornet squadrons. Four carrier air wings (CVWs) are homebased at NAS Oceana and deploy with carrier strike groups embarking from Naval Station Norfolk (NS). Strike Fighter Wing Atlantic, which mans, trains, and equips 18 FA-18 Hornet and Super Hornet squadrons, is also located at NAS Oceana. Naval Auxiliary Landing Field (NALF) Fentress, located 7 miles southwest of NAS Ocean in Chesapeake, Virginia, is equipped to simulate aircraft carrier flight decks and supports training operations by strike fighter squadrons from NAS Oceana.



NAS Oceana, NALF Fentress, and Interfacility Traffic Area (ITA) Locator Map

The Navy employs 17,000 personnel at NAS Oceana, NALF Fentress, and a third installation, NAS Oceana Dam Neck Annex, locally referred to as "Dam Neck." NAS Oceana generates over $1 billion in payroll, and goods and services annually.

The FA-18 C/D Hornet and FA-18 E/F Super Hornet are the predominant aircraft stationed at NAS Oceana and account for the majority of aircraft operations at the airfield. Operations conducted as part of the typical training syllabus for flight crews include departures, arrivals, touch-and-go's, and practice radar approaches. NAS Oceana flight crews also conduct field carrier landing practice (FCLP) at NALF Fentress and training operations in offshore training areas.

Air Wing Homecoming

Aircraft engine maintenance "run-ups" are primarily conducted in NAS Oceana's acoustical aircraft facility, known as the "Hush House." The Hush House enables maintenance personnel to test jet engines that are installed in aircraft in a fully-enclosed building. The noise absorbing materials of the building's interior, combined with dense exterior walls, eliminate engine noise that would otherwise be heard by neighboring Virginia Beach residents.

NAS Oceana Dam Neck Annex
Dam Neck Annex is home to 20 operational, training and support commands. The installation includes 1,919 acres and includes 3.2 miles of coastline along the Atlantic Ocean. It serves as the Navy's Training Center of Excellence, instructing over 20,000 students annually in over 210 courses of instruction.

Additional training and Navy Fleet support areas include:

- Synthetic warfare training to Carrier Strike Group and Amphibious Ready Group Staffs, Warfare Commanders and specified units/commands
- 24/7/365 Maritime Domain Awareness (MDA) support and vital maritime surveillance information to the Atlantic Fleet
- State-of-the-art intelligence training including real world applications

A Memorandum of Understanding has been established between the City of Virginia Beach and the U.S. Navy covering the use of the Dam Neck Annex South Gate for emergency response supporting Sandbridge residents and natural disaster evacuation routing.

Camp Pendleton/State Military Reservation[iv]

Camp Pendleton/State Military Reservation (SMR) is a Virginia Army National Guard facility located just south of the main resort area of Virginia Beach. The facility was originally laid out on approximately 400 acres in 1911 with construction beginning in 1912. Today, SMR occupies approximately 300 acres with an additional 27 acres leased from the federal government.

SMR is defined by the intact landscape created by the dominant building type, World War II-era temporary buildings, and the examples of earlier 20th century military and residential building types. The post is buffered from the public streets by extensive trees and landscaping, in addition to the required security fencing along the perimeter. The Guard currently leases a number of the buildings, particularly the WWII barracks, to various military and civilian agencies.

The first major building campaign after WWI was the construction of the REDHORSE facilities (1990s) at the north end of Regimental Camp #1 and south of Warehouse Road. The 203rd

REDHORSE Flight unit is a construction and repair unit for the Virginia Air National Guard and their headquarters is located at SMR. A memorial is located in this area to honor the airmen from REDHORSE who were killed in an airplane accident returning from training in March 2001. Additional construction projects executed during the late 1990s include an armory at the corner of General Booth Boulevard and Birdneck Road.

Barracks at Camp Pendleton

Development pressure from the City led to the transfer of some SMR parcels of land from the Guard to the City during the 1990s. These parcels included acreage beyond the original cantonment area of SMR. As a result, the boundaries of SMR incorporate all the land (with the exception of a small tract south of Lake Christine leaded from the federal government) between General Booth Boulevard, Birdneck Road, Rifle Range Road, the Atlantic Ocean, and the Croatan neighborhood. A 14.94-acre parcel of land just west of Headquarters Loop along the property boundary at General Booth Boulevard has been leased to the City for use as a parking lot by the Virginia Aquarium.

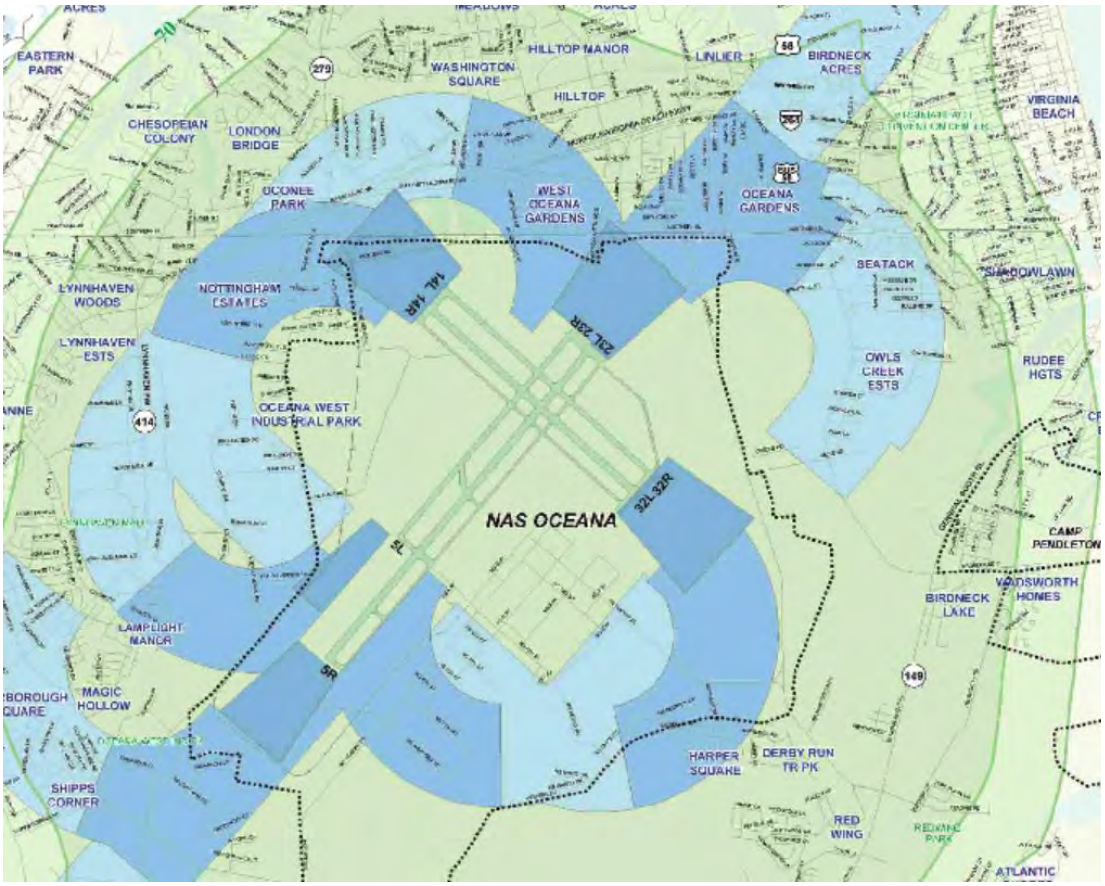
Despite the few intrusions to the original plan and subsequent configuration of Camp Pendleton/State Military Reservation, the integrity of both the architectural resources and cantonment features dating from 1912-1945 have remained intact and well preserved. As a result, the Camp Pendleton/State Military Reservation Historic District was listed on the *Virginia Landmarks Register* in June 2004 and on the *National Register of Historic Places* in September 2005 as the City's first and only, to date, state and national register historic districts.

AIR INSTALLATIONS COMPATIBILITY USE ZONES (AICUZ) AND LOCAL LAND USE PLANNING

The chief sources of noise at an airfield are maintenance run-ups and flight operations. Data on both sources of noise is incorporated into NOISEMAP, the DOD-approved computer model that projects noise impacts around military airfields, to develop a graphic depiction of noise exposure. Noise exposure is assessed for AICUZ purposes using the day-night average sound level (DNL) noise metric. The DNL is depicted graphically as a noise contour that connects points of equal noise value.

The AICUZ Program divides noise exposure into three categories, known as noise zones. Noise zones 1 through 3 are developed based on the DNL, and each noise zone has associated land use control recommendations. The noise zones provide the community and planning organizations with a necessary tool to plan compatible development near airfields. The noise zones for NAS Oceana and NALF Fentress are the noise zones presented in the *2005 Joint Land Use Study (JLUS)* http://www.hrpdcva.gov/uploads/docs/1JLUSExecSumm--Final.pdf

While the likelihood of an aircraft mishap occurring is remote, the Navy identifies areas of accident potential based on historical data from aircraft mishaps, known as Accident Potential Zones (APZs), to assist in land use planning. The Navy recommends that certain land uses that concentrate large numbers of people—apartments, churches, and schools—be constructed outside APZs. Historical data show that most aircraft mishaps occur on or near the runway, diminishing in likelihood with distance from the runway. APZs follow departure, arrival, and pattern flight tracks and are based, in part, on the number of operations conducted for specific flight tracks. The three standard APZs, in order of accident potential are the clear zone, APZ 1 and APZ 2. Thus, an accident is more likely to occur in the clear zone than in APZ 1 or 2 and is more likely to occur in APZ 1 than APZ 2. The APZs for NAS Oceana and NALF Fentress are the APZs presented in the 2005 JLUS Planning Map. These APZs illustrate the dominant flight tracks currently flown at each airfield.



NAS Oceana portion of 2005 JLUS Planning Map

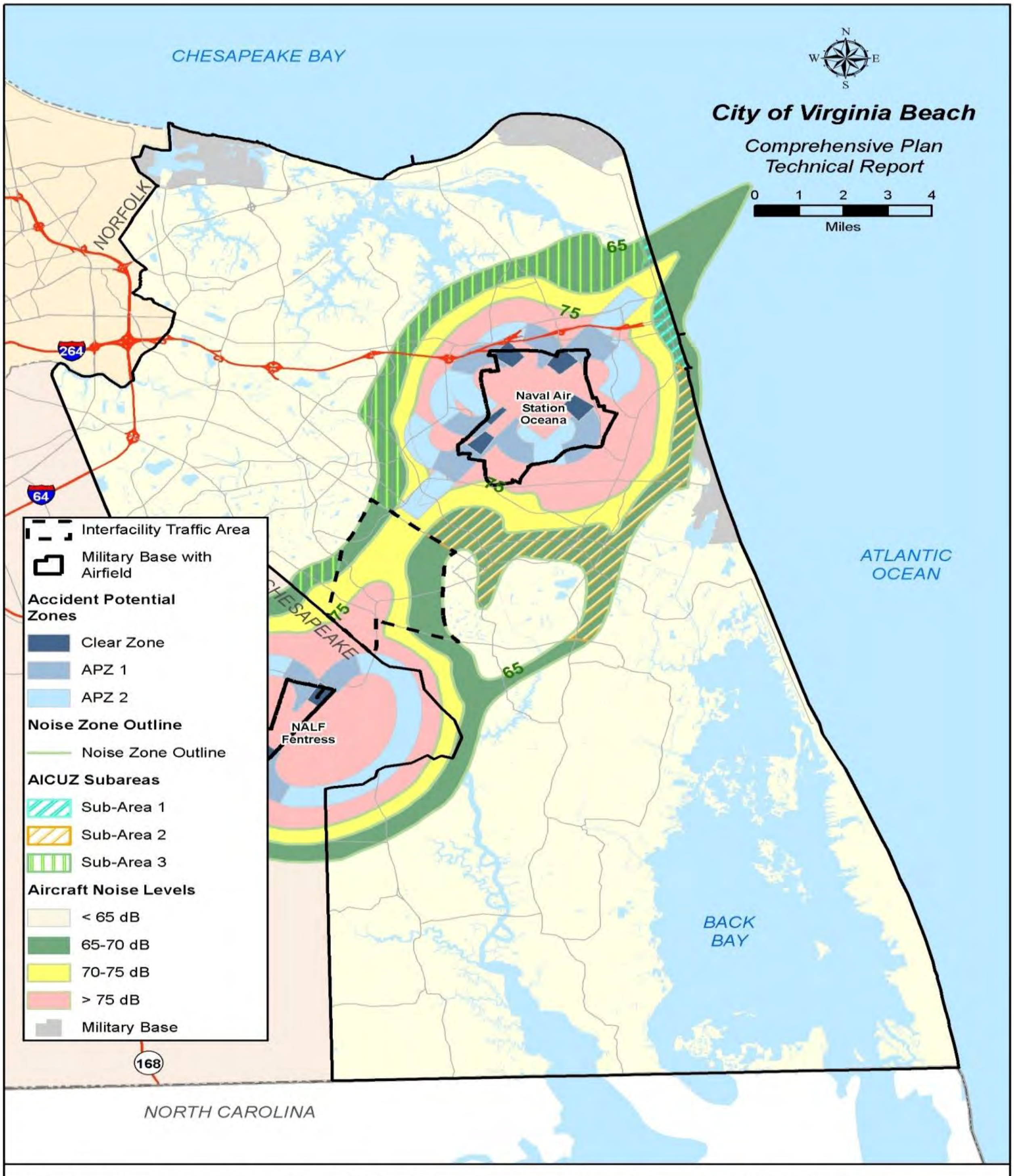
A composite noise contour and APZ map has been developed and overlaid on an aerial photograph to show the AICUZ footprint for both NAS Oceana and NALF Fentress. The AICUZ footprint shows the minimum acceptable area within which land use controls are recommended to protect the public health, safety, and welfare and preserve the defense flying mission. The AICUZ footprint for NAS Oceana and NALF Fentress and the related land use planning accomplishments and Navy recommendations are fundamental tools for the continued success of the compatible land use planning model that has been in place in the Hampton Roads region of the last several years. In addition, an updated analysis of the number of people within the existing AICUZ footprint was conducted. Using census block-level population data and the boundaries of the AICUZ footprint, it is estimated that approximately 153,320 people live within the existing AICUZ contour.

Recognizing the need to balance community growth with the Navy's mission, the Cities of Virginia Beach and Chesapeake have partnered with the Navy to develop various interrelated programs and initiatives to guide and control growth in the AICUZ footprint. These programs and initiatives, which in most cases began during development of the *Hampton Roads JLUS* through the Hampton Roads Planning District Commission in 2004 and 2005, have already lessened the Navy's operational impacts on adjacent land, while simultaneously easing pressure on the Navy's defense flying mission.

Control over land use and development in areas neighboring the airfields ultimately is the responsibility of local governments. The Navy, through its AICUZ Program, encourages local governments to plan for compatible development. Accordingly, City of Virginia Beach land use planning documents and zoning regulations identify existing and future land use and zoning in areas in the AICUZ footprint.

For example, the City prepared and adopted the *APZ-1/CZ Master Plan* (www.vbgov.com/Planning) in April 2005, as an amendment to the City's Comprehensive Plan. This plan inventoried existing land use conditions within the NAS Oceana Clear Zone and APZ-1. Using public meetings for stakeholder input, the plan recommends future planned land use in the Clear Zone and APZ-1, noting both compatible and incompatible land uses (refer to the APZ-1/Clear Zones Locater Map and Future Planned Land Use maps on the following pages). The Lynnhaven SGA, Hilltop SGA, and Resort Area SGA Master Plans, adopted as amendments to the Comprehensive Plan, also recognize the AICUZ footprint and recommend future land uses accordingly. In addition, the City adopted the *Interfacility Traffic Area (ITA) & Vicinity Master Plan* (www.vbgov.com/Planning), as an amendment to the Comprehensive Plan, originally in 2011. This plan guides future land use and development in Virginia Beach within the high noise zone contours between NAS Oceana and NALF Fentress, and is further described in Chapter 1, Section1.4 - Princess Anne Commons & Transition Area of this Policy Document. An updated version of that plan was adopted by the City Council in 2017. The update was necessary due to the significant increase in land in the ITA purchased by the City as part of the program to support operations at NAS Oceana.

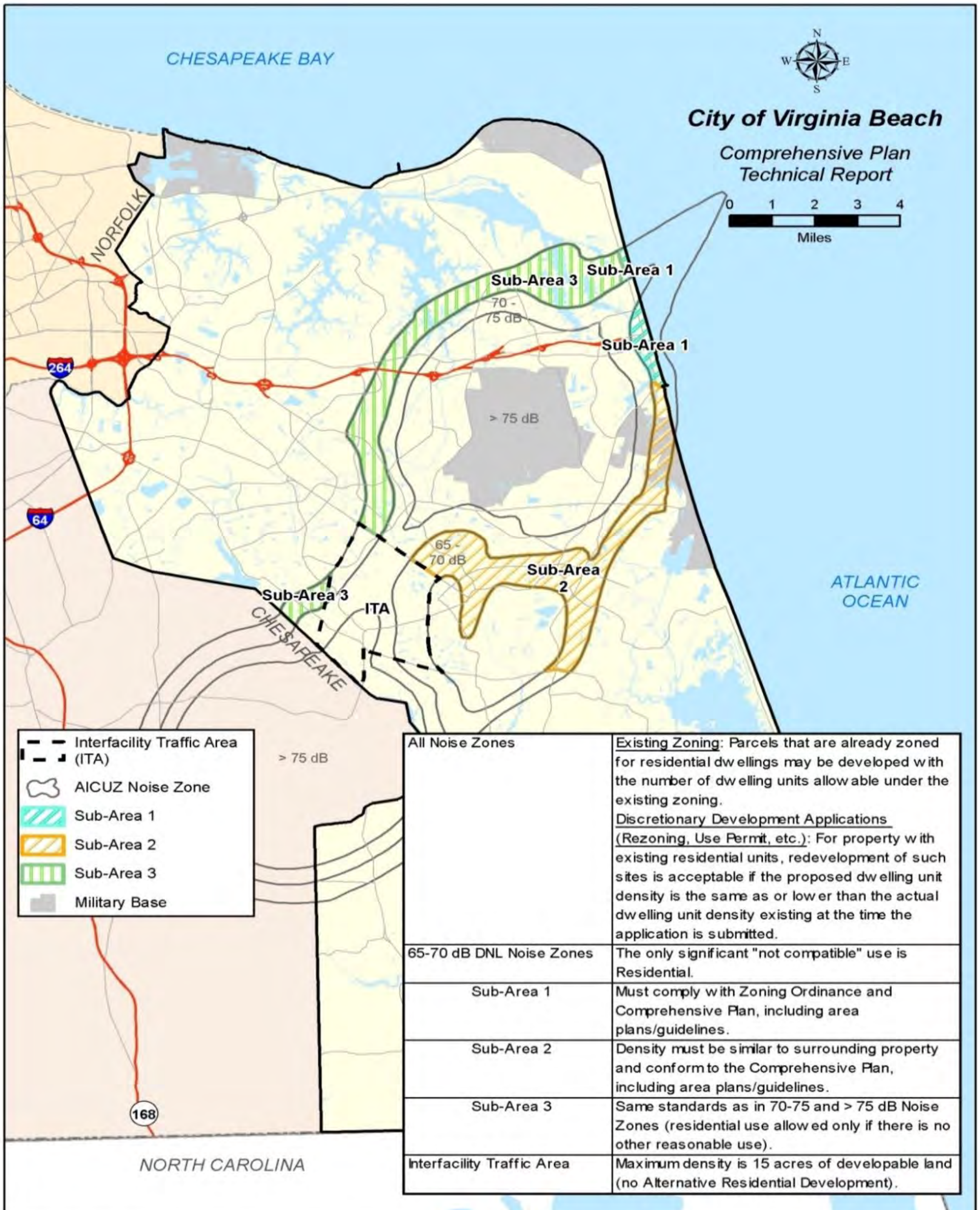
The City's AICUZ Overlay Ordinance regulates land use. AICUZ "Subareas" have also been designated by the City of Virginia Beach to correspond to high noise contours. Each of these subareas has associated land use density policies and use restrictions. The AICUZ areas and Subareas are illustrated on the maps on the following pages.



Air Installation Compatible Use Zone (AICUZ) and Sub-Areas

Sources: Virginia Beach Dept. of Planning and Community Development; Virginia Beach Dept. of Communications and Information Technology Center for Geospatial Information Services, 2016
Disclaimer: Map current as of February 2016; for general information purposes only.
Please see Appendix A for the complete map disclaimer and further information about this map.

For additional information please refer to the City of Virginia Beach Comprehensive Plan at: www.vbgov.com/Planning



All Noise Zones	Existing Zoning: Parcels that are already zoned for residential dwellings may be developed with the number of dwelling units allowable under the existing zoning. Discretionary Development Applications (Rezoning, Use Permit, etc.): For property with existing residential units, redevelopment of such sites is acceptable if the proposed dwelling unit density is the same as or lower than the actual dwelling unit density existing at the time the application is submitted.
65-70 dB DNL Noise Zones	The only significant "not compatible" use is Residential.
Sub-Area 1	Must comply with Zoning Ordinance and Comprehensive Plan, including area plans/guidelines.
Sub-Area 2	Density must be similar to surrounding property and conform to the Comprehensive Plan, including area plans/guidelines.
Sub-Area 3	Same standards as in 70-75 and > 75 dB Noise Zones (residential use allowed only if there is no other reasonable use).
Interfacility Traffic Area	Maximum density is 15 acres of developable land (no Alternative Residential Development).

Noise Zones 65-70 dB DNL Sub-Areas

Sources: Virginia Beach Dept. of Planning and Community Development; Virginia Beach Dept. of Communications and Information Technology Center for Geospatial Information Services, 2016
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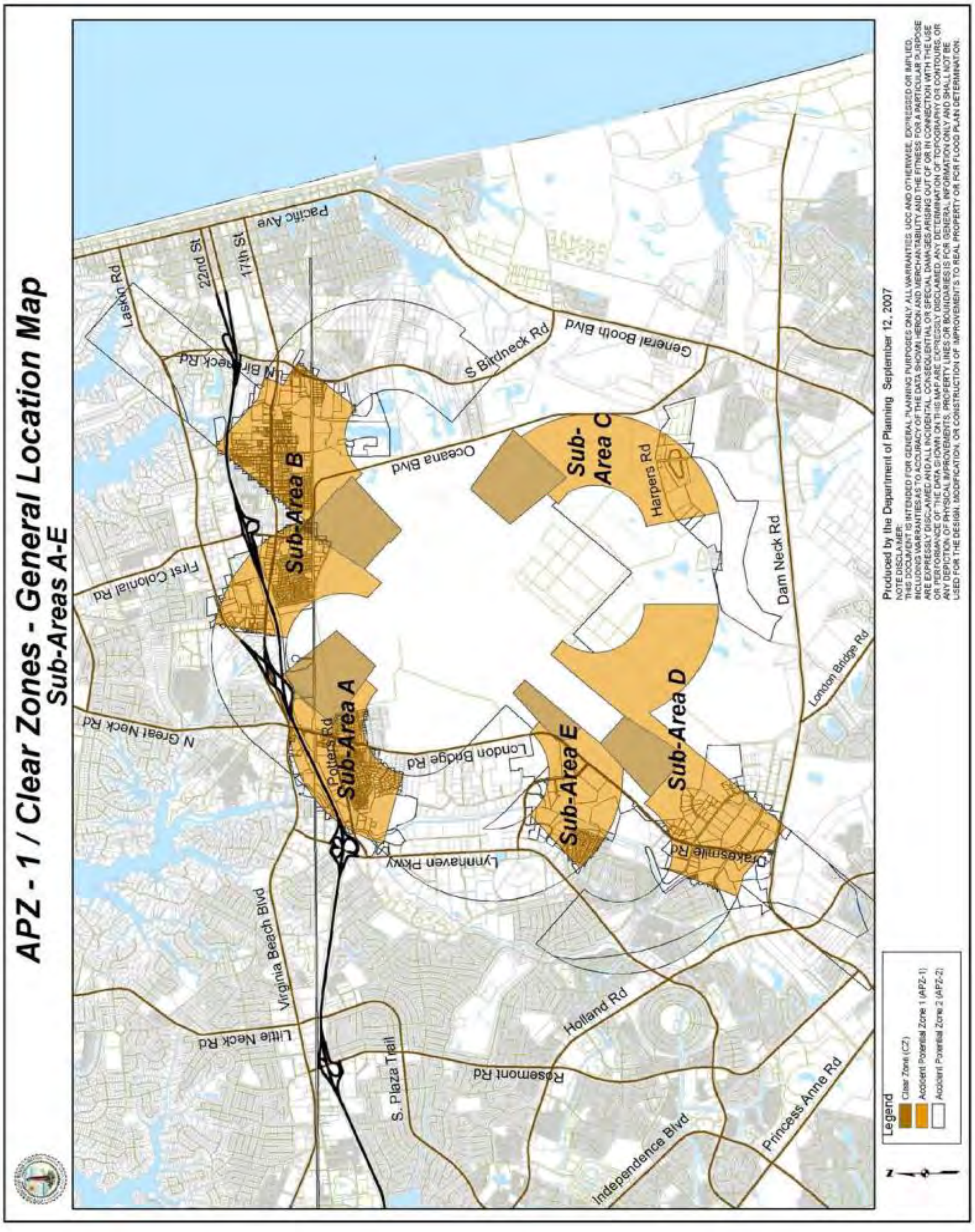
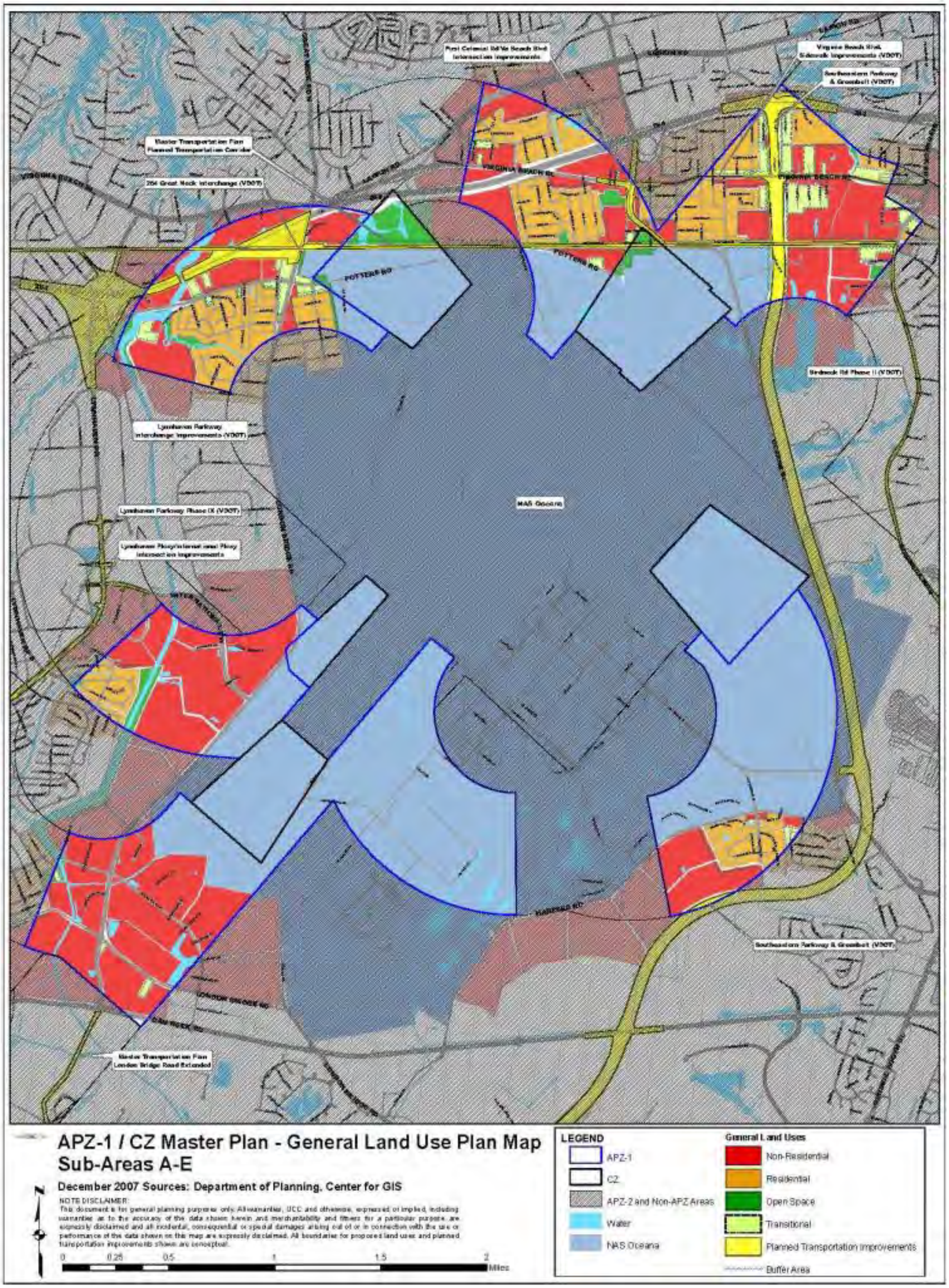

APZ - 1 / Clear Zones - General Location Map
Sub-Areas A-E
Sub-Area A
Sub-Area B
Sub-Area C
Sub-Area D
Sub-Area E
Laskin Rd
22nd St
17th St
Pacific Ave
N Birdneck Rd
S Birdneck Rd
General Booth Blvd
Oceana Blvd
Harpers Rd
Dam Neck Rd
London Bridge Rd
First Colonial Rd
N Great Neck Rd
Potters Rd
London Bridge Rd
Lynnhaven Pkwy
Drakesmile Rd
Virginia Beach Blvd
Little Neck Rd
Holland Rd
S. Plaza Trail
Rosemont Rd
Independence Blvd
Princess Anne Rd
Legend
Clear Zone (CZ)
Accident Potential Zone 1 (APZ-1)
Accident Potential Zone 2 (APZ-2)
Produced by the Department of Planning September 12, 2007


Master Transportation Plan
London Bridge Road Extended
APZ-1 / CZ Master Plan - General Land Use Plan Map
Sub-Areas A-E
December 2007 Sources: Department of Planning, Center for GIS
NOTE DISCLAIMER:
This document is for general planning purposes only. All warranties, UCC and otherwise, expressed or implied, including warranties as to the accuracy of the data shown herein and merchantability and fitness for a particular purpose are expressly disclaimed and all incidental, consequential or special damages arising out of or in connection with the use or performance of the data shown on this map are expressly disclaimed. All boundaries for proposed land uses and planned transportation improvements shown are conceptual.
0
0.25
0.5
1
1.5
2
Miles
LEGEND
APZ-1
CZ
APZ-2 and Non-APZ Areas
Water
NAS Oceana
General Land Uses
Non-Residential
Residential
Open Space
Transitional
Planned Transportation Improvements
Buffer Area

SPECIAL ECONOMIC GROWTH AREAS (SEGAs)

The City has designated 4 Special Economic Growth Area (SEGAs) on the Comprehensive Plan's "Planned Land Use Map," which are described in greater detail in Chapter 2, Section 2.4 - Economic Vitality. SEGAs are viewed as special areas with significant economic value and growth potential, with a primary consideration being adjacency to NAS Oceana or within the Interfacility Traffic Area high noise overflight zone. The City supports development and redevelopment of this area consistent with the City's AICUZ Ordinance provisions and the City's economic growth strategy.

Three SEGAs were initially designated in the 2009 Comprehensive Plan:

1. SEGA 1 – East Oceana
2. SEGA 2 – West Oceana
3. SEGA 3 – South Oceana

In 2011, when the *Interfacility Traffic Area (ITA) & Vicinity Plan* was adopted as an amendment to the Comprehensive Plan Policy Document, SEGA 4 – Princess Anne Commons was subsequently designated. The recommendations pertaining to SEGA 4 – Princess Anne are derived from the *ITA & Vicinity Master Plan*.

CITY-NAVY COOPERATION

The City's APZ-1 Ordinance (adopted December 2005 and revised to include Clear Zones) amended the City's Zoning Ordinance to prohibit all uses in APZ-1 and Clear Zones that are incompatible with OPNAV Instruction 11010.36B (the "OPNAV Instruction"). The APZ-1 Ordinance renders existing uses non-conforming but not incompatible and requires all new development or redevelopment to be consistent with the OPNAV Instruction. As an exception, the Ordinance allows incompatible uses or structures as a replacement of the same use or structure, if the replacements use or structure is of equal or lesser density or intensity than the original use or structure. Where application of the APZ-1 Ordinance leaves property without a reasonable use, the *APZ-1/Clear Zone Use and Acquisition Plan* is intended to direct reuse, rezoning. The acquisition plan focuses on voluntary purchases of pre-existing, nonconforming properties within the APZ-1/Clear Zone that have been devalued by use restrictions, and/or whose owners desire to relocate such uses outside of the APZ-1/Clear Zones. The Plan also includes the voluntary acquisition of ITA and Rural Area AICUZ properties, as well as a program to manage and/or dispose of acquired properties in all acquisition areas. Through June 2014, the City acquired or contracted to acquire 758 residential dwelling units and 63 commercial units in APZ-1 and the Clear Zone. [v]

The City-Navy Joint Review Process Group (JRP) informs the Planning Commission and City Council whether qualifying discretionary proposals, such as rezoning and conditional use permits, meet the requirements of the AICUZ Overlay Ordinance. The JRP meets as needed when rezoning applications are received by the City and consists of the following members:

- City Planning & Community Development Department Staff (JRP Coordination)
- City Attorney's Office
- Director of Planning & Community Development
- Zoning Administrator
- NAS Oceana Planning Liaison
- NAS Oceana AICUZ Program Manager

The Department of Planning & Community Development routes all discretionary review applications within the "Area of Interest" map to JEB Little Creek-Ft. Story and to NAS Oceana within AICUZ zones to their respective base Community Planning Liaison Officer (CPLO). The CPLO's review comments are included in City staff reports to the Planning Commission.

YesOceana.com Program website

The City's *YesOceana!* Program was developed by the Department of Economic Development to meet the requirements of the Defense Base Closure and Realignment (BRAC) Commission to protect our citizens and keep NAS Oceana in Virginia Beach. This innovative program consists of zoning ordinances and economic incentives to foster the conversion of nonconforming businesses in the APZ-1 into conforming ones and relocating ones that cannot be converted to another part of Virginia Beach. Program incentives include relocation assistance and BPOL Tax reduction. Not only does this approach accomplish necessary rollback, it ensures that redevelopment follows sound planning and land use principles and that any new development is of higher quality than what currently exists. For more information about this program, visit www.YesOceana.com.

PARTNERSHIPS

Since 2005, the City has established multiple partnerships with our military partners to advocate for the military presence in our community and associated economic development opportunities.

Military Economic Development Advisory Committee (MEDAC)

MEDAC was established to enhance the coordination with the local military and its various installation tenant commands. Members appointed by Virginia Beach City Council. Committee members are retired senior officers, retired senior enlisted personnel or qualified civilians having experience in the military warfare areas represented by the various local commands. MEDAC has four primary goals:

- Outreach to U.S. Navy and other military commands
- Economic development opportunities
- Workforce development
- Virginia Beach military affairs

Oceana Land Use Conformity Committee (OLUCC)

The City's Oceana Land Use Conformity Committee makes recommendations to City Council and the Virginia Beach Economic Development Authority on the following matters:

- agreements and transactions that further the purposes for which the Committee was created;

- zoning and other land use ordinances, including the advisability of adopting new or amended ordinances;
- discretionary zoning applications, such as rezoning and conditional use permits;
- ordinances imposing fees or taxes, including the advisability of adopting new or amended ordinances; and,
- staffing and resources necessary, or appropriate, to assist the Committee in the exercise of its duties.

NAS Oceana Encroachment Reduction Program Annual Report

RECOMMENDED POLICIES

- Land uses situated in AICUZs should conform to all adopted plans (e.g., APZ-1/CZ Master Plan, ITA & Vicinity Master Plan, and the Strategic Growth Area Master Plans).

AGENDA FOR FUTURE ACTION RECOMMENDATIONS: Military Installations and Support

- Support the mission of the military installations in Virginia Beach. Continue to route to the Community Planning Liaison Officers (CPLOs) all discretionary and by-right development applications within "areas of interest." Work closely with the CPLOs in the review of development applications for "areas of interest" to avoid potentially incompatible uses.

- Continue to route to the CPLOs for review all discretionary and by-right development applications within "areas of interest" to avoid potentially incompatible uses.

ENDNOTES

[ii] Joint Expeditionary Base Little Creek-Fort Story. "Major East Coast Base Supporting Overseas Contingency Ops." Presentation for Planning Department – City of Virginia Beach, January 7, 2015.
[iii] U.S. Department of the Navy. "Air Installations Compatible Use Zones Addendum." March 2014: ES-2 thru ES-6.
[iv] United States Department of the Interior, National Park Service. "National Register of Historic Places Registration Form: Camp Pendleton/State Military Reservation Historic District." August 17, 2005.
[v] City of Virginia Beach. *NAS Oceana Encroachment Reduction Program – Progress Report: Comprehensive From September 8, 2005 – June 30, 2014*: 17.

CHAPTER 2 – CITY WIDE ELEMENTS

The following sections 2.1-2.4 of the Comprehensive Plan present four 'City-wide' elements that are topic-specific versus area-specific. The policies contained here apply City-wide. Each of these topics is important to the future our city and, in some cases, fulfill state planning mandates.

- Section 2.1 – Master Transportation Plan
- Section 2.2 – Environmental Stewardship Element
- Section 2.3 – Housing & Neighborhoods
- Section 2.4 – Economic Vitality

2.1 – MASTER TRANSPORTATION PLAN

ISSUES CONFRONTING OUR TRANSPORTATION SYSTEM…

TODAY

- Land use largely accommodates automobile-oriented corridors
- Suburban land use design for majority of developed City
- Transportation infrastructure investment supporting suburban roadway system
- Increasing travel times
- Many older narrow roadways, particularly in the rural area of the City

IN THE FUTURE

- Improve and sustain the City's existing suburban and rural roadway network
- Facilitate strategic growth within the City's Strategic Growth Areas, including Transit-Oriented Development, will need to be supported by a multi-modal transportation system
- New or renovated roadway projects to follow a Complete Streets approach
- Emphasis on regional coordination to fund and implement transportation mega-projects
- Maximize Transportation Demand Management to complement transportation infrastructure investments as another tool to reduce traffic congestion

The following topics in relation to goals, policies, and action strategies are all equally important in the development of the City's transportation network and this Master Transportation Plan. The framework for the Master Transportation Plan is:

- Citywide Transportation Policies/Complete Streets
- Roadways
- Transit
- Active Transportation
- Other Regional Scale Transportation Planning
- Transportation Demand Management
- Intelligent Transportation Systems

INTRODUCTION

The City of Virginia Beach Master Transportation Plan (MTP) envisions the future of a multi-modal local and regional transportation network. The City of Virginia Beach has the largest population of any city in the Commonwealth and projections indicate our city will continue to grow. In the next ten years, changing demographics, technology, and environmental changes will have major impacts driving transportation choices and strategies. Our city is one that is in transition. Dramatic shifts in technology and changes in travel behavior will cause the Hampton Roads region to focus on urban mobility and creating sustainable transportation networks to meet transportation needs. As a result, the primary transportation goals for Virginia Beach include:

- Following the Complete Streets philosophy of designing roadways considering the needs for all users and modes in an attractive and environmentally sustainable manner.
- Promoting walkable, transit supportive, mixed-use neighborhoods in the Strategic Growth Areas (SGAs).
- Preserving and meeting the transportation needs of the City's Suburban Area and Rural Area south of the Green Line by concentrating the majority of future development in the SGAs.
- Prioritize transportation improvements to achieve the greatest benefits due to the magnitude of the transportation needs throughout the City.

The Master Transportation Plan, in accordance with the Code of Virginia §15.2-2223, is a mandatory comprehensive planning assessment of existing conditions with consideration of future trends and needs. This plan must consider designation of transportation infrastructure needs, contain maps showing road and transportation improvements, and be in accordance with the Commonwealth of Virginia Six-Year Improvement Program (SYIP). [i] The SYIP is the Commonwealth's fiscal plan to build and maintain new roads.

Since the mid-1990s, the expansion of local comprehensive planning requirements has led to the preparation of more comprehensive transportation plans by Virginia localities. The purpose of this Master Transportation Plan is to present a system of transportation needs and recommendations. It addresses Code of Virginia requirements by providing for a roadway hierarchy and a multi-modal transportation system, while aligning transportation facilities with affordable housing and community services. This plan provides maps of capital improvement projects and the cost estimates associated with their completion. Accountability of this plan will include review by the Virginia Department of Transportation (VDOT) to ensure that it aligns with the vision of the Six-Year Improvement Program (SYIP) and is consistent with the Commonwealth Transportation Board's (CTB) Statewide Transportation Plan. This plan will need review and approval for any subsequent revisions.

This Master Transportation Plan also aligns with *Envision Virginia Beach 2040* by considering transportation "a key priority, focusing on multi-modal means of connecting within our neighborhoods, across the City, region and beyond." [ii] It also aligns with the City's recent adoption of a Complete Streets policy that promotes street safety by creating and managing streets, which "shall be comfortable for pedestrians, bicyclists, transit riders, motorists, and other users."

Existing Conditions, Recent Trends and Projections

Several trends and projections will influence the overall transportation needs of the City and region as follows:

- Demographic Shifts
  - By 2045, the number of Americans over age 65 is expected to increase by 77%. About one-third of those over 65 will likely have a disability that limits mobility. Their access to critical services will be more important than ever.
  - There are 73 million Millennials aged 18 to 34 who will be an important engine of our future economy. Millennials are driving less, as evidenced by a reduction of 20% fewer miles over the 2000s decade. [iii]
  - The demographic shifts identified above are influencing the need to increase the type of living and corresponding transportation choices throughout the city.

- Physical Environment
  - Not only will the City address shifting trends in travel, but we will also assess how to deal with our changing physical environment. Constrained transportation corridors require our transportation planners and engineers to be as efficient as possible with the use of limited rights-of-way. Taking a proactive approach to these trends, the City adopted a Complete Streets policy in 2014 that is designed to enable safe access for all users of the road right-of-way.
  - Historically included in roadway project design as aesthetic treatments and for the many other benefits they provide, trees are now thought of as integral infrastructure for well-designed, multi-modal transportation corridors. Interception of storm water, reduction in urban heat islands, and providing shade for walkers, bikers, and transit users are all reasons for including trees along our transportation corridors. It is also important to note that, unlike other transportation infrastructure, the environmental benefits of well-cared for trees only increase over time.
  - Greater emphasis is being placed on improving public transit services, transit oriented development, transportation demand management, intelligent highway systems, and promotion of active transportation to reduce the reliance on driving single occupancy vehicles.
  - Since the City has an extensive shoreline and water features, environmental impacts such as sea level rise and recurrent flooding will play a key factor in how and where we travel *(see Chapter 2, Section 2.2 - "Environmental Stewardship Framework")*.

- Funding
  - There has been a distinct downward trend of federal and state funding for local road projects. This, in combination with the parallel downward trend of city revenue~~s~~ collections, necessitating that the City conduct more detailed analyses and prioritization of transportation projects.
  - It has been thirty years since the City has undertaken extensive modeling of its transportation network. Preparation of this Master Transportation Plan used a macro modeling as an additional tool for greater analysis of the primary roadway network and to aide in planned roadway infrastructure prioritization.

- Technology
  - There has been a notable advancement in technology that will affect modes of travel, along with the implementation of traffic demand management (TDM) and intelligent transportation systems (ITS). There is also the implication of new methods of technology still under development, such as autonomous (self-driving) vehicles.

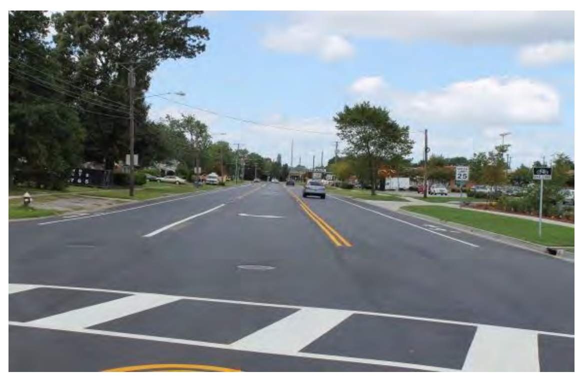
CITY-WIDE TRANSPORTATION POLICIES

Transportation underlies many aspects of successfully planning the growth and sustainability of a city. It is important to address the transportation needs of all people in an equitable manner. Transportation planning decisions must be balanced with compatible land use planning and provide necessary efficiencies. It is also important to prepare for decision making by modeling traffic behavior while understanding the community's needs in the future. With these factors in mind, the City of Virginia Beach has recently woven transportation goals into its various community vision plans as follows:

- Envision Virginia Beach 2040 (2013)
- A Community Plan for a Sustainable Future (2013)
- City of Virginia Beach Strategic Plan, 2015-2017
- Area Master Plans approved since 2007 (Strategic Growth Area Master Plans (2007-2013), Interfacility Traffic Area & Vicinity Master Plan (2011), Virginia Aquarium & Owls Creek Area Plan, etc.)
- Visioning Sessions with City Council (i.e., Annual and Mid-Year Retreats)

Most recently, the City adopted a *Complete Streets* policy and accompanying Administrative Directive (AD) in November 2014. This policy and AD guide transportation planners and engineers in the design and operation of the entire right-of-way to enable roadways to create safer access for all users, regardless of age, ability or mode of transportation. This policy and AD mean that every transportation project will make the street network better and safer for drivers, transit users, pedestrians, and bicyclists. A Complete Streets approach will be applied to all new roadway and roadway renovation projects to the greatest extent feasible, without compromising the primary functional use of the right-of-way.

Urban-style Complete Street



Suburban Style Complete Street

The goals of the City of Virginia Beach Complete Streets policy are:

- Consider all users in all aspects of the project development process for surface transportation projects to the fullest extent practicable.
- Match and balance roadway functions with user needs, both at the roadway segment level and as part of the larger transportation network.
- Develop the public rights of way in harmony with the adjacent land uses.
- Develop an attractive and sustainable transportation system.
- Promote public health by supporting healthy lifestyle choices and improved air quality.

- Promote safety and crash reduction.
- Increase the economic value of business districts and neighborhoods.
- Strengthen the community by creating a sense of place.

The entire Administrative Directive that implement's the City's Complete Streets Policy is found in the Comprehensive Plan's Reference Handbook. More information about Complete Streets can also be found on the City's website at: http://www.vbgov.com/government/departments/sga/transportation-planning/Pages/complete-streets.aspx [iv]

MASTER TRANSPORTATION PLAN FRAMEWORK

ROADWAYS

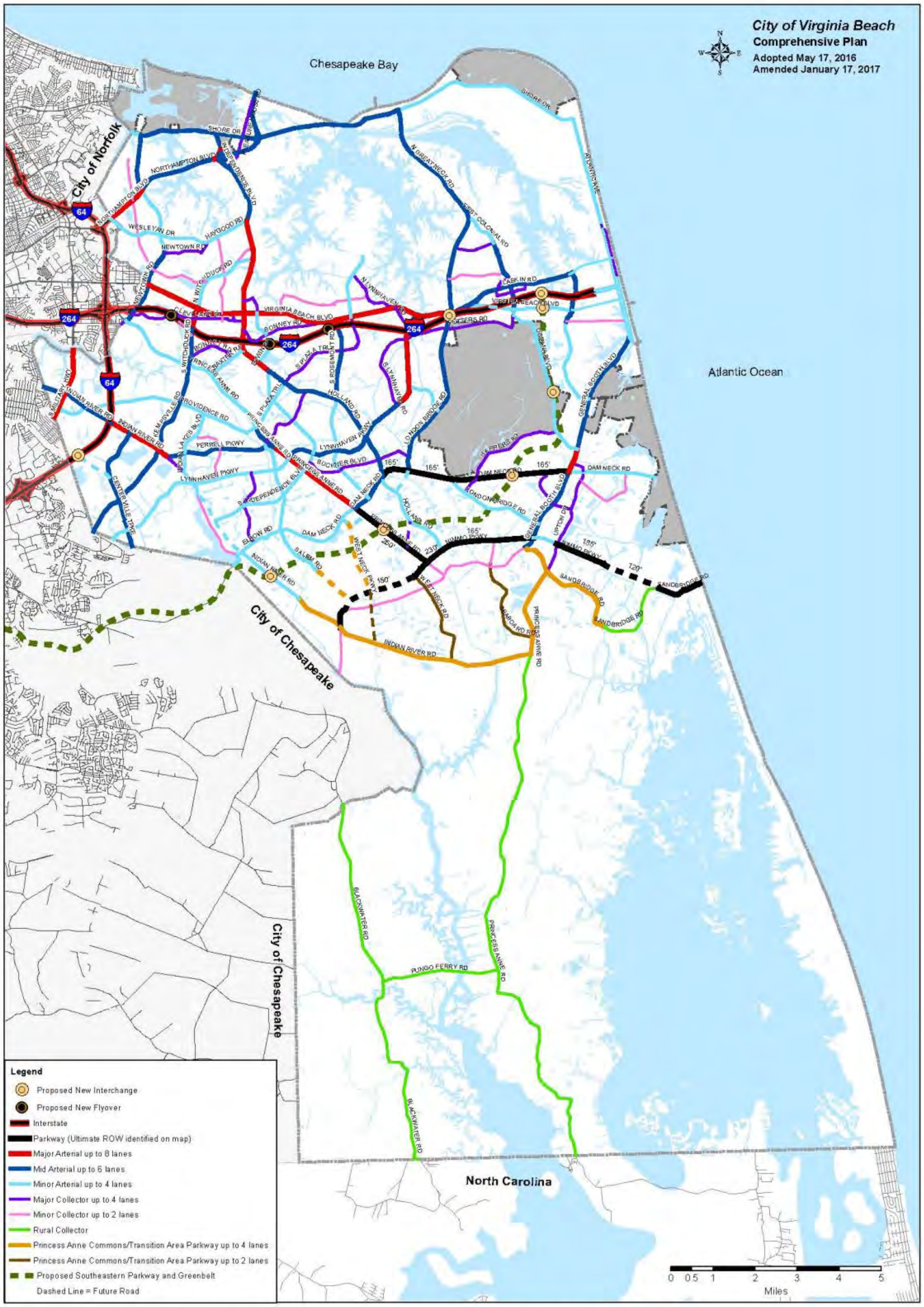
Primary Roadway Network Plan Map

A key component of the Master Transportation Plan is the "Primary Roadway Network Plan Map" *(see next page)*. This Map is a key planning tool for the development of the City's street network. The map was developed in conjunction with current specifications and standards used by the City's Public Works Department. The Primary Network Plan Map identifies the general road corridor locations, classification, and the ultimate proposed motor vehicular lane number and general configuration. The details of what amenities are incorporated in a given road section are identified in the City's Typical Section Standard Drawings contained within the *Public Works Design Standards (see exhibits pp. 2-8 and 2-9).* Each roadway cross section has alternative cross sections for constrained sections where right-of-way may be limited by the natural or built environment. The currently adopted typical sections will serve as a guide to determine ultimate rights-of-way required for new roads. Deviations to the typical section are subject to the approval of the Director of Public Works as per the general guidance of the City's Complete Streets Policy. A listing of the current major street network ultimate rights of way and estimates of cost in today's dollars are included in the Reference Handbook.

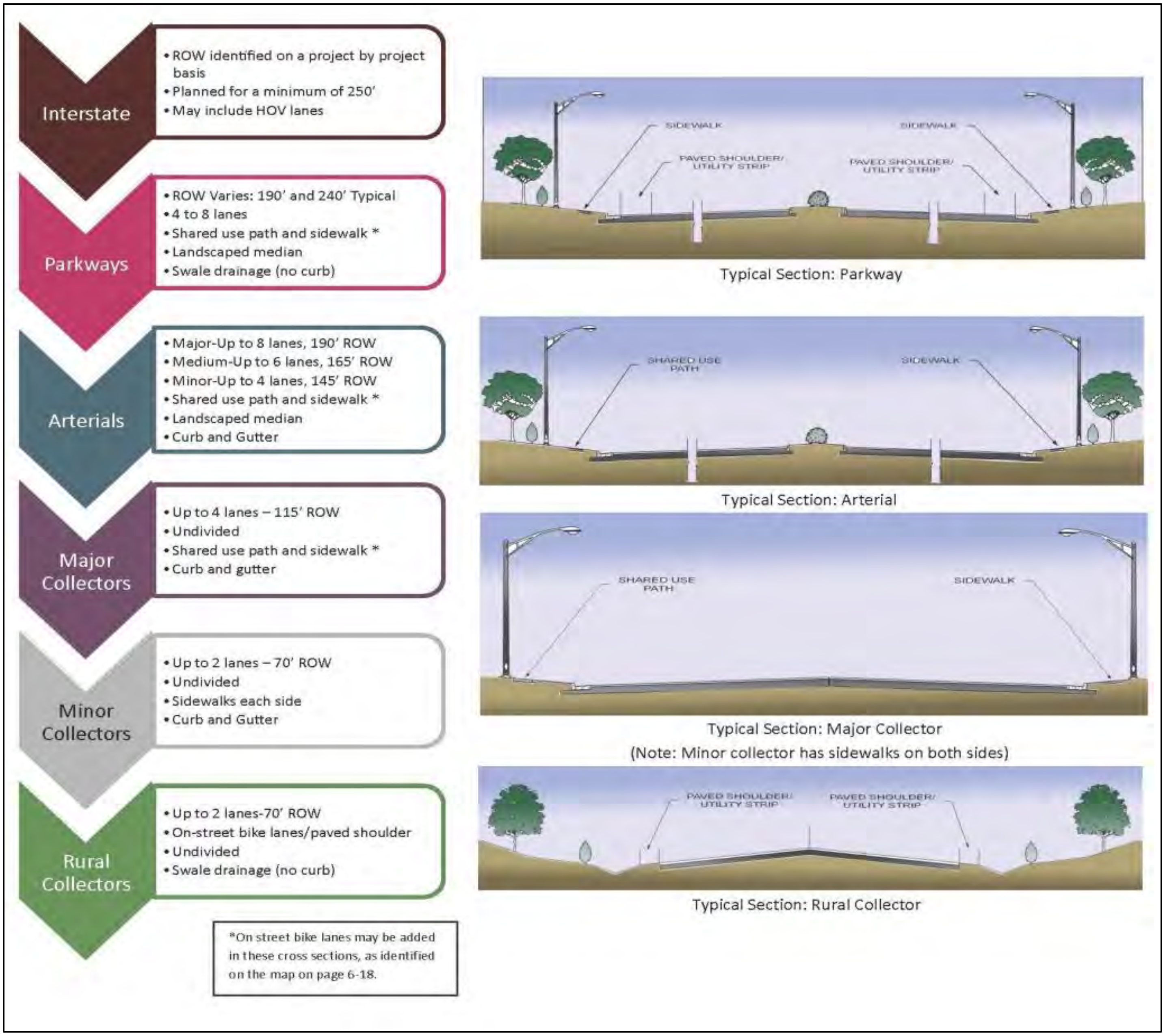
For the first time in over thirty years, the development of the Primary Roadway Network Map was accomplished through the utilization of a Travel Demand Model. This Model was developed with the inclusion of the Southeastern Parkway and Greenbelt Project (SEP&G). The City has contracted with Old Dominion University's Virginia Modeling, Analysis, and Simulation Center (VMASC) to perform a detailed micro modeling analysis of traffic impacts of including or not including the SEP&G. Until the results are available from the VMASC Analysis, the Comprehensive Plan Primary Roadway Network will contain the SEP&G. If in the future this roadway is removed from the network, the Primary Roadway Network Map will be amended to include new alignments or modified lane calls for roads with traffic volumes negatively or positively impacted by removal of the SEP&G.

The model results provide a tool for staff to decide on the following future ultimate lane call changes from the 2009 Map to the current 2016 map shown below. The lane call changes resulting from this analysis are found on p. 2-10.

PRIMARY ROADWAY NETWORK PLAN MAP (see insert next page)



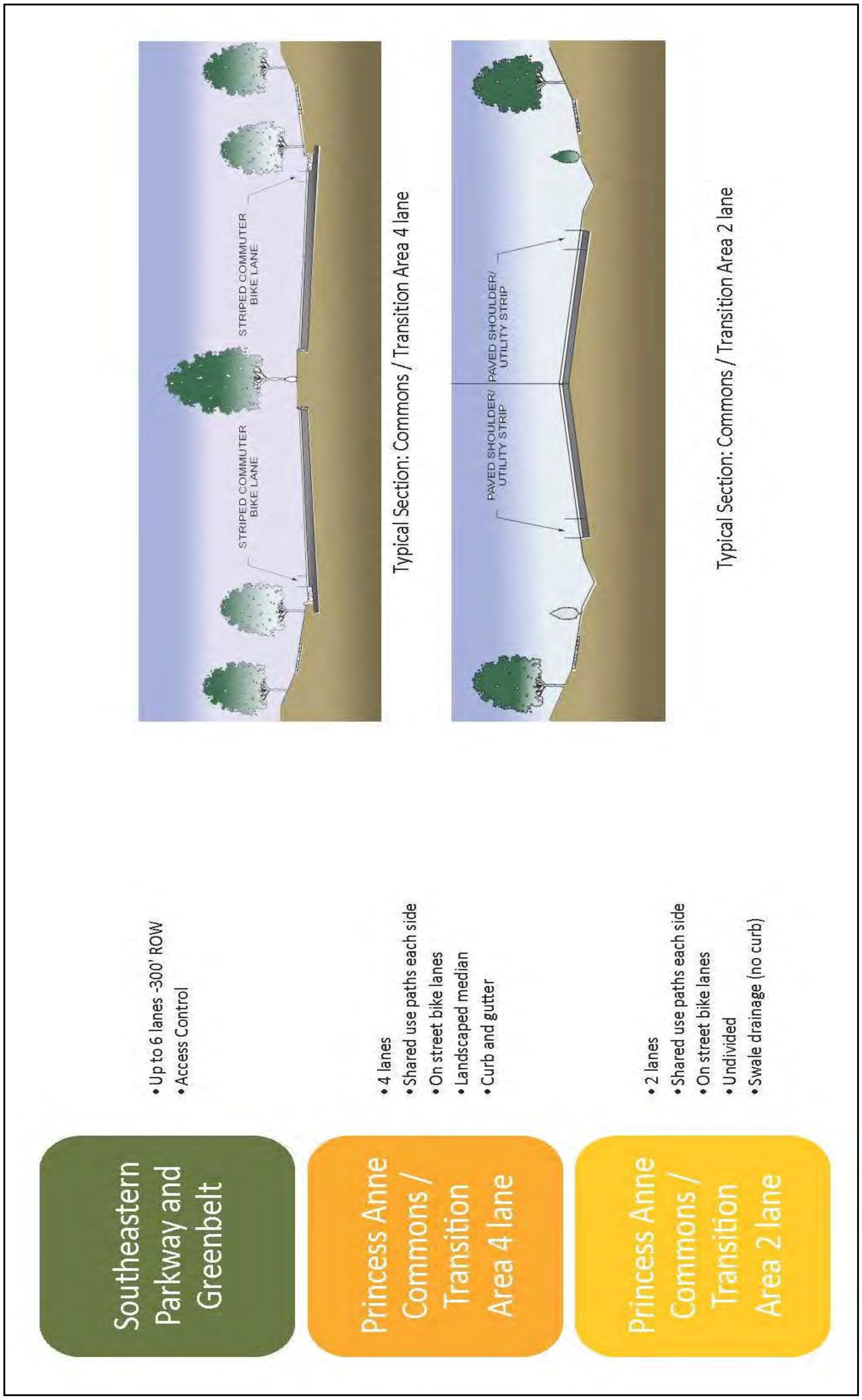
Primary Roadway Network Plan Map



*On-street bike lanes may be added in these sections.

TYPICAL SECTION STANDARD DRAWINGS
(source: City of Virginia Beach Public Works Design Standards Manual)

SPECIAL SECTIONS STANDARD DRAWING



SPECIAL SECTIONS STANDARD DRAWING

Increases in future ultimate lanes (from the 2009 to 2015 Map for the year 2040)

- Princess Anne Road (from Providence Road to just south of Ferrell Parkway) from 4 to 6 lanes.
- Military Highway (from Norfolk City limit to Chesapeake City limit) from 6 to 8 lanes

Decreases in future ultimate lanes (from 2009 to 2015 Map for the year 2040)

- Diamond Springs Road (from Northampton Boulevard to Newtown Road) from 6 to 4 lanes
- Baker Road (from Wesleyan Drive to Newtown Road) from 4 to 2 lanes
- Salem Road (from Nimmo Parkway to Indian River Road) from 4 to 0 lanes
- Birdneck Road (from Norfolk Avenue to General Booth Boulevard) from 6 to 4 lanes
- First Colonial Road (from Old Donation Parkway to Great Neck Road) from 6 to 4 lanes
- West Neck Creek Parkway (from Nimmo Parkway to Indian River Road) from 4 to 2 lanes
- Shore Drive (from Diamond Springs Road to Norfolk City limit) from 6 to 4 lanes

Other modifications

- Reflects the existing lanes for all primary roadways within the Oceanfront Transportation Planning Area shown on the 2009 Map. The model results did not indicate the need for increased lane calls for any of these roadways.
- Moved the alignment of West Neck Parkway (from North Landing Road to Indian River Road) to the area just west of Courthouse Estates and line it up with the north-south portion of Landstown Road (from North Landing Road to Landstown Road).
- Adjusted the right of way width on Nimmo Parkway/Sandbridge Road (from Atwoodtown Road to Sandfiddler Road) to accommodate a two lane Parkway section. Adjusted the right of way width of Nimmo Parkway to accommodate a four lane Parkway section (from Atwoodtown Road to Upton Road). Reclassified Nimmo Parkway to a Minor Arterial from Upton Road to General Booth Boulevard.

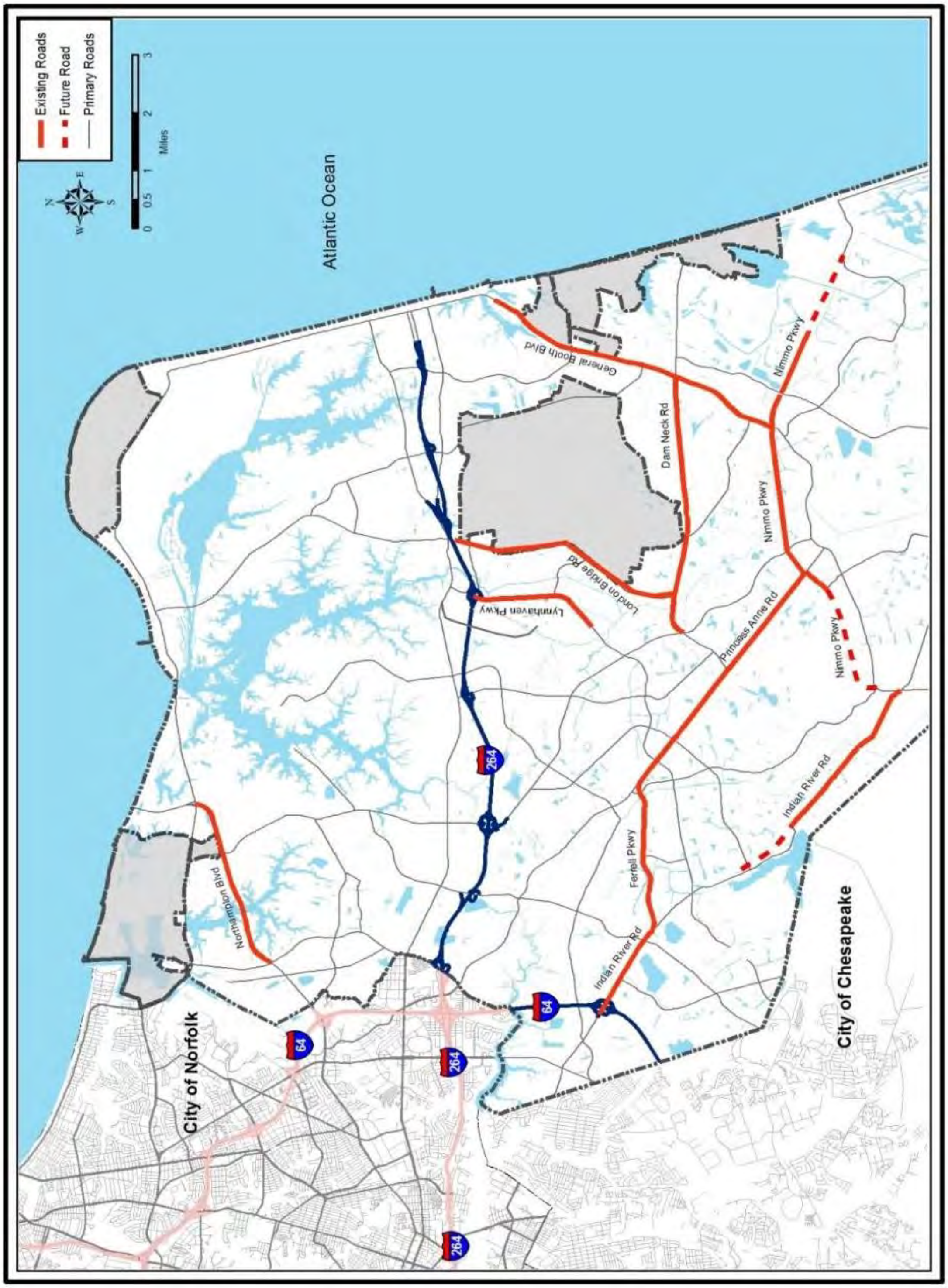
The results are summarized below, and detailed modeling information is contained in the *Reference Handbook.* This model calculated the need and lane call for a facility based upon the traffic generation of existing and projected land uses throughout the city and region for the year 2040. The model was calibrated by aligning recent year traffic assignments with the corresponding existing traffic count data. A unique feature of this model is that the lane calls are based on the implementation of a prioritized group of road improvements that have the greatest cost benefits and value for reducing system-wide delay. It is important to note that the Travel Demand Model is only one analysis tool to provide data and projections for creating the Roadways section of the city's Master Transportation Plan, as well as prioritizing the transportation projects funded through the city's Quality Physical Environment Capital Improvement Program (CIP).

Access Controlled Roadways

There are many ways to improve traffic flow on the City's busier roads. The most expensive way, in many cases, is to add additional pavement or concrete and travel lanes to existing roads. This method increases storm water runoff, and right-of-way and can have a negative impact on surrounding communities and safety. Limiting access on selected corridors may be a more cost effective method to maintain and improve the capacity of these roads. Limiting the turning movements to and from these roads can increase roadway capacity and improve traffic flows on the corridors.

The management of access points (driveways, intersections, etc.) is important to the safety and proper functioning of our roadways. Certain roads, due to their function in the overall roadway network, need a higher level of access control than roads whose function is to provide more direct access. Roads designated "Access Control" are shown on the following Access Controlled Roads Map and has restricted direct access to and from that roadway segment for new developments. Private direct access is not permitted on these roadway segments, except when the property in question has no other reasonable access to the circulation system. Developers are encouraged to utilize building orientation and signage to help identify the businesses along these corridors. The following corridors are designated as "Access Control":

- Northampton Boulevard between Diamond Springs Road and Shore Drive
- Indian River Road from Providence Road to Ferrell Parkway and from South Independence Boulevard to North Landing Road
- Ferrell Parkway
- Princess Anne Road from Ferrell Parkway to Nimmo Parkway
- Lynnhaven Parkway from I-264 to South Lynnhaven Road
- Dam Neck Road from Rosemont Road to General Booth Boulevard
- Nimmo Parkway
- General Booth Boulevard
- South Independence Boulevard from Holland Road to Lynnhaven Parkway
- London Bridge Road/Drakesmile Road from I-264 to Dam Neck Road



ACCESS CONTROLLED ROADS

Regional Transportation Plan Highway Network

Due to the fact that 46% of all workers in the Hampton Roads Region work in a different jurisdiction than where they live (US Census Bureau, 2013), transportation planning must have a regional focus. [v] The primary tool to accomplish coordinated regional planning is the *Hampton Roads 2040 Long Range Transportation Plan* (LRTP), which is scheduled for adoption by the end of 2015. Shown in the Technical Report is the Southside Hampton Roads roadway network from the 2040 LRTP, regional congested highway maps and information pertaining to the regional "mega" projects funded through the recent House Bill 2313.

Roadway Safety

Equally important to the goal of reducing congestion is the goal of improving roadway safety. As with congestion reduction, Intelligent Transportation Systems (ITS) can have a strong role in improving safety. The Commonwealth of Virginia has a federally-required *Strategic Highway Safety Plan*. The most recent update to the plan was in 2012 and addresses the four E's of transportation safety – education, enforcement and regulation, engineering, and emergency response.

The Virginia Safety plan focuses on seven primary safety areas with the greatest promise to reduce crashes and serious injuries including:

- Speeding
- young drivers
- occupant protection
- impaired driving (includes texting, cell phone use, eating, etc.)
- roadway departure
- intersections

Strategies to address several of the primary safety areas listed above will require extensive educational efforts and traffic enforcement. The focus of this plan's recommendations relate to the need for physical roadway improvements to address speeding, roadway departure and intersections. The chief non-local funding source for roadway safety improvements is the Highway Safety Improvement Program (HSIP). The HSIP process requires a data-driven, strategic approach to evaluation safety based on performance. As cited in the 2015 HRTPO State of Transportation report, the following trends are apparent:

- Total number of crashes from 2005-2014 has dropped 24%.
- Total number of injuries has fallen 13%.
- Total number of fatalities has dropped 10%.

The total number of crashes reached its low point in 2010 and has slightly increased since that date. The Comprehensive Plan's Technical Report includes a listing of ranked interstate interchanges and intersections in Virginia Beach, which would provide the greatest safety benefits if targeted for necessary funding for improvements.

Recommended Policies: Roadways

- Require traffic impact studies for any development proposal that yields a net 150 trips or more during the a.m. or p.m. peak hour.
- Evaluate funding options for infrastructure needs created by new development.
- Be creative with highway funding strategies and pursue all available grants and alternative funding strategies to reduce reliance on the shrinking federal and state funding sources.
- Promote mixed use development, higher density development, and transportation demand management, especially in designated growth and activity centers, to reduce the need for single occupancy vehicle trips and encourage~~s~~ transit-oriented development.
- When developing and updating the City's Capital Improvement Plan (CIP), review the CIP for conformity with the Comprehensive Plan (A listing of the current 2015-2020 CIP roadways is included in the Technical Report).
- Evaluate the specific transportation project impact on quality of life and aesthetics for surrounding and proposed land uses.
- Continue to improve the process of coordination between roadway and utility projects to minimize pavement cuts and traffic disruption.
- Continue to implement transportation policies that reduce cut-through traffic and calm traffic in and through neighborhoods, while ensuring connectivity for pedestrian and bicycle users and emergency vehicles.
- Utilize Intelligent Transportation Systems (ITS) to maximize the efficiency of the existing transportation system (see separate ITS section).
- Continue to participate in the refinement of the Regional Hurricane Evacuation Plan.
- Adhere to the recommendations of the 2014 Regional Safety Study strategies to address speeding, young drivers, occupant protection, impaired driving, roadway departure, intersection safety, and reliance on good data.
- Prioritize interstate interchange and local road intersections based on safety cost/benefit analysis outlined in the 2014 Safety Study.

Agenda for Future Action Recommendations: Roadways

- Adopt updated general typical sections and plan views to be consistent with those currently in the Public Works Design Standards.
- Implement the improvements shown on the City's Primary Roadway Network Map, the Regional 2040 Long Range Transportation Plan, and the Bikeways and Trails Plan to the extent funding is available in the City Capital Improvement Program and the State's Six Year Improvement Program (SYIP).

TRANSIT

Regional Transit Planning

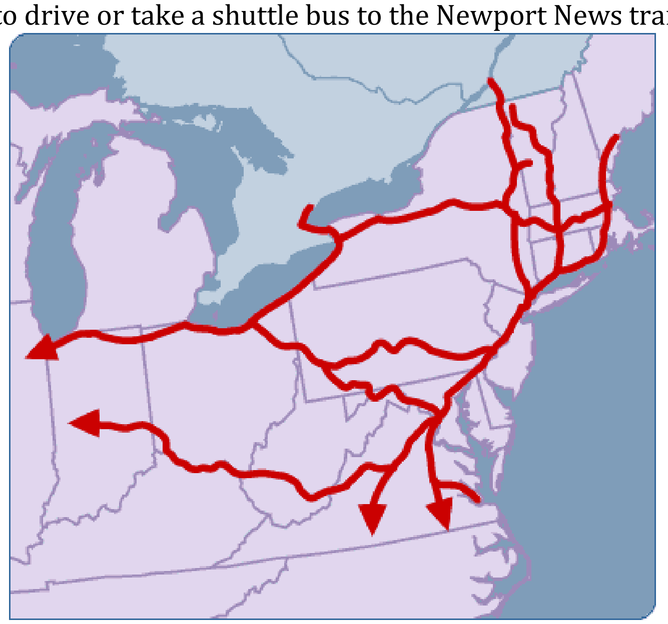
The *Hampton Roads Regional Transit Vision Plan* was completed in 2011 under the guidance of the Virginia Department of Rail and Public Transportation. This plan looks into the future, 2025 and beyond, to visualize the possibilities for the region's transit services. Transit services can be conveniently categorized as those that connect the region to other areas of the State and Nation and those that provide connections between and within the various localities.

More recently, Hampton Roads Transit (HRT) has begun a transit planning effort titled "Connect Hampton Roads (CHR)" that will serve to update the Regional Transit Vision Plan. The campaign's purpose is to create a community outreach process to "rethink mobility for the entire region." Collectively, there are 1.6 million residents in the Coastal Virginia region, and there is a prediction that the population will grow to 2 million in the next two decades. The results of the public input survey indicated that citizens feel there is a lack of transportation choices and a need for a multi-faceted transportation network. Maps and detailed information related to the regional transit plan and the initial stages of the Connect Hampton Roads effort are included in the Technical Document.

Intercity Passenger Rail

Intercity passenger rail (Amtrak) service is the primary public transit service that connects the region to the rest of the country. The private Greyhound bus company also serves to connect Virginia Beach and Hampton Roads to the rest of the state and nation. In December 2012, Amtrak began providing passenger service to Southside Hampton Roads via a new train station at Harbor Park in Norfolk. The below maps show the Amtrak routes within Virginia and the Northeast Region.

This single daily train service serves to connect the Hampton Roads region to Richmond, Washington D.C., and the Northeast Passenger Rail Corridor. Previously, the only other option was to drive or take a shuttle bus to the Newport News train station. The number of passengers who boarded or departed Amtrak trains in Hampton roads has increased 66% over the last decade.[vi] Use of this new Southside service has led the Commonwealth to commit to expanding Amtrak service to three trains in the near future. There is long term interest in pursuing high speed rail service and the Hampton Roads Transportation Planning Organization (HRTPO) took the lead in hiring a consultant to develop a detailed passenger rail vision plan that makes the business case to bring high speed rail to the region.



Amtrak Northeast Passenger Train Routes

Regional/City High Capacity Transit Network

The Norfolk Tide Light Rail line opened in 2011 and is considered to be a High Capacity Transit technology. This line connects the medical center in Downtown Norfolk with the Virginia Beach City line. HRT conducted an Origin and Destination Survey during 2013 and 2014 to determine points of origin and destination for passengers using The Tide [vii]. Results of this study indicate that a surprising 33% of all the Norfolk Tide light rail users reside in Virginia Beach. The busiest stations for Virginia Beach riders are at the eastern end of the line, including Newtown Road (57% of riders) and Military Highway (21%of riders) stations. Virginia Beach ridership is fairly dispersed throughout the remainder of the system and this study reflects that there are multiple destinations within the City of Norfolk. The vast majority of trips were from home to work. Other secondary trip purposes include colleges/universities, personal business, shopping, social visits, and medical appointments.

The Tide Light Rail station

In 2015, the Virginia Beach City Council adopted a Locally Preferred Alternative (LPA) resolution for an extension of The Tide from the Newtown Road station in Norfolk to the Virginia Beach Town Center, with new station locations at Witchduck Road, Kellam Road, and Constitution Avenue and above grade crossings at Witchduck Road and Independence Boulevard in order to bypass those roadways that experience high motor vehicle traffic volumes (*see exhibit p. 2-18*).

With this action, Virginia Beach set in motion a multi-faceted approach to the provision of enhanced transit services to Virginia Beach for the future as follows:

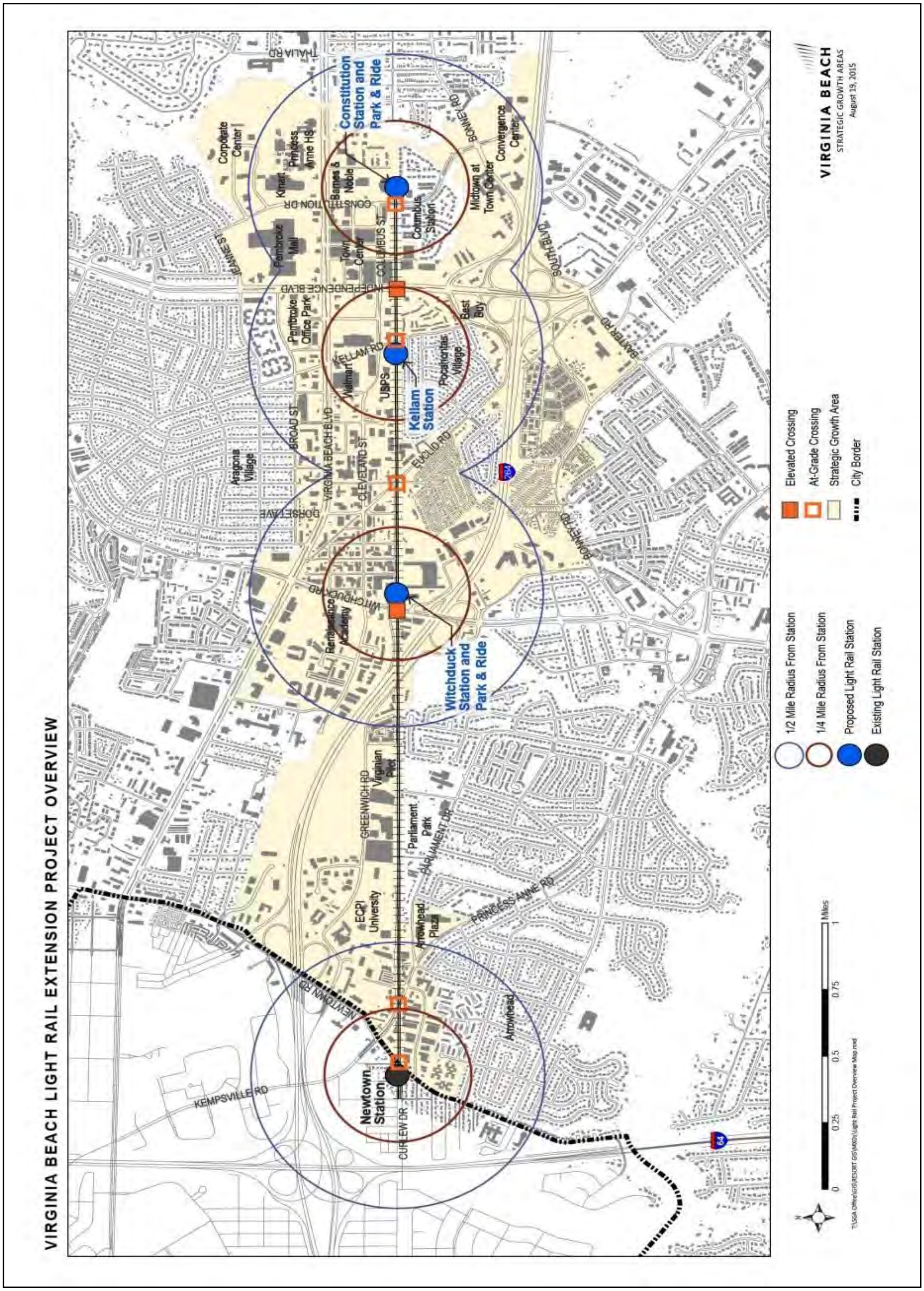
- A 3-mile extension of The Tide connecting Downtown Norfolk to Virginia Beach Town Center described above, thereby making the system truly regional, as intended, for the first time.
- Design of an end-of-line station that can be expanded to become a major passenger hub in which additional north/south and east transit corridors can logically interconnect. The City has studied the ridership potential of these extensions using the Federal Transit Association (FTA) STOPS model described later in this chapter.
- Design efforts are underway for the development of a shared use pathway running parallel to the light rail corridor to enhance connectivity between stations, along with the trail connectivity benefits as a multi-modal corridor.
- Walking/biking audits are underway for the SGAs and will form the basis of necessary infrastructure improvements to provide first mile/last mile connectivity to the transit

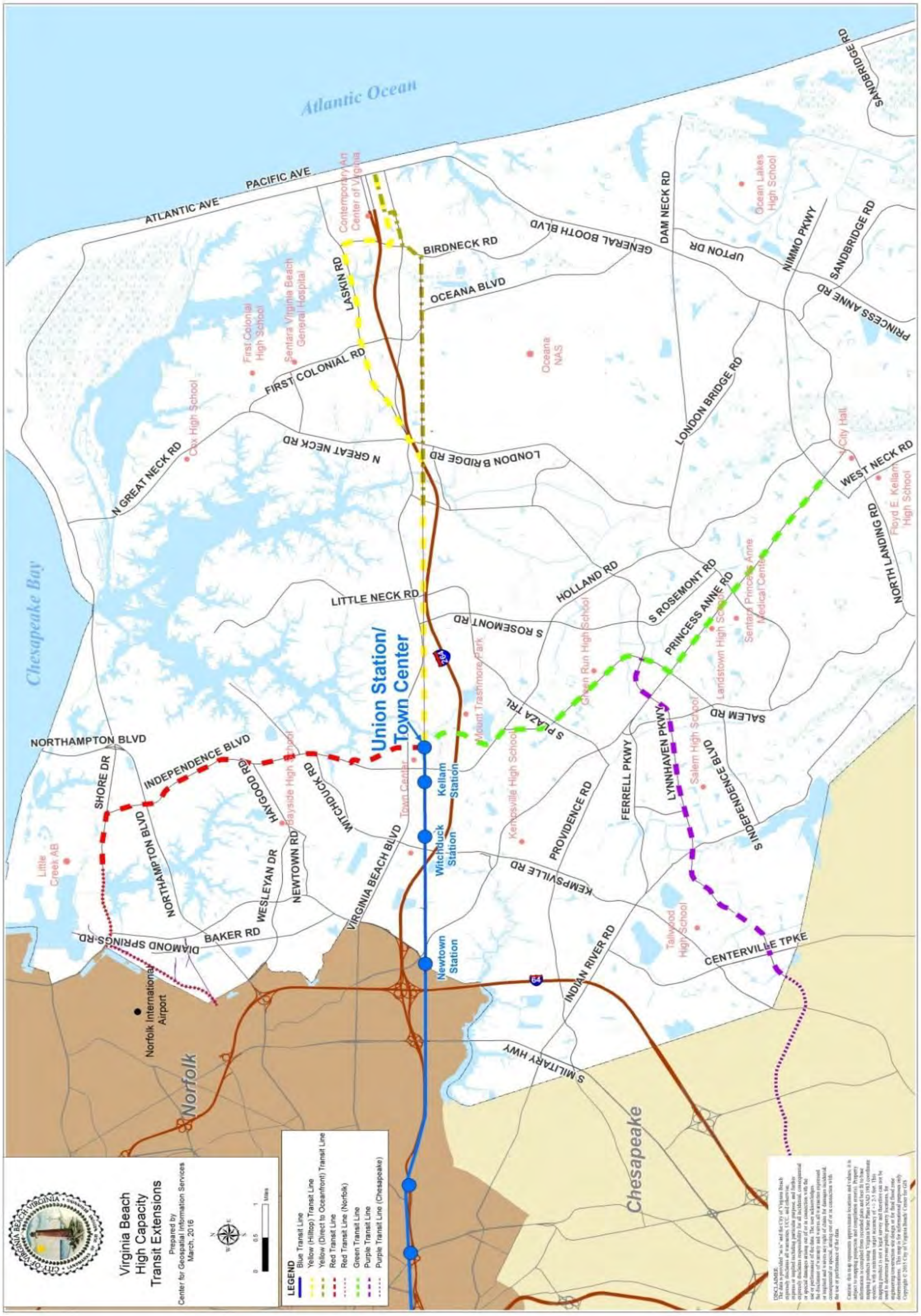
stations and bus stops along the initial Tide segment, and eventually to all of the SGAs and future transit station locations.
- An approximate doubling of the feeder bus network for The Tide extension will effectively double bus service within the City by establishing two new routes and increasing the timespan and frequency of several routes to match The Tide system operating schedule.
- Strategic land use planning and economic development to maximize transit-oriented development (TOD) along the transit rail corridor and future high capacity transit corridors connecting the SGAs. This growth strategy will focus the most intense development in these appropriate areas and help preserve the character of the City's Suburban and Rural Areas.

To further evaluate the feasibility of High Capacity Transit along various transportation corridors of the City, the Federal Transit Authority (FTA) STOPS (Simplified Trips-on-Project Software) program was utilized to model potential future transit ridership. STOPS is a stand-alone software package that applies a set of travel models to predict detailed transit travel patterns for the various transit extensions ; quantify the trips-on-project measure for all travelers and for transit dependents; and, compute the change in automobile VMT based on the change in overall transit ridership between the two scenarios.

The Virginia Beach High Capacity Transit Extension Map shown below indicates the approximate location for future extensions to the Newtown to Town Center alignment that is currently under detailed study. The modeling results indicate that the proposed alignments warrant inclusion in the Comprehensive Plan with recommendations for additional detailed study. Details associated with the modeling exercise are included in the Comprehensive Plan's Reference Handbook. Below is a brief description of the various alignment alternatives:

- The Blue line represents the Newtown Road to Town Center extension that is currently under detailed study.
- The Orange line represents the eastward extension of the Tide to the Oceanfront.
- The Green line serves the central spine of the City connecting Town Center to the north with Princess Anne Commons and the Municipal Center to the south.
- The Red line serves the central spine of the City from Town Center in the south to Joint Expeditionary Base Little Creek to the north. This alignment then turns west and south to potentially service Norfolk International Airport.
- The Purple line serves the vast suburban residential areas of Kempsville from an approximate midway point in the Green line to a potential connection with the City of Chesapeake.


VIRGINIA BEACH LIGHT RAIL EXTENSION PROJECT OVERVIEW
Newtown Station
Witchduck Station and Park & Ride
Kellam Station
Constitution Station and Park & Ride
Corporate Center
Princess Anne HS
Kmart
Barnes & Noble
Pembroke Mall
Town Center
Columbus Station
Midtown at Town Center
Convergence Center
Pembroke Office Park
Walmart
USPS
Pocahontas Village
Best Buy
Aragona Village
Renaissance Academy
Virginian Pilot
Parliament Park
ECPI University
Arrowhead Plaza
Arrowhead
THALIA RD
CONSTITUTION DR
COLUMBUS ST
BONNEY RD
INDEPENDENCE BLVD
JEANNE ST
SOUTH BLVD
KELLAM RD
BROAD ST
VIRGINIA BEACH BLVD
CLEVELAND ST
EUCLID RD
DORSET AVE
WITCHDUCK RD
BAXTER RD
GREENWICH RD
PARLIAMENT DR
PRINCESS ANNE RD
NEWTOWN RD
KEMPSVILLE RD
CURLEW DR
1/2 Mile Radius From Station
1/4 Mile Radius From Station
Proposed Light Rail Station
Existing Light Rail Station
Elevated Crossing
At-Grade Crossing
Strategic Growth Area
City Border
0
0.25
0.5
0.75
1
Miles
VIRGINIA BEACH
STRATEGIC GROWTH AREAS
August 19, 2015



VIRGINIA BEACH HIGH CAPACITY TRANSIT EXTENSIONS

precise lines and stations subject to further study

Regional & Local Bus Transit

The "Connect Hampton Roads" initiative found that reliable, frequent, and accessible local bus serves as the backbone of every successful transit system. The report describes the condition of the region's current bus system as inadequate, with routes that do not effectively connect across city boundaries~~,~~ and operating with inconsistent times, days, and frequencies. Below are the types of HRT bus routes that currently serve the City of Virginia Beach:

- *Fixed Regular Routes* – Regular routes at scheduled times and days of operation and service hours vary by route. There are currently 11 fixed routes within Virginia Beach.
- *MAX Express Routes* – The MAX, or Metro Area Express, is a regional express service connecting commuters to cities across Hampton Roads. It offers an economical, stress-free, fast ride to major employment centers from established park and ride lots. There are currently 5 fixed routes that pick up Virginia Beach residents at the Oceanfront, Silverleaf Park and Ride lot or the Indian River Park and Ride lot and take riders to major employment centers, such as the naval bases, shipyards, and Downtown Norfolk with limited stops. The Max routes cost twice the fare of traditional buses but provide limited stops and extra comfort such as free Wi-Fi. Passengers can also partake in the guaranteed ride home program.
- *Seasonal Bus Routes* – In Virginia Beach, there are 3 special shuttle routes to support the concentration of visitors at the Oceanfront. Efforts are underway to expand these shuttle service operations to include new routes from the Oceanfront to the Shore Drive/Great Neck Road business area, and a shuttle to supplement light rail and make connections in the Town Center area.
- *Special Event Shuttles* – HRT operates shuttle service for several special events within Virginia Beach, since parking is best planned to accommodate average daily visitation for general areas, rather than during peak periods or at specific venues that experience extreme congestion during events.

HRT Atlantic Avenue Trolley

Virginia Beach shares the most utilized bus route in the region with the City of Norfolk (Route 20). Route 20 connects the Oceanfront to Downtown Norfolk and serves approximately 5000 passengers daily. It has the greatest frequency and time duration of all the Virginia Beach routes. This route parallels the proposed light rail extension and bisects six of the City's eight SGAs. Most of the remaining routes serve the City's Suburban Area with hourly headways and five days a week daytime service. The current bus route map for the City can be found in the Technical document.

The City has begun to incrementally fund enhanced services with the recent extension of evening hours on two of the suburban routes. The short term strategy to increase bus ridership will be to implement the feeder bus service for the light rail extension as depicted in the Virginia Beach Transit Extension Study, by HRT [viii]. The map below shows the feeder bus network with the various transit extension options.

The feeder bus network targets new service along Witchduck Road/Kempsville Road (Route 35) from the Chesapeake's Greenbrier area to the proposed Witchduck Road station. An additional newly configured Route 39 would link Sentara Princess Anne Hospital, Lynnhaven Mall, the Hilltop SGA, and the Oceanfront. Numerous routes in the eastern portion of the City will connect to a new express bus service, which will operate from the Oceanfront to the proposed Town Center station. Bus service on seven of the City's eleven fixed routes would have greatly expanded service times and days to match the operating characteristics of light rail (*see Proposed Feeder Bus Network map below and the Comprehensive Plan's Technical Report for more details regarding the proposed bus improvements*).

Recognizing the need for transportation services to be aligned with affordable housing and community services, maps are included in the Comprehensive Plan's Technical Report that show the location of facilities for senior's care, community services, and other transit dependence indicators.

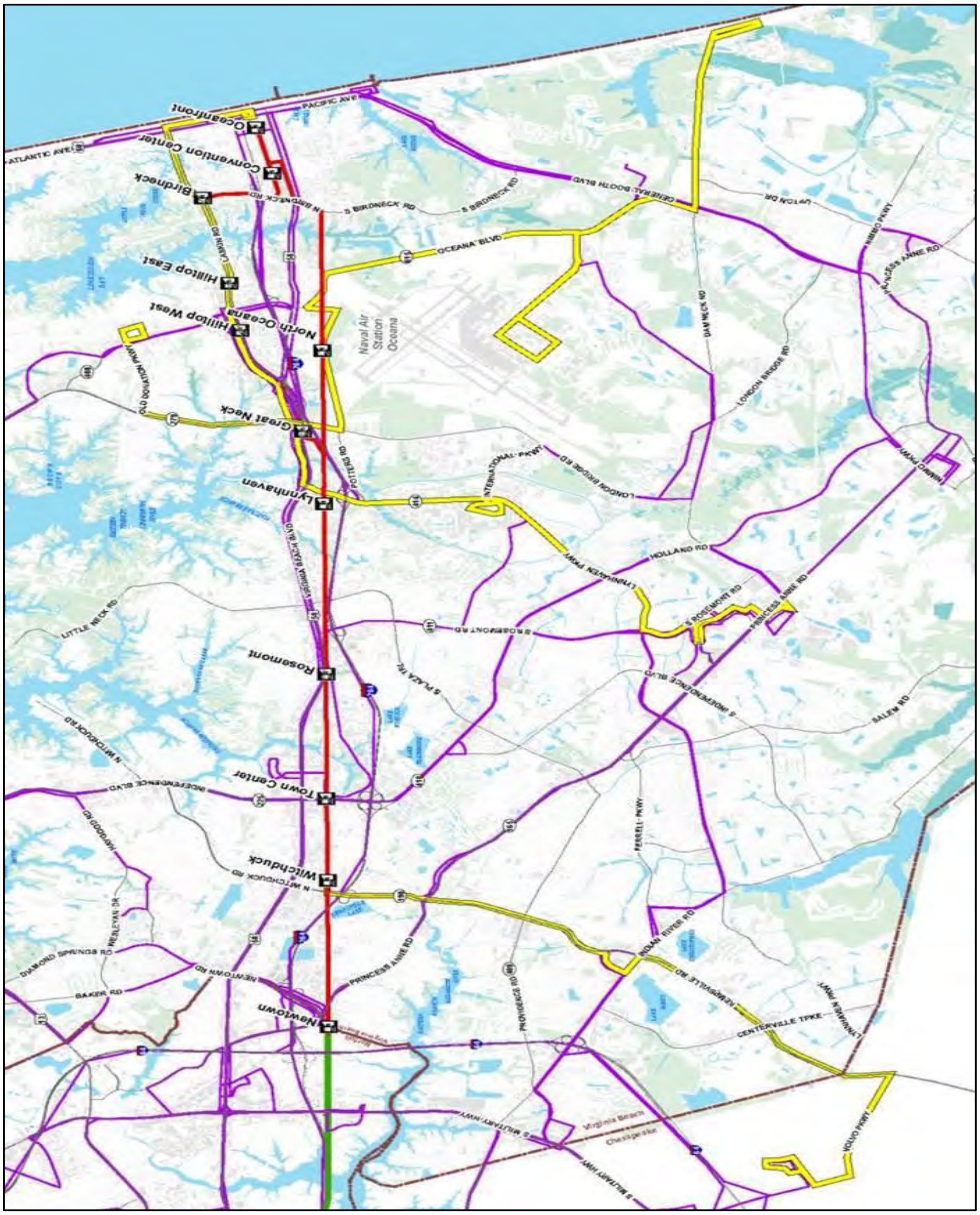
HRT and the City of Virginia Beach have acknowledged that, to improve transit services, there is a need to address basic infrastructure needs. Clean, safe, and comfortable waiting areas at light rail stations and bus stops are essential to an effective transit system. The City has an extremely low percentage of bus stops with shelters for weather protection. This is due to a combination of low funding and low ridership for justification purposes. Currently, the City has approved funding to effectively double the number of bus stop shelters within an approximate 5-year period. HRT has a similar strategy to increase the number of shelters regionally, particularly at high volume stops. A map showing the location of existing and proposed shelters for implementation in next 5 years is included in the Comprehensive Plan's Technical Report.

Paratransit

HRT Paratransit Vehicle

The American with Disabilities Act of 1990 (ADA) requires localities to provide "comparable transportation service for individuals with disabilities, who are unable to use fixed route transportation systems." [ix] HRT provides Active Paratransit customers a demand-response service along its fixed-route services. The service is provided origin-to-destination within ¾ mile of the fixed bus routes and utilizes a variety of vehicles. Paratransit service is reliant on the fixed route bus service, because any changes in the HRT bus routes will affect the paratransit service area. Paratransit service currently accounts for approximately 1/6 of the City's entire budget devoted to transit. The service can be unpredictable for annual budgeting purposes. Paratransit usage continues to increase at a rate significantly higher than bus or light rail.

There are approximately a dozen private companies, charitable organizations, and community social service agencies that also provide transportation services to serve clients who might otherwise utilize paratransit. On demand transportation providers, such as taxicabs, Uber, Lyft, and App-A-Cab also have services that may benefit senior community and disabled persons.



Proposed Bus Feeder Network

yellow lines indicate new routes

Recommended Policies: Transit

- Support the increased frequency of Amtrak train service to both the Southside and Peninsula to connect Virginia Beach and the region to Richmond, the Northeast Corridor, and the soon-to-be enhanced Southeast Corridor.
- Align Transportation Improvements and Services with affordable, accessible housing and community services through the following recommendations:
    - Provide public transit service to as many transit dependent users as possible through major bus operations restructuring with the completion of light rail and thereafter, concurrent with the annual review process. Transit dependent users include, but are not limited to, persons 65 or over, persons at or below the poverty line, and persons who have no car available.
    - For compliance with new Code of Virginia Section 15.2-2223, provide public transit service to the following transit dependent locations, including but not limited to, adult daycare, assisted living, dialysis centers, human services, libraries, nursing homes, senior residences. Enhance ADA- compliant pedestrian infrastructure from transit dependent uses to transit stations/stops to provide convenient access to transit routes and limit expensive paratransit service.
    - Discourage the approval of multi-family or group home development applications that are located over ½-mile from a fixed transit route. Although the current HRT standard for the provision of paratransit services is ¾-mile, it is necessary to provide the suggested walkable distance to accommodate many of the transit dependent users who may not be eligible for paratransit service. Many studies indicate that ½-mile is the maximum distance one should walk to access transit services.
- Bus Stop Accessibility and Shelter Improvements:
    - Continue to coordinate with HRT to increase the number of bus shelters within Virginia Beach from its current coverage of approximately 5% of all stops to 10% within the next 5 years and doubling this new amount by the year 2040.
    - Continue to enhance bus shelter/transit station design to include enhanced lighting, bicycle storage, and signage/real time information regarding schedules.
    - Consider the needs of the disabled persons and seniors' community when deviations are considered for transit routes. Maintain a paratransit service area map reflecting the ¾-mile service radius from City transit routes. Discourage uses with likely transit-dependent persons from being developed in areas outside of a ½ mile radius of a fixed route, especially multi-family residential development, age-restricted, senior or assisted living communities, employment centers, and medical and educational institutions.
    - Continue to enhance the ADA-compliant pedestrian infrastructure, particularly along transit routes, to better serve the senior/disabled persons and reduce the cost of expensive paratransit service.
- Alignment of Land Use and Economic Development Initiatives with Transportation Improvements:
    - Encourage mixed-use development throughout the Urban and Suburban Areas and encourage the highest density development within the City's Strategic Growth Areas. This form of development will induce the highest ridership for public transit and many shorter trips can be made by foot or by bicycle.

Agenda for Future Action Recommendations: Transit

- City Council has adopted a Locally Preferred Alternative to extend The Tide from the Newtown Road station in Norfolk to terminate at a new station in Town Center near Constitution Avenue. Plan for the future extension of this high capacity transit system as follows :
    - East to the Oceanfront
    - North to Joint Expeditionary Base Little Creek and south and west to Norfolk International Airport area
    - South to Princess Anne Commons and the Municipal Center
    - West to Chesapeake
- Evaluate appropriate technology for these high capacity corridors include light rail, maglev, bus rapid transit and others that depend on a rail or similar fixed guideway that separates the transit from normal vehicular use.
- Light Rail System Planning - Construct the eastern terminus of the light rail station proposed at Constitution Avenue so that it can easily be expanded to serve as a major passenger hub, with enhanced amenities and platforms to serve future east, north, and south high capacity transit corridors.
- Establish an east-west multi-modal corridor - Develop a shared use path generally within the old Norfolk Southern railroad alignment from the Newtown Road light rail station to Town Center. Study extension of this path along this railroad alignment to the east of Town Center. This proximity will allow for greater connectivity to light rail stations and greater multi-modal choice (see also see Active Transportation recommendations).
- Light Rail Station Connectivity - Enhance pedestrian/bicycle connections to all high capacity transit stations and bus route stops to provide safe access and enhanced modal choice.
- Proactive Bus Service planning recommendations:
    - Coordinate annual evaluation of new bus routing, frequency of service, and duration of service. In the near future (within 5 years), implement the proposed feeder bus network needed to serve the light rail extension from Norfolk to Virginia Beach Town Center.
    - Enhance local bus service to become a viable option for people who could choose to drive, otherwise referred to as "choice riders." The provision of frequent, reliable, comfortable service can reduce single occupancy automobile travel and, thus, address traffic congestion and reduce the need for additional construction of highway lane miles.

ACTIVE TRANSPORTATION

"Active Transportation" is the combination of walking, bicycling, and other use of other non-motorized wheeled vehicles that may benefit from the same infrastructure. Benefits can include:

- healthy activity and improved fitness
- increased social interaction and engagement
- reduced use of fossil fuels and the concomitant reduced pollution
- reduced costs of living

The vision for active transportation in Virginia Beach, adopted in the *2011 Bikeways and Trails Plan* reads:

Virginia Beach will be a City where
people can walk, run and ride anywhere
safely, efficiently and enjoyably.

Virginia Beach developed in the 1960s thru the 1990s with a suburban pattern that fostered the development of residential neighborhoods that, in some cases were isolated from the adjacent areas. This, in part, led to development of a transportation network that relied more and more on higher speed roadways to span the larger distances between the starting and ending points of trips. As this network developed, biking and walking as useful modes of transportation were not as much in the forefront of design, often including small narrow sidewalks as the primary pedestrian/bicycling infrastructure.

Atlantic Avenue

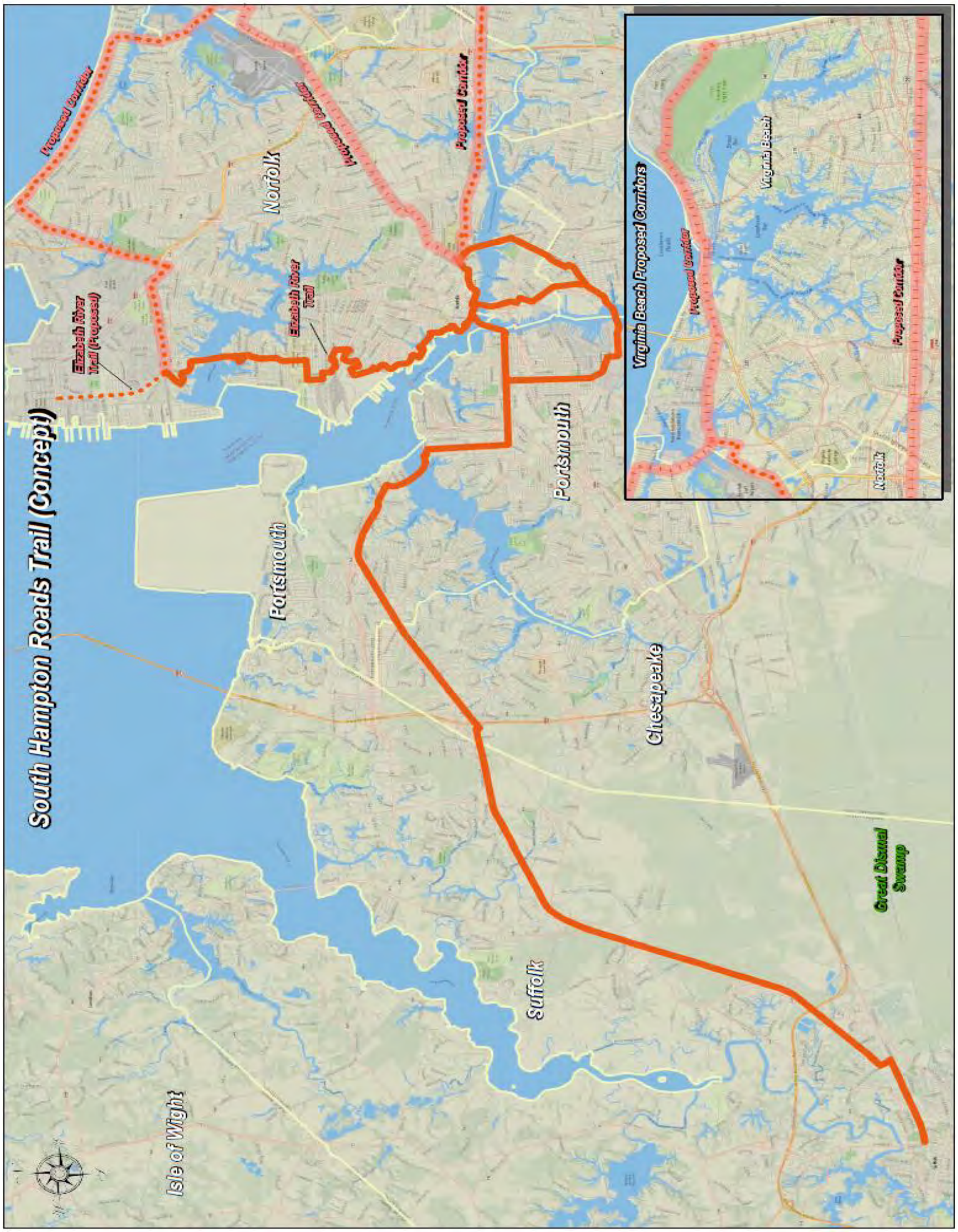
Virginia Beach's historically predominant suburban-style development model can make walking and biking challenging for the following reasons:

- <u>Distance</u>. Work centers are scattered, with limited aggregation of large employment centers, like Town Center/Pembroke and the Resort SGAs~~,~~ and the military bases that draw the majority of workers. Therefore, it is harder to match facilities to predictable work commutes. If employment is not close to home, the commute can be long. Regionally, 46% of workers commute to work in a different city than where they live.
- <u>Lack of desirable facilities</u>. Casual bike riders generally need continuous, connected facilities that match their comfort level from end to end of each trip. At present, the City's system of sidewalks, bikeways, and trails is not yet consistent in providing that continuity.

- Perceived threats from traffic. Most of the larger roads have speed limits of 45 miles per hour, with large volumes of traffic moving at least that fast. Few cyclists are comfortable in such conditions for on road cycling, and those that do often report hostile behavior from motorists.
- Neighborhood islands. Many neighborhoods are like islands surrounded by obstacles such as waterways and high-speed, high-volume roadways. Casual cyclists cannot get far without the challenge of navigating a major roadway or other hindrance.
- Interstate barriers. I-264 is a barrier running east-west across Virginia Beach, and I-64 does the same across the western portion of the City and leading into Norfolk and Chesapeake. Commuting across these barriers is very difficult, funneling cyclists and pedestrians into limited crossing spots, some of which can be difficult and dangerous. For cyclist commuters who work in Downtown Norfolk and in Chesapeake's Greenbrier area, it can be hard to reach these destinations.

Virginia Beach is not an island and our active transportation system needs to coordinate with our neighbors in Chesapeake, Norfolk, and North Carolina, as well as beyond. Several initiatives are underway, and the staffs of the cities are collaborating on a variety of new connections:

- South Hampton Roads Trail [x] (SHRT) will run 41 miles from the Oceanfront connecting the downtowns of Virginia Beach, Norfolk, and Portsmouth, and through Chesapeake to Downtown Suffolk (*see concept plan map below*).
- Beaches to Bluegrass Trail (B2B) [xi] is in planning stages with both the Virginia Department of Conservation and Recreation and Virginia Department of Transportation. It will be a "braided trail" following the SHRT, extending all the way to Cumberland Gap at the westernmost end of Virginia.
- The East Coast Greenway [xii] (ECGW) does not enter Virginia Beach, but connects to both SHRT and B2B, providing north-south connectivity from Maine to Florida.
- Bike Route 76 (BR76) spur [xiii] The Transcontinental Bike Route runs from Astoria, Oregon to Yorktown, VA. Many cyclists, who have made the journey east, and are starting their westward journey, want to do a "wheel dip" in both oceans as part of the journey, and thus they opt to begin or end their treks at the Virginia Beach Oceanfront. Creating a spur route would formalize this and provide direction for them.
- Blueways and Greenways. While sidewalks, bikeways, and trails are obvious elements of an active transportation system, blueways and greenways are growing as components too. In Virginia Beach, we are developing the Thalia Creek Greenway around Town Center. The Green Sea Byway is a wide swath running from Chesapeake to Sandbridge, generally parallel to Indian River Road.
- The *2040 Regional Long Range Plan and Map*, prepared by the Hampton Roads Transportation Planning Organization (HRTPO), includes a new Active Transportation component [xiv]. This plan highlights the many planned active transportation connections within the various localities.



GENERAL ALIGNMENT OF SOUTH HAMPTON ROADS TRAIL (CONCEPT)

Recommended Policies: Active Transportation

The vision adopted in the *2011 Bikeways and Trails Plan* still applies. This vision leads to several broad policy initiatives about how to move forward:

- Continue to implement projects using the Complete Streets policy in accordance with the City's Administrative Directive.
- Continue to prioritize active transportation facilities through the Capital Improvement Plan, the development review process, federal/state grant programs and opportunities present with the maintenance/upkeep of roads and linear utility corridors.
- Focus on facilities that serve the middle majority of active transportation users.
- Focus on continuity and connectivity within the existing system, beginning with a gap analysis.
- Enhance the bike safety and pedestrian safety educational efforts in schools, for visitors, and to the general public.
- Support regional trail systems, especially the South Hampton Roads Trail, Beaches to Bluegrass, and BR76 spur, each of which ties to the paths along the City's proposed light rail corridor.

Agenda Items for Future Action Recommendations: Active Transportation

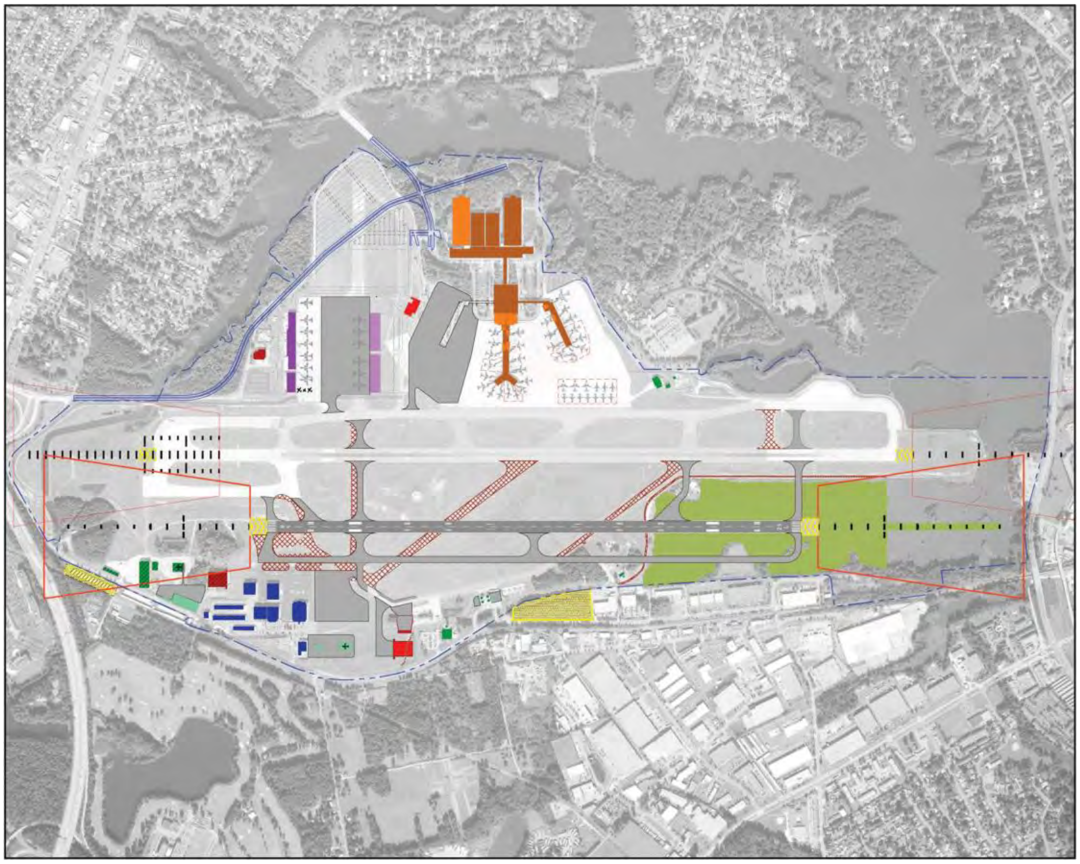
- Develop a study to identify additional and improved crossings of I-264 and I-64 to serve both the existing demand and the likely increases in demand for active transportation modes as The Tide extension begins service. The most urgent specific connection is in the Town Center area, to relieve the hazardous crossings along Independence Boulevard.
- Continue to utilize the City's Bikeways and Trails Plan [xv] [xvi] [xvii] as the guiding active transportation policy document and initiate a plan update.

OTHER MODES OF REGIONAL TRANSPORTATION

Air Travel

Air travel for Virginia Beach residents and businesses is primarily through Norfolk International Airport. The airport experienced a drop in passengers of 24% from 2005-2014 [xviii]. Nationally, airport passenger levels have increased by 3% during the same ten years. A substantial reason for the decrease in passengers was the increase in the average airfare. In 2005 average airfares were $304 which was similar to the national average. By the end of 2014, the average airfare had increased 52% to $463 which is well above the national average of $393. Other factors in passenger and flight reductions include fewer trips made by the military and the negative impacts of airline consolidation. Results from these consolidations left the two Hampton Roads Airports with nine fewer nonstop destinations and 54 fewer daily flights offered when compared to 2006.

The Norfolk International Airport Master Plan was most recently updated in December 2008 and is intended to provide the Authority with a plan that identifies necessary capital improvements *(see Master Plan exhibit below)* [xix].



Norfolk International Airport Expansion Plan

The current update includes projects that will extend the useful life and value of the Airport to meet the air transportation needs of the Coastal Virginia region through 2024. Projections from this Master Pan indicated an annual growth rate in passengers of 2.6% per year, from 1.9 million in 2006 to nearly 3.3 million in 2024. Recent capital improvements at the airport include terminal renovations in 2014.

The FAA recently terminated the Environmental Impact Statement (EIS) for improvements at the Airport [xx] as not currently meeting the purpose and need. However, FAA continues to support the inclusion of these improvements in its Master Plan,

The purpose of the proposed improvements at Norfolk International Airport is to:

- To meet relevant FAA airfield safety standards and enhance airfield safety without reducing runway availability. Relevant airfield safety standards include:
    - Runway Safety Area, which is designed to provide additional safety in the event an aircraft leaves the runway;
    - Runway Protection Zone, which is area at ground level prior to the threshold or beyond the runway end to enhance the safety and protection of people and property on the ground; and,
    - Runway Object Free Area, which is designed to provide an area clear of objects surrounding a runway.

- To enhance operational efficiency and maintain airfield utility while considering surrounding airspace and the Airport's critical design aircraft; and,
- To provide a safe, efficient southern vehicular access, on Airport property, to the Airport's terminal area.

Primary components of the Airport's proposed project include:

- Decommissioning and demolition of Runway 14/32.
- Constructing a relocated secondary parallel to and separated by 876 feet from the existing Runway 5/23. The proposed Runway 5R/23L would be 6,500 feet long by 150 feet wide.
- Access improvements to the Airport's passenger terminal area (on Airport property).

The location of the airport along the Norfolk/Virginia Beach line provides many residents and businesses with convenient access to air travel and its associated economic benefits. However, the adjacent Burton Station and nearby neighborhoods experience some negative impacts such as noise, cut through traffic impacts, overall environmental impacts and incompatible land uses. The Burton Station SGA Plan described in the land use section provides greater information regarding these benefits and impacts.

Ports

Over 19 million tons of general cargo, primarily transported in containers, was handled by the Port of Virginia (POV) in 2014, a record year. The amount of general cargo handled by the Port has increased 19% between 2005 and 2014. The maritime industry also measures containerized cargo using a standard called "20 foot equivalent units, or TEU's. The POV ranked third highest among East Coast ports in volume (in terms of TEU's) of containerized cargo handled in 2014, and seventh highest among all US ports. [xxi]

The POV is comprised of four primary facilities in Hampton Roads (the photo below shows the locations within Hampton Roads):

- Newport News Marine Terminal
- Norfolk International Terminals
- Portsmouth Marine Terminal
- Virginia International Gateway Portsmouth

Although there are no Virginia Port facilities within Virginia Beach, many of the longshoreman and spin off businesses are located within the City. Like the Norfolk International Airport, the POV is impacted by national/international economic factors and competition from other ports. The POV is well positioned for additional growth. The Panama Canal expansion will be open by 2016 and Hampton Roads is one of the few East Coast ports that can serve the largest ships. Additionally, there have been recent rail expansions to handle additional cargo.

Port of Virginia

The *2040 Master Plan* is POV's infrastructure investment strategy to create economic benefits and unconstrained growth opportunities to Virginia through maritime commerce [xxii].Critical components of this strategy include:

- Expanding terminal capacity at a sufficient pace to keep up with growing demand.
- Remaining flexible to new opportunities and conditions.
- Coordinating terminal access improvements with state transportation and economic development plan.

The POV attracts diverse businesses seeking efficient access to growing markets via international trade lanes and inland freight corridors. It is well-positioned to continue capturing a significant share of future container cargo growth due to its excellent facilities, shifts in global trade patterns, and efficient intermodal connections.

Economic activity related to the POV currently employs more than 343,000 Virginians, with $13.5 billion in compensation, and generates $41.1 billion in revenues and $1.2 billion in taxes. As port capacity increases, growth in trade-related businesses will spur further growth in local businesses, creating more jobs, economic activity, and opportunities for a prosperous Commonwealth. Competitive participation in the global market depends in part on being able to efficiently transfer goods through Port facilities. Business growth will result in greater need for terminal facilities. The POV, in its mission to stimulate maritime commerce, will use the *2040 Master Plan* to ensure the capacity to support growth in Virginia is available when it is needed. By 2040, demand for terminal capacity is forecasted to be over three times the existing demand (2.1 million TEU today vs. 7.2 million TEU in 2040). Existing capacity must more than double to meet forecasted demand (3.4 million TEU existing).

Capacity improvements will initially be achieved at APMT and NIT (4.6 million TEU total build out capacity), but further growth must look to the construction of new terminals, or the redesign of existing terminals, in order to provide the 2.6 million TEU remaining shortfall in capacity. The *2040 Master Plan* schedules the projects and identifies the funding necessary to construct the improvements in time to meet demand.

Other Maritime

The Atlantic Intracoastal Waterway (AIWW) is a major maritime facility that accommodates a variety of commercial and recreational water uses within the City including:

- US Coast Guard
- Federal Law Enforcement Training Center for Homeland Security
- Barge traffic supporting intermodal transportation to deep draft ports
- Military equipment and supply transportation barges and vessels
- Commercial fishing vessels and charter fishing vessels
- Cruise and tour boats
- Recreational vessels
- NOAA research vessels
- *Department* of Energy research vessels
- US Army Corps of Engineers and industry dredging vessels


Pungo Ferry Bridge over North Landing River (AIWW)

The Elizabeth River system, the Lynnhaven River system, Back Bay, and Owl's Creek also provide a variety of recreational and commercial activities throughout the City.

Freight

Trucks are the primary mover of freight within Hampton Roads. Roadway congestion adds to the operating costs of companies and shippers, impacting the economic competitiveness of the Port of Virginia, Hampton Roads, and the State of Virginia. The overall tonnage of domestic goods that will be moved into, within, and out of Hampton Roads by truck is expected to increase 65% from 66.9 million tons to 110.1 million tons between 2010 and 2040. HRTPO published a series of technical reports regarding freight and identified several major bottlenecks. Virginia Beach is fortunate to not contain one of these bottlenecks within its borders. However, all of the major routes out of Hampton Roads to the west of Virginia Beach contain major bottlenecks which affect many Virginia Beach residents and businesses.

General cargo volumes at the Port of Virginia continue to rise. About 30-35% of all containers handled by the Port of Virginia are transported by rail, which accounted for a total of 448,100 containers shipped by rail in 2014. This is up from 231,100 containers in 2009. The Hampton Roads network is owned and operated by two large Class I railroads (CSX and Norfolk Southern) and four smaller Class III railroads. With the increasing number of freight trains and the reintroduction of passenger rail into South Hampton Roads, safety and congestion at crossings are major concerns. There are 620 crossings, of which over 80% are at grade.

Recommended Policies: Other Regional Transportation Modes

- Support the implementation of the Port of Virginia's Master Plan to enhance the state and regional economy, while ensuring that the impacts of the port operations on the region are mitigated.
- Support the implementation of the Norfolk International Airport Master Plan to ensure its continued role in serving the Southside Hampton Roads with convenient air travel, while ensuring that future actions of the Airport properly consider the impacts on the adjacent built and natural environment. This includes opportunities to enhance multi-modal connections to and from the airport.
- Work with the US Army Corps of Engineers, the US-Coast Guard, and various other agencies to support maintenance and improvements that enhance water travel for both commercial and recreational purposes.

TRANSPORTATION DEMAND MANAGEMENT

Transportation demand management, traffic demand management or travel demand management (all TDM) is the application of strategies and policies to reduce travel demand, specifically that of single-occupancy private vehicles, or to redistribute this demand in space or in time. Congestion in Virginia Beach, like that in most major US cities, is primarily concentrated during the morning, school hour, and particularly the afternoon rush hours. During off peak hours, many of the same roadways function at an acceptable level. In 2013, 82% of the commuters in Hampton Roads drove alone to work with a mean travel time of 24 minutes. Although-Hampton Roads and Virginia Beach employment centers are dispersed throughout the region, there are several large employments centers that lend themselves well to TDM strategies.

Because of these traffic patterns, some congestion could be alleviated by reducing demand during the peak hours. By increasing roadway capacity through relatively inexpensive technological improvements, such as signal coordination and "Intelligent Transportation Systems (ITS)" or the changing of traffic habits, more expensive road widening could be delayed or avoided. TDM congestion management strategies and a continued push for the use of alternative transportation modes are targeted at the reduction of congestion and the need for more road construction projects.

Many regional TDM programs are offered through the regional TRAFFIX program. TRAFFIX was established in 1995 and is supported administratively by HRT. TRAFFIX receives annual state funding and promotes a variety of programs and incentives, including the following: [xxiii]

- Carpooling and commuter matching

  Carpool matches have increased from 6,987 in 2010 to 14,952 in 2014.

- Guaranteed ride programs for anyone who gets to work by means other than driving alone

  The NuRide reward program is for anyone who gets to work by means other than driving alone. NuRide registrations have roughly doubled from 673 in 2010 to 1,258 in 2014 and even more impressive is the total trips recorded have increased from 96,211 in 2010 to 457,266 in 2014.

- Information regarding Park and ride/Park and sail lots

  VDOT owns and maintains several lots where commuters may park to join car/vanpools or take transit to their work destinations. There are two park and ride locations within Virginia Beach~~,~~ including Silverleaf (located at the intersection of Independence Boulevard and Holland Road) and Indian River (located at the intersection Indian River Road and Reon Drive).

- Vanpooling/leasing

- Teleworking or working from home

TRAFFIX works with area employers, including the military, to educate, develop, and implement transportation alternative programs for their employees.

Other effective TDM strategies include:

- Local ordinances that encourage mixed use development and integration of land uses to reduce the amount of distance between residential, work and other activities to make active transportation and transit choice alternatives.
- Parking pricing strategies to discourage use of automobiles and encourage the use of transit.
- Flexible work hours.

Transit and Active Transportation use are considered important components of TDM, as described in the previous sections.

Recommended Policies: Transportation Demand Management

- Continue to emphasize alternatives to road widening/new construction to alleviate congestion. Multi-modal transportation, ITS, and the various TDM strategies outlined in this chapter are the key alternatives to accomplish this.
- Strive for a per-capita net reduction of motor vehicle trips and trip distances.
- Continue to focus on changing land use development patterns to encourage mixed use and TOD development in appropriate areas throughout the City, particularly in the Strategic Growth Areas.
- Continued support of the TDM programs such as the region's "TRAFFIX" program, which offers programs and incentives for car/van pooling and other trip reducing services.
- Encourage and provide incentives for employers to reduce peak hour demand by utilizing flexible or off-peak work schedules and telecommuting.

Agenda for Future Action Recommendations: Transportation Demand Management (TDM)

- Develop a comprehensive TDM Plan, including telecommuting, flexible work schedules, and off peak business hours, especially in the City's main employment centers. Utilize TRAFFIX staff to survey major employers in these centers to formulate the TDM plans with necessary incentives.
- Recognize and reduce the impacts of parking supply on travel demand by developing new fee-based parking strategies and regulations in appropriate areas with good transit service.

INTELLIGENT TRAFFIC SYSTEMS (ITS)

Even since the late 2000s, there have been substantial technological advancements that have improved or otherwise made information easier to obtain to make travel decisions. This section describes both the regional and local implementation of this technology by discussing the City's Traffic Management System; the effect of Mobile Apps; the City's Parking Management approach; a variety of Future Trends in transportation; and, and recommended future action items.

Various cities throughout the region maintain ITS infrastructure as part of their transportation management systems. At a regional level, VDOT maintains infrastructure at nearly every mile along the interstate highway. Technology currently in use by VDOT includes:

- *Transportation Operation Centers* – Centers that incorporate various ITS technologies to assist staff with traffic monitoring, incident response, and information dissemination.
- *CCTV Cameras* – Provides roadway images to transportation operations centers and the public.
- *Vehicle Detection Devices* – Records traffic volumes and speeds. Notifies transportation operations center staff of congestion and incidents.
- *Electronic Toll Collection* – Allows travelers to pass quickly through special lanes, avoiding backups and delays due to paying tolls.
- *Reversible Roadway Gates* – Allows traffic on limited access roadways to be reversed based on commuting patterns, maximizing the use of the existing roadway.
- *511 Virginia* – Provides up-to-date traveler information via telephone, the internet, and other methods.
- *Transit Automatic Vehicle Location (AVL)* – Provides the location of transit vehicles, aiding on-time performance.
- *Emergency Vehicle Signal Preemption* – Changes the traffic signal when emergency vehicles approach, improving the safety and response time of emergency vehicles.
- *Changeable Message Signs* – Provides up-to-date information to the traveling public.
- *Advanced Signal Systems* – Improves the coordination and timing of traffic signals in a corridor or throughout an entire city, reducing the number of stops and delays. [xxiv]

In January 2006, the City of Virginia Beach formed the Traffic Management Center (TMC). The TMC has a direct connection to VDOT's TOC, which allows for data and video sharing. [xxv] The TMC facilitates a transportation communication network applying technology and engineering to traffic management and disseminating traffic related information. The City of Virginia maintains a traffic management system which:

- Consists of a 100-mile fiber optic cable backbone, 50-miles of twisted pair copper cable, and 54 closed-circuit television cameras;
- Controls all of the city's 380 traffic signals;

- Provides a connection to the Virginia Department of Transportation's Traffic Operations Center (TOC), and will provide the City of Virginia Beach with direct access to video from the TOC'S interstate cameras;
- Includes seven permanent, changeable message signs and 50 systems detectors (to detect instantaneous changes in traffic flow); and,
- Features traffic data collectors to provide information for analysis. [xxvi]

Mobile Apps

In the age of smartphones, apps have become a commuter's modern-day compass. Mobile apps are transforming the way we travel and how we think about mobility. A wealth of travel related information is now at the fingertips of all commuters. We are only beginning to value the data generated from and the utility of these apps. The creation of real-time and historical data may shape the future landscape of our transportation networks and transform the way we currently travel. The apps are inclusive of all types of travel modes and, in some cases, have the ability to streamline those travel modes into one seamless journey.

Parking Management

The Virginia Beach Parking Management Office manages more than 8,250 off-street spaces in eight parking garages and ten surface lots at the Oceanfront (Resort), Croatan Beach, Sandbridge Beach, Little Island, and Town Center. These locations are intended to accommodate long-term parking use and to provide overnight parking. Monthly leases are available at the Oceanfront and Town Center garages. Weekly leases are available at the Oceanfront garages to accommodate hotel guests that have multiple vehicles. When there is coordination of effective parking management with transit infrastructure and services, it can have a combined positive impact on traffic congestion. [xxvii] Currently, the City of Virginia Beach has implemented the use of this app at on-street parking locations at the Oceanfront. "Parkmobile" allows users to start and manage parking transactions using a mobile app. [xxviii]

Smarter Systems

The future of traffic management systems will improve vastly with advances in technology. Adaptive traffic signal control technology, otherwise known as smart traffic signals, will both reduce harmful vehicle emissions and travel times. New technology combines concepts of artificial intelligence and traffic theory to allow traffic signals to communicate with one another and adapt to traffic conditions in real time. States are adopting active traffic management (ATM) systems. These systems are found on interstate highways and consist of a system of computer software, sensors, and cameras. The system is built to recognize issues and reduce secondary accidents. In Virginia, an ATM pilot is currently in use on I-66. The system uses overhead lane signs to provide advance notice of traffic conditions, such as:

- Variable speed limit signs direct drivers to incrementally reduce their speeds
- Symbols direct drivers to change lanes due to lane blockage
- Overhead message signs warn drivers of slowdowns, backups and collisions ahead [xxix]

Emerging technologies in Information and Communication (ICT), Global Positioning Systems (GPS), and ITS will continue to advance and affect the way we currently travel. Communicating real-time traffic information has become instantaneous with digital platforms provided by the internet. Most state Departments of Transportation use social media and mobile apps to communicate time-sensitive traffic and travel information to a broader audience than in decades past. [xxx]

Connected Vehicles

Research is currently underway by the United States Department of Transportation (USDOT) and National Highway Traffic Safety Administration (NHTSA) to develop connected vehicle technology, including vehicle-to-vehicle (V2V) technology. Connected vehicle applications provide connectivity between vehicles, infrastructure, and wireless devices to prevent crashes, reduce carbon emissions, and promote continuous real-time connectivity. Vehicle safety applications will provide data such as speed and location flowing from nearby vehicles. Vehicles will identify risks and provide drivers with warnings to avoid other vehicles preventing collisions involving rear-end, lane change, and intersection crashes. [xxxi]

Vehicle Automation

In June 2015, Governor Terry McAuliffe announced efforts to move forward with an automated industry partnership. The partnership includes VDOT, the Department of Motor Vehicles (DMV), the Virginia Tech Transportation Institute (VTTI), and Transurban. As a result of the work, the Commonwealth will create Virginia Automated Corridors (VAC). The new initiative will streamline the use of Virginia roads and state-of-the-art test facilities for automated-vehicle testing, certification, and migration towards deployment. [xxxii] A more detailed description of vehicle automation is provided in the Technical Report.

Recommended Policies: Intelligent Transportation Systems (ITS)

- Utilize Intelligent Transportation Systems (ITS) to maximize the efficiency of the existing transportation system.
- Encourage the use of ITS to optimize road capacity, in conjunction with VDOT and regional efforts. Examples of ITS include traffic signal systems, variable message signs, traffic cameras and electronic toll collection.
- Consider leveraging third party traffic data and analytics for real-time traffic management, incident response how data from apps and other credible sources can assist in future planning and predicting trends.
- Continue to develop technology to manage varying transportation needs that take into consideration the characteristics of urban development areas.
- Continue to support ITS technology as developed and maintained by VDOT at the regional level.
- Work in unison with all Hampton Road cities, the Hampton Roads Transportation Planning Organization (HRTPO) and VDOT to improve effective regional planning with coordination provided through the Transportation Operations Committee (TOC).

Agenda for Future Action Recommendations: Intelligent Transportation Systems (ITS)

- Update plans for traffic signalization every three years.
- Monitor trends regarding emerging technologies in the area of Information and Communication (ICT), Global Positioning Systems (GPS), and ITS. Stay current with trends in ITS to develop it as an on-going resource for transportation network infrastructure.

- Create parking strategies that merge technology and infrastructure. Adopt innovations to deliver live parking data to citizens including heat maps that can show drivers available parking on a block-by-block basis. Consider dynamic meter pricing raising the price for on-street parking during peak time to make some spaces available. When spaces are available, drivers spend less time searching for parking.
- Consider developing dynamic pricing mechanisms for roads, parking spaces, and shared-use assets to balance supply and demand.
- Continue to develop and implement adaptive signal control in coordination with FHWA. The City is currently developing an application and is awaiting approval from FHWA.
- To promote the use of local transit, consider equipping parking garages with more internal directional signage to show the location of transit stops.

2.2 - ENVIRONMENTAL STEWARDSHIP FRAMEWORK

CITY OF VIRGINIA BEACH ENVIRONMENTAL STEWARDSHIP GUIDING PRINCIPLES

- Preserve, protect and maintain our natural resource areas.
- Improve stewardship of our natural resources.
- Protect our most vulnerable citizens from natural and man-made hazards and assist in their recovery following catastrophic events.
- Restore and protect the Chesapeake Bay and its tributaries, Owls Creek, the North Landing River, and Back Bay.
- Expand public access to our waterways.
- Establish linkages with other environmental plans.
- Ensure that citizens are involved in protecting and maintaining quality environmental resources.
- Promote Virginia Beach as a model of environmental stewardship.
- Be a city that incorporates environmental resources and their enhancement thoroughly into our identity and our quality of everyday life.
- Environmental goals and policies set forth in this Comprehensive Plan should be implementable.

INTRODUCTION

Given its coastal location, our citizens and visitors value Virginia Beach foremost for its vast natural resources and open spaces. Our natural landscape consists of beaches and dunes, inland waterways fringed by tidal marshes and non-tidal wetlands, a vast tree canopy of maritime and inland forests, and farmland. Many of these natural systems are conservation lands, managed by federal, state, and local government as parks, wildlife refuges, natural areas, and wildlife management areas. Miles of shoreline and a multitude of water access points for recreational and commercial boating and fishing, hiking and biking, wildlife observation, and an array of water sports are enjoyed daily.

Along with this rich bounty of natural landscape comes the responsibility for active stewardship for both present and future generations to continue to enjoy, as well as for the many benefits afforded by land and waterway conservation and stewardship. They provide economic value through tourism and environmental value in and of themselves, which in turn creates a quality of life unparalleled in non-coastal communities.

New challenges face our city as evidenced by recent trends and longer-term projections. When asked what are the most important things that should be considered when updating this Comprehensive Plan, our citizens and business owners stated that, aside from transportation, it is environmental stewardship. More specifically, our citizens desire to protect and expand open spaces and recreational opportunities, and for local government to help address flooding, the effects of sea level rise, and stormwater management needs. The General Assembly passed legislation in 2011 requiring that all local comprehensive plans acknowledge the state's preference for "Living Shorelines" when designing erosion control measures. This is to include state guidance for comprehensive coastal resource management plans and best practices in the comprehensive plan. More recently in 2015, a new law was passed requiring local comprehensive plans to include adaptation and mitigation plans and strategies for addressing sea level rise and recurrent flooding.

To do the latter effectively, impacts on both the built and natural environment, including critical public and private, and green infrastructure, must be considered. In addition, it is necessary to understand and plan accordingly for the potential impacts of these hazards on our most vulnerable populations, including the elderly, disabled, low-income persons, and those without an individual means of transportation, in order to put forward the most equitable community resiliency strategies.

A defining character of Virginia Beach can be its environmental stewardship of our ecosystems. We can and should also strive to become a city that incorporates environmental resources and their enhancement thoroughly into our very identity and our quality of everyday life. This chapter presents the City's Environmental Stewardship Framework, which is an implementable way to achieve these desired characteristics for our future. This comprehensive framework and its underlying Guiding Principles were first put forward in the *2009 Comprehensive Plan*. Both the Framework and the Guiding Principles were validated by both our citizens and the Virginia Beach Planning Commission during the Comprehensive Plan review and update process; however, the Planning Commission felt that some enhancements were needed, and points needed to be emphasized in the Guiding Principles. Updated policy recommendations and recommendations for future action are presented, reflecting both current and projected needs through the year 2040.

Environmental Stewardship Framework

- Sustainability Plan
- Water Resources Protection and Management
- Parks and Conserved Lands
- Green Infrastructure
- Living Resources and Ecosystems Protection Management
    - Urban Forestry
    - Living Shorelines
    - Unique Plant and Animal Habitats
- Sea Level Rise, Recurrent Flooding, and Hazard Mitigation
- Land Development and Stormwater Management
- Energy Management and Alternative Energy Resources Development
- Solid Waste Management
- Noise, Light, and Air Pollution Management

A COMMUNITY PLAN FOR A SUSTAINABLE FUTURE

In 2008, the eighth Core Strategy-- "Ensure Sustainability"-- was added to the *City's Strategic Plan.* In June 2010, the American Institute of Architects (AIA) assembled the Sustainability Design Assessment Team (SDAT) at the request of the City to identify elements of our physical environment, community statistics, and City services that were supportive of or in conflict with the principles of "livability." Later that year, this initiative was acknowledged and reflected in the City Council's *2010 - 2014 Strategic Plan* (http://www.vbgov.com/government/departments/city-manager/Documents/2015-2017StrategicPlan.pdf) and the Environment and Sustainability Office (ESO) was established within the City's Department of Planning. The new ESO was immediately charged with developing a comprehensive sustainability plan for Virginia Beach that would reflect and blend both the perspectives of the City government and those of the community.

Through a series of community meetings, focus groups, and the input from a stakeholder team, *A Community Plan for a Sustainable Future*, commonly referred to as *the* "*Sustainability Plan,"* was adopted by City Council in March 2013, (http://www.vbgov.com/government/offices/eso/sustainability-plan/Pages/default.aspxadd).

The Sustainability Plan is organized around the three pillars of sustainability-- social, economic, and environmental-- and divided into a series of ten "Elements." Taken together, the Elements describe the totality of the facets that relate to the sustainability of the City of Virginia Beach – both its government and the community at large. Each Element is focused around a "Vision Statement," several "Goals" related to the "Vision Statement," and a series of "Objectives" that outline ways to achieve each "Goal."

In May 2014, a small group of City staff was assembled to continue the community's work on the Sustainability Plan, and to identify and use metrics to provide meaningful measurement of the goals of the Sustainability Plan and progress toward implementing *Envision Virginia Beach 2040.* A series of metrics was developed for each of the ten Elements and refined by an interdisciplinary team of City staff. In addition to identifying the metrics, the team also developed at least one, but in many cases, a series, of specific objective statements for each metric. These objective statements include specific targets for achievement by the community, which will allow progress to be tracked, reported, and analyzed. It is the ultimate goal that these metrics be adopted by City Council and incorporated into an interactive dashboard, allowing the community to view progress toward each metric, and the overall success of implementation of the City's Sustainability Plan over time.

WATER RESOURCES PROTECTION AND MANAGEMENT

Water is one of the most essential natural resources upon which modern life depends. Conserving and protecting it with the most efficient and sustainable practices is paramount to preventing shortages and ensuring a continuation of a high quality of life. The City seeks to preserve, enhance, and restore water quality in all of its waterways for the protection of the environment and to experience efficient use benefits for the present and future generations.

The City's goal is to bring partners in both city government and the community together to help improve our most valuable natural and man-made resources by protecting public health and safety, minimizing the impacts of stormwater runoff, controlling invasive plant and animal species, and creating and protecting sustainable habitats. The City is slowly but steadily making progress in reaching its goals of cleaner and healthier waterways. There has been ongoing and focused community outreach, new state and federal mandates for onsite stormwater management, shoreline protection and restoration, increased planting buffers, and open space protection and conservation. All of these efforts have contributed to steady water quality improvements within the City's primary and secondary watersheds, and in surface and groundwater resources management.

Water quality monitoring is a critical element of any program designed to manage and protect drinking water supplies. The Commonwealth's ongoing water quality monitoring program evaluates the physical, chemical, and biological character of water in relation to human health, ecological conditions, and designated water uses. These water quality monitoring programs include the sampling of streams, lakes, reservoirs, and groundwater resources that serve as primary sources for drinking water and are also extended to wetlands and surface runoff. Without accurate and current data on the state of the water resources, effective conservation and remediation programs cannot be accomplished, nor can the effectiveness of the monitoring programs be evaluated.

Surface Water

One of the City's most valuable natural resources is undoubtedly its surface water resources. The geography of the City comprises three primary watersheds and seven secondary watershed areas (*see Watershed Areas Map in the "Environment" chapter of the Technical Report*). The core components that make up the watersheds that require protection and management consist of wetlands, shorelines, riparian buffers, storm drainage systems, and the land upon which they drain. Collectively, these components determine the overall environmental health, quality, and sustainability of all of the City's natural resources.

Recommended Policies: Surface Water

- Continue to ensure and improve water quality by developing and implementing initiatives to protect our water resources.
- Maintain the Atlantic Ocean and Chesapeake Bay water quality for water contact recreation.
- Demonstrate that provisions of the Clean Water Act are addressed as they apply to achieving total maximum daily load (TMDL) requirements through the City's annual MS4 report.
- Ensure that the goals set forth by the Southern Rivers Area Management Program are met.

Agenda for Future Action Recommendations: Surface Water

- Implement regulatory requirements relating to stormwater management, including but not limited to meeting NPDES MS4 and Chesapeake Bay TMDL mandates.
- Promote partnerships with the non-governmental organizations to achieve the City's water quality improvement goals.
- Implement recommendations of the 2014 Chesapeake Bay Watershed Agreement.
- Develop design criteria that help achieve water quality objectives in conjunction with other SGA objectives, such as preserving open space and planning for sea level rise and recurrent flooding.
- Complete efforts that are currently underway to develop a Stormwater Master Planning Analysis and Inventory.

Groundwater

Groundwater is a vital and finite resource that must not be taken for granted. It is finite because it is dependent on the availability of groundwater recharge zones. The more impervious the ground surface becomes over time, the less the underlying shallow and deep water aquifer systems are able to recharge with groundwater.

The volume of seasonal water used by residents and businesses for lawn watering and other irrigation activities is important for City government to understand, because the primary source of this water is a fragile shallow aquifer that is the only fresh groundwater source available within the City. Residents in the Rural Area rely solely on this aquifer, not only for crop irrigation but also for indoor domestic uses such as drinking, bathing, and cooking. The groundwater close to the surface is mostly fresh, whereas the groundwater found at depths of 200 feet and greater is mostly saline and generally too salty to drink or use for irrigation.

As of 2008, more than 20,000 private wells operating in the northern portion of the City tap fresh groundwater in the City's shallow aquifer system. Pumping from these many wells often causes groundwater levels to drop below sea level. When groundwater levels fall below sea level, salty sea water intrudes and mixes with fresh groundwater, which increases chloride concentrations in the water, potentially making it unusable. Many other sources found to cause groundwater pollution include drainage from crop lands, urban lawns, golf courses treated with fertilizers and pesticides, livestock, underground failing septic systems, underground storage tanks, unsound land disturbing practices, etc. It is imperative that an action plan be established to monitor all activities that may contribute to the degradation and depletion of the city's aquifers.

Recommended Policies: Groundwater

- All golf courses should maximize the use of recycled water for irrigation.
- Public water and sewer extension plans should be coordinated with groundwater protection goals for all areas north of the Green Line where septic tanks and wells have exceeded their life cycle and are failing.

Agenda for Future Action Recommendations: Groundwater

- Develop a targeted educational program that increases public awareness about the importance of protection and conservation of non-potable groundwater resources and their use.
- Establish protocols to conserve and protect groundwater on city properties:
    - Develop an integrated pest management (IPM) and nutrient management plan.
    - Complete an underground storage tank (UST) remediation on all City sites.

Plans and Programs References:

- EPA Chesapeake Bay TMDL Program (Mid-Atlantic States) http://www2.epa.gov/chesapeake-bay-tmdl
- Virginia Beach Watersheds and Drainage Studies
- Virginia Stormwater Management Program (VSMP) http://www.deq.virginia.gov/Programs/Water/StormwaterManagement.aspx
- Virginia DEQ Municipal Separate Storm Sewer System (MS4) Permits http://www.deq.virginia.gov/Programs/Water/StormwaterManagement/VSMPPermits/MS4Permits.aspx
- Virginia Erosion and Sediment Control Program http://www.deq.virginia.gov/Programs/Water/StormwaterManagement/ErosionandSedimentControl.aspx
- Virginia Wetlands and Stream Protection Program http://www.deq.virginia.gov/Programs/Water/WetlandsStreams.aspx
- Virginia DEQ Coastal Zone Management Program http://www.deq.state.va.us/programs/coastalzonemanagement.aspx

PARKS AND CONSERVED LANDS

Virginia Beach has a large network of parks and conserved lands that contain abundant natural resources. The City's inventory of parkland totals over 7,000 acres, with thousands more acres of parks and conservation lands owned by federal, state, and non-profit groups within the city limits. This network of green and blue spaces is vital to our way of life and our heritage. The importance of the ecosystem benefits provided by these areas is being documented through emerging research in the areas of climate change, sea level rise, recurrent flooding, urban health, air purification, carbon storage, agricultural production, and pollination. It is now widely recognized that ecosystems – including urban ecosystems such as parks, protected areas, and waterways – provide essential services for people.

Open space, park lands, and waterways are integral to the City's character and unique identity within the region. Early development of the region was shaped primarily by waterways used for transportation. Today, these same waterways are important for different reasons. They are the thread that ties neighborhoods together. They provide drinking water, recreation, flood control and wildlife corridors. Virginia Beach's waterways are the backbone of the natural resource system within the City. Conservation of remaining natural resource areas was identified by our citizens during public input sessions as one of the top priorities for updating this Comprehensive Plan.

Local waterways should be protected with natural and/or restored buffer areas, large and small open spaces, park lands and low impact development that work together to form continuous corridors known as greenways. Virginia Beach should acquire, manage, and protect lands for public use in a strategic manner to develop an interconnected system of green spaces that provides public access, conserves natural ecosystem functions, sustains clean air and water and provides places for flood control, recreation and civic engagement.

The "2011 Virginia Outdoors Demand Survey (VODS)," administered by the Virginia Department of Conservation and Recreation, finds high regard for the importance of outdoor recreation opportunities and a strong commitment to the protection of natural areas among the general public. Public support is very strong for public access to open spaces and outdoor recreational opportunities, as well as for public expenditures to make those opportunities available.

Tourism is a major industry in Virginia Beach and the Hampton Roads region. In recent years, Virginia Beach has successfully increased the number of outdoor recreation events to include walks/running races and sports tournaments in collaboration with the private sector. Bikeway and trail connectivity continues to be the top recreational need identified by citizens. Significant progress has been made over the last five years to improve the trail network.

New park spaces will be needed within Strategic Growth Areas to serve increasing population density within a walkable environment. There is also a growing interest in partnerships with conservation agencies and citizen groups to improve public access to conservation lands and parks within the North Landing River watershed.

Recommended Policies: Parks and Conserved Lands

- Continue partnerships with tourism industry and private recreation providers to create additional outdoor recreational activities and amenities that will increase economic activity, especially in the resort shoulder seasons.

Agenda for Future Action Recommendations: Parks and Conserved Lands

- Acquire open space in strategic locations, including in the SGAs, that can provide multiple benefits in terms of flood control, water quality, public access to waterways, preserving or creating tree canopy, and preserving unique ecological and cultural heritage sites.
- Commit resources to maintain the high quality of the existing park system and to expand the trail system.
- Implement the recommendations in the Virginia Beach Bikeways and Trails Plan.
- Implement the recommendations in the Virginia Beach Outdoors Plan.

Plans References:

- *Virginia Beach Outdoors Plan*
  http://www.vbgov.com/government/departments/parks-recreation/design-development-projects/Pages/outdoors-plan.aspx
- *Virginia Beach Bikeways and Trails Plan Urban Forestry Management Plan*
  http://www.vbgov.com/government/departments/parks-recreation/landscape-management/Pages/urban-forestry.aspx
- *Green Sea Blueway and Greenway Management Plan*
  http://www.vbgov.com/government/offices/eso/north-landing-river-study/Pages/default.aspx

GREEN INFRASTRUCTURE

Understanding the benefits that are inherent within our natural ecosystems is the first step to being able to integrate those concepts into more sustainable land use planning. "Green Infrastructure" refers to strategically planned and managed networks of natural lands, working landscapes, and other open spaces that conserve ecosystem values and functions and provide associated benefits to human populations. It can refer to natural ecosystems or man-made stormwater and landscape features that are designed and constructed to mirror natural ecosystem functions. Green Infrastructure can help meet State requirements for the treatment and storage of rain water runoff, which emphasize the use of drainage systems that incorporate natural processes.

Bow Creek and Stumpy Lake are examples of green infrastructure. As part of the Bow Creek Recreation Center and Golf Course renovation project, portions of Bow Creek that had been channelized over time were restored to their natural characteristics. Stumpy Lake serves as a drinking water supply reservoir for the City of Norfolk. As the headwaters of Gum Swamp, located in the South Princess Anne Commons Area, it also provides stormwater management for the watershed. By preserving this natural resource area as part of the City's green infrastructure system, multiple benefits are derived including flood control, wildlife habitat and movement corridors, migratory waterfowl nesting, and provision of a continuous greenway from Stumpy Lake to the North Landing River.

Bow Creek Recreation Center and Golf Course – before renovation

Bow Creek Recreation Center and Golf Course – after renovation with green infrastructure design.

Bow Creek Recreation Center and stormwater management pond designed as green infrastructure integrated with the renovated golf course.

The *Virginia Beach Outdoors Plan* (http://www.vbgov.com/government/departments/parks-recreation/design-development-projects/pages/outdoors-plan.aspx) and the *Virginia Beach Bikeways and Trails Plan* (http://www.vbgov.com/government/departments/parks-recreation/design-development-projects/pages/bikeways-trails-plan.aspx) are the primary tools for implementation of our green infrastructure system. These plans identify opportunities for property acquisition and development, conservation easements, as well as specific projects for construction. The Department of Parks and Recreation receives funding in the Capital Improvement Program (CIP) on an annual basis to support open space acquisition, development and management. It is important for this annual funding to continue in order to adequately plan for and secure future green spaces for use as green infrastructure. The three key green infrastructure projects discussed in the *Outdoors Plan* include:

- **Stumpy Lake/North Landing River Greenway**

  This greenway corridor begins at Stumpy Lake and follows Indian River Road to the North Landing River and Back Bay. There are opportunities to connect this greenway with Chesapeake and North Carolina trail systems as well as a larger regional trail system known as the East Coast Greenway. The East Coast Greenway is planned as a long-distance family friendly bike trail from Maine to Florida. Properties in this corridor are being acquired through the Open Space Acquisition program, the AICUZ program for the Interfacility Traffic Area, and the Agricultural Reserve Program. This area is also addressed in the *Green Sea Blueway and Greenway Management Plan*.

- **Thalia Creek Greenway**

  Located just south of Town Center in Pembroke, Thalia Creek Greenway is an example of an urban greenway system that goes beyond the rivers and parklands. Urban greenways provide transportation links, strengthen community identity, and are a way of bringing together unrelated developments. As other areas of the City begin to experience increased density, it is recommended that greenway and open space systems be integrated into all Strategic Growth Area plans. For more information on the *Thalia Creek Greenway Master Plan*, see: http://www.vbgov.com/government/departments/parks-recreation/design-development-projects/Documents/thalia-creek/thalia-creek-greenway-master-plan.pdf

- **West Neck Creek Greenway and West Neck Creek Natural Area Park**

  The West Neck Creek Natural Area is the center for this greenway corridor. To the north, there are opportunities to connect large residential areas along Holland Road to this greenway. To the south, this greenway could merge with the Stumpy Lake/North Landing River greenway.

Designing greenway systems that include recreational opportunities will help local citizens understand the benefits of clean water and the value of healthy waterways. These interconnected greenway systems can be described as green infrastructure. However, merely designating greenway corridors is not enough. Expanding and creating new trail networks that link greenways and allow seamless movement of users through the City's greenways and natural areas will also facilitate sustainable use of these areas. Trail networks provide alternate transportation routes and recreation areas for City residents, and they can help preserve greenways for wildlife. Diligently undertaking the upkeep and maintenance of trail networks within the City's green spaces will ensure that water resources, sensitive habitats, and wildlife are protected, valued, and minimally impacted by users.

Green Infrastructure that is part of a larger greenway plan can also be used to help preserve land within the floodplain, allowing the City to minimize the impacts of flooding and adapt to sea level rise. The City has acquired numerous properties within the Princess Anne Commons and Interfacility Traffic Area (ITA) that contain floodplains and environmentally sensitive areas. These areas should be examined to identify their potential to be incorporated into a larger greenway network.

Recommended Policies: Green Infrastructure

- Incorporate green infrastructure elements into new commercial and residential developments.

Agenda for Future Action Recommendations: Green Infrastructure

- City properties within the Princess Anne Commons and Interfacility Traffic Area should be studied to identify conservation lands and green infrastructure opportunities that can complement the plans for future economic development projects.

LIVING RESOURCES AND ECOSYSTEMS PROTECTION MANAGEMENT

Urban Forestry

Virginia Beach's urban forest touches the lives of its citizens every day. It consists of all trees in the City on both public and private lands. The City's trees are cherished by residents for promoting strong neighborhoods and a good quality of life. The urban forest provides numerous benefits to the City and its residents, including cleaner air and water, cooler temperatures, and energy savings. With proper management, these benefits increase every year as trees continue to grow and thrive. Virginia Beach's urban forest is a vital component of the City's infrastructure.

Urban forestry consists of practices that the City employs to maximize the social, aesthetic and functional values of its forest resources. Through these practices, the City is able to accomplish a broad array of multiple benefits and functions at lower cost than man-made infrastructure would allow. Urban forestry practices can help offset adverse effects of heat islands and urban runoff, provide shade for people, and provide habitat for wildlife.

The City's *Urban Forest Management Plan*
*(*https://www.vbgov.com/government/departments/parks-recreation/parks-trails/caring-for-our-parks/Documents/2013-ufmp.pdf)
provides policy guidance, goals and objectives for urban forest management in Virginia Beach. The plan delivers a vision of a strong urban forest that thrives through mutually beneficial partnerships and effective resource commitment. Its overarching mission is to enhance the Virginia Beach urban forest through education, community involvement, proactive management, and responsible stewardship.

Recommended Policies: Urban Forestry

- Increase tree plantings and preservation of existing trees on all public properties.
- Undisturbed natural areas and important natural features should be identified during the site development design process. Begin by identifying existing natural characteristics of the site that should be preserved. Natural site amenities may consist of a significant stand of trees. Within reason, existing tree and groundcover that are healthy should be preserved and integrated into the overall design of development.

Agenda for Future Action Recommendations: Urban Forestry

- Implement the recommendations in the *Urban Forest Management Plan*.
- Improve the viability and resilience of the City's urban forest by initiating the three-trophic layer (canopy trees, understory trees, shrub and groundcover) approach.
- Improve inspections and enforcement capabilities to better achieve the objectives of local landscaping and tree protection ordinance requirements.
- Enhance policies that guide development requirements for landscape practices on proposed projects.

Living Shorelines

Coastal ecosystems reside at the interface between the land and water and are naturally very complex. They perform a vast array of functions by way of shoreline stabilization, improved water quality, and habitat for fishes; from which humans derive direct and indirect benefits.

The science behind coastal ecosystem resource management has revealed that traditional resource management practices limit the ability of the coastal ecosystem to perform many of these essential functions. The loss of these services has already been noted throughout coastal communities in Virginia as a result of development in coastal zone areas coupled with common erosion control practices. Beaches and dunes are diminishing due to a reduction in a natural sediment supply. Wetlands are drowning in place as sea level rises and barriers to inland migration have been created by construction of bulkheads and revetments. There is great concern on the part of the Commonwealth that the continued armoring of shorelines and construction within the coastal area will threaten the long-term sustainability of coastal ecosystems under current and projected sea level rise.

In the 1980s, interest arose in the use of planted wetlands to provide natural shoreline erosion control. Today, a full spectrum of living shoreline design options is available to address the various energy settings and erosion problems found. Depending on the site characteristics, they range from marsh plantings to the use of rock sills in combination with beach nourishment.

Research continues to support that these approaches combat shoreline erosion, minimize impacts to the natural coastal ecosystem and reinforce the principle that an integrated approach for managing tidal shorelines enhances the probability that the resources will be sustained. Therefore, adoption of new guidance and shoreline best management practices for coastal communities is now necessary to ensure that functions performed by coastal ecosystems will be preserved and the benefits derived by humans from coastal ecosystems will be maintained into the future.

In 2011, the Virginia Assembly passed legislation to amend §28.2-1100 and §28.2-104.1 of the *Code of Virginia* and added section §15.2-2223.2, to codify a new directive for shoreline management in Tidewater Virginia. In accordance with section §15.2-2223.2, all local governments shall include in the next revision of their comprehensive plan beginning in 2013, guidance prepared by the Virginia Institute of Marine Science (VIMS) regarding coastal resource management and, more specifically, guidance for the appropriate selection of living shoreline management practices. The legislation establishes the policy that living shorelines are the preferred alternative for stabilizing eroding shorelines.

This guidance, known as Comprehensive Coastal Resource Management Guidance, has been prepared by VIMS for localities within the Tidewater region of Virginia and shared through their Comprehensive Coastal Resources Management Portal (CCRMP) (http://www.ccrm.vims.edu/ccrmp/). It explicitly outlines where and what new shoreline best management practices should be considered where coastal modifications are necessary to reduce shoreline erosion and protect our fragile coastal ecosystems. This guidance includes a full spectrum of appropriate management options that can be used by local governments for site-specific application and consideration of cumulative shoreline impacts. The guidance applies a decision-tree method using a resource mapping database that will be updated periodically, and a digital geographic information system model created by VIMS.

Recommended Policies: Living Shorelines

- Refer to the guidance presented in the City of Virginia Beach Comprehensive Coastal Resource Management Portal (CCRMP) prepared by VIMS to guide regulation and policy decisions regarding shoreline erosion control: http://ccrm.vims.edu/ccrmp/va_beach/.
- The above-referenced Shoreline Best Management Practices should become the recommended adaptation strategy for erosion control. Departure from these recommendations by an applicant wishing to alter the shoreline should be justified at a hearing of the board(s).
- Use the VIMS Decision Trees for onsite review and subsequent selection of appropriate erosion control/shoreline best management practices: http://ccrm.vims.edu/decisiontree/index.html.
- Use the VIMS CCRMP Shoreline Best Management Practices for management recommendations for all tidal shorelines found at: http://ccrm.vims.edu/ccrmp/va_beach/
- Available open spaces adjacent to marsh lands should be preserved to allow for inland retreat of marshes as a result of rising sea levels.

Agenda for Future Action Recommendations: Living Shorelines

- Train regulatory boards (Wetlands and CBPA) on decision making tools developed by the Center for Coastal Resources Management at VIMS.
- Follow the development of the state-wide General Permits being developed by the Virginia Marine Resources Commission (VMRC). Ensure that local policies are consistent with the provisions of the permits.
- Educate citizens and stakeholders on new shoreline management strategies including Living Shorelines.

- Evaluate and develop a locality-wide regulatory structure that encourages a more integrated approach to shoreline management.
- Evaluate and recommend cost share opportunities for construction of living shorelines.

Unique Plant and Animal Habitats

Virginia Beach is uniquely located geographically such that it affords the most biological diversity found in the state east of the Blue Ridge Mountains. Its position between the mouth of the Chesapeake Bay and the Albemarle-Pamlico Sounds makes the City the northernmost home to many southern plant and animal species, and the southernmost home to many northern plant and animal species.

Abundant waterways and wetlands provide diversity of habitat for many songbirds, shorebirds, wading birds, raptors and waterfowl. A wide variety of freshwater, brackish and salt water fish and shellfish species are also present. Additionally, several endangered and threatened species, including loggerhead sea turtles and bald eagles, call Virginia Beach home.

Virginia Beach is fortunate to possess these plentiful aquatic resources, which hold value for the City in seafood harvests, recreation, and aesthetics. Protecting sensitive spawning and nursery habitats will help ensure that the City's natural resource based industries continue to thrive. Local fisheries and shellfish harvesting should be of special concern. As noted in the Virginia Department of Environmental Quality's *Water Quality Assessment Report*, fishing is impaired in half of the City's secondary watershed areas. Shellfish harvesting is assessed less broadly within Virginia Beach's network of water quality monitoring stations, but it is impaired in at least three of the eight secondary watersheds. Virginia Beach should support a well-coordinated effort between federal and state regulators and private stakeholders to prevent any further harm to its fisheries, and to remedy problems that have led to the decline of its fisheries. The location and health of sensitive spawning and nursery habitats within proposed development areas should be addressed in the development review process.

Recommended Policies: Unique Plant and Animal Habitats

- Protect and restore unique plant and animal habitats to sustain Virginia Beach's high biological diversity in the Southern Rivers area.
- Protect the diversity of habitats through a variety of conservation tools. Use the recommendations cited in the adopted Natural Heritage Report, 1994 when considering development~~s~~ that may affect designated wildlife protection areas.
- Promote continued coordination between the Hampton Roads Planning District Commission (HRPDC), The Nature Conservancy, and the Virginia Department of Conservation and Recreation/Division of Natural Heritage (VDCR/DNH) of their respective work programs for sharing inventory data bases.
- Use existing maps and other resources that show the important fish spawning and nursery locations to limit impacts of future development. Reference these locations on development plans.
- Reference Natural Heritage Areas on development plan applications and review during the development review process.
- Continue to partner with Wildlife Response, Inc. to treat and care for injured wildlife.

Agenda for Future Action Recommendations: Unique Plant and Animal Habitats

- Develop and implement policies and programs that protect, restore and enhance critical habitats along the City's waterways.
- Restore and attain sustainable inventories of native edible oysters in the Lynnhaven River.
- Restore oyster reefs in the Lynnhaven and Owls Creek estuaries by developing a hatchery plan and constructing sanctuary reefs.
- Work with Virginia Institute of Marine Science (VIMS) and other partners to restore Submerged Aquatic Vegetation (SAV) through planting and habitat enforcement efforts.
- Undertake one wetlands restoration project in the Elizabeth River Watershed the Lynnhaven River Watershed, Back Bay Watershed, North Landing River Watershed, and Rudee Inlet/Owls Creek Watershed.
- Develop a City program to effectively manage invasive plants and animals.

SEA LEVEL RISE, RECURRENT FLOODING, AND HAZARD MITIGATION

Sea Level Rise and Recurrent Flooding

Sea level rise is a major concern for Coastal Virginia and particularly for the Hampton Roads region, which is listed as the largest population center in the country at greatest risk from sea level rise outside of New Orleans. The region has been experiencing increased nuisance flooding, defined by the National Oceanic and Atmospheric Administration (NOAA) as a daily rise in water level above the minor flooding threshold set locally by NOAA's National Weather Service. In 2014, the Sewells Point Tide Station recorded eight days of nuisance flooding. The number of nuisance flooding events is expected to increase as sea levels rise. Since the City's *2009 Comprehensive Plan* was adopted, action has been taken at the national, state, regional, and local levels to plan and prepare for sea level rise and recurrent flooding.

Regional Planning Efforts

Between 2010 and 2012 the Hampton Roads Planning District Commission (HRPDC) released a series of reports focusing on the impacts of climate change on the region. The first report researched potential impacts and engaged local government staff. The second report analyzed the impacts of storm surge flooding on various sectors, such as the built environment and the economy, and public engagement. The third report analyzed the potential impacts of sea level rise on the region's population, built environment, infrastructure, economy, and natural environment. In addition, the HRPDC established a Sea Level Rise Advisory Committee in 2014 comprised of representatives of all HRPDC localities. They also organized a "Dutch Dialogue" in June 2015 to bring together local and Dutch experts to develop strategies for integrated water management and resiliency for two neighborhoods in Hampton Roads, with intended transferability for all Hampton Roads Communities.

In June 2014, the Hampton Roads region was selected to participate in a pilot project with the aim of developing a "whole of government" (federal, state, local) and "whole of community" approach to sea level rise preparedness and resilience planning that can be used as a template for other regions while also furthering a collaborative and efficient approach to resilience planning regionally.

Given its coastal location and being the largest city population-wise in Virginia, Virginia Beach has necessarily been an active participant in the current regional planning efforts. Moving forward, Virginia Beach should remain involved in regional planning efforts and participate in new efforts as opportunities arise.

State Planning Efforts

In 2012, the General Assembly passed Senate Joint Resolution No. 76 directing the Virginia Institute of Marine Science (VIMS) to study adaptation strategies to address recurrent coastal flooding in Tidewater and the Eastern Shore of Virginia. Their report was released in 2013 and presented a series of local potential sea level rise scenarios, in addition to evaluating and recommending adaptation options for local governments (*see* *http://ccrm.vims.edu/recurrent_flooding/Recurrent_Flooding_Study_web.pdf*).

The Secure Commonwealth Panel established a Recurrent Flooding Sub-Panel in fall 2014 that provided recommendations for how the Commonwealth can respond and adapt to recurrent flooding and sea level rise. Additionally, Governor McAuliffe re-established the Climate Change Commission to review, update, and prioritize the recommendations of the *2008 Climate Change Action Plan*, as well as identify sources of revenue to fund implementation of the plan's recommendations *(see* *http://www.sealevelrisevirginia.net/docs/homepage/CCC_Final_Report-Final_12152008.pdf*).

The Climate Change Commission has appointed the state's first Chief Resilience officer to lead the effort to prepare Virginia for the current and future effects of climate change.

Local Planning Efforts

As a coastal community, Virginia Beach is proactive in addressing sea level rise. Our oceanfront has been protected from rising sea levels and coastal storms through two major civil works projects: one at the Resort area and the other at Sandbridge. In addition, Chesapeake Bay Beach, Cape Henry Beach, and Ocean Park Beach are replenished approximately every six years as part of the Lynnhaven Inlet maintenance dredging performed by the U.S. Army Corps of Engineers (USACE).

In 2013, Virginia Beach updated its floodplain ordinance and moved it to Appendix K of the City Code as a standalone ordinance. One of the major steps taken during the update was to adopt two feet of freeboard for all new construction and substantial improvements to existing construction. In addition, the City has participated in several rounds of Federal Emergency Management Agency (FEMA) grant funding to elevate homes with multiple flood losses. To date, seven homes have been elevated, and another thirteen have received funding for elevation.

To ensure protection of critical public infrastructure, the Department of Public Utilities has inventoried all sewer pump stations subject to flooding and is evaluating infiltration and inflow from 2, 5 and 10-year storm events. Sea level rise is a contributing factor for some of these stations and collection systems. Aging infrastructure and Virginia Department of Environmental Quality Consent Order mandates have also led to elevating some of our infrastructure or reinforcing it such that it would be resistant to infiltration and inflow from sea level rise and recurrent flooding. As the City replaces sewer pump stations, adds generators, and rebuilds collection systems, groundwater level and flooding are being considered in their design and construction.

In 2014, City Council launched the Comprehensive Sea Level Rise and Recurrent Flooding Capital Improvement Program project which is now known as Sea Level Wise to enable Virginia Beach to establish long-term resilience to sea level rise and associated recurrent flooding. The first phase of Sea Level Wise focused on establishing a full understanding of flood risks by analyzing sea level rise and recurrent flooding impacts to both built infrastructure and the natural environment. Phase tow concentrated on developing and evaluating options for addressing short-term and long-term flood risks. During Phase three, a comprehensive planning process brought together all the distinct Sea Level Wise components to form an integrated Adaptation Strategy to guide adaption efforts across the entire City, as well as actionable adaptation projects for each of the City's four major watersheds. The final phase involves implementing the projects identified throughout this effort.

As part of developing the adaptation study, the City has identified sea level rise planning horizons in order to complete the vulnerability assessment and develop adaptation strategies. Two scenarios were selected for short- and long-term planning purposes, using the NOAA, USACE, and VIMS projection scenarios:

- 1.5-foot of projected rise for the short term planning horizon.

- 3 feet of projected rise for the long-term planning horizon (50+ years) to be used as a basis for making long-term decisions, such as public infrastructure (roadways, bridges, alternative transportation modes, public utilities, and stormwater drainage system) design and replacement.

In addition to planning for sea level rise, several neighborhoods have been impacted by flooding from storm and rainfall events. The City is undertaking a drainage study to develop solutions to address flooding in these neighborhoods and protect them from future events. The City is also exploring the benefits of participating in FEMA's Community Rating System (CRS) Program, which could provide discounts on federal flood insurance premiums paid by property owners.

In Virginia Beach, living near the water remains desirable. Projected patterns for future development should be evaluated and considered to determine the vulnerability to flooding over time. Sea level rise must be particularly considered in areas with relatively flat topography, such as the Southern Rivers Watersheds Area, as small changes in sea level can adversely impact greater land areas. Care should be taken when locating and building homes and other structures, as well as new development and residential subdivisions, to ensure that they are adequately protected from flooding now and into the future.

Hazard Mitigation

Environmental hazards are very real to our coastal area. The City must focus on long-term sustainability by identifying short and long term impacts associated with natural events. The *2011 Southside Regional Hazard Mitigation Plan* (http://www.hrpdcva.gov/uploads/docs/2011%20Southside%20HR%20Hazard%20Mitigation%20Plan.pdf) recommends specific actions designed to protect residents, business owners and the built environment from hazards that pose the greatest risk. A comprehensive mitigation approach addresses hazard vulnerabilities that exist today and in the foreseeable future. Therefore, projected patterns of future development must be evaluated and considered in terms of how that growth will increase or decrease a community's hazard vulnerability over time.

Land use is a particularly important theme in Southside Hampton Roads, where many communities are facing increasing growth rates. Local policies that guide community growth and development, incentives tied to natural resource protection, and public awareness and outreach activities should be considered to reduce participating jurisdiction's future vulnerability to identified hazards.

The *Southside Regional Hazard Mitigation Plan* is currently in the process of being updated and rewritten into a *Regional Hazard Mitigation Plan*, with expected adoption in late 2016. Care should be taken to ensure consistency between the Comprehensive Plan and the *Regional Hazard Mitigation Plan*, especially related to strategies to mitigate recurrent flooding and sea level rise.

Recommended Policies: Sea Level Rise, Recurrent Flooding, and Hazard Mitigation

- Concentrate new development at higher elevations outside special flood hazard areas.
- Use alternative construction techniques to minimize fill in the Floodplain Subject to Special Restrictions.
- Wherever possible in the development approval process, avoid developing inside special flood hazard areas, especially in the Southern Watershed Area, which is characterized by limited relief and a minimal hydraulic gradient.

Agenda for Future Action Recommendations: Sea Level Rise, Recurrent Flooding, and Hazard Mitigation

- Develop a program to educate the public on the beneficial functions and values of floodplains.
- Implement the findings and recommendations of the Sea Level Wise Response Strategy.
- Preserve and enhance beaches and dunes along the City's Atlantic Ocean and Chesapeake Bay shorelines.
- Implement the recommendations of the *Regional Hazard Mitigation Plan*.

LAND DEVELOPMENT AND STORMWATER MANAGEMENT

Land is a precious resource, limited in amount, highly valued and often exploited, a commodity that is constantly being sold, developed, or redeveloped. As the City matures, its land inventory becomes even scarcer. Management of land in its natural state demands that we employ wise management and stewardship practices to safeguard the City's natural heritage. Similarly, developed land should be used in a sustainable manner so that its value to present and future generations is maintained or enhanced. Integrated Site Design and stormwater management are key techniques that can be used to enable responsible and more sustainable land development practices.

"Filterra" stormwater treatment system draining a parking lot at new suburban development site

The City has recently drafted an *Integrated Site Design Guide* as the latest in a series of initiatives intended to help developers accomplish sustainable development in the city. While this effort is designed to update the City's current *Landscaping Guide*, which was published in 2002 and revised in 2009, it is not an attempt to increase current landscape requirements or costs related to landscaping and stormwater management. The Guide seeks to maintain the beneficial landscaping strategies that have been successful in beautifying Virginia Beach over the last 20 years. The Guide will be the tool box from which landscape architects and designers, civil engineers, planners, developers, business owners, and even homeowners will combine landscape techniques with design components to meet the City site plan review requirements. The draft plan can be viewed at: *http://www.vbgov.com/government/offices/eso/Documents/isdg-2014.pdf*.

Stormwater management regulations were passed by the General Assembly after many years of assembling diverse stakeholder input. This landmark decision has more recently devolved from state agency to local government implementation and enforcement without additional resources to local governments. As a result, the City of Virginia Beach adopted new stormwater management regulations and fees, which became effective July 1, 2014. Perhaps more than anything else in recent years, these state-mandated regulations have changed the way development projects are designed and approved in Virginia Beach. In addition, since adoption of the *2009 Comprehensive Plan*, the City of Virginia Beach prepared a *Comprehensive Stormwater Management Plan* that was approved by the Department of Environmental Quality.

Southern Watershed Subject to "Special Drainage Considerations"

In addition, the Southern Watershed (see Southern Watershed map in Chapter 1, Section 1.5 – Rural Area) is subject to "special drainage considerations." Drainage in the Southern Watershed is highly impacted by the presence of high ground water, poorly draining soils, and high water surface elevations in downstream receiving waters. Therefore, it is recommended that the developer of any property in the Southern Watersheds understand and evaluate these factors prior to undertaking the project and properly account for these factors in the project design. Receiving waters in the Southern Watersheds are subject to wind driven tidal influences. High ground water elevations and poorly draining soils can result in increased runoff, can limit the capacity of stormwater conveyance systems, and can counter the use of certain Best Management Practices, such as infiltration.

All of these effects must be fully considered and evaluated in the analysis and design of drainage systems in the Southern Watersheds. Accordingly, it is strongly recommended that the developer has a preliminary drainage study prepared by a qualified professional engineer in advance of any request to approve a discretionary (versus by-right) development application that involves land disturbance in the Southern Watershed. The drainage study should fully and accurately evaluate the effects of the foregoing factors on the planned development and on upstream and downstream areas. The proposed drainage system for the planned development would provide positive drainage that meets City standards and does not result in flooding within the planned development or to upstream or downstream areas.

Recommended Policies: Land Development and Stormwater Management

- "Low Impact Development" design features should be incorporated into the City's major buildings and parking area projects and in all private development plans.
- All waterfront development proposals in the Strategic Growth Areas (SGAs) should be coordinated with the City's Parks and Recreation Department for potential public water access (e.g., canoe/kayak put in, parkland, plaza, etc.,) in accordance with adopted SGA Master Plans.

Agenda for Future Action Recommendations: Land Development and Stormwater Management

- Complete and adopt the Integrated Site Design Guide as a component of Planning's Design Specifications and Standards.

- Enhance stormwater management by exploring alternatives to conventional stormwater management facilities (SWMFs), such as Low Impact Development (LID) approaches that are applicable to the Coastal Plain.
- Work with regional partners to implement the *Green Sea Blueway and Greenway Management Plan.*
- Develop online tools to assist the public with identification of sensitive environmental areas in the development review process.

ENERGY MANAGEMENT AND ALTERNATIVE ENERGY RESOURCES DEVELOPMENT

The City's goal for the year 2040 or earlier for energy resources management is three-fold:

1. All public and private development employs design features that achieve higher levels of energy efficiency;
2. Use energy as efficiently and as effectively as possible, while investing and planning for the continuity of municipal operations during energy disruptions; and,
3. Reduce energy consumption City-wide by 10%, in support of the Commonwealth of Virginia's goal to reduce electric energy consumption by 10% below 2006 levels by 2020, as stated in the in the *2014 Virginia Energy Plan* (https://www.dmme.virginia.gov/DE/2014_VirginiaEnergyPlan2.shtml).

To accomplish this, the City of Virginia Beach became a partner of Virginia Energy Sense. Virginia Energy Sense is the Commonwealth's energy education program under the guidance of the State Corporation Commission. Their mission is to work toward the *2014 Virginia Energy Plan's* electric energy consumption reduction goal by helping Virginias understand their energy use, and what they can do to save energy easily and cost-effectively. Energy efficiency and energy conservation are the most affordable, available tools to achieve this goal. The Virginia Energy Sense program provides the tools to educate and empower all Virginians to get involved and lower the amount of electricity they use.

The City of Virginia Beach can only hold itself and its operations fully accountable for energy consumption and conservation. Making an impact throughout the community will take the entire community—government and its citizens and businesses—working together as partners toward a more sustainable future. This necessary partnership is articulated well in the City's *A Community Plan for a Sustainable Future* (http://www.vbgov.com/government/offices/eso/sustainability-plan/Pages/default.aspxadd).

Our public schools are a major part of the City's inventory of municipal buildings. As such, they are key partners in the pursuit of energy use management. Virginia Beach City Public Schools (VBCPS) has become an internationally-recognized leader for its sustainable design principles and a growing list of innovative LEED-certified buildings. In addition to LEED projects and the constant evaluation of sustainable practices throughout the school division, sustainability has been implemented throughout the curriculum. Sustainability is a vital component of the *Compass to 2020 - Strategic Plan for Student Success* (http://www.vbschools.com/compass/landing.asp), which is implemented by the VBCPS Board. VBCPS was recognized by the USGBC as the "Best Green School Division Nationwide" for 2012.

Virginia Beach has undertaken a variety of initiatives to increase energy efficiency in City buildings:

- The Joint Energy Committee was created in spring 2007 in response to the City's rising energy costs. It reviews current City energy practices, evaluates new technology for potential incorporation into the City's energy strategy, and sets energy consumption goals for municipal operations. The JEC includes representatives from both the City and VBCPS that have been identified to date as the largest energy consumers, as well as representatives from the City's Department of Management Services (Budget Office). The JEC is jointly chaired by City and VBCPS executive managers.

- The City's Energy Office was created in July 2010. Since its creation, the office has led the way on a number of initiatives, helping to monitor and reduce the City's energy consumption.

- In the 2008, the City of Virginia Beach adopted an administrative directive requiring, whenever technically and fiscally possible, all new City building projects that have over 10,000 square feet of conditioned space to be designed and constructed to achieve a LEED-certified rating. To date 8 buildings have achieved LEED certification and another 6 are being designed for certification.

- The City pursues ENERGY STAR benchmarking and certification on existing buildings; to date, 5 have received certification. Currently, VBCPS has 28 facilities (nearly 2.9 million square feet) that have earned ENERGY STAR certification. Twenty facilities were either certified or recertified in 2014.

<u>Mayor's Energy Advisory Committee (MEAC)</u>

The City of Virginia Beach recognizes that local leadership and commitment to energy efficiency are keys to having a large influence over energy use in our community. Nationally, the Virginia Beach Region is 20th overall and is ranked 1st among mid-size cities for number of buildings in the EPA's Energy Star program. Of the 81 Energy Star certified buildings in the region, 35 are buildings located in the City boundaries. With the goal of local leadership and commitment to energy efficiency, the Mayor's Energy Advisory Committee (MEAC) was formed in 2013 to proactively position Virginia Beach to be an active leader in the movement toward a more sustainable and intelligent energy future for our nation, the commonwealth and the community.

MEAC focused on five major areas:

- Updates on the offshore energy efforts and its timeline for decision makers.
- Development of energy conservation programs.
- Tracking energy legislation and policy development.
- Providing energy-related advisory and support activities.
- Advising on new opportunities and actions.

The Committee's recommendations were presented to City Council in 2015.

Alternative Energy Task Force

In 2009 Mayor William D. Sessoms, Jr. created the Mayor's Alternative Energy Task Force to position Virginia Beach as a leader in the movement toward a more sustainable and intelligent energy future. Members of the task force included representatives from local, state and federal government, universities and research institutions, and industry and citizen groups. The overarching mission of this task force was to develop goals, strategies, and objectives to reduce Virginia Beach's reliance on foreign sources of energy and to ensure adequate future sources of energy to meet domestic needs. The results of this work are captured in the *Alternative Energy Task Force Report* dated September 7, 2010 http://www.hrp.org/Site/docs/ResourceLibrary/VB_AETFFinalReport_07Sep10.pdf.

Recommended Policies: Energy Resources Management

- Build Leadership in Energy and Environmental Design (LEED™) structures or their equivalent for all public buildings.
- Retrofit City buildings to save energy using Energy Star standards.
- Increase our urban forest canopy to absorb more carbon dioxide (CO2).
- Use energy efficient lighting and reduce wasteful electricity use.

Agenda for Future Action Recommendations: Energy Resources Management

- Prepare action and public communications plans to support the Commonwealth's goal to reduce electric energy consumption by 10% below 2006 levels by 2020.
- Implement City's commitment to the US Mayors' "Climate Protection Agreement." http://www.usmayors.org/climateprotection/agreement.htm

Recommended Policies: Alternative Energy Resources Development

- Support research and development of alternative energy sources and encourage their use.
- Link energy resource development and management opportunities to the City's economic development strategy and the region's long-term economic development goals.

Agenda for Future Action Recommendations: Alternative Energy Resources Development

- Encourage research and development of alternative energy sources and promote their use.
- Work with the Virginia Coastal Energy Research Consortium (VCERC) on-offshore wind development.

NOISE, LIGHT, AND AIR POLLUTION MANAGEMENT

Noise Pollution

Noise pollution is unwanted or disruptive sound that interferes with normal activities such as sleeping or conversation or disrupts or diminishes one's quality of life. Many Virginia Beach citizens are affected by noise created by surface transportation, aircraft and stationary sources. The need to minimize these impacts must be balanced against other required planning objectives as cited in state law. This point is especially true as it applies to the City's Air Installation Compatible Use Zone (AICUZ) program and the recommendations cited in the 2005 Hampton Roads Joint Land Use Study.

Recommended Policies: Noise Pollution

- Adhere to Air Installation Compatibility Use Zones (AICUZ) and other policy and programmatic recommendations cited in the Oceana Land Use Conformity Program (http://www.yesoceana.com/about-oceana-land-use-conformity/) and the 2005 Hampton Roads Joint Land Use Study (http://www.vbgov.com/government/departments/planning/areaplans/Documents/Oceana/JointLandUseStudy.pdf) both adopted by City Council.
- Relocate existing and locate proposed higher noise generating businesses and activities to locations inside the City's higher AICUZ zones and away from residential areas.

Agenda for Future Action Recommendations: Noise Pollution

- Explore alternative means of noise attenuation along roadways and at intersections where noise attenuation is not mandated through the use of wider shoulders and increased vegetation.

Light Pollution

Light pollution is the inappropriate or excessive use of artificial light and can cause sky glow, glare, light trespass, decreased visibility at night, and energy waste. Much of the outdoor lighting used at night is inefficient, overly bright, poorly targeted and improperly shielded. The Dark Skies Initiative seeks to raise awareness of light pollution and encourages shielding outdoor lighting to reduce night-time glare and limit light being emitted into the sky so that the stars and other celestial objects can be visible. The benefits include aid to migrating wildlife, stress reduction and aesthetic value, as well as energy savings. Currently, Virginia Beach is installing LED lights on all new light fixtures and upgrading existing light fixtures to LEDs as they are naturally replaced.

Recommended Policies: Light Pollution

- All outdoor lighting should be of a design that accentuates the site and provides sufficient illumination for the development without projecting light and glare onto adjacent properties or into the sky.
- Lighting poles should be of minimum height, possessing a pedestrian scale, but provide adequate illumination.
- Lighting for pedestrians should be provided from storefronts using either indirect illumination form the building or direct illumination under canopies or awnings.
- Lighting of non-residential buildings should be designed as an integral part of the building's architecture to be as unobtrusive as possible. Lighting especially on the rear of buildings that face residential areas should be designed and placed so that it does not direct or reflect any illumination into residential properties.

Agenda for Future Action Recommendations: Light Pollution

- Develop and adopt a Dark Skies Initiative Administrative Directive.

Air Pollution

Chesapeake Bay Airshed and Watershed

Air pollution is the introduction of particle matter, gasses, odors, or other harmful materials into the Earth's atmosphere. Air pollution is a significant risk factor for a number of health conditions including respiratory infections, heart disease, COPD, stroke and lung cancer and can lead to difficulty breathing, coughing, asthma and worsening of existing respiratory and cardiac conditions. Hampton Roads is located at the eastern edge of the Chesapeake Bay Airshed, an area that is over four times larger than its watershed and covers much of the Ohio valley and the mid-Atlantic region. Distance from remote, industrial pollution sources and Hampton Roads' coastal location have contributed to fewer air quality problems as compared to other metropolitan areas of similar size.

While air pollution is largely a problem that must be addressed at the regional level, there are a number of actions that can be taken at the local level to demonstrate a focused approach at helping to reduce air quality declines, including transit improvements, ride-sharing and better facilities for bikes and pedestrians. Collectively, these actions will help to mitigate against projected pollution increases only slightly; but they can also offer transportation alternatives that can potentially reduce traffic congestion and thereby improve the region's air quality in the future, especially when combined with new technologies being developed in the transportation industry.

Recommended Policies: Air Pollution

- Reduce air pollutant loadings, in part, by working to achieve the 2014 Chesapeake Bay Watershed Agreement goals related to air pollution.
- Increase tree preservation and replacement efforts to help reduce CO2.

SOLID WASTE MANAGEMENT

The City of Virginia Beach is a leader in the field of waste management. Its recycling program is regarded as one of the most successful in the Commonwealth. The City has increased its operational capacity at the City Landfill #2 facility by participating in the Regional Refuse Derived Fuel (RDF) Plant and Power Plant that supplies electrical power to the Norfolk Naval Shipyard in Portsmouth, Virginia. The City must continue this leadership role by being proactive in looking ahead to the next generation's demands for solid waste disposal capacity once the current Landfill #2 facility reaches its operational life capacity.

Recommended Policies: Solid Waste Management

- Manage solid waste generation in such a manner to eliminate, reduce, or recycle waste products to the greatest extent practical.
- Operate the City's waste management facilities to safeguard land, air and water resources for economic and environmental efficiency.
- Ensure all appropriate adaptive reuse "close out" measures for the City's landfill are employed to protect the public health, safety and welfare.
- Recycle and separate waste materials at their source to help extend the life of the City's landfill and the regional landfill.

Agenda for Future Action Recommendations: Solid Waste Management

- Participate with the region's localities to develop a post-2018 SPSA (Southeastern Public Service Authority) Agreement for regional waste management.
- Expand participation and types of materials accepted in the City's recycling program.
- Promote increased recycling in the tourism industry through the development of incentives.

2.3 - HOUSING & NEIGHBORHOODS

HOUSING THAT IS SAFE, DECENT, DIVERSE, AFFORDABLE, AND ATTRACTIVE HELPS FOSTER:

- Neighborhood Stability and Quality
- Higher Quality Physical Environment
- Diverse Lifestyle Choices
- Civic Pride
- Lifelong Learning
- Economic Vitality
- Higher Quality of Life

INTRODUCTION

The purpose of this chapter is to provide comprehensive planning policies to guide and protect the future character of housing and neighborhoods citywide. A key indicator of every successful city is how well it safeguards the health and quality of its housing and neighborhoods. As defined in the Suburban Area Chapter, neighborhoods are"…a cohesive arrangement of properties, structures, streets, and uses within an area that most or all of which is residential, and that shares distinct physical, social and economic characteristics." Thus, housing and neighborhoods are discussed as one entity in this chapter as a cohesive arrangement, intertwined in affecting the existence of stable neighborhoods that thrive in the context of quality housing and civic pride of the residents.

Single Family Neighborhood

Policies complementary to this chapter that apply to neighborhood development and housing needs can be found in the Urban Areas and Suburban Area chapters. Design Guidelines for housing and neighborhood development and compatibility are found in the Comprehensive Plan's Reference Handbook for the Planning Area Development Guidelines and the Special Purpose Guidelines.

VISION

> Virginia Beach will be a City with vibrant, well-maintained neighborhoods where all residents have the opportunity to obtain desirable, safe, and affordable housing and enjoy a high quality of life.

This vision aligns with the city's *A Community for a Lifetime* report that envisions Virginia Beach to be a community with diverse, distinctive neighborhoods and diverse living choices.[xxxiii] This means that residents should find a wide range of well-built housing options in price, size, and location, with equal opportunity to rent or own housing and in neighborhoods that meet their needs. This opportunity includes access to a variety of affordable housing alternatives for all people including members of the vital services community, young professionals, the workforce, families, and senior citizens. Our neighborhoods and housing are to be safe, attractive, well-maintained, continuously renewed, and refreshed. Residents will have easy access to amenities such as open space and places of historical and cultural significance. They will have places of employment at all times, high quality infrastructure and are linked by public transit and efficient roadways. Residents should expect that, when infill housing occurs, that it will be consistent with the neighborhood character and add value to the neighborhood. New housing development will meet the future needs of our population and achieve multiple goals for our overall development pattern.[xxxiv] Future needs also include housing for our homeless population. Virginia Beach does have a challenge with the higher cost of rental units and finding landlords that will rent to our homeless population. With the opening of the Housing Resource Center by early 2018, our idea will come to fruition for a single source for a variety of services to reduce the impact of homelessness. This facility will provide new shelter and housing options to help individuals and families get off the street. In addition, various types of programs will be available to help house our homeless.

Rendering of Housing Resource Center

Achieving this vision will result in recognition that Virginia Beach is a well-planned community of exciting, diverse, and interconnected neighborhoods; each offering unique opportunities for living, work, play, and growth in a culturally rich and safe environment.

EXISTING CHARACTERISTICS AND TRENDS IN HOUSING

The following section presents existing general characteristics, conditions, and trends that indicate vitality relating to housing including types, age, condition, value, tenancy, and overall affordability. Details and further explanation of these trends can be found in the Comprehensive Plan's Technical Report.

Existing Characteristics

The city's residential areas north of the Green Line offer a wide variety in housing and neighborhoods. Prevalent among this variety is the suburban pattern of low to medium density housing found in neighborhoods with diverse single-family and multi-family housing types, demographics, and property values. While not nearly as prevalent as the suburban form yet is a growing segment in the attributes of Virginia

Single Family Home in the Rural Area

Beach, is the more urban pattern with mid-rise to high-rise multifamily dwellings, often found in mixed-use developments in our Strategic Growth Areas. South of the Green Line to Indian River Road, the housing and neighborhoods range from suburban style subdivisions to typical farmhouses and rural residential single lot dwellings. Further south beyond Indian River Road are farm homes, rural residential neighborhoods, and estate homes.

Desirability Standards for Housing

Among the key trends shaping the future of residential development in Virginia Beach are the changing housing and neighborhood desirability standards of our young adults and our older adults. Generally, young adults tend to gravitate to centrally located urban areas as they seek a more urban lifestyle that offers a variety of opportunities to live, work, and play with access to more multi-modal transportation options, such as the city's Strategic Growth Areas (SGAs). The likely result of this trend will be less demand for suburban home ownership and more demand for a greater concentration of multiple housing choices in urban areas. For the older adults of Virginia Beach, otherwise known as Baby Boomers, their changing housing desirability standards are reflected in a greater demand for a wider range of housing options for seniors ranging from in-home care, to an urban lifestyle with lower home maintenance, to aging-in-place facilities and communities.

The Cosmopolitan Apartments at Town Center

Housing Development

For many years the percentage of single family detached homes in the city was near 60 percent. However, as of 2015, this percentage has gradually shrunk as single family detached dwellings now represent 56 percent of the city's housing units, reflecting an increasing trend that less single-family homes are being built. This is due in part to the dwindling supply of available land for development combined with the changing social, economic and market demands. Instead, more additions are being made to existing homes and multifamily development is increasing.[xxxv] This declining rate of construction of single family dwellings has been occurring since 2008 when only 1,743 single family units were constructed, while 4,007 apartments and 3,420 condos units were built.[xxxvi] Apartments now account for 19 percent of the city's housing stock, followed by duplexes and condominiums at 14 percent and townhouses at 11 percent. While this is relatively small on a percentage basis, it does reflect a trend toward more compact residential development. Compact

Compact Single Family Neighborhood

development is consistent with the city's comprehensive planning strategy that seeks to reduce sprawl, protect valued natural resources, and optimize efficient use of existing infrastructure.

Age of Housing Stock

The age of the housing units in Virginia Beach also plays a role as a vitality indicator of the city and its neighborhoods, as well as in planning for the future. The average age of housing units is increasing and will continue to increase through 2040. As of 2015, the city's Real Estate Assessor's records indicate that 42 percent of the housing stock is 40 years old or older. Assuming an annual growth rate of 1,300 housing units, which is about the current rate, this percentage will increase to 70 percent by 2040. Even more significant for this time period is that 60 percent of the housing stock will reach the age of 55 years old or older. Typically, it becomes a challenge to keep housing in this age range sustainable as it will more likely need not only maintenance, but also major repairs and improvements. This trend emphasizes that as housing stock ages, it is in the city's best interest to continue to protect stable neighborhoods and work toward assisting homeowners to reinvest in their homes to achieve healthy housing stock and neighborhoods.

Single Family Neighborhood circa 1970s

Physical Conditions of Housing

Given the relationship between neighborhood vitality and aging housing stock, the physical condition of housing units plays a key role in maintaining the general health of the city and its neighborhoods. It serves as a direct reflection of the city's efforts to promote vibrant, blight-free neighborhoods. As the housing stock ages, the city must monitor and evaluate the condition of housing to aid in knowing where and how to preserve and enhance neighborhoods. Other benefits to evaluating housing stock on a routine basis are that it serves as a key to understanding housing trends as well as determining where to concentrate enforcement and rehabilitation services. A repeatable method for surveying housing conditions every 3 – 5 years throughout the city would be valuable in this regard.

The method the city has used to gauge the physical condition of its housing stock began in 1990 as a process of periodically conducting "windshield" surveys to classify exterior conditions by one of four categories:

- Standard – no exterior deficiencies with zero building maintenance code violations;
- Deficient – minor defects to be easily corrected in the course of regular maintenance;
- Deteriorated - structure defects of greater severity that is not normally repaired in the course of regular maintenance; or
- Dilapidated - critical defects that are not feasible to repair and endanger the health or safety of occupants.

Five citywide surveys of a variety of housing units have been completed from 1990 to 2014. As measured by these five surveys, it is indicated that the condition of housing in Virginia Beach has constantly remained in good condition overall despite an increase in average age. The 2014 survey indicated that over 86 percent of housing in Virginia Beach meets or exceeds the 'standard' or acceptable level.[xxxvii] This represents an improvement of 7 percent over the 24-year life of the survey program, compared to the results of the 1990 survey when 79 percent of our housing was found to be in 'standard' condition. The contributing factors to this high rate of acceptable housing conditions in 2014 may include the continued attractiveness of the city as a place to live: the increasing housing values; the delivery of effective public services, such as infrastructure and code enforcement of building and property maintenance; and, most importantly, property owners doing a good job of maintaining and reinvesting. However, it remains essential that the city continue to focus attention to using a proactive approach for identifying deficient and deteriorated housing, as well as fostering an approach that demands conformance with adopted building and property maintenance codes. This is the critical factor in eliminating widespread neighborhood blight while ensuring the preservation of safe and decent housing.

Achieving Ownership

For most homeowners, housing represents the family's largest single financial investment. However, based upon median income and housing values, the trend is showing that achieving home ownership is becoming more and more difficult.

Single Family Home

According to the city's Real Estate Assessor's Annual Report for Fiscal Year 2015-2016, the average value for residential units increased by 2.3 percent for 2014. As the average annual housing values in the city continue to increase, the result has been to further increase the size of an existing housing affordability gap that is already wide. For 2015 the average home price in Virginia Beach is $225,300[xxxviii], approximately 3.18 times the city's median income level of $70,900[xxxix] for a family of four making Virginia Beach moderately unaffordable for home buyers.

What this means is that household incomes are increasing much slower than the value of our housing stock. This affordability gap will preclude many potential homeowners from buying their first homes and will also put additional demand on the rental housing market, contributing to still higher rents.

Tenancy

The percentage of renters in Virginia Beach is increasing. From 2010 to 2014, renter occupied housing increased from 34.3 percent to 38.1 percent; while the percentage of owner occupied housing decreased from 65.7 percent to 61.9 percent.[xl]

Multifamily Housing

Housing Affordability

Housing affordability is a significant issue for tens of thousands of residents in Virginia Beach. Frequently this involves households that are financially stressed due to housing costs, otherwise known as being 'housing cost burdened'. The conventional public policy indicator of housing affordability in the United States, as defined by U.S. Department of Housing and Urban Development (HUD) **http://portal.hud.gov/hudportal/HUD** is that, in general, the term for affordable housing applies to housing for which the occupant(s) is/are paying no more than 30 percent of their income for gross housing costs, including utilities. Households that pay more than 30 percent of their income for housing are considered 'housing cost burdened' and may have difficulty affording necessities such as food, clothing, transportation, and medical care. This definition is not universally used since HUD notes that some jurisdictions may define affordable housing based on other, locally determined criteria. Therefore, this definition is intended solely as an approximate guideline. However, HUD further explains that a family with one full-time worker earning the minimum wage cannot afford the local fair-market rent for a two-bedroom apartment anywhere in the United States.

Townhouse Neighborhood

This housing cost burden measure provides the actual "affordability outcome" of the housing choices made by individual households. These choices are constrained by not only each household's income and preferences, but also by the housing availability[xli]. In Virginia Beach, of the estimated 84,737 households with a mortgage; 40.8 percent are considered housing cost burdened and of the estimated 56,234 households renters, 53.4 percent are considered housing cost burdened. From 2010 through 2014, the combined effect of the housing price increases and increased demand for rental housing elevated rents from $1,200 to $1,291, almost an eight 8% percent increase.[xlii] This rate of increase clearly impacts affordability for many workforce and low and moderate income households.

GUIDING PRINCIPLES FOR HOUSING AND NEIGHBORHOOD PLANNING

Housing is an indispensable building block of neighborhoods and of the local economy. It contributes to household wealth, creates jobs, boosts local revenues, adds wages, and contributes to the tax base. The following guiding principles for housing and neighborhood planning recognize that the general health of the city's housing stock and neighborhoods are of critical importance to its citizens and to its continued economic vitality.

- Safe Housing and Neighborhoods
- Affordability and Equal Opportunity
- Quality Design and Energy Efficiency
- Stability, Preservation, Renewal, and Enhancement
- Compatible Redevelopment
- Housing with a Range of Affordability in Strategic Growth Areas
- Adequate Infrastructure and Transportation Connectivity

As expressed in Chapter 1, Section 1.3 - Suburban Area, planning principles have been established to encourage quality development of housing and neighborhoods so as to guard against blight and possible threats to their stability. This is accomplished by:

- Ensuring the appropriate use of land to accommodate future housing demand without sprawl;
- Promoting housing rehabilitation;
- Improved quality of design;
- Diversifying housing type and cost range; and
- Enhancements to the transportation system.

Safe Housing and Neighborhoods

The basic foundation of a good neighborhood is safety. Safety from crime drives many of our decisions about where to live. A continuing emphasis on protection from and intervention against crime through effective Police Department actions is a critical contributor to good neighborhoods. In addition, the city supports community design alternatives and development guidelines that help protect people and property, reduce crime, improve the attractiveness of the setting, and promote a sense of comfort and security. An excellent source for providing safety in design and development can be found in the city's *Crime Prevention Through Environmental Design* (CPTED) philosophy and program strategies.

Another technique, known as "Neighborhood Traffic Calming", increases public safety within neighborhoods by slowing vehicular movement and reducing 'cut through' traffic. This technique is discussed in the Suburban Area Chapter. Greater connectivity that allows safe movement from home to destinations beyond the neighborhood without having to rely on automobiles is also desired by our citizens. This is particularly desired for the city's Urban Areas.

Street Calming in the Old Beach Neighborhood

Hazard Mitigation

The safety of our neighborhoods can be threatened by a variety of potential events. One such threat that is very real to our coastal area communities is the potential for environmental hazards, such as hurricanes and wide-spread flooding, that disrupts the surrounding natural environment and adversely affects people's health. Depending on the level of a community's hazard vulnerability, recovery from such events can be sluggish and costly. Given the potential for these occurrences and its effect, it is essential that our communities in Hampton Roads have an awareness of and ability to prepare for mitigation to aid in recovery. In response to this need, a regional comprehensive mitigation approach was undertaken in 2011 to address the region's hazard vulnerabilities that exist now and in the foreseeable future. The outcome was the *Southside Regional Hazard Mitigation Plan,* found online at http://www.vbgov.com/government/departments/fire/emergency-mgmt/Pages/emer-mgt-reg-mit-plan.aspx, which recommends specific actions designed to protect residents, business owners, and the built environment from hazards that pose the greatest risk. These recommendations can be applied to reduce a community's future vulnerability by identifying hazards and enacting local policies to guide growth and development, providing incentives tied to natural resource protection, and providing public awareness and outreach activities. One significant aspect of a community's future vulnerability is its land use development pattern. This is a particularly important theme in Hampton Roads where many communities are facing increasing growth rates which could determine their future vulnerability. Therefore, projected patterns of future development must be evaluated and considered in terms of how that growth will increase or decrease a community's hazard vulnerability over time. One area that the city must focus on is the identification of short and long term impacts from natural and man-induced events in order to prepare for long-term sustainability.

Sea Level Rise and Recurrent Flooding

Sea level rise is a major concern for Coastal Virginia, particularly for the Hampton Roads region. Hampton Roads ranks as the second most vulnerable area in the U.S. for sea level rise, behind New Orleans. Due to its coastal location, Virginia Beach continues to be an active participant in current regional planning efforts for Adaptation and Mitigation Planning for sea level rise and recurrent flooding. In 2013, Virginia Beach updated its floodplain ordinance. Among the major changes to the ordinance was the adoption of two feet of freeboard for all new construction and for substantial improvements to existing construction. In addition, the city has participated in several rounds of FEMA grant funding to elevate homes that have experienced sever repetitive loss. To date, seven homes have been elevated, another eight have funding to be elevated, and five homes are currently under review to receive funding. The City has also developed the Sea Level Wise Adaptation Strategy, which consists of four complimentary themes, each with a specific approach to flood risk management. The layers are designed to support each other, integrating structural and non-structural measures to ensure comprehensive flood protection across a range of environmental conditions. Adaptation strategies fall broadly into the categories of natural mitigation, preparing the community, engineered defenses, and adapting structures. In addition to planning for sea level rise, several neighborhoods have been impacted by flooding from storm and rainfall events, otherwise known as 'recurrent flooding'. The city is undertaking a drainage study to develop engineered solutions to address flooding in these neighborhoods and reduce their risk for flooding.

Recommended Policies: Sea Level Rise and Recurrent Flooding

- Concentrate new development at higher elevations outside special flood hazard areas.
- Use alternative construction techniques to minimize fill in the 'Floodplain Subject to Special Restrictions.'
- Wherever possible in the development approval process, avoid developing inside floodplain areas and similar low-lying areas.

Affordability and Equal Housing Opportunity

EQUAL HOUSING OPPORTUNITY

Fair housing is a fundamental civic principle. An important goal is to maintain and improve upon the diversity in housing and neighborhoods that is already a positive component of our city. This diversity includes the type, value, and design of housing and neighborhoods. This will, in turn, help the city meet its goals for a quality physical environment, community opportunities, and economic vitality. Overall, both now and in the future, the city of Virginia Beach is committed to ensuring that all citizens enjoy equal access and opportunity to an adequate supply of safe, attractive, decent, diverse, and affordable housing. This supply of housing needs to have a range of values of both owner-occupied and rental units that will accommodate present and future needs. In certain cases when housing units are being removed due to the development projects, the city should assist in the replacement of housing units being lost to public projects. The private sector should be encouraged to provide relocation assistance to residents who are displaced by private projects.

<u>Affordability and Accessibility</u>

Despite the slowdown in the housing market, housing prices in Virginia Beach still remain above what is considered affordable to moderate income, working professionals. Due to the gap between income and housing prices for both owners and renters, many of the city's vital workforce members are not able to live where they work, forcing them to commute longer distances or relocate to other communities. Being able to live where you work contributes to quality of life, not just for the individual, but for the community as well. The city recognizes that there is a need to increase affordable housing opportunities in safe, vibrant, well maintained neighborhoods, and to preserve existing affordable single-family and multifamily housing.

Rendering of Crescent Square - a Permanent Supportive Housing Apartment Development for Adults with Low-income

The city promotes the development and affordability of housing with equitable access for all citizens, including the provision of workforce housing. This includes promoting a range of incentives to create, increase, and preserve the supply of high quality and affordable housing, especially for those in the low to moderate income brackets. In cases of redevelopment, incentives should be provided that preserve and/or enhance affordability. These incentives might include:

- Reasonable density increases
- Development fee waivers

- Time-limited property tax abatements
- Expedited zoning and development reviews

One type of affordable housing is provided through workforce housing programs. To promote this type of affordable housing the city established the Workforce Housing Program (WHP) to help eligible buyers purchase a workforce housing unit with special financing that allows for more affordable monthly mortgage payments. Workforce Housing Units are supplied by developers who voluntarily include such units in their project design in combination with market-rate units; in exchange, they can receive a "bonus density" for their development at the time of conditional rezoning application consideration by city Council.


Workforce Housing – Riverlake Neighborhood

By allowing developers to build more units with no additional land cost, rental and "for-sale" units are more affordable for those who qualify. This incentive for an increase in density for the construction of workforce housing applies to those areas of the city in which the Comprehensive Plan recognizes to be appropriate, including Strategic Growth Areas. The WHP also gives the city a first right of refusal to buy back the property at the time of resale, therefore helping to maintain an affordable stock of homes. Equally important is to ensure that workforce housing will be well-designed, of high quality, and well-integrated into the overall development of which it is a component. A brief summary of development and design provisions relating to Workforce Housing development, such as the incorporation of WFH units with the market rate residential units, is addressed in the Comprehensive Plan's Reference Handbook. More information about the Workforce Housing Program can be found at: http://www.vbgov.com/government/departments/housing-neighborhood-preservation/about-us/Pages/workforce-housing.aspx.

Recommended Policies: Affordability and Equal Opportunity

- Encourage the development of housing types and arrangements for individuals and groups with special needs, including those with physical and mental disabilities.
- Facilitate development of affordable housing that is well-designed and constructed, available throughout the city, and accommodates citizens with special needs.


First Colonial Inn
Independent Living for Seniors

- Support the location of special housing to be within areas that afford their residents proximity with easy access to useful services and facilities including transportation, hospitals, medical offices and facilities, shopping, financial services, and recreation and entertainment areas.
- Allow and encourage the type and location of housing for seniors designed to meet their special needs and services including, but not limited to, independent living, assisted living, and nursing facilities.
- Expand the supply of decent, safe, and affordable housing opportunities so that housing-related causes of homelessness are reduced.
- Facilitate the movement of people who become homeless into permanent housing as quickly as possible and provide opportunities for housing consistent with the city's housing and neighborhood policies.

veterans of the U.S. Armed Forces

Beach Park West - Permanent supportive housing that serves low-income special needs persons.

Quality Design and Energy Efficiency

Residential development should enhance the quality of life for residents by incorporating a safe, innovative design that integrates planning elements, such as connectivity, visually and functional open space, pedestrian networks, and landscaped streetscapes. The composition and context of these community design elements, as well as other design considerations, play a critical role in defining quality community appearance.

Single Family Home – Matthew's Green Neighborhood

Connectivity in a Residential Neighborhood

When designing any development, it is important to remember that good design does not interrupt the existing land use pattern or dominant the character of the surrounding area; rather, it is complementary. To accomplish this, design elements should include a scale and mass that exhibit a proportional relationship between the built environment and the people who will live, work, and play in that setting. Furthermore, quality in design and construction of housing and neighborhoods, in all price ranges, is the most cost effective approach to achieving these guiding principles over the long term. Sacrificing initial quality in the name of affordability, or any other reason, will only end up postponing costs and shifting them to others.

A recurring theme throughout this Plan, along with enhancing the quality of life for residents, is that new housing and new developments, as well as the rehabilitation and revitalization of existing housing and neighborhoods, should be aligned with the city's overall policies of being ecologically responsible and energy efficient. This can be achieved by reducing environmental impact, reducing energy use, and creating a sustainable, built environment.

Recommended Policies: Quality Design and Energy Efficiency

- Housing locations should be designed to be attractive and affordable to a range of income groups, ages, cultures, and household types.
- Encourage the development of housing that is ecologically responsible, energy-efficient and contributes to our quality physical environment.
- Use all available resources including those provided by the city's Historical Review Board and Historic Preservation Commission, as well as the Princess Anne County/Virginia Beach Historical Society to preserve designated historic resources.
- Seek responsible, innovative, and mutually agreeable options with homeowners and developers, where appropriate, in order to preserve existing historic structures and properties at risk.

Historic Carraway House Circa 1735 Saltbox Style

Stability, Preservation, Renewal, and Enhancement

Most of the city's housing and neighborhoods are successful, attractive, and unchanging. The majority are located in the Suburban Area. Although the guiding principle that this Plan "…recognizes the primacy of preserving and protecting the overall character, economic value and aesthetic quality of the stable neighborhoods…" was written for the Suburban Area chapter, this principle can be easily applied citywide. Therefore, this chapter reiterates the crucial significance of preserving, renewing, and enhancing our stable neighborhood areas while sustaining the quality, diversity and character of the housing stock and our neighborhoods over time. Key elements to achieving preservation and renewal include:

- Ensuring Safety
- Ensuring Property Maintenance
- Providing adequate public services and facilities

The city has several activities and programs that have successfully formed the basis our ongoing work with neighborhoods and homes needing renewal or showing conditions of blight. These programs include:

- *Affordable Home Repair Loans:* provides affordable loans for emergencies and exterior home repair through the Housing Rehabilitation Program to help homeowners repair their homes and reduce future maintenance costs.
- *PREmier Homes and Neighborhoods Program:* Provides a variety of free resources and tools for proactive home maintenance and improvements while maintaining neighborhood character and design.
    - The *Virginia Beach Pattern Book* was created as a tool to guide homeowners in the appropriate renovation, remodeling, or updating of their home in the context of their neighborhood design.
- Grant opportunities are available for non-profit organizations wishing to develop or maintain affordable housing.

- In 2016, a housing study will be conducted to help define additional strategies and initiatives for achieving neighborhood preservation.

Compatible Redevelopment

Preserving neighborhood quality requires that all types of new residential and non-residential development either maintain or enhance its context. This can be particularly challenging as certain retail centers adjacent to residential areas become underperforming, creating opportunities for redevelopment. Often these are prime locations that may be appropriate for adaptive re-use or mixed-use redevelopment that includes primarily residential uses or a mixed use development with residences. Where found to be compatible with adjoining uses, this type of redevelopment could improve the quality of the surrounding area, help absorb some of the city's future housing demand, and increase the tax base. Achieving these goals is predicated on:

- compatibility with surroundings;
- conformance to AICUZ policy;
- quality of site and buildings;
- attractiveness of site and buildings;
- inclusion of workforce housing that promotes affordability;
- reasonable site configuration;
- safe and efficient access; and,
- energy efficient design.

Housing with a Range of Affordability in Strategic Growth Areas

The policies for the Strategic Growth Areas (SGAs) are to be applied where areas are not constrained by AICUZ regulations. These policies are intended to provide benefits that include reducing sprawl, expanding housing affordability, reducing income isolation, increasing job accessibility, and accommodating alternative, cost-effective capital improvement and transportation systems. By applying these polices to those SGAs, the result will be that SGAs will have the mixed-income and mixed use neighborhood developments with a variety of housing types that will advance the city's goals of providing diverse, high-quality and affordable housing. For this reason, each SGA Master Plan includes a portion of workforce housing and other types of affordable housing as a design principle in order to provide of diversified housing choices, including workforce housing, as well as recommendations for mixed use, mixed-income, and transit-oriented development. Despite this, success in realizing housing affordability in the SGAs has been difficult. Providing additional incentives may be needed to encourage the inclusion of workforce housing in new development proposals.

Recommended Policies: Housing with a Range of Affordability in SGAs

- In the SGAs that can include residential uses, design housing to be attractive and affordable to a range of income groups, ages, cultures, and household types with an emphasis on workforce housing.
- Promote and facilitate Transit Oriented Development (TOD) principles to achieve a mix of urban housing types with a range of market values. This should include workforce housing within pedestrian-friendly communities in proximity of transit stops with an effective bus feeder system and other transit hubs.

- Promote and facilitate public/private shared cost to provide infrastructure needs, including structured parking.

Adequate Infrastructure and Transportation Connectivity

Providing adequate infrastructure and transportation connectivity ensures the overall quality and livability of neighborhoods, provides civic pride, and maintains property values. Connectivity between neighborhoods and other areas reduces car use and encourages walking, bicycling, and other physical activities.

Recommended Policies: Adequate Infrastructure and Transportation Connectivity

- Coordinate the timing and location of capital improvements in neighborhoods as inter-related systems in order to achieve multiple outcomes and advance the city's strategic goals.
- Coordinate transportation, jobs, and housing to maximize accessibility for all citizens.
- Align transportation infrastructure with housing facilities for seniors and persons with disabilities.
- Continue to improve and expand transportation and transit options for the senior and disabled communities, including appropriate sidewalk facilities and properly located senior housing opportunities.
- Locate housing for seniors and disabled persons within walking (or other means of mobility) proximity to transit stops.

Agenda for Future Action Recommendations: Adequate Infrastructure and Transportation Connectivity

- Develop an integrated housing strategy addressing affordability and neighborhood preservation, based on best available data and national best practices
- Perform a housing study to help define additional strategies and initiatives for achieving neighborhood preservation.

2.4 - ECONOMIC VITALITY

VISION

Through its visioning process with *Envision Virginia Beach 2040* and its strategic planning, Virginia Beach has chosen to become a place where all citizens and businesses can prosper. We desire to be able to create our own future because we are less dependent than ever before on the state and federal governments. Our goal is for our economy to be vibrant, growing, and sustainable. We desire to have median household incomes that exceed the national average, and for incomes continue to rise. We aspire to attract visitors from around the world throughout the year to enjoy our beautiful natural environment and the various amenities that our hospitality industry provides. We aim to attract, retain, and grown high-caliber companies offering good salaries to employ our young adults and attract creative youth from other markets, and we want this talented workforce to live and thrive in our city. We believe that there are rich opportunities for people of all ages to participate in our vitality.[xliii]

In the future, we expect that our new and existing businesses will continue to benefit from a well-trained, diverse and available workforce, particularly from our transitioning U.S. Veterans, even as those businesses' needs continually change. We realize, more than ever, the value of our small businesses and desire to become a leader in the new business growth and development of minority-owned firms. We want to maximize our investment in infrastructure by developing our land so that it preserves our quality of life and physical environment and serves the needs of generations to come. We aspire for all public and private development to be sensitive to the environment, enabling us to attract sustainable businesses. This sensitivity is valued highly by our citizens, the business community, and visitors. To those ends, we must remain committed to a regional international airport, an enhanced regional public transportation system, and continued improvement of state and city road systems to make it easier for people to get to Virginia Beach and more convenient to move around the city and region.[xliv] The extension of light rail into Virginia Beach Town Center should optimize development and redevelopment, as well as associated job growth for the Pembroke and Newtown Strategic Growth Areas, in particular.[xlv]

Defense spending, federal and state aid, and consumer spending are not as strong as we had experienced prior to 2008. To be resilient and a city of choice, new avenues of economic growth are needed. We believe our future growth will depend on the City's ability to focus on greater diversification of its economy, such as a focus on the biomedical, cyber security, and healthcare fields, while growing and retaining our existing tourism industry, as well as our hallmark employers and our base of Small, Women and Minority-Owned (SWaM) businesses.[xlvi] As an early leader in fostering strategic partnerships within the fields of Science, Technology, Engineering, Arts, and Mathematics (STEAM), as well as through entrepreneurship innovation opportunities between Virginia Beach City Public Schools, the City's Department of Economic Development, and our institutes of higher education, we hope to yielded young students choosing to stay in our city because of the high quality of life we continue to enjoy. Those highly qualified STEAM workers should, in return, serve us well to help Virginia Beach become a national and international hub for the biomedical, cyber security, fiber, alternative energy, and healthcare industries.[xlvii]

STEM Robotics Demonstration

CURRENT REALITY AND TRENDS

Our current reality in 2016 is that, after many years of prosperity, we now find ourselves slowly climbing out of what has been an uncertain and volatile economic environment. The local economy has been trying to recover from the significant decline of the housing market – the city's primary source of revenue. Property values in Virginia Beach declined beginning in 2009 but are now rising slowly. Similarly, household income has been on the decline since its 2008 peak. However, according to the most recent 5-year forecast, both residential and commercial real estate assessments are expected to grow each year over the forecasted period. Fifty-five percent of our residents are able to live and work in Virginia Beach.[xlviii]

Pressure is mounting to remain competitive and make it a priority to balance sustainable land use development with economic growth. Maintenance and management of our roads, sanitary sewer, potable water, and stormwater systems have taken on more importance as these systems have begun to show defects consistent with aging infrastructure. This maintenance must be performed continually, yet there is a shortfall of ongoing funding. Additionally, necessary improvements remain unfunded, causing a growing backlog of needs with costs continuing to grow. It is imperative that we work very closely with the Hampton Roads Sanitation District (HRSD) during the development and subsequent implementation of the Regional Wet Weather Management Plan to ensure that the work priorities for rehabilitation of the City's sanitary sewer systems mesh with and support our economic drivers.[xlix]

The hospitality industry continues to trend upward. Significant future growth requires the ability to compete nationally with such economic development enhancements as a convention center headquarters hotel and major entertainment venue offerings, better access for new domestic and international markets, and higher quality core products (e.g., new hotel development, 19th Street corridor, additional hospitality and sports tourism venues and attractions). Our regional transportation system in its current state will limit our growth, unless the system is substantially improved. The new regional transportation fund is helping to address some of these issues. The strategy of guiding the visitor experience throughout the City's wealth of beachfront communities, as well as to the growing Town Center, has aided in distributing tourism economic benefits.[l]

Our highly skilled workforce makes it attractive for companies to choose to locate here. This is a testament to our robust and effective workforce development programs. There are strong STEAM opportunities here, and the partnership between Virginia Beach City Public Schools, the Virginia Beach Department of Economic Development and our institutes of higher education will provide highly qualified workers for these industries. Additionally, graduation rates from our public schools continue to rise, as do test scores. [li]

LifeNet Headquarters Building in Princess Anne Commons.

ECONOMIC VITALITY FRAMEWORK

Envision Virginia Beach 2040, prepared by citizen's committee appointed by the Mayor, was endorsed by City Council in 2013. The Committee mission: "To provide a thoughtful vision for Virginia Beach in the Region to achieve by 2040." This vision document describes how our city will look and what people will experience as residents and visitors in 2040. It articulates a high quality of life in Virginia Beach. "Thriving Economy" is one of the vision's 6 major themes, and states:

> *We have a thriving regional economy that leverages our assets with high employment and dynamic business growth. We educate, attract, and retain a talented and diverse workforce, and provide a broad base of employment with an emphasis on high-paying jobs.*

The City's *Economic Development Strategy* is a key tool to help ensure we achieve this vision over time. The 2015 Strategy identifies six priority areas that we should focus on in the coming years:

- Target Industries
- Economic Vitality
- Diversification, Retention, Innovation
- Project Development
- Workforce Development
- Research

This is supplemented by the City's *2015-2017 Strategic Plan*, which presents strategies to help direct our efforts toward making progress in each of these priority areas as follows: [lii]

- We desire to be a top quality, year-round destination for domestic and international visitors and our citizens.
- We desire to be a growing, diverse economy that attracts and retains private companies that want to invest.
- We desire our workforce to be highly talented and to have the skills necessary to meet the needs of our targeted businesses.

- We will provide and maintain the infrastructure required to support economic vitality and develop our resources in a sustainable manner (economically, socially, and financially), so that we are an appealing community for citizens, visitors and businesses.

- Recognizing that defense spending is likely to decline over time, we value and support our military installations and local commands.
- We develop plans, incentive efforts, detailed specific area plans, programs, zoning codes, and projects to implement the Strategic Growth Area Plans and other adopted area plans throughout the city.
- We should complete the planning process and public involvement to secure funding for, and support implementation of, a fully integrated, comprehensive transportation system.

Sunrise over Virginia Beach Oceanfront Resort Area

To realize our economic vitality goals and strategies, our long-range land use planning process should seek to identify a sufficient amount of land area with appropriate zoning, in the most strategic locations. The City's Strategic Growth Areas (SGAs), which are described in Chapter 1, Section 1.1 - Urban Areas (Strategic Growth Areas), and Strategic Economic Growth Areas (SEGAs), which are described below, are the primary focus areas for the City's long-term economic development and efficient land use growth strategy. It is the City's desire to direct the majority of its future growth and development (or redevelopment) into these areas in a manner consistent with the adopted plans, policies, and design guidelines for these areas. To attract private sector partners who want to work with the City to achieve its desired outcomes for these areas, City Council has recently updated its policy, "Guidelines for Evaluation of Investment Partnerships for Economic Development." For assistance with developing in the SGAs and SEGAs or information regarding City Council's policy, visit www.vbgov.com/sga.

Recommended Policies:

- All economic development projects should adhere to the following:
  - land use strategies set forth for each Planning Area of this Comprehensive Plan;
  - adopted area plans (e.g., SGA Master Plans, Historic Kempsville Area Master Plan, Virginia Aquarium & Owl Creek Area Plan, et als.) adopted by reference as part of this Comprehensive Plan;

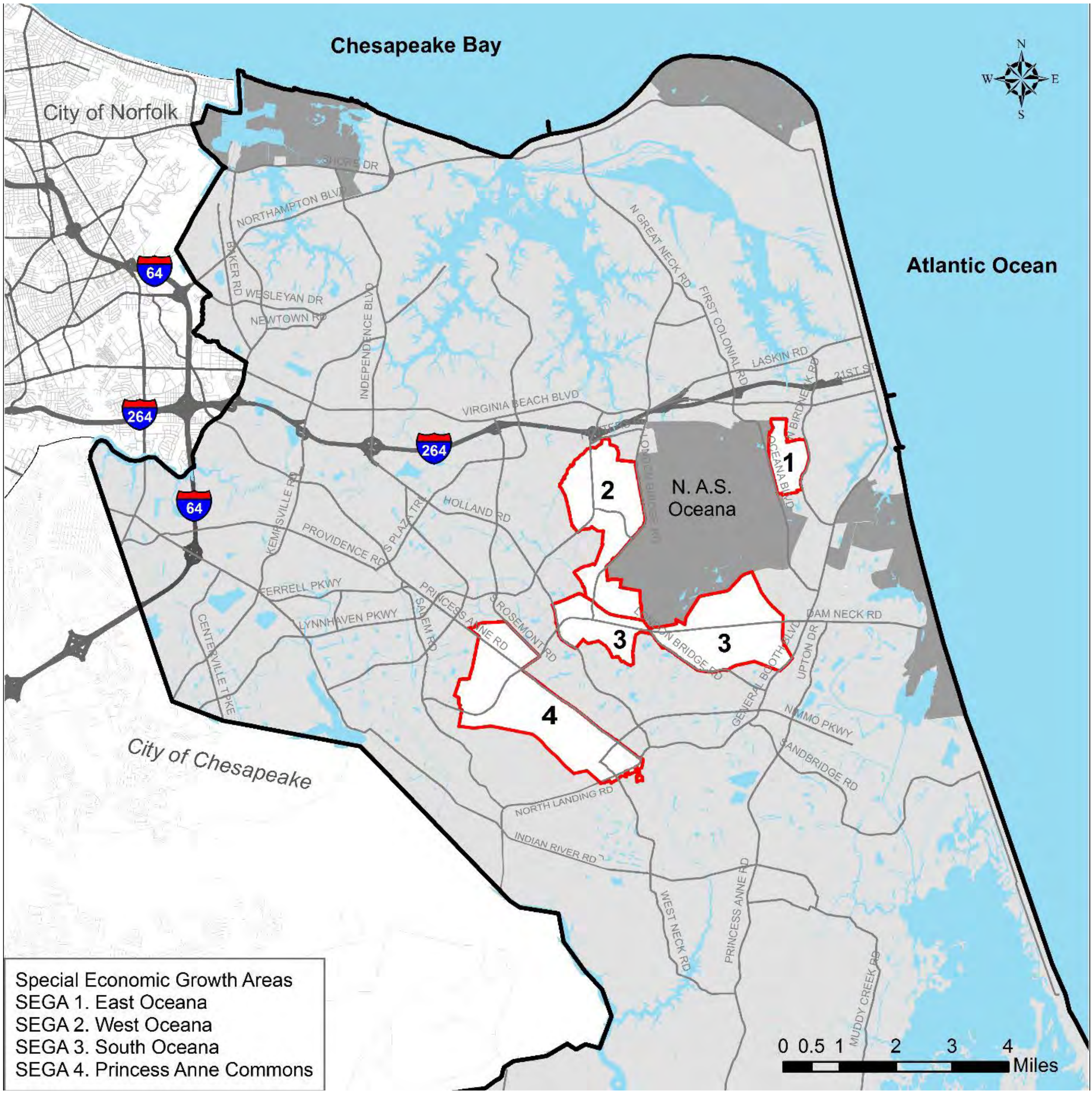
  - Suburban Focus Area (SFA) and Special Economic Growth Area (SEGA) recommendations contained in this Comprehensive Plan; and,
  - all adopted Design Guidelines adopted as amendments to, or incorporated by reference as part of, this Comprehensive Plan.
- Economic development activity should further the vision for "Economic Vitality" set forth in the Envision Virginia Beach 2040 visioning document. It should also further the strategies set forth in the Economic Vitality Strategy and Quality Physical Environment Strategy in the City's Strategic Plan.
- Projects should consider how to best incorporate the design principles contained in the City's Integrated Site Design Manual, once adopted by City Council.

SPECIAL ECONOMIC GROWTH AREAS (SEGAs)

The City has designated 4 Special Economic Growth Area (SEGAs) on the Comprehensive Plan's "Planned Land Use Map":

- SEGA 1 – East Oceana
- SEGA 2 – West Oceana
- SEGA 3 – South Oceana
- SEGA 4 – Princess Anne Commons

SEGAs are viewed as special areas with significant economic value and growth potential, with a primary consideration being adjacency to NAS Oceana or within the Interfacility Traffic Area high noise overflight zone. The City supports development and redevelopment of these areas consistent with Air Installation Compatibility Use Zones (AICUZ) ordinance provisions and the City's economic growth strategy.



SPECIAL ECONOMIC GROWTH AREA (SEGA) LOCATOR MAP

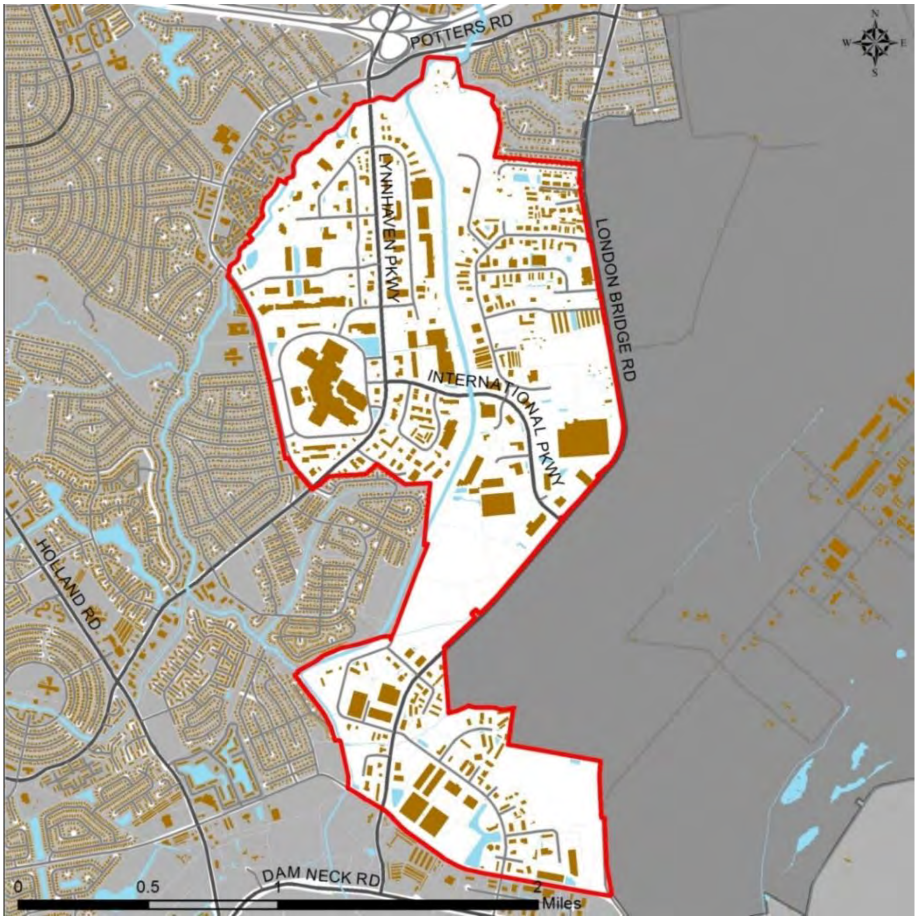
Special Economic Growth Area 1 – East Oceana

Special Economic Growth Area 1 - East Oceana encompasses the property generally located on both sides of Bells Road between Oceana Boulevard and Birdneck Road. It includes most of the land to the south of Southern Boulevard. As one of the City's Planning Areas, it overlays a portion of the Historic Seatack Community on the west side of Birdneck Road; therefore, sensitivity to the neighborhood context and needs of that community are very important considerations in realizing compatible economic development here. In addition, much of this area is constrained by floodplain or Navy restrictive easements and all of it is within the highest AICUZ noise zone. The southern part of this tract is outside any accident potential zone. The planned Southeastern Parkway and Greenbelt will impact the western part of this area. Modeling efforts are underway to determine whether or not the Southeastern Parkway and Greenbelt should remain as part of the City's Primary Roadway Network Plan to serve this Economic Growth Area and other parts of the City or if an alternative solution is more responsive to the today's needs and those of the future, based on adopted future land use plans.

Recommended Policies:

- In the eastern area- low intensity light industrial uses and limited retail with significant buffers to shield the surrounding Seatack neighborhood from possible intrusive impacts.
- In the western area -medium intensity industrial and other utilitarian activities.
- The southern part of this site is not encumbered by accident potential zones and may accommodate new or relocated commercial and other non-residential uses that are AICUZ compatible.

Special Economic Growth Area 2 – West Oceana

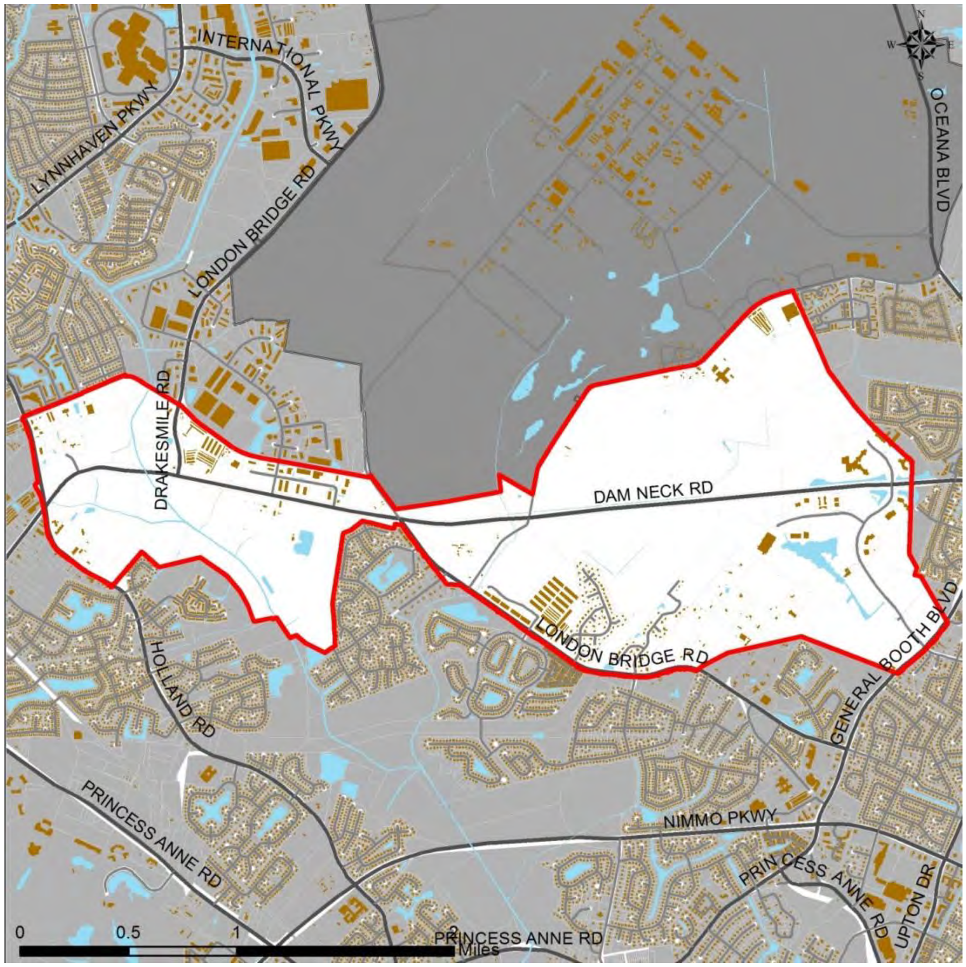


Special Economic Growth Area 2 - West Oceana is generally bound by London Bridge Road, Lynnhaven Creek, South Lynnhaven Road, and Potter's Road. It includes Lynnhaven Mall, surrounding retail and office complexes and Oceana West Industrial Park. Much of this area is subject to Navy restrictive easements and all of this area is inside the AICUZ high noise zone. The majority of this area has been subdivided and is zoned for commercial and industrial uses.

Recommended Policies:

- This entire site is within the 75+ DNL noise zone. All new or improved development proposals must adhere to the City's AICUZ provisions.
- The area west of Lynnhaven Parkway is recommended for corporate office, retail, and other comparable commercial use due to this site's high visibility. Special attention should be given to ensure high quality site, landscape and building designs.
- The undeveloped tract on the southeast corner of Lynnhaven Parkway and Potters Road is an appropriate site for open space acquisition. However, if this does not occur, this site should be developed for low intensity retail and/or office uses. Development must respect the adjoining natural open space area.

Special Economic Growth Area 3 – South Oceana

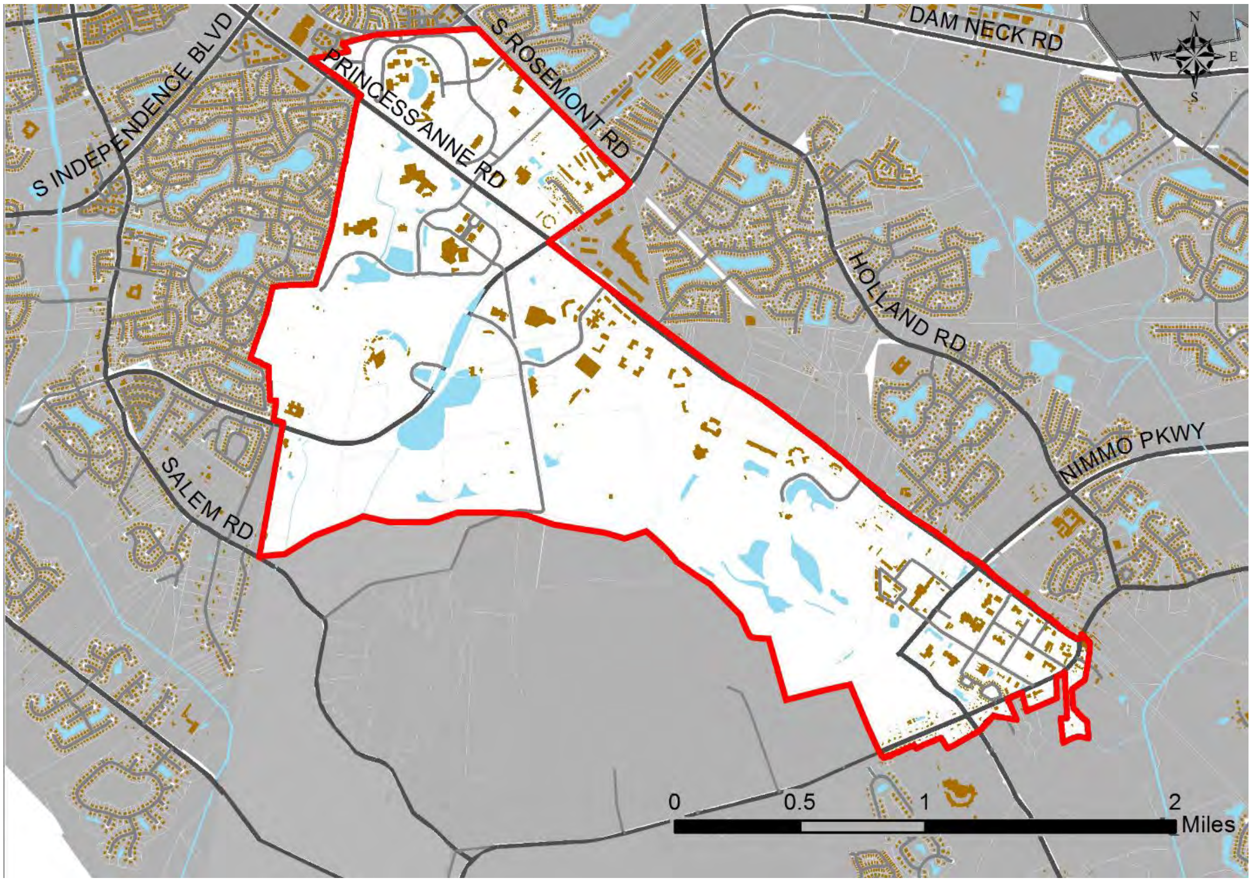


Special Economic Growth Area 3 - South Oceana is a large hourglass shaped tract of land encompassing properties on both sides of Dam Neck Road between Holland Road and Corporate Landing Parkway. There are large tracts of undeveloped land in the area east of London Bridge Road. High quality corporate businesses have developed in the Corporate Landing Business Park. The proposed Southeastern Parkway will traverse the eastern part of this strategic area generally in a northeast to southwest direction and, when built, will provide this area with good regional access.

In the western part of this area, between Drakesmile Road and Holland Road, there are considerable environmental constraints. To varying degrees, portions of this area are impacted by high noise zones, accident potential zones and Navy restrictive easements. Floodplain and other environmental constraints affect the western region of this area south of Dam Neck Road. However, the area located north of Dam Neck Road and east of Holland Road is free of these constraints and, therefore, possesses greater development opportunities.

Recommended Policies:

- No additional residential uses are recommended for any part of this area.
- All proposed land uses in this area must align with the City's AICUZ provisions and Oceana Land Use Conformity program.
- Every effort should be made, where feasible, to consolidate parcels to achieve a more unified development pattern.
- Accesses to London Bridge and Holland Roads should be kept to a minimum.
- Direct private access to Dam Neck Road will not be permitted except when the property in question has no other reasonable access to the circulation system as it is part of the City's Access Controlled Roadway Network (see Chapter 2, Section 2.1 - Master Transportation Plan).
- Build attractive thoroughfares to serve this area.
- Corporate Landing Business Park is located in the eastern part of this site and serves the mid-eastern area of the City. It is reserved for high quality, high wage employment consistent with the City's Economic Development Strategy.
- High quality employment, corporate parks and light industrial uses are recommended for other undeveloped tracts in the eastern part of this SEGA.
- Measures to mitigate negative impacts on adjoining stable residential areas must be part of any development proposal in this area. Mitigation measures should include adequate screening, and light and noise attenuation in building and site design.
- Attractive building designs should be showcased along key arterials and the proposed Southeastern Parkway route.
- The western region of this area is planned for non-residential uses to include a mix of light industrial, low- rise office and limited retail use.



Special Economic Growth Area 4 – Princess Anne Commons

SEGA 4 – The northern portion of Princess Anne Commons was designated in recognition of the land development constraints and economic development opportunities associated with this area's location within a military aircraft overfly zone. This area will focus on providing locations for:

- Participatory sports
- Entertainment venues
- Tourism
- Biomedical research
- Hospitality uses which can benefit from their proximity to campuses of Tidewater Community College and the Old Dominion University/Norfolk State University.

Proposed developments within SEGA 4 –Princess Anne Commons should adhere to the following general recommendations, unless otherwise addressed in Chapter 1, Section 1.4 - Princess Anne Commons & Transition Area.

Recommended Policies:

- Strive to achieve extensive open space connectivity throughout the Commons.
- Protect the most sensitive land areas where natural resources have been identified.
- Residential development should be limited to areas outside of AICUZ restricted areas.

- Mixed-use town center-style development should be planned within the Municipal Center and Historic/Cultural District.
- The *Design and Development Guidelines Princess Anne Commons* should be adhered to for high quality building types to ensure appropriate quality and character.
- Except as specified in the *ITA and Vicinity Master Plan*, expansion of suburban infrastructure should be designed in northern, but not southern, part of Princess Anne Commons and not south of Indian River Road.
- Development should remain limited along existing unimproved roadways.
- Explore the potential for extension of mass transit service to Princess Anne Commons and the Municipal Center from the Town Center (Pembroke SGA).

Agenda for Future Action Recommendations: Economic Vitality

- Continue to promote Virginia Beach as a year-round destination.
- Develop a Transit-Oriented Development land use and zoning strategy for the SGAs.
- Reshape non-conforming business districts (e.g., Pembroke SGA-Central Village District, etc.) into well-planned and designed commercial nodes that are compatible with adopted plans and design guidelines. Recent examples of this include London Bridge Commerce Center repurposing in the Lynnhaven SGA and various commercial areas in the Resort SGA.
- Update the Master Plan for Corporate Landing Park and the associated design guidelines.
- Inventory the conditions of neighborhood commercial centers and strip shopping centers. Consider incentives for façade improvements (e.g., cost-share grants, etc.). Consider opportunities for repurposing over-parked commercial parking lots for possible permanent or temporary/seasonal infill uses, while adhering to recently updated commercial use parking standards in the Zoning Ordinance.
- Inventory industrial zoning districts to determine if there is a sufficient supply of appropriate zoning for both light and heavy industrial uses, especially for the types of desired compatible land uses within SEGAs.

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[xxxvi] Ibid
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CHAPTER 3 - PLAN IMPLEMENTATION

It is incumbent on all of us to do our part to ensure the success of this Comprehensive Plan through its implementation. Plan implementation occurs in various ways.

Foremost, it begins with establishing familiarity with the plan. The Comprehensive Plan is, by its very nature, the articulation of the City's future planned land use vision and repository of its associated land use policies. In order to bring about that shared vision, familiarity with the five Planning Areas, the City-wide elements, their corresponding policies and recommendations, and the Reference Handbook-- which references all other plans, studies, and design guidelines documents adopted by reference as part of the Comprehensive Plan-- is essential. This applies whether the user is a customer preparing an application for development review or a City official who references it during the review to determine consistency with City policy. The Planning Commission and the City Council should consult the Comprehensive Plan's Policy Document and Reference Handbook in their consideration of discretionary development applications. The *Code of Virginia* (15.2-2232) states the Comprehensive Plan "shall control the general or approximate location, character and extent of each feature shown in the plan." Decisions made should be consistent with the City's long-range vision for 2040 and the policies contained in this plan.

The locally-adopted Capital Improvement Plan (CIP) is one of four tools Virginia's local governments are authorized to use when implementing their local comprehensive plan. The CIP is one of the oldest tools of plan implementation in existence. For too many years, the tool was viewed as a resource only to be used by public works and engineering. Over the past thirty-five years, however, the CIP has come into its own as a tool of plan implementation.[i] By design, the CIP focuses on a locality's immediate and longer-term capital assets and infrastructure needs. Capital assets and infrastructure needs traditionally include land, facilities, parks, playgrounds, streets, bridges, bike and pedestrian systems, water and sewer systems, technology systems and equipment, and other items of value from which the community derives benefit for a significant number of years.[ii]

The *Code of Virginia* requires that the adopted CIP be consistent with the adopted local Comprehensive Plan. Recognizing the important linkage between long-range land use planning and capital improvement planning, the *Code of Virginia* (15.2-2239) enables local planning commissions to, at the discretion of the governing body, prepare and revise annually a CIP based on the comprehensive plan of the locality for a period not to exceed the ensuing 5 years.[iii] In Virginia Beach, although the Planning Commission has not been delegated this authority by the City Council, there is still a proper role for the Planning Commission to play as a stakeholder in the preparation and public review of the CIP.

Plan implementation is also accomplished by monitoring and reporting on our progress. It is important to do this with regard to both the effectiveness of the policies contained in the Comprehensive Plan (how well they are working or not to achieve desired outcomes) and the implementation of the plan's recommendations contained in the "**Agenda for Future Action**."

An "Agenda for Future Action Summary" table is presented in this chapter as a quick reference tool. It is derived from the recommended next steps actions following adoption of the plan that are contained in each corresponding chapter of the Policy Document. It is presented with suggestions for which entity(s) (e.g., City Administration or community group) should take lead responsibility for implementing that stated recommendation, and a suggested time frame of completion. In essence, it serves as our blueprint for important next steps that either reinforces or adds to the land use policies put forward in this plan. The implementation time frame purposely corresponds with the City's 6-year CIP, the first year of which is adopted annually by City Council as the Capital Improvement Budget; and, because the Planning Commission is required by state law to conduct review the Comprehensive Plan in 5-year intervals and recommend to City Council any necessary updates or amendments.

By monitoring progress our progress, and holding both City officials and the public accountable for partnering on its implementation, we can be informed and make necessary mid-course corrections in order to stay focused on achieving our city's long-range range for 2040. It is recommended that the Department of Planning & Community Development prepare an annual report on Comprehensive Plan effectiveness and implementation status to be presented to the Planning Commission. Subsequently, the Planning Commission should prepare an annual report to the City Council with any intermediate recommendations for amendment. This ensures that the Comprehensive Plan stays dynamic and responsive as needs change and new situations arise over time, in between the 5-year review periods.

Finally, another key plan implementation tool is the systematic and holistic review of the City's various development ordinances (e.g. Comprehensive Zoning Ordinance, Subdivision Ordinance, Site Plan Ordinance, Floodplain Ordinance, Landscape Ordinance, etc.). The land use vision articulated in the Comprehensive Plan depends on our land development regulations for implementation. Therefore, it is incumbent upon City leaders and administrators to use this Plan's recommendations as the platform for updating local development regulations, so that they can enable or bring about the desired outcomes we seek for our city's future growth and development. The development ordinances, coupled with public and private investment decisions, bring to life our many years of community planning, manifested in the body of adopted planning documents that comprise the Comprehensive Plan. It is essential that we set ourselves to the immediate task of review our development ordinances to this end so that all of our land use planning and implementation tools are consistent and mutually-supportive. After all…it's our future!

AGENDA FOR FUTURE ACTION - RECOMMENDATIONS SUMMARY

ACTION ID	RECOMMENDED ACTION	LEAD RESPONSIBLE PARTY(S)	ESTIMATED TIME FRAME FOR COMPLETION
Chapter 1, Section 1.2 - Urban Areas (Strategic Growth Areas)			
Burton Station SGA			
1.2-1	Update the *Burton Station SGA Master Plan* through a public process to reflect changes to the foundational assumptions that guided the development of the Burton Station SGA plan, particularly the extensive changes affecting future land use throughout the western half of the SGA.	Department of Planning & Community Development	Up to 2 years Completed 11/20/2018
Pembroke SGA			
1.2-2	Prepare a Master Transportation Plan for the Pembroke SGA using a public process that involves the adjacent neighborhoods.	Department of Planning & Community Development	Up to 2 years
Chapter 1, Section 1.3 - Suburban Area			
1.3-1	Draft Infill Development Design Guidelines in the Comprehensive Plan's Reference Handbook.	Department of Planning & Community Development	Up to 2 years
1.3-2	Develop planning and zoning tools and incentives to encourage new investment in declining neighborhood commercial centers.	Department of Planning & Community Development, Department of Economic Development, City Attorney's Office	Up to 2 years
1.3-3	Develop planning and zoning or other tools to assist distressed property owner associations with the preservation and maintenance of neighborhood parks and open spaces.	Department of Planning & Community Development, Department of Housing & Neighborhood Preservation, Office of Volunteer Services	2-6 years
1.3-4	Revise the Suburban Area section of the Comprehensive Plan, as appropriate, when sea level rise and recurrent flooding policies are adopted by City Council.	Department of Planning & Community Development	2-6 years Completed 6/2/2020
1.3-5	To ensure that the function of Princess Anne Road is not reduced due to numerous access points within Suburban Focus Area 2.1 (North Courthouse), the City should construct all or a portion of at least two lanes of London Bridge/Drakesmile Extended.	Department of Public Works	6+ years
1.3-6	Study the area between Holly Road and Pacific Avenue, north of 32nd Street to 42nd Street to determine need for infill development and redevelopment policies and design guidelines.	Department of Planning & Community Development, Planning Commission	Up to 2 years Completed 3/8/2017
1.3-7	Using a public process involving area stakeholders, study the Historic Seatack Community and Vicinity Area for potential designation as a Suburban Focus Area (SFA) with associated land use recommendations.	Department of Planning & Community Development, Planning Commission	Up to 2 years Completed 12/14/2016
Chapter 1, Section 1.4 - Princess Anne Commons & Transition Area			
Princess Anne Commons			
1.4-1	Update the *Princess Anne Commons Design Guidelines*.	Department of Planning & Community Development, Princess Anne Commons Task Force	Up to 2 years
1.4-2	Conduct a relocation feasibility study of the existing public facility yards located between Rosemont Road and Princess Anne Road to assess possible alternative uses for this area.	Department of Public Works, Department of Planning & Community Development, Department of Economic Development, Princess Anne Commons Task Force	2-6 years

AGENDA FOR FUTURE ACTION - RECOMMENDATIONS SUMMARY

ACTION ID	RECOMMENDED ACTION	LEAD RESPONSIBLE PARTY(S)	ESTIMATED TIME FRAME FOR COMPLETION
1.4-3	Conduct an inventory of all natural resource features on City-owned property in the Princess Anne Commons to determine which ones should be retained during development for their inherent water quality benefits. These features can be combined with man-made stormwater facilities and trails and incorporated into a "green infrastructure" network that can serve as an amenity for economic development sites.	Department of Parks & Recreation, Princess Anne Commons Task Force	Up to 2 years
1.4-4	Update or replace the *ITA & Vicinity Master Plan* through a public planning process to reflect changes that have occurred since the plan was adopted in 2011. Pay particular attention to infrastructure planning and design to support planned land uses.	Department of Planning & Community Development, Princess Anne Commons Task Force, Transition Area - ITA Citizens Advisory Committee	Up to 2 years Completed 12/12/2017
Transition Area			
1.4-5	Explore the feasibility of amending the Agricultural Reserve Program ordinance to include properties located in the Transition Area.	City Attorney's Office, Department of Agriculture	Up to 2 years
Chapter 1, Section 1.5 - Rural Area			
1.5-1	Review Section 402(b) of the Zoning Ordinance (Agricultural Districts) for possible amendment to address Code of VA Section 15.2-2157(c) and because it limits density by reference to how well different soil types can accommodate a traditional on-site septic system. The City should consider factors other than soil types to limit density, including, but not limited to: adverse impact on agriculture; the presence of floodplains; groundwater table elevation and drainage; and, drainage, roadway, and other infrastructure conditions.	Zoning Administrator, City Attorney's Office	Up to 2 years
1.5-2	Using GIS, analyze floodplains in the Rural Area to determine where future rural residential development should be avoided.	ComIT/Center for GIS, Environment and Sustainability Office, Department of Planning & Community Development.	Up to 2 years
1.5-3	Use GIS Analysis to determine how many platted lots of 5 acres or less along rural roadways that were not considered buildable due to soil constraints are potentially buildable under state AOSS regulations. Assess the extent to which rural roadways may be impacted.	ComIT/Center for GIS, Department of Planning & Community Development, Department of Health, Department of Public Works	Up to 2 years
1.5-4	Formally delineate the Pungo Rural Village boundary using stakeholder input and community consensus-building.	Department of Planning & Community Development	2-6 years
1.5-5	Using stakeholder input and community consensus-building, prepare a Master Plan for the Pungo Rural Village to determine the type and form of future desired growth. An important aspect of this planning process should be to anticipate when that growth might reasonably be expected to occur.	Department of Planning & Community Development	2-6 years
1.5-6	Conduct a study in Pungo Rural Village to determine if the existing on-site septic systems should be used if Rural Area development policies remain at the current density limit, or if such systems cannot be repaired or rehabilitated using AOSS technology if they are currently found to be failing. If it is found that existing onsite systems are failing and cannot be repaired, or if development with increased density is anticipated (or desired) to such an extent that onsite technology will not work, a study should be conducted to determine the need for, technology options, and feasibility for providing public sanitary sewer treatment systems for the Pungo Rural Village. The study should also investigate and evaluate the feasibility and cost of various alternatives.	Department of Public Utilities, Department of Public Health, Department of Planning & Community Development	2-6 years
1.5-7	Enhance the Pungo Village Design Guidelines in the Comprehensive Plan's Reference Handbook with illustrations.	Department of Planning & Community Development	Up to 2 years

AGENDA FOR FUTURE ACTION - RECOMMENDATIONS SUMMARY

ACTION ID	RECOMMENDED ACTION	LEAD RESPONSIBLE PARTY(S)	ESTIMATED TIME FRAME FOR COMPLETION
Chapter 1, Section 1.6 - Military Installations & Support			
1.6-1	Support the mission of the military installations in Virginia Beach. Continue to route to the Community Planning Liaison Officers (CPLOs) all discretionary and by-right development applications within "areas of interest" Work closely with the Community Planning Liaison Officers (CPLOs) in the review of development applications for "areas of interest" to avoid potentially incompatible uses.	City Manager's Office, City Attorney's Office, Department of Planning & Community Development	On-going
1.6-2	Continue to route applications for all discretionary and by-right development within "areas of interests" and AICUZ to the Community Planning Liaison Officers (CPLOs) to avoid potentially incompatible uses.	Department of Planning & Community Development	On-going
Chapter 2, Section 2.1 - Master Transportation Plan			
Roadways			
2.1-1	Adopt updated general typical sections and plan views to be consistent with those currently in the Public Works Design Standards.	Strategic Growth Areas Office/Transportation Division, Department of Public Works	Up to 2 years
2.1-2	Implement the improvements shown on the City's Primary Roadway Network Map, the Regional 2040 Long Range Transportation Plan, and the *Bikeways and Trails Plan* to the extent funding is available in the City's *Capital Improvement Plan (CIP)*, the State's *Six Year Improvement Program (SYIP).*	Department of Public Works, Department of Parks & Recreation	6+ years
Transit			
2.1-3	City Council has adopted a Locally Preferred Alternative to extend The Tide from the Newtown Road station in Norfolk to terminate at a new station in Town Center near Constitution Avenue. Plan for the future extension of this high capacity transit system as follows:	City Council, Department of Public Works, Strategic Growth Areas Office, Department of Planning & Community Development	2-6 years
	1. East to the Oceanfront		6+ years
	2. North to Joint Expeditionary Base Little Creek - Ft. Story and south and west to Norfolk International Airport area		6+ years
	3. South to Princess Anne Commons and the Municipal Center		6+ years
	4. West to Chesapeake		6+ years
2.1-4	Evaluate appropriate technology for these high capacity corridors including light rail, maglev, bus rapid transit (BRT) and others that depend on a rail or similar fixed guideway that separates the transit from normal vehicular use.	Strategic Growth Areas Office/Transportation Division	6+ years
2.1-5	Light Rail System Planning - Construct the eastern terminus of the light rail station proposed at Constitution Avenue so that it can easily be expanded to serve as a major passenger hub, with enhanced amenities and platforms to serve future east, north, and south high capacity transit corridors.	Department of Public Works, Strategic Growth Areas Office	2-6 years
2.1-6	Establish an east-west multi-modal corridor - Develop a shared use path generally within the old Norfolk Southern railroad alignment from Newtown Road to Town Center. This proximity will allow for greater connectivity to light rail stations and greater multi-modal choice.	Strategic Growth Areas Office, Department of Parks & Recreation Department of Public Works	2-6 years
2.1-7	Light Rail Station Connectivity - Enhance pedestrian/bicycle connections to all high capacity transit stations and bus route stops to provide safe access and enhanced modal choice.	Strategic Growth Areas Office, Department of Parks & Recreation, Department of Public Works	2-6 years
2.1-8	Coordinate annual evaluation of new bus routing, frequency of service, and duration of service. In the near future (within 5 years), implement the proposed feeder bus network needed to serve the light rail extension from Norfolk to Virginia Beach Town Center. Enhance local bus service to become a viable option for people who could choose to drive, otherwise referred to as "choice riders." The provision of frequent, reliable, comfortable service can reduce single occupancy automobile travel and, thus, address traffic congestion and reduce the need for additional construction of highway lane miles.	Strategic Growth Areas office	2-6 years
Active Transportation			

AGENDA FOR FUTURE ACTION - RECOMMENDATIONS SUMMARY

ACTION ID	RECOMMENDED ACTION	LEAD RESPONSIBLE PARTY(S)	ESTIMATED TIME FRAME FOR COMPLETION
2.1-9	Develop a study to identify additional and improved crossings of I-264 and I64 to serve both the existing demand and the likely increases in demand for active transportation modes as The Tide extension begins service. The most urgent specific connection is in the Town Center area, to relieve the hazardous crossings along Independence Boulevard.	Department of Parks & Recreation, Strategic Growth Areas Office, Department of Public Works	2-6 years
2.1-10	Continue to use the City's *Bikeways and Trails Plan* as the guiding active transportation policy document and initiate a plan update.	Department of Parks and Recreation	2-6 years
Transportation Demand Management (TDM)			
2.1-11	Develop a comprehensive TDM Plan, including telecommuting, flexible work schedules, and off peak business hours, especially in the City's main employment centers. Utilize TRAFFIX staff to survey major employers in these centers to formulate the TDM plans with necessary incentives.	Strategic Growth Areas Office/Transportation Division	2-6 years
2.1-12	Recognize and reduce the impacts of parking supply on travel demand by developing new fee-based parking strategies and regulations in appropriate areas with good transit service.	Strategic Growth Areas Office/Transportation Division, Resort Area Office	2-6 years
Intelligent Transportation Systems (ITS)			
2.1-13	Update plans for traffic signalization every three years.	Department of Public Works	2-6 years
2.1-14	Monitor trends regarding emerging technologies in the areas of Information and Communication (ICT), Global Positioning Systems (GPS), and ITS. Stay current with trends in ITS to develop it as an on-going resource for transportation network infrastructure.	Strategic Growth Areas Office/Transportation Division	2-6 years
2.1-15	Create parking strategies that merge technology and infrastructure. Adopt innovations to deliver live parking data to citizens including heat maps that can show drivers available parking on a block-by-block basis. Consider dynamic meter pricing raising the price for on-street parking during peak time to make some spaces available. When spaces are available, drivers spend less time searching for parking.	Strategic Growth Areas Office/Transportation Division	2-6 years
2.1-16	Consider developing dynamic pricing mechanisms for roads, parking spaces, and shared-use assets to balance supply and demand.	Strategic Growth Areas Office/Transportation Division	2-6 years
2.1-17	Continue to develop and implement adaptive signal control in coordination with the Federal Highway Administration (FHWA).	Department of Public Works	2-6 years
2.1-18	To promote the use of local transit, consider equipping parking garages with more internal directional signage to show the location of transit stops.	Strategic Growth Areas Office/Transportation Division	2-6 years
Chapter 2, Section 2.2 - Environmental Stewardship Framework			
Water Resources Protection and Management - Surface Water			
2.2-1	Implement regulatory requirements relating to stormwater management, including but not limited to meeting NPDES MS4 and Chesapeake Bay TMDL mandates.	Department of Planning & Community Development, Department of Public Works, Department of Public Utilities, Department of Parks & Recreation	2-6 years
2.2-2	Promote partnerships with the non-governmental organizations to achieve the City's water quality improvement goals.	Green Ribbon Committee, Clean Waters Task Force	On-going
2.2-3	Implement requirements of the 2014 Chesapeake Bay Watershed Agreement.	Department of Planning & Community Development, Department of Public Works, Department of Parks & Recreation Green Ribbon Committee, and Clean Waters Task Force	2-6 years
2.2-4	Develop design criteria that help achieve water quality objectives in conjunction with other SGA objectives, such as preserving open space and planning for sea level rise and recurrent flooding.	Departments of Planning & Community Development, Department of Public Works, Department of Parks & Recreation, Strategic Growth Areas Office	6+ years

AGENDA FOR FUTURE ACTION - RECOMMENDATIONS SUMMARY

ACTION ID	RECOMMENDED ACTION	LEAD RESPONSIBLE PARTY(S)	ESTIMATED TIME FRAME FOR COMPLETION
2.2-5	Complete efforts that are currently underway to develop a Stormwater Master Planning Analysis and Inventory.	Department of Public Works	2-6 years
Water Resources Protection and Management - Ground Water			
2.2-6	Develop a targeted educational program that increases public awareness about the importance of protection and conservation of non-potable groundwater resources and their use.	Clean Waters Task Force	2-6 years
2.2.7	Establish protocols to conserve and protect groundwater on city properties: 1. Develop an integrated pest management (IPM) and nutrient management plan. 2. Complete an underground storage tank (UST) remediation on all City sites.	Department of Planning & Community Development, Department of Parks & Recreation	6+ years
Parks and Conserved Lands			
2.2-8	Acquire open space in strategic locations, including SGA's, that can provide multiple benefits in terms of flood control, water quality, public access to waterways, preserving or creating tree canopy, and preserving unique ecological and cultural heritage sites.	Department of Parks & Recreation, Department of Planning & Community Development, Strategic Growth Area Office	6+ years
2.2-9	Commit resources to maintain the high quality of the existing park system and to expand the trail system.	Department of Parks & Recreation	6+ years
2.2-10	Implement the recommendations in the *Virginia Beach Bikeways and Trails Plan.*	Department of Parks & Recreation, Department of Public Works	2-6 years
2.2-11	Implement the recommendations in the *Virginia Beach Outdoors Plan.*	Department of Parks & Recreation	6+ years
Green Infrastructure			
2.2-12	City properties within the Princess Anne Commons and Interfacility Traffic Area should be studied to identify conservation lands and green infrastructure opportunities that can complement the plans for future economic development projects.	Princess Anne Commons Task Force, Department of Parks & Recreation, Department of Economic Development, Department of Public Works	Up to 2 years
Living Resources and Ecosystem Protection Management - Urban Forestry			
2.2-13	Implement the recommendations in the *Urban Forest Management Plan*.	Department of Parks & Recreation	2-6 years
2.2-14	Improve the viability and resilience of the City's urban forest by initiating the three-trophic layer (canopy trees, understory trees, shrub and groundcover) approach.	Department of Parks & Recreation, Department of Planning & Community Development	2-6 years
2.2-15	Improve inspections and enforcement capabilities to better achieve the objectives of local landscaping and tree protection ordinance requirements.	Department of Planning & Community Development, Department of Parks & Recreation	2-6 years
2.2-16	Enhance policies that guide development requirements for landscape practices on proposed projects.	Department of Planning & Community Development, Department of Parks & Recreation	Up to 2 years
Living Resources and Ecosystem Protection Management - Living Shorelines			
2.2-17	Train regulatory boards (Wetlands and CBPA) on decision making tools developed by the Center for Coastal Resources Management at VIMS.	Department of Planning & Community Development, City Attorney's Office	Up to 2 years
2.2-18	Follow the development of the state-wide General Permit being developed by the Virginia Marine Resources Commission (VMRC). Ensure that local policies are consistent with the provisions of the permit.	Department of Planning & Community Development	Up to 2 years
2.2-19	Educate citizens and stakeholders on new shoreline management strategies including Living Shorelines.	Clean Waters Task Force, Green Ribbon Committee	2-6 years

AGENDA FOR FUTURE ACTION - RECOMMENDATIONS SUMMARY

ACTION ID	RECOMMENDED ACTION	LEAD RESPONSIBLE PARTY(S)	ESTIMATED TIME FRAME FOR COMPLETION
2.2-20	Evaluate and develop a locality-wide regulatory structure that encourages a more integrated approach to shoreline management.	City Attorney's Office, Department of Public Works, Department of Parks & Recreation, Department of Planning	2-6 years
2.2-21	Evaluate and recommend cost share opportunities for construction of living shorelines.	Clean Waters Task Force, Green Ribbon Committee	2-6 years
Living Resources and Ecosystem Protection Management - Unique Plants and Animal Habitats			
2.2-22	Develop and implement policies and programs that protect, restore and enhance critical habitats along the City's waterways.	Department of Planning & Community Development	2-6 years
2.2-23	Restore and attain sustainable inventories of native edible oysters in the Lynnhaven River.	Department of Planning & Community Development, Department of Public Health, Clean Waters Task Force, and Green Ribbon Committee	2-6 years
2.2-24	Restore oyster reefs in the Lynnhaven and Owls Creek estuaries by developing a hatchery plan and constructing sanctuary reefs.	Department of Planning & Community Development, Clean Waters Task Force, and Green Ribbon Committee	2-6 years
2.2-25	Work with Virginia Institute of Marine Science (VIMS) and other partners to restore Submerged Aquatic Vegetation (SAV) through planting and habitat enforcement efforts.	Department of Planning & Community Development, Department of Public Works, Clean Waters Task Force, and Green Ribbon Committee	6+ years
2.2-26	Undertake one wetlands restoration project each year in the Elizabeth River Watershed, the Lynnhaven River Watershed, Back Bay Watershed, North Landing River Watershed, and Rudee Inlet/Owls Creek Watershed.	Department of Planning & Community Development and community organizations	2-6 years
2.2-27	Develop a City program to effectively manage invasive plants and animals.	Department of Planning & Community Development, Department of Parks & Recreation	6+ years
Sea Level Rise, Recurrent Flooding, and Hazard Mitigation			
2.2-28	Develop a program to educate the public on the beneficial functions and values of floodplains.	Department of Planning & Community Development	Up to 2 years
2.2-29	Complete the City *Comprehensive Response Plan to Sea Level Rise and Recurrent Flooding* for all areas of the City and implement the recommendations therein, subject to funding.	Department of Planning & Community Development, Department of Public Works	2-6 years
2.2-30	Preserve and enhance beaches and dunes along the City's Atlantic Ocean and Chesapeake Bay shorelines.	Department of Public Works	6+ years
2.2-31	Implement the recommendations of the *Regional Hazard Mitigation Plan*.	Fire Department/Emergency Management, Department of Planning & Community Development, Department of Public Works	2-6 years
Land Development Management/Stormwater Management			
2.2-32	Complete and adopt the *Integrated Site Design Guide* as a component of Planning's *Design Specifications and Standards.*	Department of Planning & Community Development	2-6 years
2.2-33	Enhance stormwater management by exploring alternatives to conventional stormwater management facilities (SWMFs), such as Low Impact Development (LID) approaches that are applicable to the Coastal Plain.	Department of Planning & Community Development, Green Ribbon Committee, Clean Waters Task Force	2-6 years
2.2-34	Work with regional partners to implement the *Green Sea Blueway and Greenway Management Plan.*	Department of Planning & Community Development, Department of Parks & Recreation, Convention & Visitors Bureau, City Attorney's Office	6+ years

AGENDA FOR FUTURE ACTION - RECOMMENDATIONS SUMMARY

ACTION ID	RECOMMENDED ACTION	LEAD RESPONSIBLE PARTY(S)	ESTIMATED TIME FRAME FOR COMPLETION
2.2-35	Develop online tools to assist the public with identification of sensitive environmental areas in the development review process.	Department of Planning & Community Development, Communication/IT - Center for GIS	Up to 2 years
Energy Resources Management			
2.2-36	Prepare action and public communications plans to support the Commonwealth's goal to reduce electric energy consumption by 10% below 2006 levels by 2020.	City Manager's Office	2-6 years
2.2-37	Implement the City's commitment to the US Mayor's "Climate Protection Agreement."	City Manager's Office	2-6 years
Alternative Energy Development			
2.2-38	Encourage research and development of alternative energy sources and promote their use.	Mayor's Energy Advisory Committee	2-6 years
2.2-39	Work with the Virginia Coastal Energy Research Consortium (VCERC) on offshore wind development.	City Manager's Office	2-6 years
Noise Pollution			
2.2-40	Explore alternative means of noise attenuation along roadways and at intersections where noise attenuation is not mandated through the use of wider shoulders and increased vegetation.	Department of Public Works, Department of Planning & Community Development, Department of Parks & Recreation	6+ years
Light Pollution			
2.2-41	Develop and adopt a Dark Skies Initiative Administrative Directive.	Department of Planning & Community Development, Department of Museums	2-6 years
Solid and Hazardous Waste Management			
2.2-42	Participate with the region's localities to develop a post-2018 SPSA (Southeastern Public Service Authority) Agreement for regional waste management.	Department of Public Works, City Manager's Office	Up to 2 years
2.2-43	Expand participation and types of materials accepted in the City's recycling program.	Department of Public Works	2-6 years
2.2-44	Promote increased recycling in the tourism industry through the development of incentives.	Resort Area Advisory Committee, Department of Public Works	2-6 years
Chapter 2, Section 2.3 - Housing and Neighborhoods			
2.3-1	Develop an integrated housing strategy addressing affordability and neighborhood preservation, based on best available data and national best practices	Department of Housing and Neighborhood Preservation	2 years
2.3-2	Perform a housing study to help define additional strategies for achieving neighborhood preservation.	Department of Housing and Neighborhood Preservation	Up to 1 year
Chapter 2, Section 2.4 - Economic Vitality			
2.4-1	Continue to promote Virginia Beach as a year-round destination.	Convention & Visitors Bureau	On-going
2.4-2	Develop a Transit-Oriented Development land use and zoning strategy for the SGAs.	SGA Office	2-6 years
2.4-3	Reshape non-conforming business districts (e.g., Pembroke SGA-Central Village District, etc.) into well-planned and designed commercial nodes that are compatible with adopted plans and design guidelines.	Department of Economic Development, Strategic Growth Areas Office, Department of Planning & Community Development	6+ years
2.4-4	Update the Master Plan and associated design guidelines for Corporate Landing Commerce Park.	Department of Economic Development, Department of Planning & Community Development	Up to 2 years

AGENDA FOR FUTURE ACTION - RECOMMENDATIONS SUMMARY

ACTION ID	RECOMMENDED ACTION	LEAD RESPONSIBLE PARTY(S)	ESTIMATED TIME FRAME FOR COMPLETION
2.4-5	Inventory the conditions of neighborhood commercial centers and strip shopping centers. Consider incentives for façade improvements (e.g., cost share grants, etc.). Consider opportunities for repurposing over-parked commercial parking lots for possible permanent or temporary/seasonal infill uses, while adhering to recently updated commercial use parking standards in the Zoning Ordinance.	Department of Economic Development, City Attorney's Office	2-6 years
2.4-6	Inventory industrial zoning districts to determine if there is a sufficient supply of appropriate zoning for both light and heavy industrial uses, especially for the types of desired compatible land uses within SEGAs.	Department of Economic Development, Department of Planning & Community Development	Up to 2 years

ENDNOTES

[i] Michael Chandler. "The CIP in Virginia: An Overview and Explanation." Virginia Tech, Land Use Education Program Workshop: Funding the Future – the Role of the CIP. October 29-30, 2015. Richmond, VA.
[ii] *Ibid.*
[iii] *Ibid.*

2023 Virginia Community Flood Preparedness Fund

Marsh Restoration in Back Bay, Virginia Beach

CITY OF VIRGINIA BEACH

Table of Contents

Appendix A – Application Form

Applicants must have prior approval from the Department to submit <u>applications, forms, and supporting documents by mail in lieu of the WebGrants portal.</u>

Appendix A: Application Form for Grant and Loan Requests for All Categories

Virginia Department of Conservation and Recreation
Virginia Community Flood Preparedness Fund Grant Program

Name of Local Government:

Category Being Applied for (check one):

☐ **Capacity Building/Planning**

☑ **Project**

☐ **Study**

NFIP/DCR Community Identification Number (CID) 515531

Name of Authorized Official and Title: Toni Utterback, Stormwater Engineering Center Administrator

Signature of Authorized Official: Katie E Shannon for Toni Utterback

Mailing Address (1): 2875 Sabre Street, Suite 250

Mailing Address (2): ______

City: Virginia Beach **State:** Virginia **Zip:** 23452

Telephone Number: (757) 385-8746 **Cell Phone Number:** (____) ______

Email Address: TPUtterback@vbgov.com

Contact and Title (If different from authorized official): C.J. Bodnar, Technical Services Program Manager

Type text here

Mailing Address (1): 2875 Sabre Street, Suite 250

Mailing Address (2): ______________________________

City: Virginia Beach **State:** Virginia **Zip:** 23452

Telephone Number: (757) 385-8430 **Cell Phone Number:** (____) ________________

Email Address: CBodnar@vbgov.com

Is the proposal in this application intended to benefit a low-income geographic area as defined in the Part 1 Definitions? Yes ____ No ✓

Categories (select applicable activities that will be included in the project and used for scoring criterion):

Capacity Building and Planning Grants

☐ Floodplain Staff Capacity.

☐ Resilience Plan Development

- ☐ Revisions to existing resilience plans and modifications to existing comprehensive and hazard mitigation plans.
- ☐ Resource assessments, planning, strategies, and development.
  - Policy management and/or development.
  - Stakeholder engagement and strategies.

☐ Other: ______________________________

Study Grants (Check All that Apply)

☐ Studies to aid in updating floodplain ordinances to maintain compliance with the NFIP, or to incorporate higher standards that may reduce the risk of flood damage. This must include establishing processes for implementing the ordinance, including but not limited to, permitting, record retention, violations, and variances. This may include revising a floodplain ordinance when the community is getting new Flood Insurance Rate Maps (FIRMs), updating a floodplain ordinance to include floodplain setbacks, freeboard, or other

higher standards, RiskMAP public noticing requirements, or correcting issues identified in a Corrective Action Plan.

- ☐ Revising other land use ordinances to incorporate flood protection and mitigation goals, standards, and practices.
- ☐ Conducting hydrologic and hydraulic (H&H) studies of floodplains. *Changes to the base flood, as demonstrated by the H&H must be submitted to FEMA within 6 months of the data becoming available.*
- ☐ Studies and Data Collection of Statewide and Regional Significance.
- ☐ Revisions to existing resilience plans and modifications to existing comprehensive and hazard.
- ☐ Other relevant flood prevention and protection project or study.

Project Grants and Loans (Check All that Apply – Hybrid Solutions will include items from both the "Nature-Based" and "Other" categories)

Nature-based solutions

- ☐ Acquisition of property (or interests therein) and/or structures for purposes of allowing floodwater inundation, strategic retreat of existing land uses from areas vulnerable to flooding; the conservation or enhancement of natural flood resilience resources; or acquisition of structures, provided the acquired property will be protected in perpetuity from further development, <u>and where the flood mitigation benefits will be achieved as a part of the same project as the property acquisition.</u>
- ☑ Wetland restoration.
- ☐ Floodplain restoration.
- ☐ Construction of swales and settling ponds.
- ☑ Living shorelines and vegetated buffers.
- ☐ Permanent conservation of undeveloped lands identified as having flood resilience value by *ConserveVirginia* Floodplain and Flooding Resilience layer or a similar data driven analytic tool, or the acquisition of developed land for future conservation.
- ☐ Dam removal.
- ☐ Stream bank restoration or stabilization.
- ☐ Restoration of floodplains to natural and beneficial function.

Other Projects

- ☐ Structural floodwalls, levees, berms, flood gates, structural conveyances.
- ☐ Storm water system upgrades.
- ☐ Medium and large-scale Low Impact Development (LID) in urban areas.

- ☐ Developing flood warning and response systems, which may include gauge installation, to notify residents of potential emergency flooding events.
- ☐ Dam restoration.
- ☐ Beneficial reuse of dredge materials for flood mitigation purposes
- ☐ Removal or relocation of structures from flood-prone areas where the land will not be returned to open space.
- ☐ Acquisition of property (or interests therein) and/or structures for purposes of allowing floodwater inundation, strategic retreat of existing land uses from areas vulnerable to flooding; the conservation or enhancement of natural flood resilience resources; or acquisition of structures, provided the acquired property will be protected in perpetuity from further development, <u>and where the flood mitigation benefits will **not be** achieved as a part of the same project as the property acquisition.</u>
- ☐ Other project identified in a DCR-approved Resilience Plan.

Location of Project or Activity (Include Maps): Bonney Cove in Back Bay, Virginia Beach

NFIP Community Identification Number (CID#) : 515531

Is Project Located in an NFIP Participating Community? ☑ Yes ☐ No

Is Project Located in a Special Flood Hazard Area? ☑ Yes ☐ No

Flood Zone(s) (If Applicable): Zone VE (EL 5 Feet), Zone AE (EL 4 Feet), Zone Open Water

Flood Insurance Rate Map Number(s) (If Applicable): 5155310215G and 5155310220G

Total Cost of Project: $53,378,490

Total Amount Requested $5,000,000

Amount Requested as Grant $5,000,000

Amount Requested as Project Loan (not including short-term loans for up-front costs) ____________________

Amount Requested as Short-Term loan for Up-Front Costs (not to exceed 20% of amount requested as Grant) __________________________

For projects, planning, capacity building, and studies in low-income geographic areas: Are you requesting that match be waived? □ Yes □ No

<u>Additional Information for Loan Requests</u>
Requested Loan Security: ______________________________

(General Obligation, Lease, Revenue, Special Fund Revenue, and/or Moral obligation from other government entity)

Desired loan term: __________________________________

Since the date of your latest financial statements, did the applicant issue any new debt? ______
(If yes, provide details)

Is there any pending or potential litigation by or against the applicant? ______________

Attach five years of current audited financial statements (FY18-22) or refer to website if posted
(Not necessary for existing VRA borrowers)

Attach FY2024 adopted budget or refer to website

Attach current Capital Improvement Plan

Attach adopted Financial Policies

Attach a list of the ten largest employers in the Applicant's jurisdiction.

Attach a list of the ten largest taxpayers in the Applicant's jurisdiction

Appendix B: Budget Form

Appendix B: Budget Narrative Template

Applicant Name: Community Flood Preparedness Fund & Resilient Virginia Revolving Loan Fund Detailed Budget Narrative Period of Performance: June 2024 through June 2027 Submission Date: November 12, 2023									
								Grand Total State Funding Request	$ 5,000,000
								Grand Total Local Share of Project	$ 38,356,966
National Fish and Wildlife Foundation Grants								Federal Funding (if applicable)	$ 10,021,524
								Project Grand Total	$ 53,378,490
								Locality Cost Match	% 71.85
Breakout By Cost Type	Personnel	Fringe	Travel	Equipment	Supplies	Contracts	Indirect Costs	Other Costs	Total
Federal Share (if applicable)								10,021,524	10,021,524
Local Share								37,330,166	37,330,166
State Share								5,000,000	5,000,000
Pre-Award/Startup								276,800	276,800
Maintenance								750,000	750,000
Total	$	$	$	$	$	$	$	$53,378,490	$ 53,378,490

1. Federal Share represents National Fish and Wildlife Foundation (NFWF) Grants. NFWF is not a federal agency.
2. Local Share represents the total project cost less design and implementation (monitoring and initial maintenance) costs.
3. State Share represents the CFPF grant request.
4. Pre-Award costs represent project design costs.
5. Maintenance costs represent implementation (monitoring and initial maintenance costs).

Scope of Work Narrative

Introduction

The City of Virginia Beach ("City") is pleased to submit the Marsh Restoration in Back Bay project for consideration under the Flood Prevention and Protection Projects category in the 2023 Virginia Community Flood Preparedness Fund. The City has made significant investments in the study of historical flooding data, current and future hydrology, and the projected increase in flood frequency due to changing rainfall patterns and sea level rise. These studies culminated in Virginia Beach's Resilience Plan, socialized as "Sea Level Wise,"[1] which includes a conceptual suite of projects focused on flood control and resilience. The Virginia Beach Resilience Plan leverages four overarching adaptation strategies to identify actionable projects for each of the City's four unique major watersheds. This project represents the first adaptation project to advance to construction to implement the City's Resilience Plan.

The adaptation strategy for the Southern Rivers Watershed, which includes Back Bay, is presented in Figure 1. The strategy focuses on employing natural mitigation methods, an integrated system of defense structures, and complementary measures, such as land-use strategies. Collectively these approaches are designed to strategically reduce flow into and within Back Bay and improve flood storage and overall coastal resiliency. Marsh restoration was identified as a key resilience-building strategy as part of an extensive evaluation of structural and non-structural alternatives. Marsh restoration provides multiple benefits of flood risk reduction, enhanced habitat, and improved water quality.

As part of the Virginia Coastal Resilience Master Planning Framework, a precursor to the first phase of the Virginia Coastal Resilience Master Plan (CRMP), the Commonwealth of Virginia identified guiding principles for a statewide resilience strategy. One of these guiding principles is recognizing the importance of protecting and enhancing natural infrastructure and prioritizing nature-based infrastructure.[2] The City's marsh restoration project aligns with this principle and was highlighted as an exemplary nature-based project in the CRMP (refer to pages 178-179).[3]

[1] City of Virginia Beach (2020). Virginia Beach Sea Level Wise Adaptation Strategy (Website).
[2] Office of Governor Ralph S. Northam Commonwealth of Virginia. (2020). Virginia Coastal Resilience Master Planning Framework (PDF).
[3] Office of Governor Ralph S. Northam Commonwealth of Virginia. (2021). Virginia Coastal Resilience Master Plan Phase 1 (PDF).

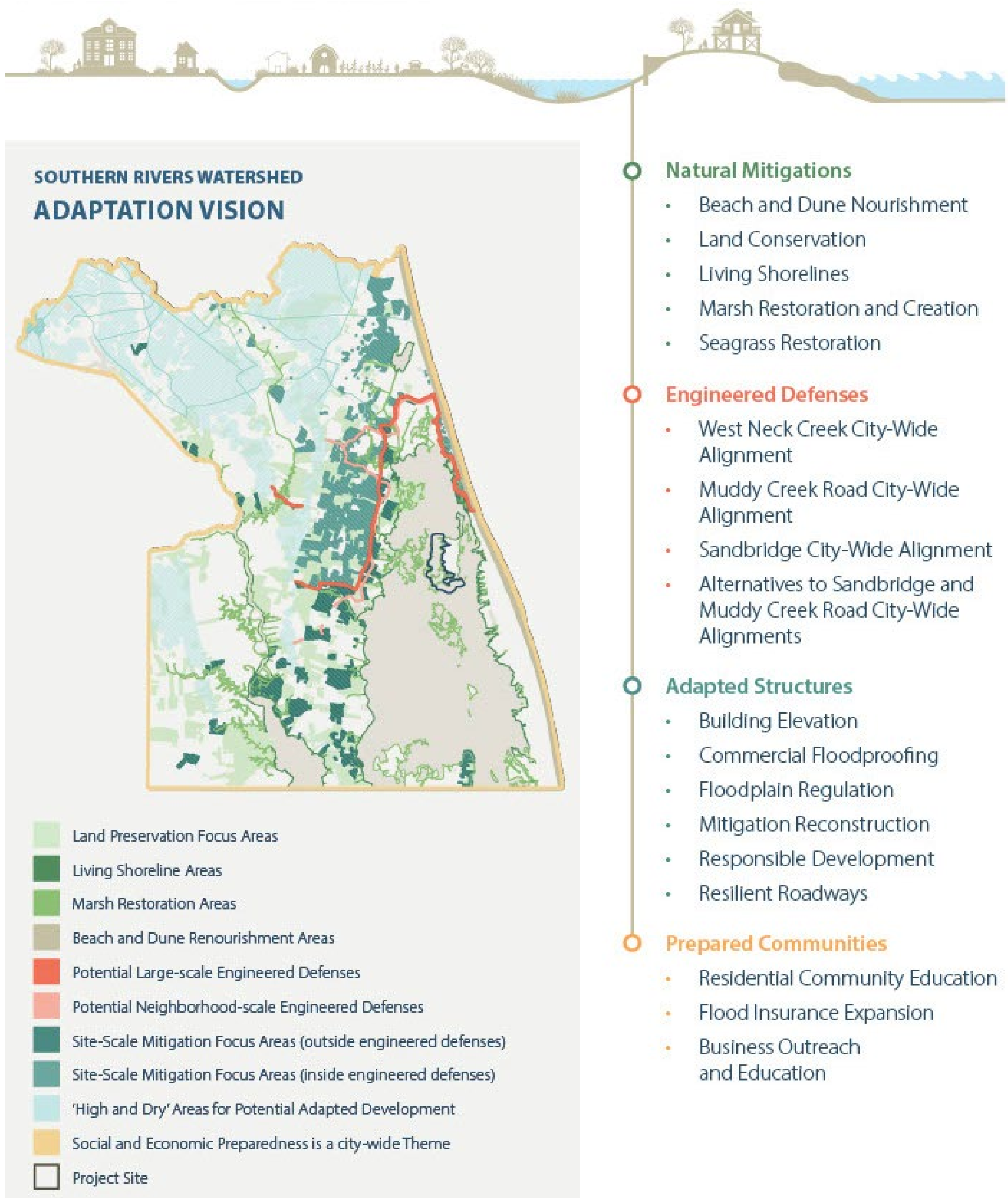

Figure 1: Adaptation Vision for the Southern Rivers Watershed.

Hydraulic modeling analysis identified Bonney Cove as a location where marsh restoration has the potential to reduce the propagation of floodwater through key pathways within Back Bay (Figure 2). The City prioritized this project as the first to advance to construction due to its significant benefits to community and habitat resilience.

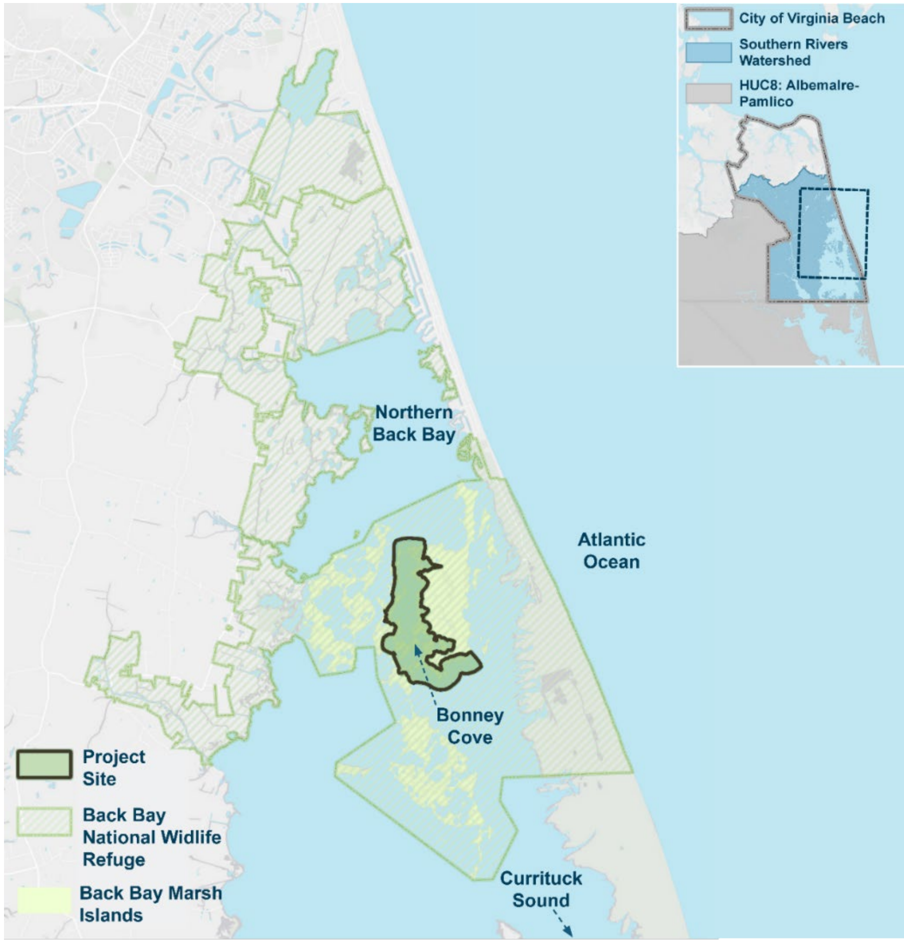

Figure 2: Project site location map.

This project represents a collaborative effort between the City's Department of Public Works alongside other City departments, public constituents, local nonprofits, and state and federal agencies. In selecting the project location and developing the design approach, the City has coordinated closely with the Back Bay National Wildlife Refuge (BBNWR), part of the U.S. Fish and Wildlife Service (USFWS), and the Virginia Department of Wildlife Resources (VDWR). Environmental organizations committed to stewardship of Back Bay have also contributed input throughout the design process, including the Back Bay Restoration Foundation (BBRF), Friends of Back Bay, the Back Bay National Wildlife Refuge Society, and the Albemarle-Pamlico National Estuary Partnership (APNEP). Project field investigations involved local support from Old Dominion University (ODU) and others, and outside expertise from Louisiana. The National Fish and Wildlife Foundation (NFWF) provided grant funding under the National Coastal Resilience Fund (NCRF) to support design, permitting, and environmental assessments. Broad support of the project is demonstrated by contributions from the organizations noted above along with other stakeholders engaged in the restoration effort.

Needs and Problems

Specific Problem Being Solved – Habitat Degradation and "Wind Tide" Flooding

Marshes are vital to the Southern Rivers Watershed for the ecological and flood reduction benefits they provide. The Southern Rivers Watershed contains 90% of the City's land area under an elevation of three feet, making this area particularly susceptible to flood impacts. As illustrated in Figure 3, sustained southerly winds push water up from the Albemarle-Pamlico Sound through the Currituck Sound and into Back Bay, creating a phenomenon referred to locally as "wind tide flooding". Marsh habitat loss has contributed to the opening of a secondary channel in Bonney Cove that has increased water flow during wind tide and other flood events to areas with high community exposure.

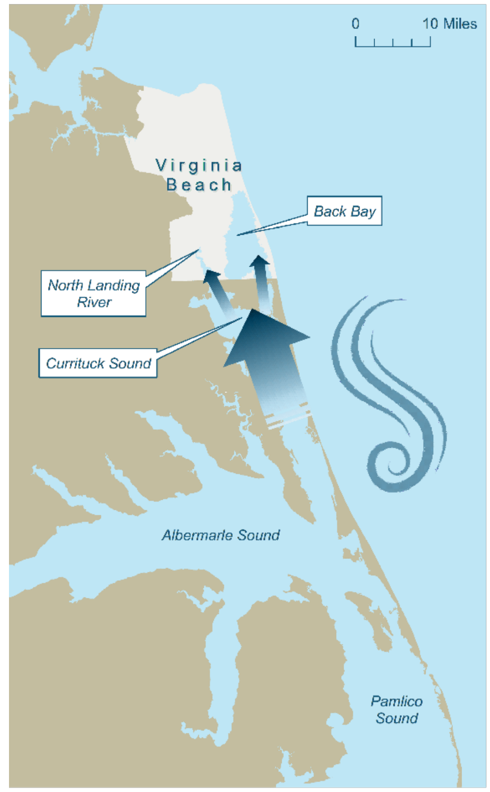

Figure 3: Flood pathways in the Southern Rivers Watershed.

Within today's marsh system, it takes between two to five days of sustained southerly winds to cause flooding, depending on the wind speed and direction. Over the last four years, more than five wind tide flooding events have occurred in this area. The increasing frequency of flooding events is primarily attributed to a foot of relative sea level rise in the last 50 years and degradation of marsh and seagrass habitat.

This marsh restoration project aims to address the challenges of habitat degradation and "wind tide" flooding by stabilizing two critically eroding marsh islands, decreasing turbidity to promote the growth of aquatic vegetation, and providing flood risk reduction benefits through increased friction and wave attenuation.

Factors Contributing to the Identified Problem

This growing flood risk in the Southern Rivers Watershed can be attributed mainly to the reduced friction in the water column from the increased water depth and eroded vegetation, which allows water to move more quickly through key hydraulic pathways. Another term for this is "fetch", which is defined as the open water distance over which a given wind can blow and generate higher waves without obstruction. Unmitigated, the continued loss of these marsh island systems and aquatic vegetation is expected to result in more frequent and intense wind tide flooding events.

Emergent Marsh Degradation

Approximately 50% of former marshland at the site (260 acres) has eroded into open water leading to the opening of a wide secondary channel ("Bonney Cove") that is about two miles

long and half a mile wide (Figure 4). The southern exposed edge of the adjacent marsh islands is exposed to approximately 1.5 miles of fetch in the predominant wind direction.

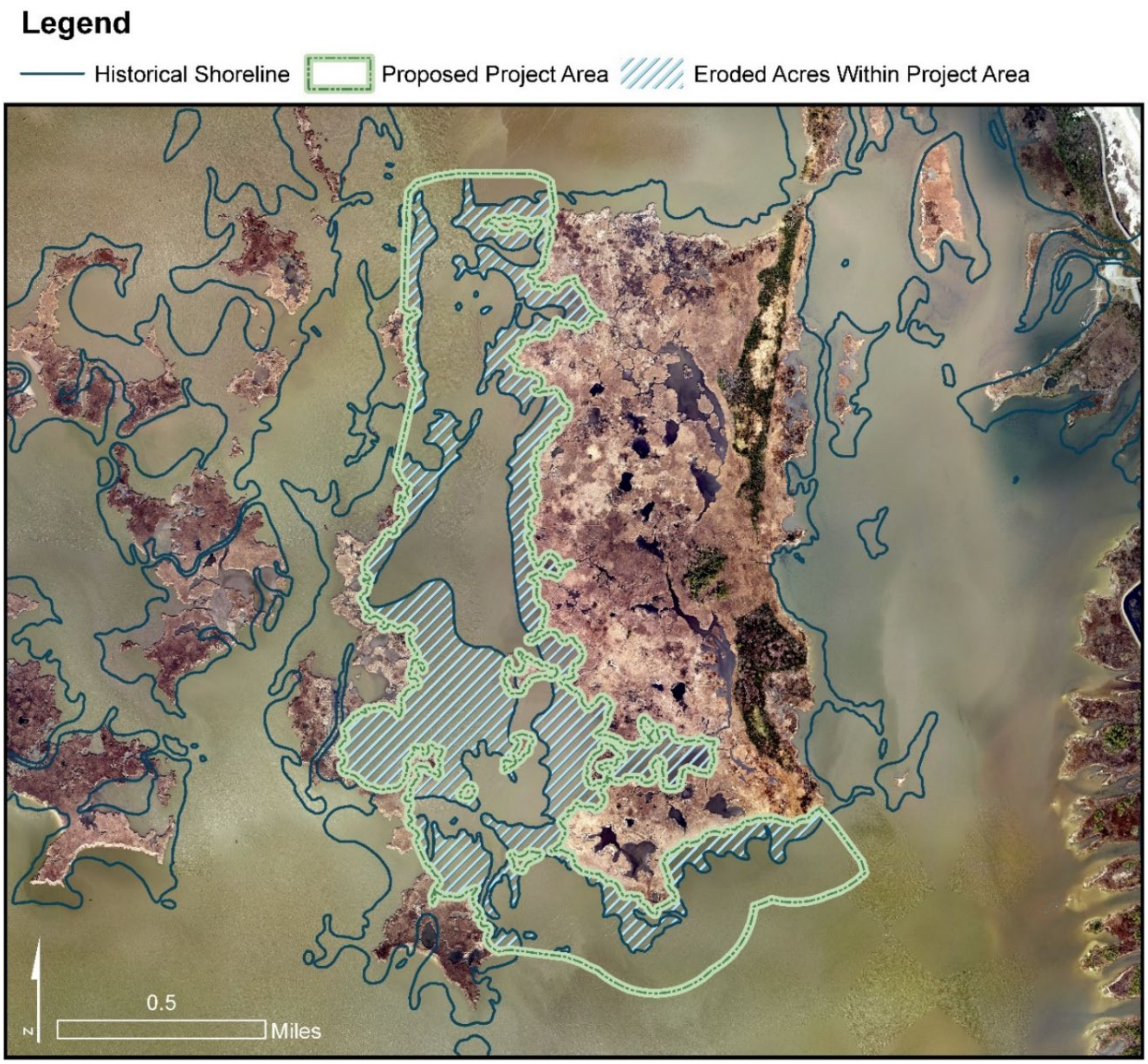

Figure 4: Historical marsh erosion within the project area.

Submerged Aquatic Vegetation (SAV) Loss

SAV used to be abundant at the site (around 45% coverage, overall) but is now extremely sparse, ranging from 0% to 10% coverage across the site, on average. Field studies conducted by the VDWR show that wind-driven waves and high flow velocities are the primary drivers of this loss, particularly in the last 5 years as shown in Figure 5.

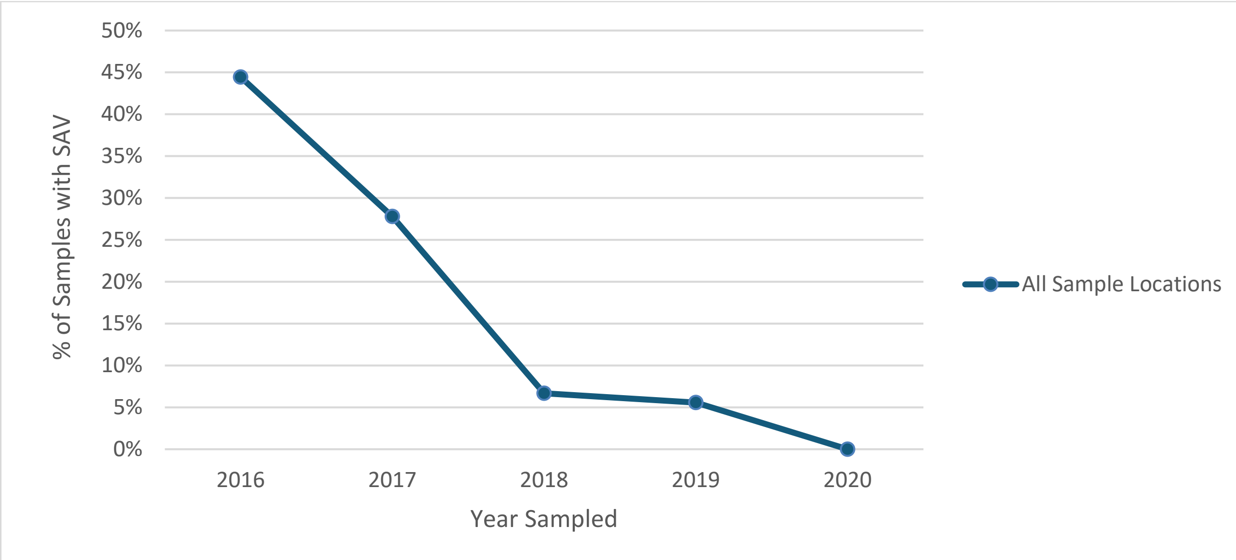

Figure 5: SAV sampling data from VDWR within the project vicinity.

Why is the Project Needed Locally/Regionally?

Pilot Project

The City's design concept for the marsh restoration project leverages "marsh terracing," an innovative coastal engineering technique widely used in Texas and Louisiana to convert shallow subtidal bottom to marsh. This technique has not yet been implemented along the U.S. East Coast and has not yet been implemented in the Mid-Atlantic region. Through the export of proven expertise from successful marsh terraces, this project would lay the foundation for future projects in the region, Virginia, and other states along the East Coast. The project would document detailed cost estimates, demonstrate effective construction practices for large-scale marsh creation projects, identify best sources for local/regional materials, and establish partnerships with permitting officials at various levels of government. The City has outlined a preliminary sequencing plan for marsh island restoration projects in Back Bay to strategically close hydraulic pathways and address priority restoration areas as shown in Figure 6. Some of these projects would require coordination with the State of North Carolina to realize its broader resilience efforts.

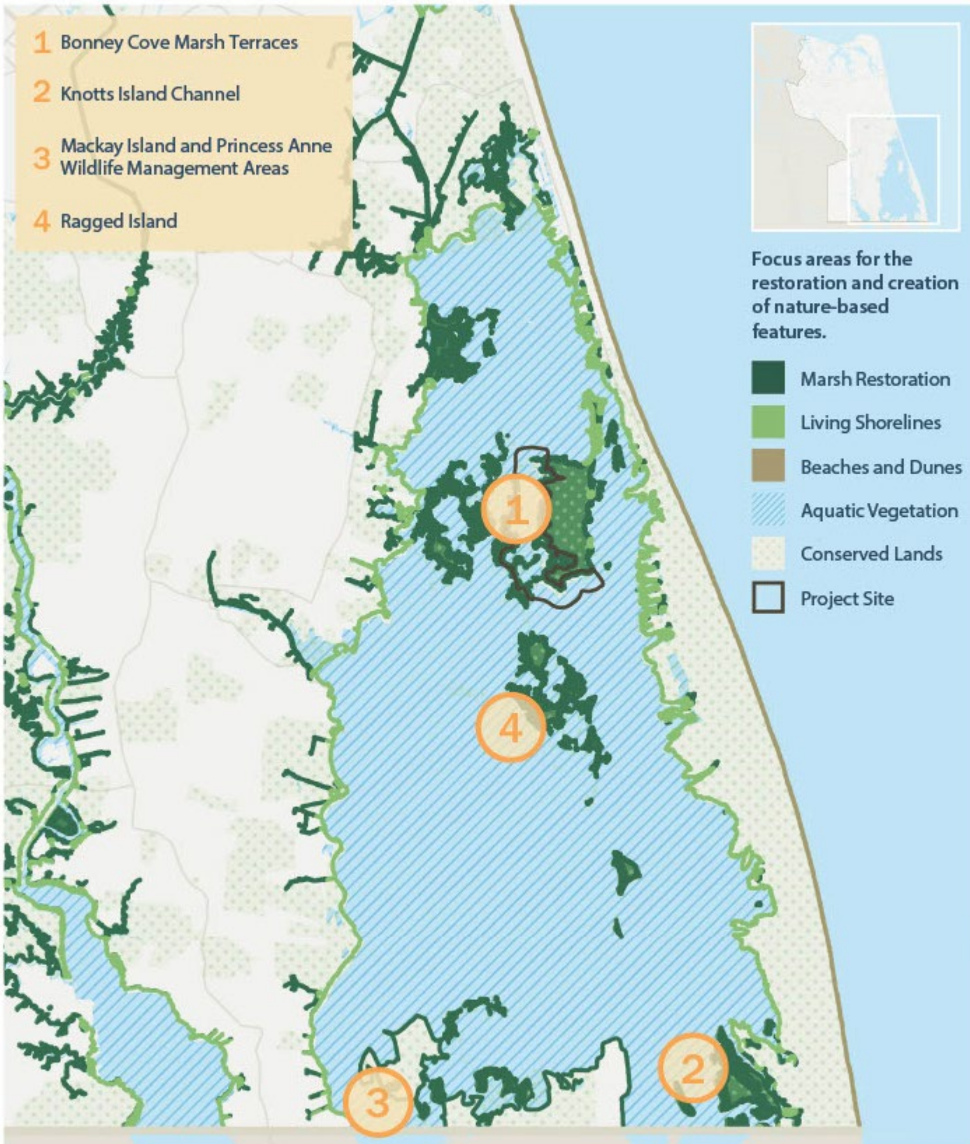

Figure 6: Preliminary Sequencing Restoration Plan.

Virginia Coastal Resilience Master Plan Exemplary Project

The CRMP impact assessment shows a high vulnerability of nature-based features to coastal flood hazards that is consistent with the City's analysis. In the Hampton Roads region, the CRMP impact assessment estimates a decrease from 40,600 acres to 2,940 acres of tidal wetlands by 2080, representing a 93% decline in tidal wetlands.[4] Back Bay was identified as a hotspot for tidal wetland loss, emphasizing the critical location of the City's marsh restoration effort. Specifically, the Virginia CRMP impact assessment shows that portions of tidal wetlands within the project area have "High" and "Very High" impact levels, which indicates areas of tidal marsh

[4] Office of Governor Ralph S. Northam Commonwealth of Virginia and Virginia Department of Conservation and Recreation (2021). Virginia Coastal Resilience Master Plan Phase 1 (PDF).

that are anticipated to be lost through inundation causing conversion to open water (Figure 7).

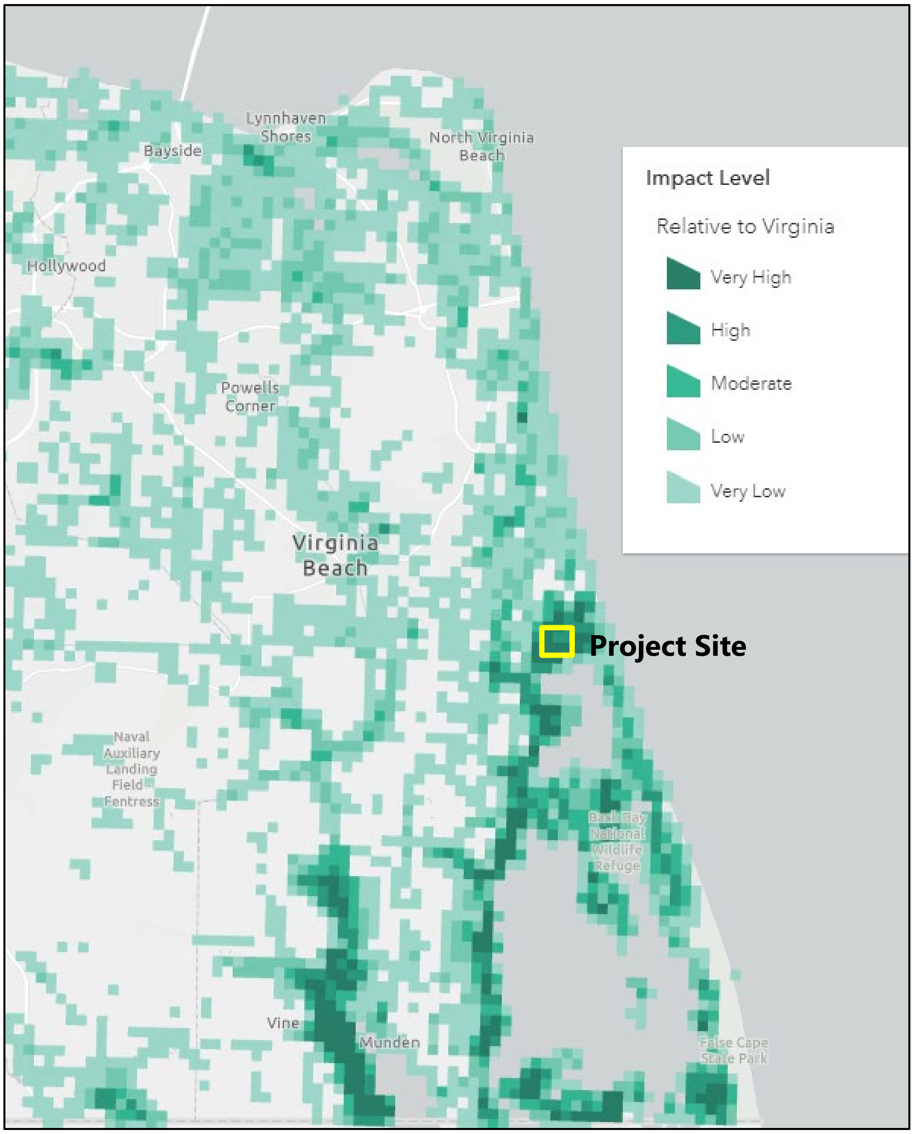

Figure 7: Virginia CRMP Impact Assessment for Tidal Wetlands.

Currituck Sound Coalition High Priority Area

In coordination with Audubon North Carolina, the Currituck Sounds Coalition designated the project site as a High Priority Area for restoring and enhancing vulnerable and degraded marshes with "high flood risk reduction benefits and habitat value" as shown in Figure 8[5].

[5] Audubon North Carolina. (2021). Currituck Sound Coalition Marsh Conservation Plan. (PDF)

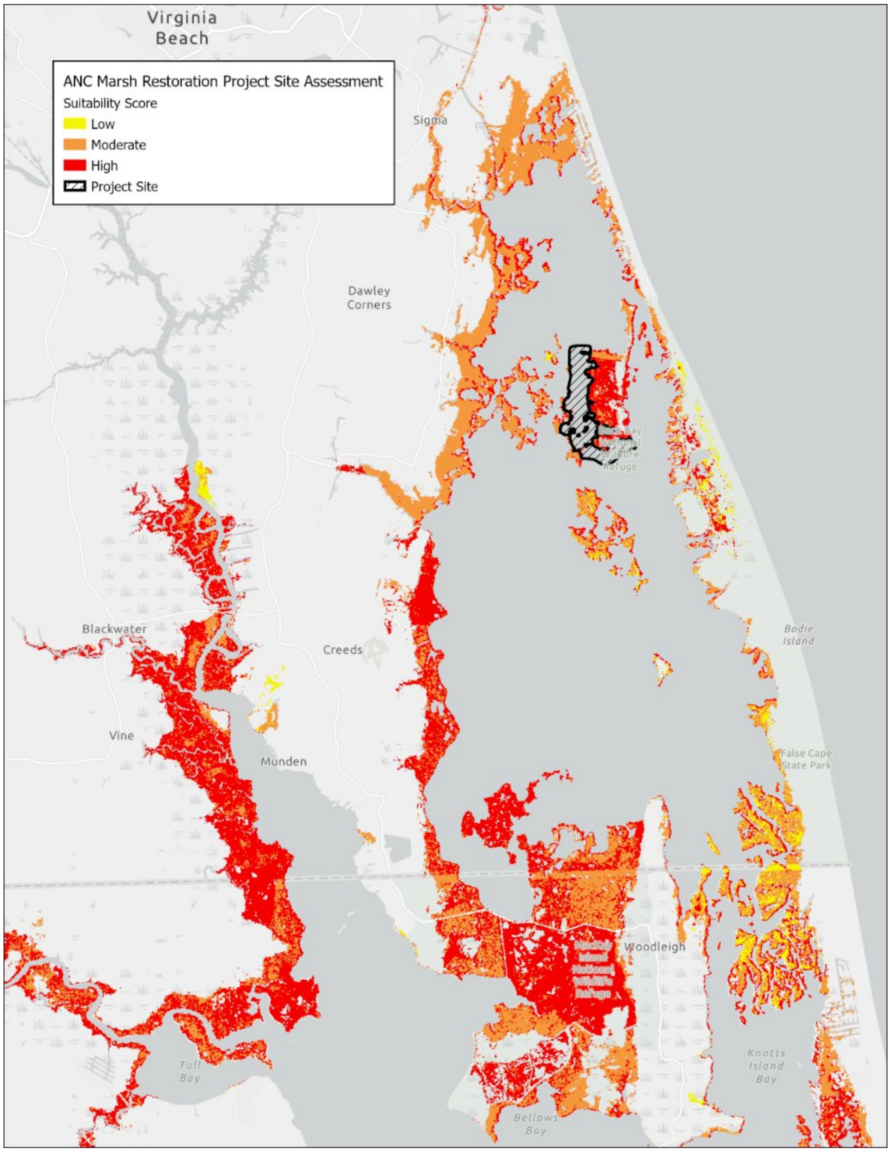

Figure 8: Audubon North Carolina Marsh Restoration Project Site Assessment

Ecological Core for Flood Resilience

The Virginia Department of Conservation and Recreation Natural Heritage Data Explorer provides data from ConserveVirginia v3.0 and other data to support conservation planning. The following map in Figure 9 displays Ecological Cores and the Floodplains and Flooding Resilience Category layer (blue polygon) from ConserveVirginia. The project area contains "High" (C3) and "General" (C5) Ecological Cores and is within the boundaries of the Floodplain and Flooding Resilience area.

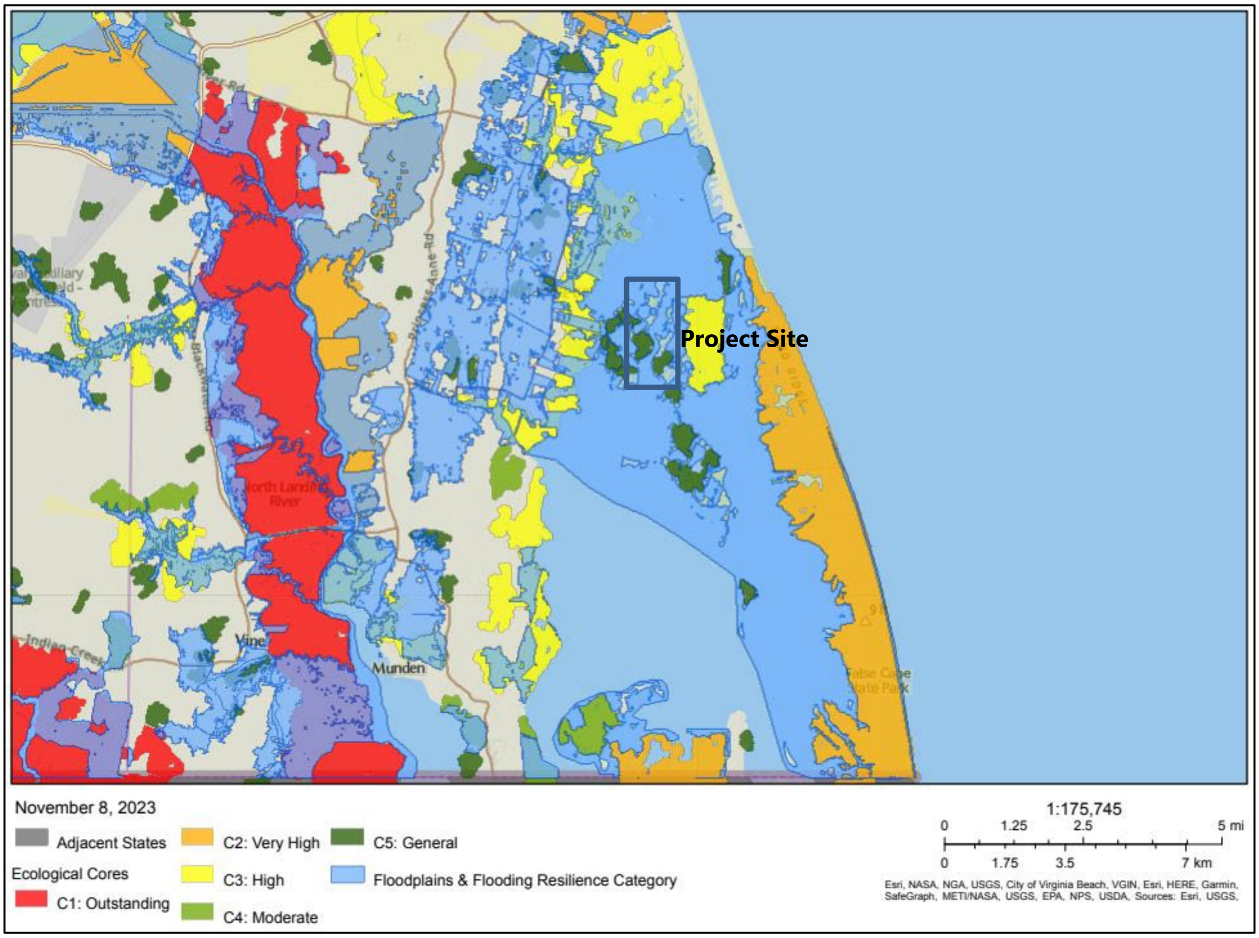

Figure 9: Virginia Natural Heritage Data Explorer Ecological Cores and ConserveVirginia Data.

The safety threats, or environmental concerns related to flood risk.

The City's risk assessment forecasts that approximately 70% of the remaining marsh (730 acres) surrounding the project site will convert to open water with three feet of sea level rise if unmitigated. Fragmentation of this adjacent marsh would result in about eight miles of fetch acting on the southern extent of the site in the predominant wind direction. Without these central marsh islands, the northern shorelines of Back Bay would be exposed to 12 miles of fetch from the Knotts Island Channel at the Virginia-North Carolina boundary. This condition would leave the fringing marshes highly vulnerable to accelerated erosion.

How does the project decrease the risk to public safety through flood risk reduction?

Construction of the forty-one individual marsh terraces, totaling 27,000 linear feet (a 51-acre footprint), across Bonney Cove offers a nature-based technique that will stabilize and protect the marsh island in the center of the bay and reduce erosion of the fringing marsh systems to the north. Numerical modeling was leveraged to quantify specific erosion reduction benefits of the project for wave heights and flow velocities:

- **Wave Height Reduction**: The marsh terraces are expected to reduce wave heights within the project site by approximately 45%. This reduction is consistent with other field studies, which have found that average wave heights within two terraced sites were 37% to 48% lower than those observed at the reference site (Brasher 2015). Wave energy reduction is anticipated to increase the potential for sediment deposition on the terraces' leeward side, leading to the growth of new emergent marsh and reducing erosion of adjacent marsh. Approximately five miles of marsh island shoreline around Bonney Cove will benefit directly from the erosion reduction associated with the computed wave attenuation.
- **Flow Velocity Reduction**: The marsh terraces reduce flow velocity within the project area. This reduction in velocity will reduce bottom shear stress, decrease turbidity, increase light penetration into the water column and promote the growth of SAV. Reducing bottom shear stress will make conditions more suitable for SAV growth between the terraces. Field studies of marsh terraces in Texas and Louisiana document an approximately 45% to 56% reduction in turbidity and the emergence of SAV in the years following terrace construction (Brasher 2015).
- **Wind Shear Stress Reduction**: Although not included as a parameter within the numerical modeling effort, the bald cypress trees planted on the terraces within the middle of the site are expected to reduce wind speed within the project site. This will further reduce wind-generated waves within the project site on the terraces' leeward and windward sides. Research shows that trees that grow to at least 30 feet at maturity result in lower wind speeds of up to 60 to 150 ft on the windward side and up to 900 ft on the leeward side (USDA).

How does the project protect or conserve natural resources?

The proposed project aims to restore marsh island communities in Bonney Cove that have historically provided environmental and flood reduction benefits to the communities in northern Back Bay. As illustrated in Figure 10, when an intact marsh begins to fragment and convert to open water, fetch increases and enables greater wave energy, increasing marsh erosion rates, and ultimately accelerating conversion to an ever-expanding body of open water. Strategic marsh restoration and creation in Bonney Cove would help mitigate the cycle of marsh island erosion and loss of SAV currently occurring in Back Bay, thereby protecting the remaining marsh islands and reducing fetch and wave energy.

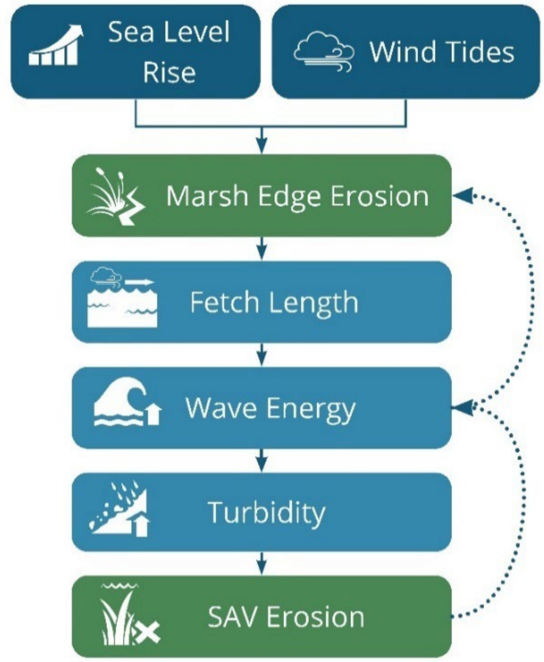

Figure 10: Cycle of marsh erosion, SAV loss, and increased wind-driven flooding.

The primary objective of this project is to create a sustainable coastal marsh island system in Back Bay through reclamation of historically lost marsh habitat and protection of existing marsh complexes from erosion. This restoration effort aims to provide multiple benefits of reduced flood impacts, enhanced fish and wildlife habitat, and improved water quality. The project is designed to achieve the following outcomes:

- Decrease turbidity to create conditions that promote the growth of emergent vegetation and aquatic grasses;
- Maximize habitat value for ecologically important fish and wildlife populations (e.g. Largemouth Bass, Bluegill, Yellow Perch, Striped Bass, Blueback Herring, Alewife, American Eel, etc.); and,
- Reduce fetch, wave heights, and flow velocities to mitigate erosion of fringing marsh systems that provide a buffer for the low-lying neighborhoods and roads that experience frequent flooding in northern Back Bay.

The City selected marsh terracing as the preferred restoration approach because the design is compatible with Back Bay's shallow bottom and the historical loss of habitat. Marsh terraces are narrow, man-made islands placed in shallow open water to restore previous marsh environments. Typically arranged in a chevron pattern, the overall field of marsh terraces dissipates waves, decreases turbidity, and slows down the moving water. The resulting calmer water conditions allow more sunlight to penetrate to the shallow bottom, promoting the establishment and growth of marsh seagrass and ultimately improving habitat quality for fish and wildlife. Further, as opposed to one continuous marsh platform, marsh terraces maximize habitat for a variety of fish and wildlife species, as illustrated in Figure 11.

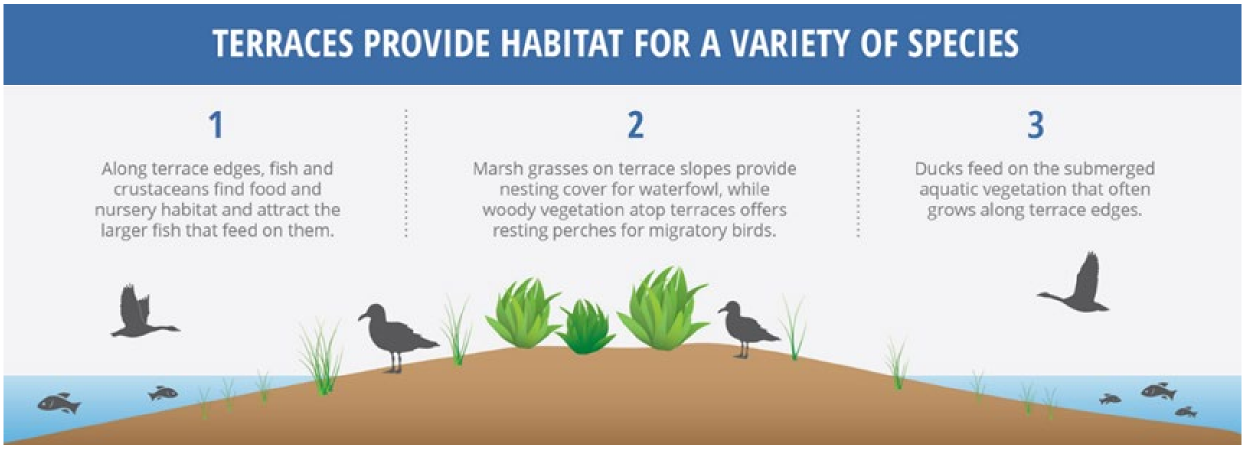

Figure 11: Conceptual diagram of marsh terraces.

Groups to be targeted who might directly benefit from this flood risk reduction effort.

The northern Back Bay communities adjacent to the project area and interested stakeholders have been engaged in the planning effort through public meetings. These meetings provided an opportunity for the community to provide feedback on the 30% and 95% designs and artistic renderings. We anticipate the project to benefit properties and infrastructure assets in northern Back Bay, including the following:

- **Reduce erosion rates along approximately 8 miles of shoreline by reducing wind and wave energy north of the project site.** Most of the properties along this reach of shoreline are not protected by traditional erosion risk reduction measures, such as bulkheads. Maintaining a naturalized shoreline while protecting fringe marsh is a priority of the City and its project partners. This approach will ensure that these marsh systems can migrate landward in response to sea level rise.
- **Reduce flood risk to commercial and residential properties north of the project site.** There are approximately 70 commercial and 2,350 residential structures within the two census block groups surrounding the project site. Around 635 of those structures are vulnerable to flooding during a 50-year event today. With three feet of sea level rise, approximately 2,060 structures are expected to be vulnerable to flooding during a 50-year return period event, representing about 85% of the residential structures within the project vicinity. These numbers underscore the importance of implementing the proposed project alongside complimentary flood risk reduction projects.
- **Reduce the magnitude and duration of flooding along critical access roads and critical facilities.** In addition to Muddy Creek Road, two other critical access roads are anticipated to benefit from delayed flooding. This includes Shipps Cabin Road (intersecting with Muddy Creek Road) and Sandpiper Road, which runs parallel to the eastern bank of Back Bay and provides ingress/egress out of the Sandbridge community (Figure 12).

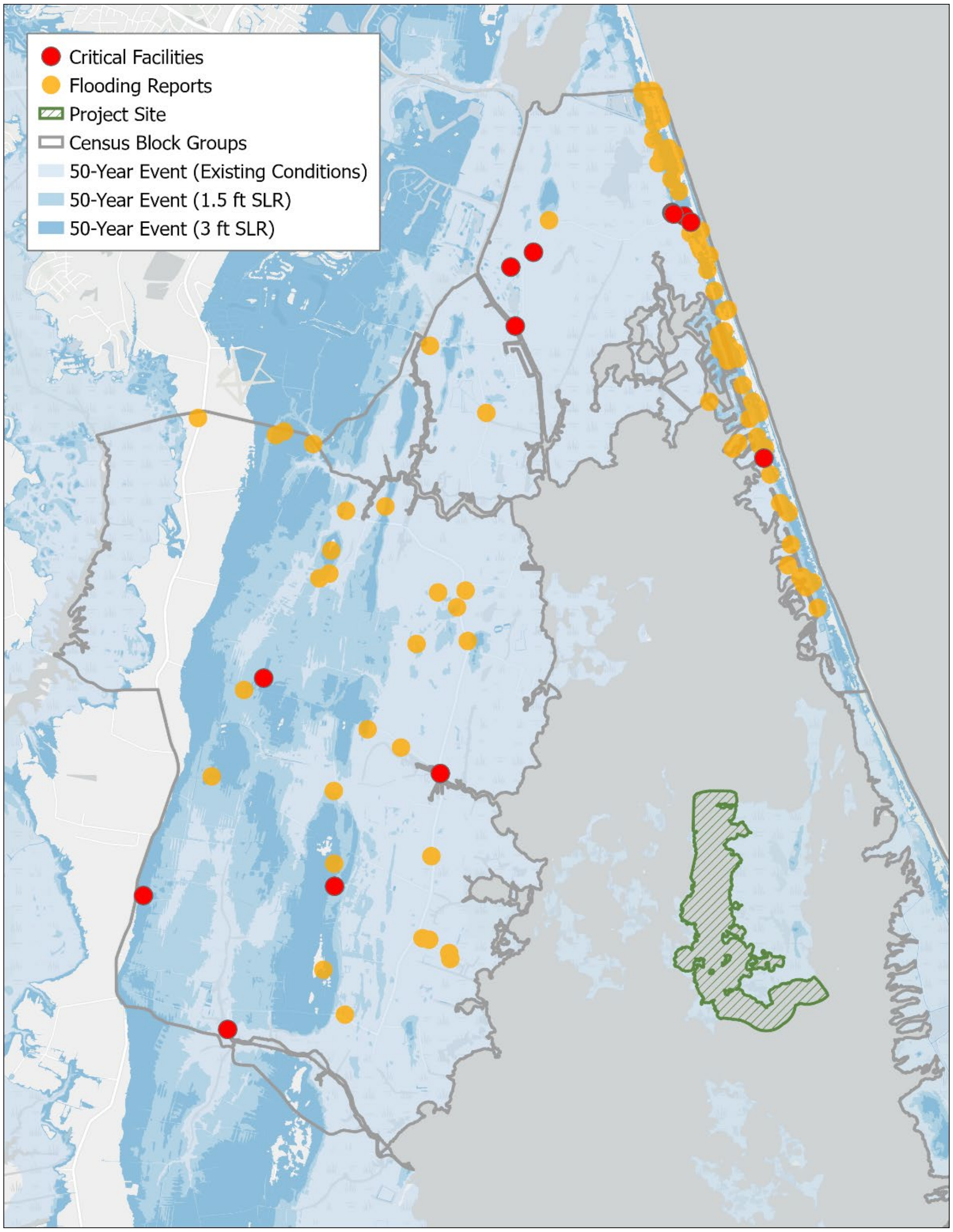

Figure 12: Critical facilities and flooding reports within project vicinity.

What would happen (or not happen) if the applicant does not receive funding?

If this project does not advance from design to construction, erosion of the adjacent marsh would continue to occur, resulting in fragmented habitat lacking the capacity to reduce wave action and slow water velocities. It is anticipated that wind-driven flooding events will continue to increase in frequency, resulting in increasing flooding of the low-lying properties and roadways surrounding northern Back Bay.

Alternatives Analysis

The proposed project offers the best approach for addressing the needs and problem statement outlined in this Scope of Work narrative. The project would result in the creation of 46.5 acres of marsh terraces, which would produce a net gain of approximately 16 acres of low/high marsh habitat by the end of the project construction compared to the No Action Alternative. The integrated system of marsh terrace ridges and perimeter rock armoring would stabilize the two critically eroding marsh islands (Long Island to the east, and a series of smaller unnamed islands to the west) from continued degradation. The tall terrace design improves the functionality and resiliency of the marsh system while also providing diversified habitat for fish and wildlife in the form of increased marsh edge as sea level rises. Numerical modeling of the preferred alternative demonstrated that the project would decrease wave heights and decrease the overall flow velocity of water moving through the project site, reducing water exchange in Back Bay during flooding events, encouraging sediment deposition, mitigating wave effects and consequent erosion, and result in localized water quality benefits. The proposed terraces would not only create a platform for vegetation growth within the marsh, but also reduce wave fetch in these large open water areas. The reduction in wave energy would lead to improved water clarity to promote the growth of SAV in the area between the terraces (approximately 310 acres).

Dredging in between the terraces to obtain sediment for the terrace cap would ensure no invasive vegetation is introduced into Back Bay, which is a high priority of the USFWS and VRMC. The dredging areas would also create valuable fish habitat to attract signature Back Bay fish and wildlife populations such as Largemouth Bass. The proposed dredging areas in between the terraces was evaluated and not anticipated to increase erosion of the adjacent marsh system. Furthermore, dredging in-situ material for building terraces is a widely accepted approach in Gulf Coast region marsh creation/terracing projects, as determined through conversations with project owners in Louisiana. Some terrace cap material will also be obtained from the Nimmo VII-A project. Through export of proven expertise from successful marsh terracing projects, this project would lay the foundation for future similar projects in the region through the development of detailed cost estimates, identification of best sources for local/regional materials, and establishment of partnerships with permitting officials at various levels of government.

Goals and Objectives

The overarching goal of this project is to construct the City's first nature-based adaptation project in the Southern Rivers Watershed and one of the CRMP's exemplary nature-based projects. This project aims to stabilize two critically eroding marsh islands from further degradation, decrease turbidity to promote the growth of aquatic vegetation, and provide flood risk reduction benefits through increased friction and wave attenuation. Table 1 below provides a high-level overview of the specific objectives established to solve the problem/need identified – specifically habitat degradation and wind tide flooding along with measure(s) of success. A more detailed description of these objectives is provided in the Supporting Documentation section.

Table 1: Overview of Project Objectives.

Objectives	Description	Measure(s) of Success	Timing of Measures
Objective 1	Create a Construction Access and Staging Area	a. Secured permits for construction. b. Contractor Selection. c. Construction of Staging Area.	a. December 2023 b. April-May 2023 c. June 2023 -February 2024
Objective 2	Restore Marsh and Aquatic Vegetation	a. Secured permits for construction. b. Restoration of 46.5 acres of habitat.	a. December 2023 b. March - October 2025 and March – October 2026
Objective 3	Engage Stakeholders and Disseminate Effective Practices	Number of people meaningfully engaged in the process of the project within the agreement period.	Continuous through period of performance.

Work Plan

Current Status and Ongoing Activities

The marsh terrace project design is progressing and will be ready for construction in the CFPF grant timeline. Table 2 summarizes ongoing tasks related to the project and an anticipated schedule for completion.

Table 2: Completed, ongoing, and anticipated activities leading up to construction.

Activity	Description	Schedule
Stakeholder Scoping Workshop	In November 2020, the City hosted a virtual workshop to receive initial input from project stakeholders.	Completed (Fall 2020)
Site Characterization and Vegetation Survey	In fall 2020, a site characterization and vegetation survey within Bonney Cove was conducted under a USFWS Special Use Permit (SUP). The purpose of the survey was to document existing emergent marsh and submerged aquatic vegetation (SAV) species composition and percent coverage within the proposed project area. MAP Environmental, Inc. conducted a literature review of marsh terracing projects in the Gulf Coast region to identify effective practices for project planning and design.	Completed (Fall 2020)
Bathymetric Survey	An updated bathymetric survey of Bonney Cove, also covered under a USFWS SUP, was completed in March 2021. This data serves as an input to identify appropriate design elevations to determine quantities of materials necessary to build the proposed marsh terraces and for numerical modeling of project alternatives.	Completed (Spring 2021)
Geotechnical Investigation	A geotechnical investigation of Bonney Cove was conducted in the spring of 2021. The permitted survey, (Virginia Marine Resources Commission (VMRC) Permit No. 2020-2286, U.S. Army Corps of Engineers (USACE) Permit No. 2020-02439, and USFWS SUP) included the collection of 10 soil borings in locations that avoided aquatic vegetation habitat. The soil samples were retrieved by drilling with a specialized airboat-mounted drill rig which was essential for drilling in shallow areas as it avoids disruption to bottom habitat. The soil samples were analyzed to determine the suitability and physical characteristics of the soils within the project area. Additional soil analysis was conducted to determine the suitability of Back Bay sediments for building components of the marsh terraces.	Completed (Spring 2021)

Activity	Description	Schedule
Water Quality and Hydrodynamic Survey	ODU conducted a water quality and hydrodynamic survey of Bonney Cove in the spring of 2021. The USFWS permitted survey collected water samples and deployment/retrieval of hydrodynamic sensors (pressure sensors, acoustic Doppler current profilers, and optical backscatter sensors) at three sampling points in Bonney Cove. Sensor equipment was deployed for two one-month periods (3/10/2021 – 4/12/2021 and 5/19/2021 – 6/8/2021). The water level, wave, and current data served as an input to the numerical model calibration. The water quality parameters (including pH, salinity, temperature, dissolved oxygen, chlorophyll, and turbidity) will serve as a reference to compare pre-and post-construction water quality conditions.	Completed (Summer 2021)
30% Design	Dewberry leveraged the field-collected data to establish design criteria for the project to ensure that it will be resilient in the face of changing future conditions during wind-tide events. Artistic design renderings were developed to enable stakeholders to visualize the implemented project.	Completed (Fall 2021)
Public Engagement – 30% Design	The City held a public information meeting on October 14, 2021, at Creeds Elementary School. The project team delivered a 10-minute presentation of the proposed project followed by an open-format discussion where participants reviewed the preliminary (30%) designs and artistic renderings and submitted comments regarding environmental and community impacts.	Completed (Fall 2021)
Numerical Modeling	Numerical modeling has been completed to evaluate the proposed project's impact on water levels, wave heights, and flow velocities within and surrounding the project area. Potential water quality impacts were also evaluated. The numerical modeling effort involved the development of an XBeach model, which is a nearshore model that accounts for wave-vegetation interactions based on field-derived drag coefficients.	Completed (Winter 2021)
Environmental Assessment and Scoping	In coordination with the USFWS and with technical assistance from Dewberry, the City evaluated the potential environmental impacts of the project. The draft environmental assessment document was distributed to key stakeholders with jurisdictional authority or a vested interest in the project for review and comment.	Completed (Summer 2023)

Activity	Description	Schedule
60% Design	After numerical modeling and stakeholder review of the 30% design, the engineering design plans were advanced from 30% to 60%.	Completed (Spring 2023)
95% Design and Public Engagement	The engineering design team prepared 95% engineering design plans to address comments on the 60% plan set. The City held a second public information meeting from 6:00 – 7:30 p.m. on July 13, 2023, at the Senior Resource Center in Virginia Beach where the project team delivered a 10-minute presentation of the proposed project followed by an open-format discussion where participants reviewed the 95% designs, updated artistic renderings, and submitted comments.	Completed (Fall 2023)
Construction Permit Applications Submitted	The City submitted the Joint Permit Applications for the proposed project, including the initial post-construction monitoring plan, to VMRC and the USACE in August 2023.	Completed (Summer 2023)
Modeling of Potential Adverse Impacts	In response to public concerns, the City performed additional numerical modeling of both northerly and southerly wind events and reviewed water level responses at locations in Back Bay for any potential adverse impacts. No adverse impacts were found for either type of event.	Completed (Fall 2023)
Publication of Frequently Asked Questions	The City will be publishing findings for the potential adverse impacts modeling, along with other responses to public concerns raised at the question in a Frequently Asked Questions webpage in November 2023.	In Progress (Fall 2023)
100% Design	The engineering design team prepared and submitted the 100% engineering design plans to the City for review. The plans will be finalized on receipt of any comments from the permitting process, anticipated to occur by end of 2023.	In Progress (Fall 2023)
Contractor Procurement	The engineering team will provide final plans, specifications, and construction estimates (PS&E). The City will prepare the bid Request for Proposal (RFP), provide Bid Packages, and review bids obtained, and select a construction contractor.	Planned (Winter 2023 - Spring 2024

What are the major activities and tasks?

The key activities and tasks to be competed under the agreement period are summarized in Table 3. Please refer to the Supporting Documentation section for a more detailed description of these activities and tasks.

Table 3: Overview of Activities and Tasks.

Activities	Description	Tasks
Activity 1	Construction Staging Area Preparation and Construction	1. Mobilize equipment 2. Stabilize road, establish construction staging area, abutments, install pre-engineered bridge, construct ramp to water and slurry basins. 3. Establish traffic flagging stations. 4. Install pipe and booster stations.
Activity 2	Marsh Terrace Construction	1. Construct 41 terraces (2-phased approach). 2. Demobilize equipment.
Activity 3	Stakeholder Engagement	1. Develop project marketing materials. 2. Attend and document engagement activities.

Who is responsible for completing the activities and tasks?

Responsibility for completing the project's activities and tasks lies with a collaborative effort led by the City's Department of Public Works. To ensure the successful execution of the project, the City has assembled a diverse team of consultants, advisors and subject matter experts. For a comprehensive understanding of the specific roles and responsibilities of each entity involved in carrying out the proposed scope of work, please refer to the *Supporting Documentation – Approach, Milestones, and Deliverables – Project Partner*s section of this report, which provides a detailed description of how each team member contributes to the project's overall success.

What is the timeframe for accomplishing activities and tasks?

An overview of the planned project timeline is shown in Figure 13. Grant activities will initiated in Summer 2024 with construction of the staging area and material acquisition. Please refer to the *Supporting Documentation – Approach, Milestones, and Deliverables –Milestone Schedule* section of this report for a detailed outline for each activity and associated deliverables.

Figure 13. Timeline overview for project implementation.

Identify the required partners to ensure success and where they are represented in the workplan.

A diverse team of consultants, advisors, and subject matter experts, led by the City's Department of Public Works, has been assembled to complete the project's activities and tasks. Please refer to the *Supporting Documentation – Approach, Milestones, and Deliverables – Project Partner*s section of this report for a detailed description of each team member's role, responsibilities, and contribution to the project's overall success.

Deliverables

An overview of the project deliverables is provided in Table 4. Please refer to the *Supporting Documentation – Approach, Milestones, and Deliverables* section of this report for more detail.

Table 4: Summary of Deliverables.

Activities	Deliverables
Activity 1: Construction Staging Area Preparation and Construction	1. Material acquisition. 2. Progression and completion of the construction staging area, with daily inspections to monitor progress. 3. Documented progress and completion through quarterly reports to DCR.
Activity 2: Marsh Terrace Construction	1. Progression and completion of the 2025 and 2026 construction phases, including plantings, with daily inspections to monitor progress. 2. Demobilization and removal of equipment from construction staging area. 3. Documented progress and completion through quarterly reports to DCR.
Activity 3: Stakeholder Engagement and Lessons-Learned Dissemination	1. Project marketing materials. 2. Records documenting number of stakeholders engaged during the outreach activities.

Maintenance plan tied to the identified viability of the project. Plan for sustaining the project after the agreement period (if applicable)

The City has developed a draft Annual Monitoring Plan and Post-Construction Monitoring Report that was submitted along with the Joint Permit Application for the project. See Attachment 5 for a copy of the draft report.

Project maintenance will be addressed by the City of Virginia Beach's Public Works Stormwater Operations Group. Any maintenance issues identified by the monitoring effort or other observers will be flagged to the Operations Group to address. The City intends to maintain the construction staging area to support future project maintenance needs. After completion of the monitoring program, the City will perform inspections every 2-5 years and make any repairs needed for the life of the project.

Evaluation

Indicators of Success

Indicators of success for this project have been identified during the development of the monitoring plan. Three (3) indicators of success were defined in relation to the primary objectives of the project (as defined elsewhere in this document), and include:

- The establishment of a sustainable coastal marsh island system.
- Stability of the marsh terrace structures.
- Establishment of a sustainable SAV community.

What data will be collected and how will it be used to measure success?

Data collection for the project has been detailed in the proposed monitoring plan and includes two sets of data: one set associated with as-built surveys to establish baseline reference conditions for subsequent monitoring efforts, and monitoring data to assess the success of the project in meeting the indicators defined above. Baseline and monitoring data will be compiled in an annual report and distributed to permitting agencies, and stakeholders as appropriate, to fulfill monitoring requirements and ensure success criteria are being met and maintenance needs are addressed.

Baseline data, which is proposed to be collected after the completion of each of two phases of terrace installation, will include the following data:

- Coordinates and diagrams of established transects, as well as site photographs from photo stations established along each sampling transect, as defined in the Methods section of the monitoring plan.
- Final location of all planted vegetation (upland plantings, high marsh plantings and low marsh plantings).
- Final location and extent of SAV plantings.
- Final grade topographic surveys (plan, profile, and cross sections).
- Discussion of the project design versus as-built conditions.

Monitoring data will be collected at the end of the full growing season during each monitoring year and include the following:

- Site photographs from photo stations defined in the Methods section of the monitoring report.
- Estimated percent cover and change in coverage from the as-built conditions to sampling year conditions for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- Estimated percent cover and change in coverage from planted conditions to sampling year conditions for SAV planting quadrants

- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

This monitoring data will be used to define success by tracking the establishment of the proposed vegetative communities on and between the proposed marsh terraces as well as the structural integrity of the marsh terrace structures themselves. Vegetation cover thresholds for each year will be defined to ensure planted communities are appropriately established on each marsh terrace. Acceptable measures of deviation will be defined for structural elements to ensure design requirements are met. Maintenance and mitigation measures defined in the monitoring plan will be implemented as required if success criteria are not met during any particular monitoring year.

How was cost effectiveness evaluated and measured against the expected outcomes?

Through a BCA approach using FEMA methods and ecosystem service valuations, a BCR of 1.17 was calculated for the project. This BCR is greater than 1, indicating the project can be considered cost-effective. The project also provides an additional $9.2M in value over the current estimated project costs.

A description of the BCA analysis and methods is provided in the following Benefit Cost Analysis Section.

What products, services, meetings, outreach efforts etc. will be conducted and how will success be measured?

The City is firmly dedicated to fostering meaningful engagement with project partners and external stakeholders throughout the project, with the goal of raising awareness about the project's approach and its benefits and enhancing the likelihood of its successful adoption in other areas within the region and the state.

Activity 4, titled "Stakeholder Engagement and Lessons-Learned Dissemination," provides a comprehensive outline of the City's outreach strategy, encompassing proposed deliverables and outreach endeavors. This strategic plan entails the development of project marketing materials, along with the facilitation of presentations and meetings with local and regional stakeholders, as well as participation in state and national-level conferences.

To gauge the effectiveness of our efforts, the City will employ metrics to track and document the number of individuals engaged throughout the project. This information will be regularly communicated to DCR to serve as a key performance indicator for project success.

For a more detailed breakdown of the tasks and deliverables associated with Activity 4, please refer to the Supporting Documentation section of this application.

Project Progress Monitoring Plan

The City's Project Progress Monitoring Plan is designed to guarantee the seamless and effective execution of the project. We have established a robust internal system to oversee the entire project lifecycle, ensuring that all key stakeholders are aligned with the project's objectives, activities, deliverables, and schedule.

The process commences with a kickoff meeting involving all project partners, where we collectively set the stage for the project. During this meeting, we thoroughly review the project's objectives and scope, ensuring that everyone is on the same page. This initial step is instrumental in fostering a shared understanding of the project's vision and goals among all involved parties.

In addition to the kickoff meeting, we place a strong emphasis on quality assurance and control. We meticulously assess each contractor's quality management system to ensure that well-defined procedures are in place to maintain the highest standards of quality throughout the project. This dedication to quality is paramount to delivering a successful project that meets the City's standards and the expectations of our stakeholders.

The City is committed to ongoing and transparent communication with our design and construction contractors, as well as our advisory stakeholders. Regular meetings will be held to monitor progress, address any potential challenges, and ensure the project adheres to the proposed milestone schedule and deliverables as outlined in this grant application. This proactive approach to project monitoring allows us to stay on track, identify and address issues promptly, and uphold our commitment to the successful completion of the project.

Supporting Documentation

Project Information

The following sections provide details regarding the project site and highlight the impacted population, residential and commercial structures, and critical facilities. This section also provides an overview of the historical, existing, and projected flood conditions in and around the project site.

Population

As shown in Figure 14, two census block groups (518100454.121 and 518100464.001) adjacent to Back Bay are within the extent of the anticipated project benefits. The total population of these two block groups is 3,531.[6] The residential population has grown approximately 1.8% in the past two decades. The median household income in 2021 dollars is $99,078. There are approximately 2,500 residential housing units, of which 43.1% are owner-occupied, 11.4% are renter-occupied, and 45.5% are vacant. The high percentage of vacant housing units can likely be attributed to seasonal rentals within the Sandbridge Resort Area. The race and ethnicity demographics of the community are 94.4% White, 1.4% Black, 3.4% Hispanic, and less than 1% Asian and American Indian.

[6] Population, household income, housing units, and demographic data obtained from Esri ArcGIS Community Analyst (2022). Esri forecasts for 2021 based on U.S. Census Bureau 2010 data.

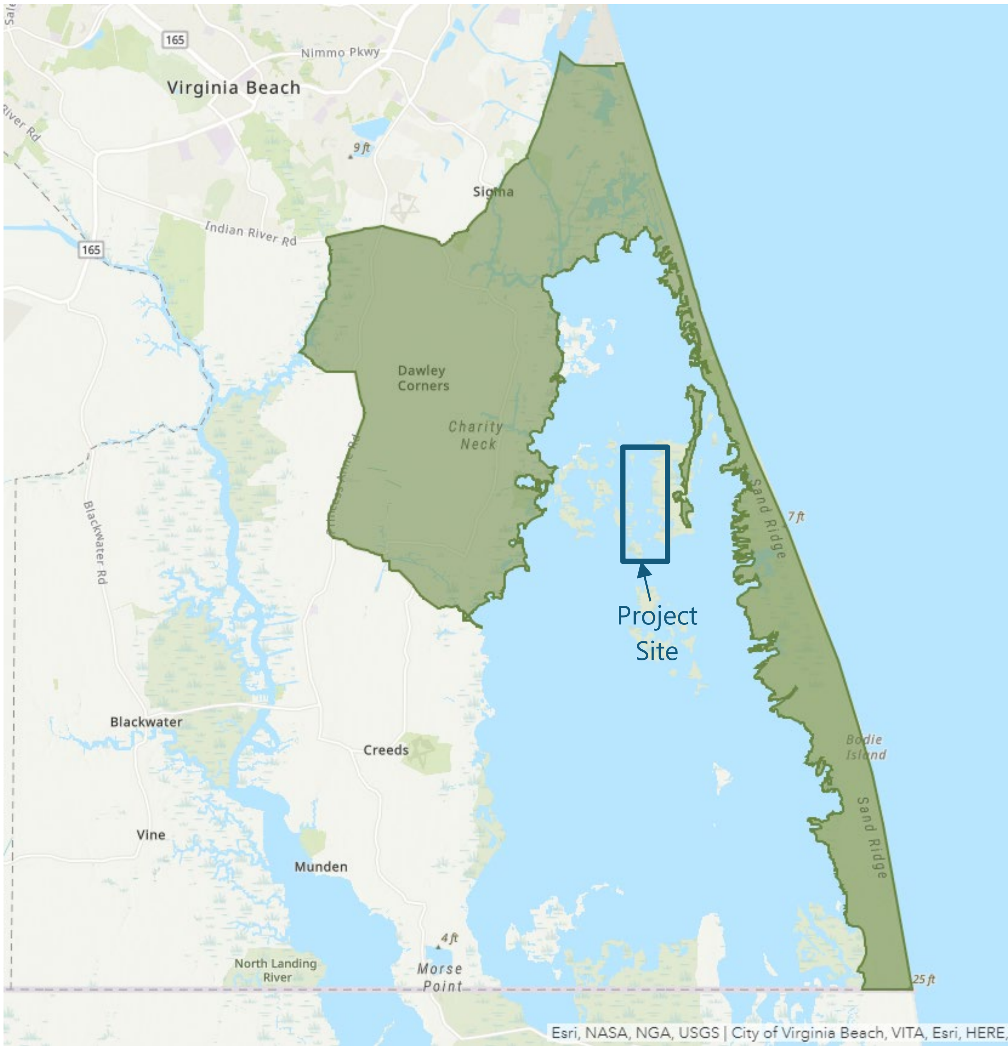

Figure 14: Census block groups selected for population estimates.

Historic Flooding Data and Hydrologic Studies Projecting Flood Frequency

Historical and Existing Flood Data

The project is located within a Federal Emergency Management Agency (FEMA) mapped Special Flood Hazard Area (SFHA), as shown in Figure 15 and Figure 16. Based on the City's current flood maps (effective January 16, 2015), the project site's flood zones are VE, AE, and Open Water. Portions of the site are within Otherwise Protected areas.

The following maps provide an overview of the existing flood hazards for the project area, including the northern boundary (Figure 15) and southern boundary (Figure 16). Based on the City's current flood maps (effective January 16, 2015), the project site contains VE and AE flood zones and Open Water.

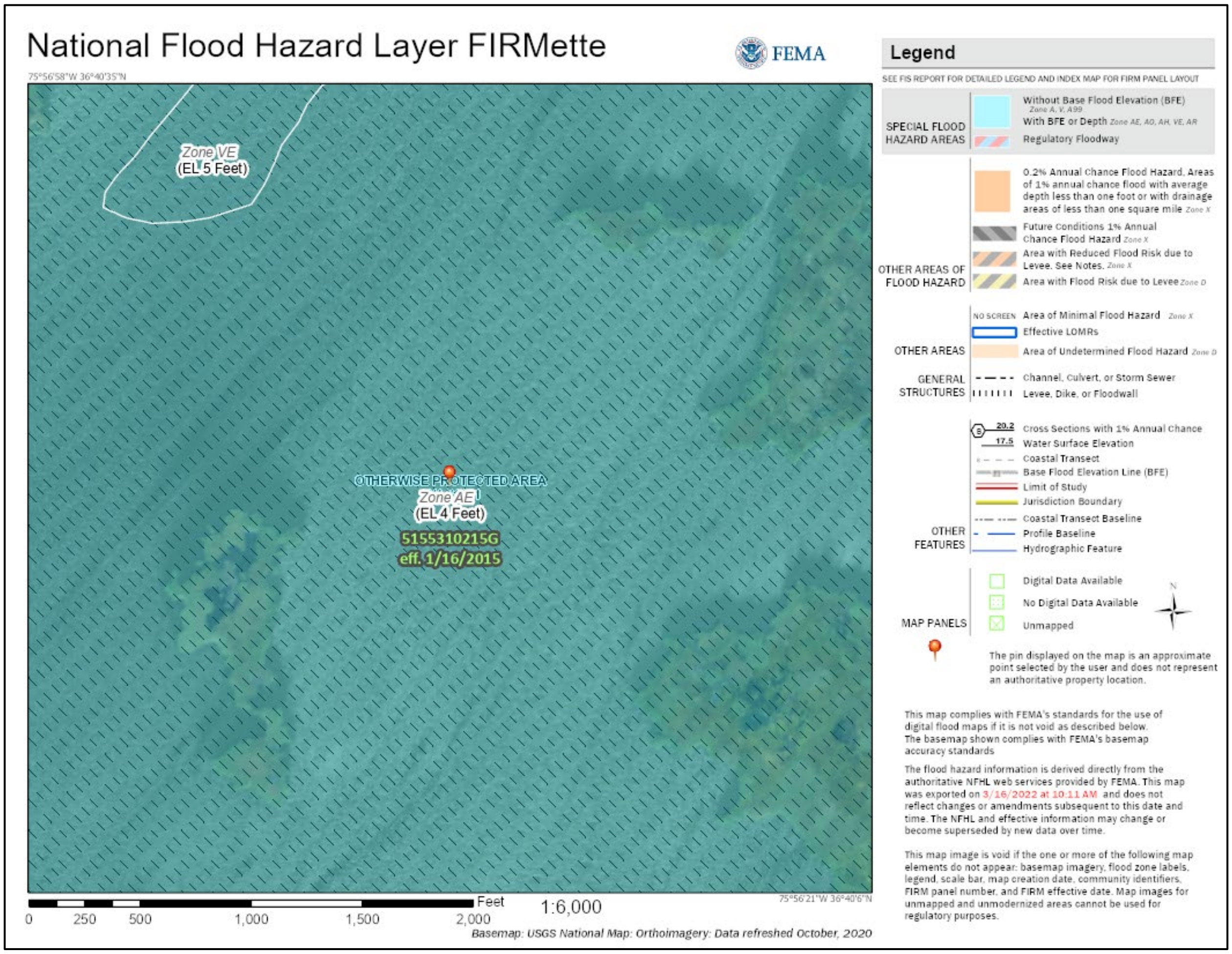

Figure 15: FIRMette for the project area (northern boundary).

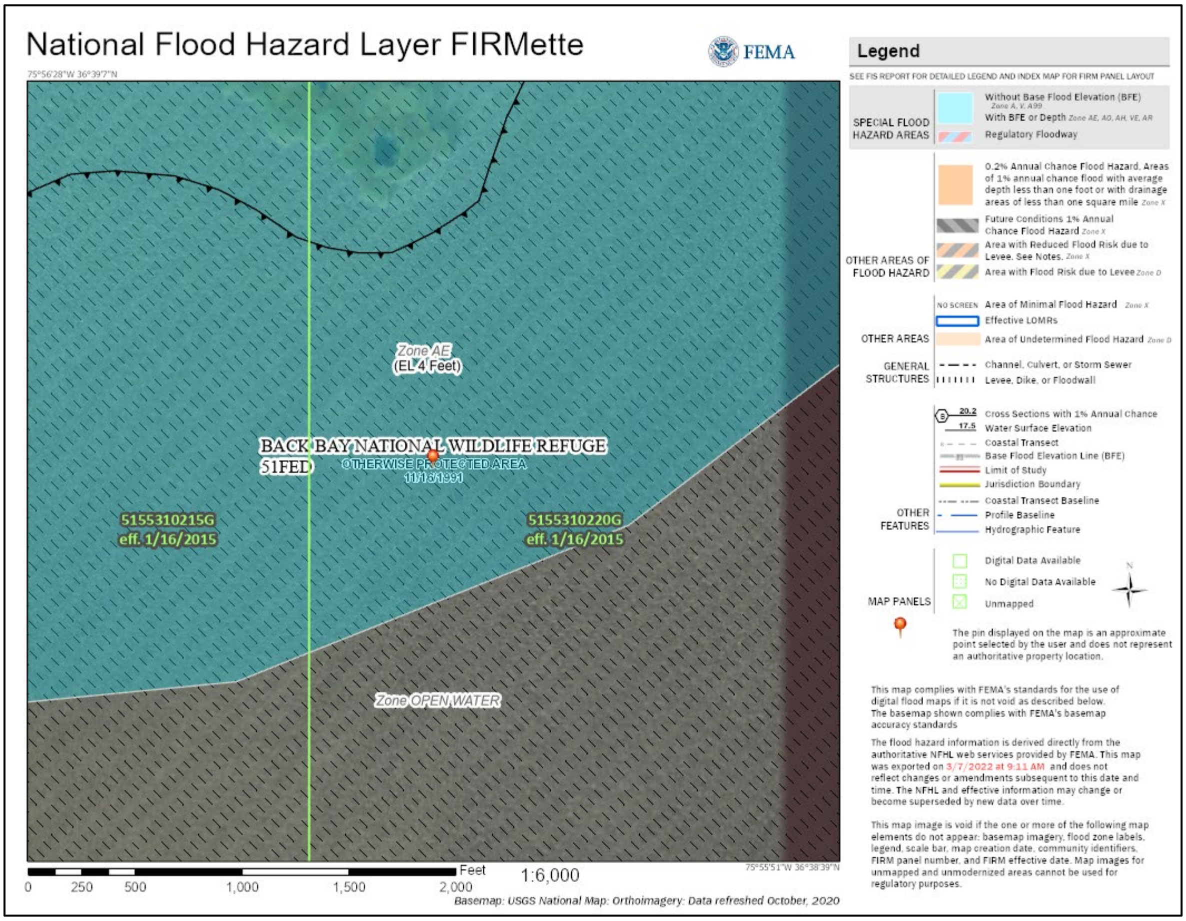

Figure 16: FIRMette for the project area (southern boundary).

The City maintains records of where residents report flood issues and what type of flooding is causing the issue. Residents regularly report flood issues through a hotline, which are then recorded in a flood event database. The census block groups adjacent to the project area reported 111 flood issues associated with heavy rain or high tide between 2001 and 2019. Critical facilities and flood incidences are relatively concentrated in the Sandbridge Resort Area.

Projected Flood Frequency

The USFWS, the City, and other stakeholders have made significant investments in detailed assessments, sophisticated computer models, and water level gauges to better understand historical and future wind tide flooding. Figure 17 displays the projected flood pathways under the 10-year and 100-year storm event under a 3 feet sea level rise scenario surrounding the project site.

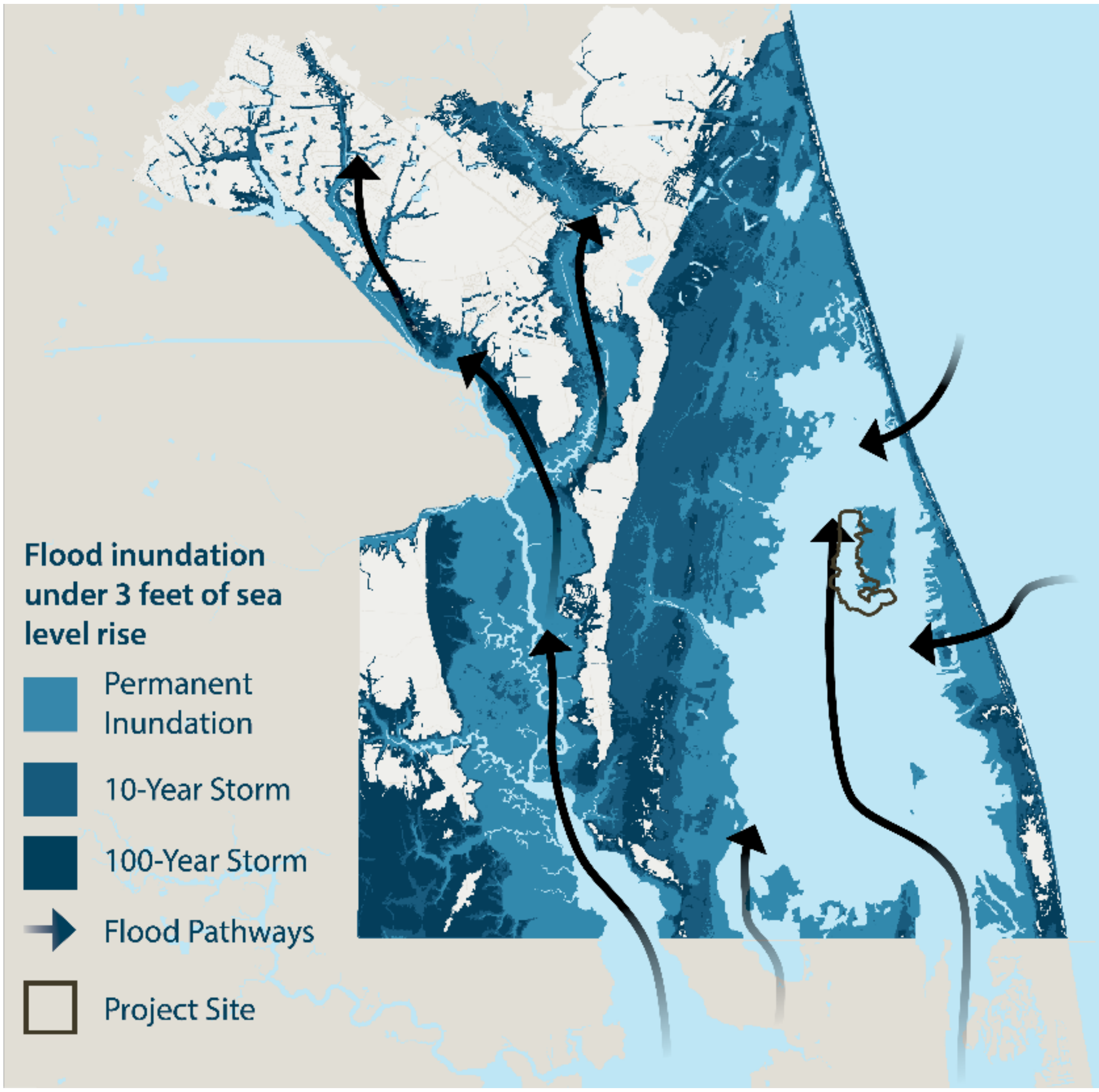

Figure 17: Flood pathways into the Southern Rivers Watershed with 3 feet of sea level rise.

Numerical modeling also shows that as sea levels continue to rise, a shorter duration wind event will produce more wind-induced flooding in less time. The three lines in Figure 18 represent the water level response to a sustained 15-mph wind for each sea level rise scenario. With the existing marsh system today (blue line), it takes approximately five days of sustained southerly wind to cause flooding. With 1.5 feet (yellow line) and 3 feet (red line) of sea level rise, the peak water level could be reached two to three days sooner, respectively. Model simulations showed that marsh island creation across Back Bay would help delay the onset of flooding by several days, which would allow the City and residents more preparation time[7].

[7] City of Virginia Beach. (2018). Analysis of Marsh Response to Sea Level Rise (PDF).

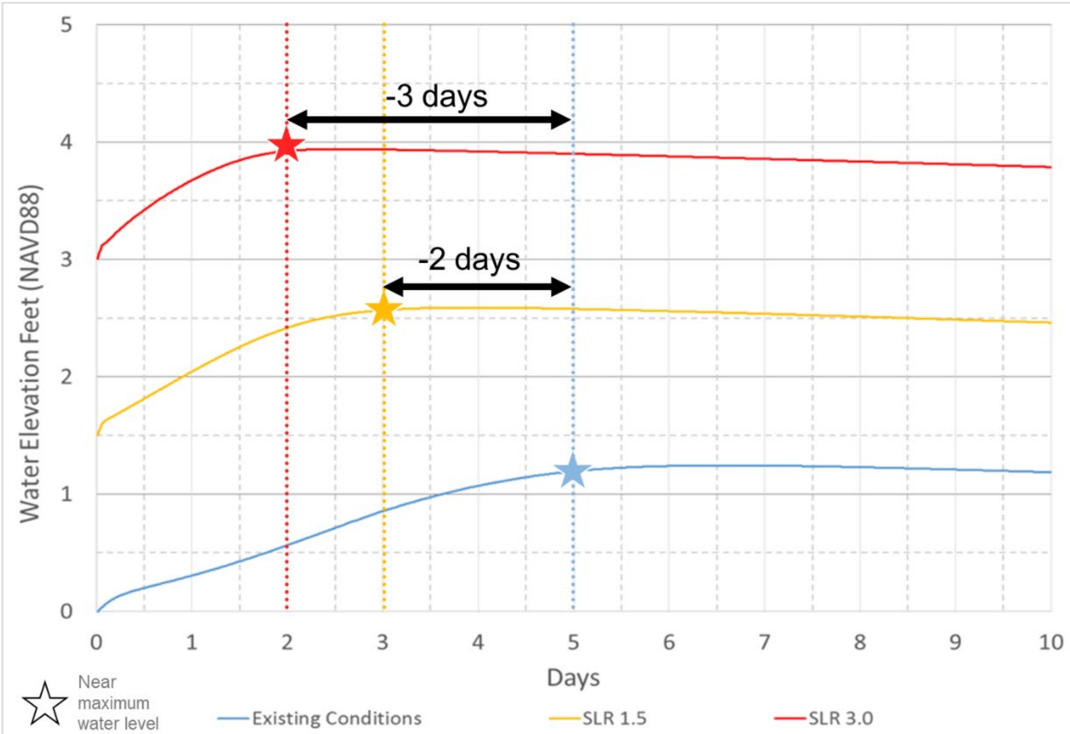

Figure 18: Water-level response under sustained 15-mph southerly wind.

The City analyzed future marsh conditions using the Sea Level Affecting Marshes Model (SLAMM).[7] Figure 19 illustrates areas likely to experience accelerated degradation of marsh in Back Bay due to rising water levels. If no action is taken, substantial marsh loss is projected in Bonney Cove under 3 feet of sea level rise. Within a 1-mile radius of Bonney Cove, the City's SLAMM model predicts that approximately 730 additional acres could be eroded into open water in response to sea level rise. This represents more than a 70% reduction as compared to the existing marsh system surrounding Bonney Cove today. It is also presumed that open water areas would continue to experience high levels of turbidity, which will continue to negatively affect SAV communities in Back Bay.

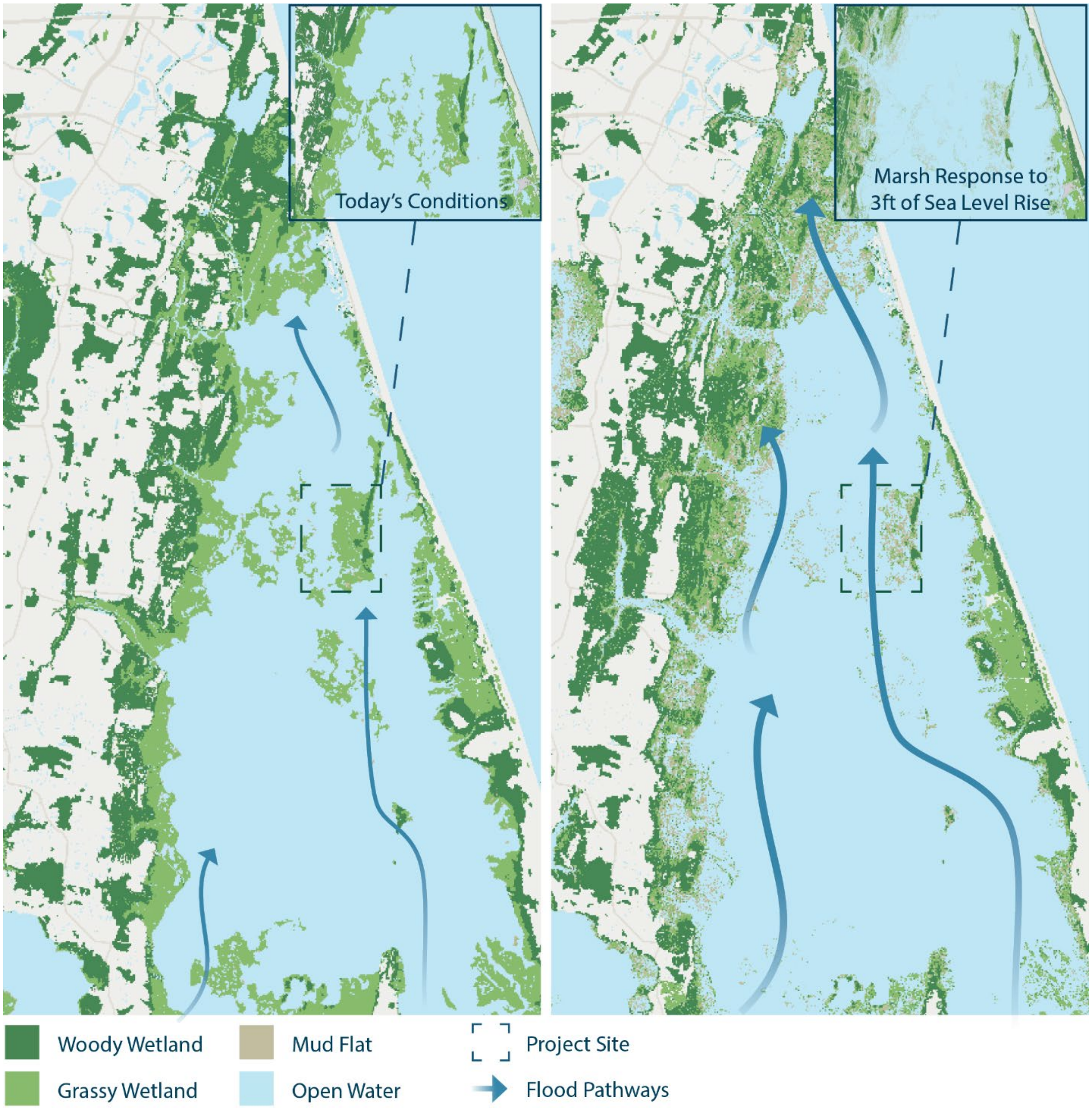

Figure 19: Comparison of current marsh conditions to future marsh conditions with 3 feet of sea level rise.

The proposed project site in Bonney Cove has a predominant south-southwest wind direction, which contributes to significant wave generation in the large unobstructed open-water areas and provides a continuous source of scouring and erosion in those areas. Marsh loss is likely to continue in the project area, creating a negative feedback cycle as continued fragmentation of the marsh would further deteriorate the remaining stands of healthy marsh and increase fetch. Today, the site faces low to medium fetch exposure, but in the future, the site could experience high to very high fetch exposure, as defined by the Virginia Institute of Marine Science (VIMS)

Shoreline Design Guidelines for Shore Protection in Virginia's Estuarine Environments.[8] Projections of increasing fetch at the site, along with the transects used for the wind fetch analysis, are summarized in Figure 20.

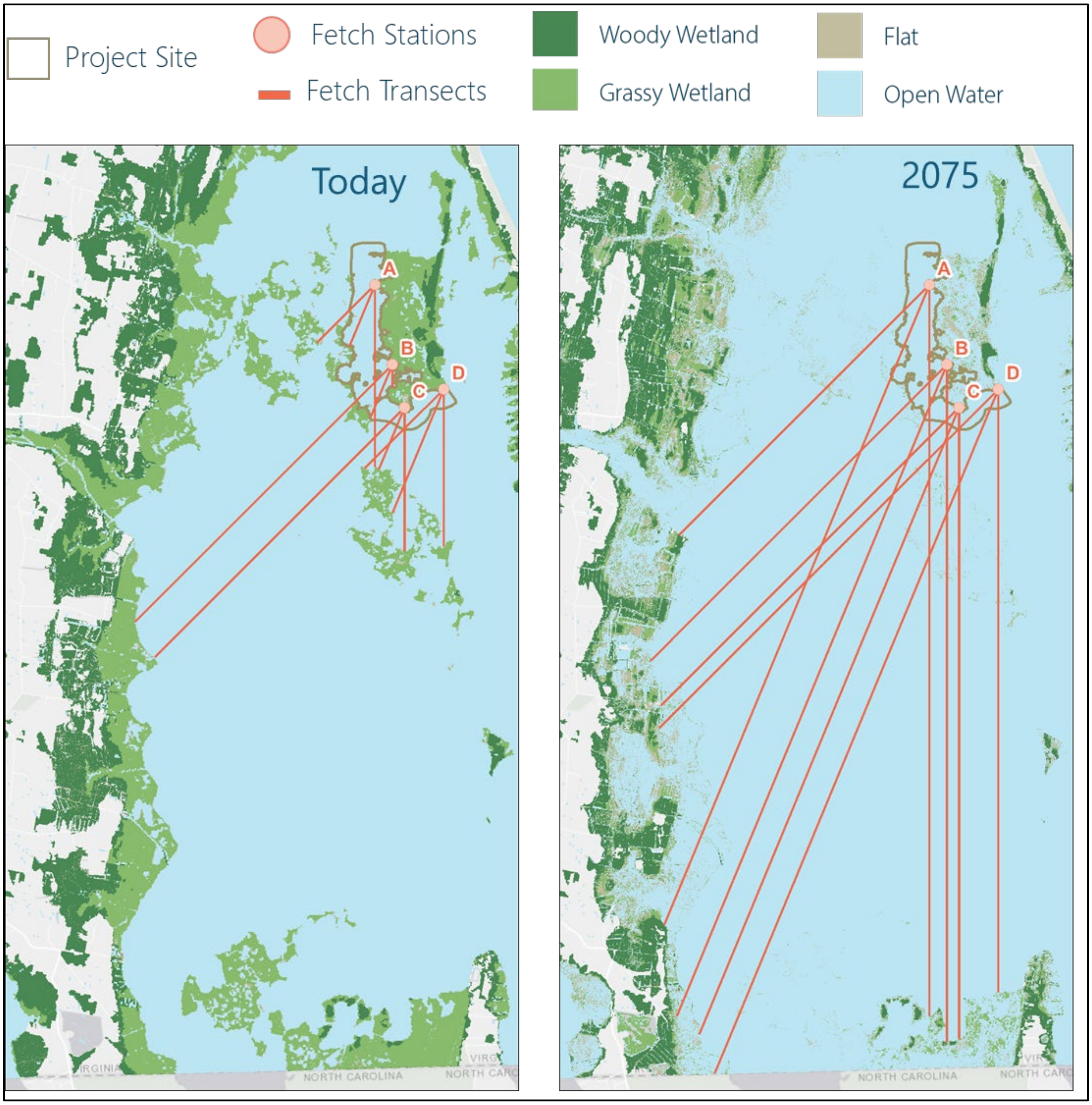

Figure 20: Wind fetch analysis of project area.

The following table displays specific values of fetch distances and classifications that correspond with the transects displayed in Figure 20 above.

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[8] Virginia Institute of Marine Science. (2010). Living Shoreline Design Guidelines for Shore Protection in Virginia's Estuarine Environments; Version 1.2 (PDF).

Table 5: Measurements of fetch transects referenced in Figure 20.

Fetch Transect	Length, Miles (Today)	Classification	Length, Miles (3 feet SLR)	Classification
A-SW	0.9	Low	3.7	High
A-SSW	0.7	Low	7.3	Very High
A-S	1.9	Medium	7.7	Very High
B-SW	3.8	Medium	4.4	High
B-SSW	0.6	Low	7.4	Very High
B-S	0.2	Very Low	7.2	Very High
C-SW	3.7	Medium	4.4	High
C-SSW	0.7	Low	7.2	Very High
C-S	1.5	Medium	6.7	Very High
D-SW	1.2	Medium	5.1	Very High
D-SSW	1.4	Medium	7.8	Very High
D-S	1.7	Medium	6.4	Very High

No Adverse Impact

The City conducted additional hydraulic numerical modeling to identify any potential adverse impacts in response to concerns raised during a public meeting in July 2023. The City utilized a Danish Hydraulic Institute MIKE FLOOD model developed for stormwater master planning activities in Lower Southern Rivers Watershed of Virginia Beach. This model encompasses the entirety of Back Bay and extends into North Carolina's Currituck Sound. Model performance has been validated against observations from multiple flood events.

The effort looked at water level and velocities in response to a historical southerly wind tide flood in May 2017 and a northerly wind event associated with Tropical Storm Ophelia in September 2022. These events were ran with model grids depicting with- and without project conditions, considering the 100% project design specifications. The northerly wind event was

included to address concerns from residents of Knott's Island, at the southern end of Back Bay. Both the terrace field and the construction staging area were included in the with-project condition. The modeling found that there were no increases in water levels to areas within Back Bay or to Knotts Island. Negligible changes in water velocity (0.2 ft/s or less) were observed in the channel to the west of the terrace field. No increases in water levels were observed in the area of the construction staging area.

Local Government to Provide its Share of the Cost

The City of Virginia Beach is fully prepared to cover the cost share of the proposed project, as highlighted in the attached budget narrative, "Amount of Cash Funds Available." The funding for the grant match is contained within the City budget.

Benefit-Cost Analysis

FEMA recognizes the economic value of restoration projects and has provided ecosystem service economic valuations for benefit cost considerations. The approach and values used here are consistent with FEMA Benefit-Cost-Assessment (BCA) toolkit approaches and ecosystem service valuations published in "FEMA Ecosystem Service Value Updates, June 2022[9]." The 2022 FEMA guidance provides methods and values for various nature-based projects, including coastal wetlands. The valuations recognize ecosystem services for coastal wetlands including aesthetic value, climate regulation (carbon sequestration), flood and storm hazard reduction, habitat, recreation/tourism, water filtration and supply benefits of coastal wetland features.

Feasibility and Effectives Criteria

The project meets FEMA's Feasibility and Effectives Criteria for a Coastal Wetland as defined in the 2022 guidance, including:

- Land cover associated with the project is a "Estuarine and Marine Wetland" as classified for NWI for remaining marsh within and adjacent to the study area. The area of the project is also a historical marsh.
- The project demonstrates "ecosystem restoration" by using the terrace approach to recover degraded, damaged, and destroyed wetlands and submerged aquatic vegetation in the Back Bay ecosystem.
- The project meetings EPA concepts of restoration through direct creation of marshes (the terraces themselves) and enhancement of the ecosystem (reduction of water turbidity to enhance growth of submerged aquatic vegetation).
- The project will result in notable increased health and function of the local ecosystem in the "after mitigation" scenario through reduction of wave heights, water flow, and significantly decreased turbidity within the project area, as well as reduction of wave heights to adjacent areas.

[9] FEMA Ecosystem Service Value Updates, June 2022 (PDF).

- The project approach was aligned with established principles and techniques on wetland restoration, as outlined in the Coastal Wetlands and Tidal Flats section of the International Guidelines on Natural and Nature-base Features for Flood Risk Management10.

Design Life

As mentioned, the project useful life is 30-years. The FEMA 2022 guidance allows 50-years a typical lifespan; however, as stated in the project description, the elevation of the terraces was set based on a 30-year design life and estimated settlement.

Ecosystem Services Valuation

- The 2022 guidance values ecosystem services for coastal wetlands at $8,955 in 2021 U.S. dollars (USD), per acre, per year.
- The project will restore 46.5 acres of intertidal and upland marsh through direct creation of the marsh terraces. The project will also promote the growth of SAV in between the terraces, an area estimated at 310 acres. This provide for a total project benefit area of (46.5 + 310) = 356.5 acres.
- Project benefits occur over a period of time into the future; while most of the project costs are incurred up front and in the present. FEMA conducts its BCAs on a net present value basis, meaning the present value of the benefits gained from the project over the life of the project are compared to the total project cost to establish the BCR. Because project benefits accumulate over time, project benefits are calculated on an average annual basis ("annualized") and then multiplied by a Present Value Coefficient (PVC) to determine the present value of the annualized benefits.
- The present value coefficient is calculate as follows:

$$PVC = \left[\frac{1-(1-r)^{-T}}{r}\right]$$

where *r* is the discount rate and *T* is the useful life of the project. The CFPF 2023 Grant Manual does not specify a discount rate for the benefits calculation; therefore, the latest FEMA program grant guidance was reviewed. For the 2023 FEMA Building Resilient Infrastructure and Communities (BRIC) and Floodplain Mitigation Assistance Grant Program (FMA) cycles FEMA has established a set discount rate of 3%[11]. The 3% discount rate provides for a PVC of 19.60 for a 30-year lifecycle for the project.

- Project benefits were calculated by:

$$Benefits = PVC \times Project\ Area \times Coastal\ Wetland\ Benefits$$

- The benefit cost ratio (BCR) was calculated as:

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[10] International Guidelines on Natural and Nature-Based Features for Flood Risk Management - Engineering With Nature (dren.mil)

[11] FEMA Fact Sheet. Notice of Funding Opportunity for Fiscal Year 2023 Building Resilient Infrastructure and Communities Program (PDF).

$$BCR = \frac{Benefits}{Costs}.$$

A summary of the calculated values is provided in the below table:

Table 6. Summary of BCA parameters and results.

Project Area	Benefits (acre / year, 2021 USD)	Project Lifespan	Benefits, 3% discount rate	Project Cost	BCR, 3% discount rate
356.5	8,954	30	$62,566,588	$53,378,490	1.17

The calculated BCR for the project was 1.17, based on the FEMA ecosystem services valuation approach. This BCR is greater than 1, indicating the project can be considered cost-effective. The project also provides an additional $9.19M in value over the project cost.

Local Floodplain Management Regulations

The City recognizes the vital importance of floodplains in the natural movement of water through the community. Appendix K of the Virginia Beach Code of Ordinances regulates development in the community's floodplains. The City requires that a permit is obtained for any construction or development in the Special Flood Hazard Area. For more information and details regarding the City's floodplain management and ordinances, please refer to the following:

- Link to current floodplain ordinance: Virginia Beach Floodplain Ordinance.

In addition, a copy of the current floodplain ordinance has been included in *Part IV, Section E5*. For further information regarding the City's hazard mitigation and comprehensive planning, please refer to the following:

- Link to current hazard mitigation plan: Regional Hazard Mitigation Planning.
- Link to current comprehensive plan: Virginia Beach Comprehensive Planning.

Other Necessary Information to Establish Project Priority

Repetitive Loss and/or Severe Repetitive Loss Properties

The repetitive loss database shows 113 repetitive loss and severe repetitive loss properties within the two census block groups (518100454.121 and 518100464.001) associated with the project area.

Residential and/or Commercial Structures

A detailed economic flood loss assessment presented in the City's Resilience Plan showed that approximately 45% of the entire future risk exposure in the City is concentrated in the Southern Rivers watershed. Of that risk, 65% is concentrated in three communities north of Back Bay

(Figure 21).[12] Under a "no action" scenario, average annualized flood losses would increase from $974 thousand, representing present day conditions, to $6 million with 1.5 feet of sea level rise as anticipated by 2050. This figure equals an increase of six times present day conditions. With 3 feet of sea level rise as anticipated by 2080, annualized losses are expected to drastically increase to $80 million, more than 80 times today's conditions.

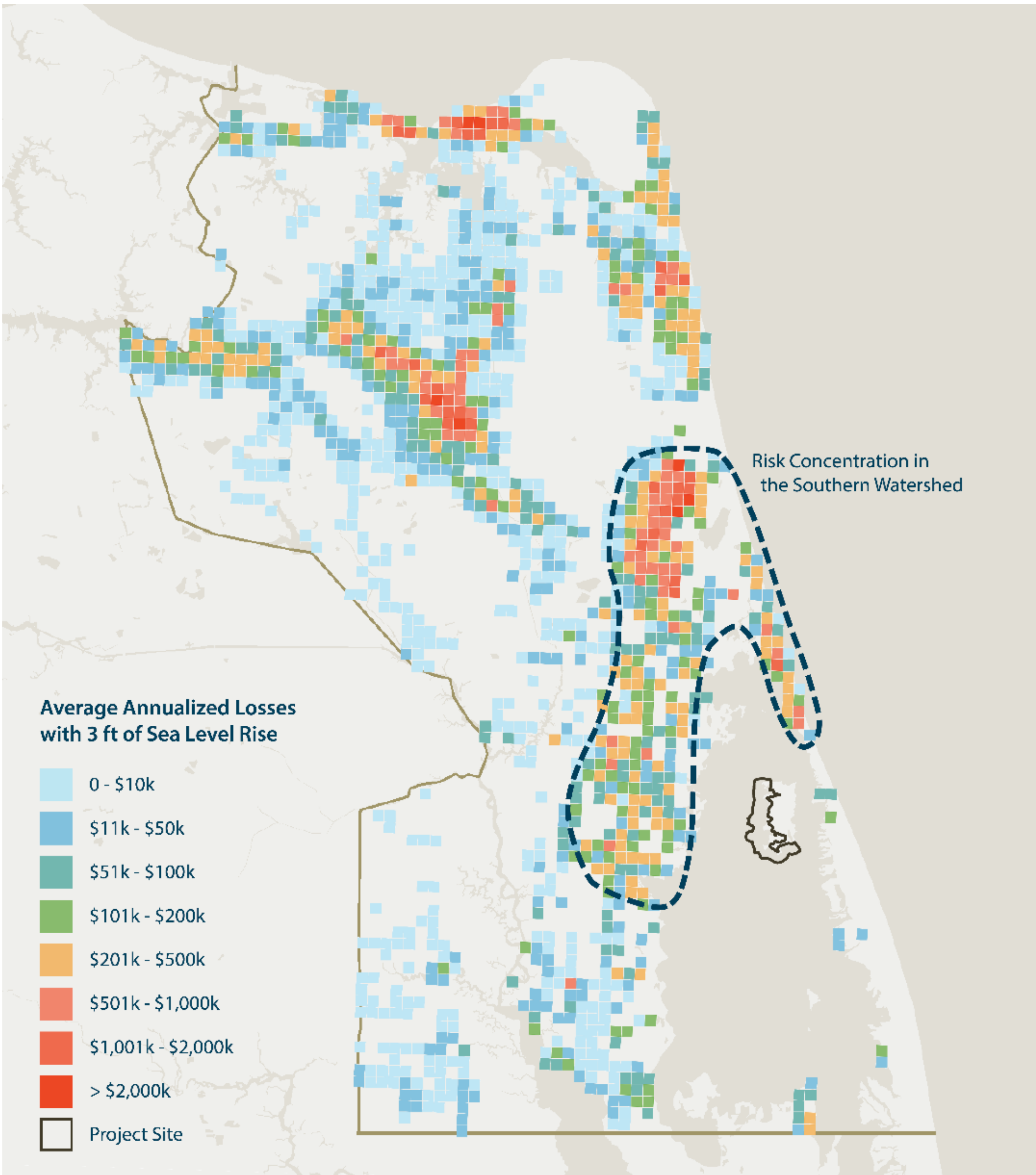

Figure 21: Concentration of average annualized losses estimated with 3 feet of sea level rise under a "no action" scenario presented in the City's Resilience Plan.

[12] City of Virginia Beach. (2020). Coastal Flooding and Economic Loss Analysis (PDF).

Within the two census block groups adjacent to Back Bay near the project area, there are approximately 70 commercial structures and 2,350 residential structures. Of those structures, approximately 635 structures are vulnerable to flooding during a 50-year event today. With 3 feet of sea level rise, approximately 2,060 structures are expected to be vulnerable during a 50-year event, representing approximately 85% of the residential structures within the project vicinity. These numbers underscore the importance of implementing the proposed project alongside complimentary flood risk reduction projects.

Critical Facilities

The two census block groups near the project site include 10 critical facilities. Table 7 summarizes critical facilities by type, total number, and the number of facilities exposed to the 50-year storm scenario under current and future "no action" scenarios. Under current 50-year storm conditions, 2 communication facilities and 1 electric power station would be exposed to flooding. With 3 feet of sea level rise, the number of critical facilities exposed to flooding increases to 9 total facilities.

Table 7: Summary of critical facilities located in the selected census block groups and flood hazard exposure to the 50-year storm event under current conditions and with 1.5 feet and 3 feet of sea level rise.

Type of Facility	Number of Facilities	Current 50-year storm	50-year storm with 1.5 feet sea level rise	50-year storm with 3 feet sea level rise
Communication	3	2 (66%)	2 (66%)	3 (100%)
Electric Power	1	1 (100%)	1 (100%)	1 (100%)
Fire Station	1	0	0	0
Potable Water	2	0	2 (100%)	2 (100%)
School	1	0	0	1 (100%)
Wastewater Treatment	2	0	0	2 (100%)

Need for Assistance

The City of Virginia Beach has invested significant time, money, and staff resources in understanding, communicating, and planning for the threats of sea level rise and recurrent flooding to the community. The City is ready to begin the implementation of adaptation measures, and the marsh terrace project is the first project to advance to construction from the City's Resilience Plan. The project represents the first step in restoring Back Bay and the larger Albemarle-Pamlico estuary, and serves as a pilot for additional restoration projects. Virginia Beach understands that flood mitigation costs are substantial and is seeking funds to support project implementation alongside dedicated resources procured by the City. The City's

Department of Public Works Stormwater Engineering Center has closely coordinated with the City's Department of Planning & Community Development throughout the design and permitting process. The Department of Public Works will oversee the construction of the marsh terrace project, including providing construction inspectors to monitor that the project is built to the City's design standards and technical specifications. Additionally, the City has access to necessary software, including AutoCAD and ArcGIS Desktop, and support from consultants to augment the City's technical capabilities.

Examples of City staff who will support the project include the following:

- Program Manager for the Technical Services Division of the Stormwater Engineering Center.
- Project Manager for Green Infrastructure Projects for the Technical Services Division of the Stormwater Engineering Center.
- Environmental Planner / Certified Floodplain Manager from the Wetlands & Shoreline Construction Team of the Planning Administration Division of the Department of Planning & Community Development.
- Planning Evaluation Coordinator from the Chesapeake Bay Preservation Area & Southern Rivers Watershed Team of the Planning Administration Division of the Department of Planning & Community Development.
- Full-time Construction Inspector assigned exclusively to this project from the City's Construction Bureau or under contract with the City Public Works Engineering Division.
- Grant Coordinator from the City's Public Works Engineering Division.

Additional staffing will be provided as needed to ensure project success.

This project benefits communities in northern Back Bay with a high concentration of flood losses (as shown in Figure 21). These communities contribute significantly to Virginia Beach's rural economy, including agriculture, forestry, fishing, hunting, and eco-tourism. In Hampton Roads, these industries contribute a combined $100 million in gross domestic product.[13] Protection of vulnerable natural infrastructure, such as the marshes in Back Bay, is critical to ensuring these industries can continue to thrive within the region.

Alternatives

Several other alternatives were considered but not advanced due to technical and environmental limitations. These alternatives are briefly summarized below.

[13] Office of Governor Ralph S. Northam Commonwealth of Virginia and Virginia Department of Conservation and Recreation. (2021). Virginia Coastal Resilience Master Plan Phase 1 (PDF); data referenced sourced from the US Bureau of Economic Analysis. (2019).

Alternative 1 - No Action Alternative

Under this alternative, no action would be taken to restore marsh habitat in the shallow open water channel of Bonney Cove. Erosion of the adjacent marsh would continue to occur, resulting in fragmented habitat lacking the capacity to reduce wave action and slow water velocities. It is anticipated that wind-driven flooding events will continue to increase in frequency, resulting in increasing flooding of the low-lying properties and roadways surrounding northern Back Bay.

Alternative 2 - Alternative Terrace Configuration Design(s)

Several configuration alternatives for the terraces were considered during the design process. These included four alternative layouts with different spacing and terrace top widths:

- **Alternative 2a** (Figure 22): Terraces would be spaced at approximately 300-foot intervals and have a top width of 15 feet. Between the base of the terraces, there would be approximately 220 feet for potential establishment of SAV habitat.
- **Alternative 2b** (Figure 23): Terraces would be spaced at approximately 300-foot intervals and have a top width of 30 feet. Between the base of the terraces, there would be approximately 200 feet for potential establishment of SAV habitat.
- **Alternative 2c** (Figure 24): Terraces would be spaced at approximately 600-foot intervals and have a top width of 15 feet. Between the base of the terraces, there would be approximately 520 feet for potential establishment of SAV habitat.
- **Alternative 2d** (Figure 25): Terraces would be spaced at approximately 600-foot intervals and have a top width of 30 feet. Between the base of the terraces, there would be approximately 500 feet for potential establishment of SAV habitat.

A common feature across all of these design alternatives was a breakwater that spanned the entire length of the southern extent of Long Island and a northern breakwater that spanned the northern exposed section of the project site.
Alternative 2a and 2b were eliminated due to constructability concerns regarding the quantity of sediment that would be required and due to the limited amount of room for SAV establishment in between the terraces (approximately 220- and 200- feet of potential SAV habitat between terraces for Alternative 2a and 2b, respectively).

Alternatives 2c and 2d were discussed extensively amongst the project team; however, it was ultimately determined that they did not maximize the opportunity for species diversity (by including both smaller and larger terraces). These alternatives were combined to form the preferred alternative presented in this document. Additional refinements that were made to these alternatives include the removal of the perimeter breakwater, as the proposed design elevation evaluated in the geotechnical analysis revealed stability issues with these large features.

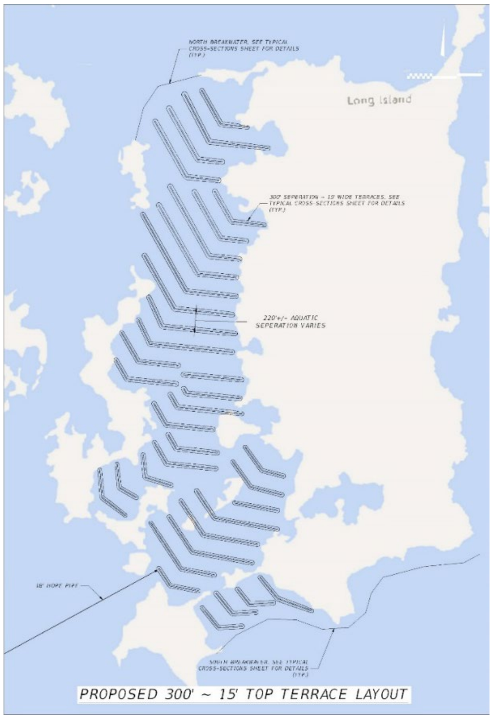

Figure 22: Alternative 2a.

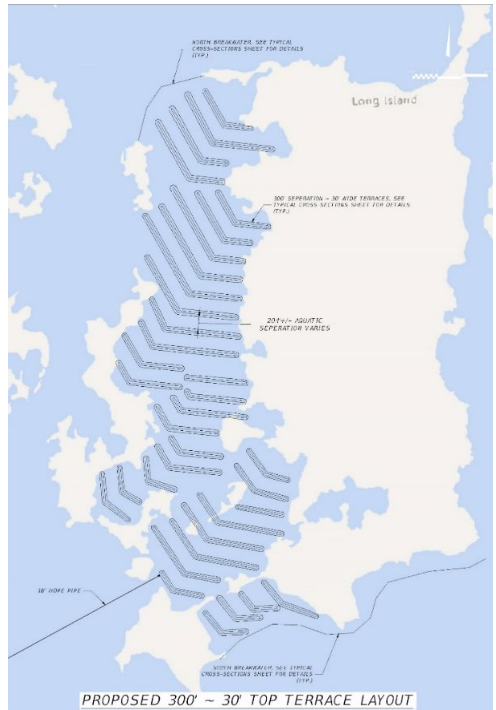

Figure 23: Alternative 2b.

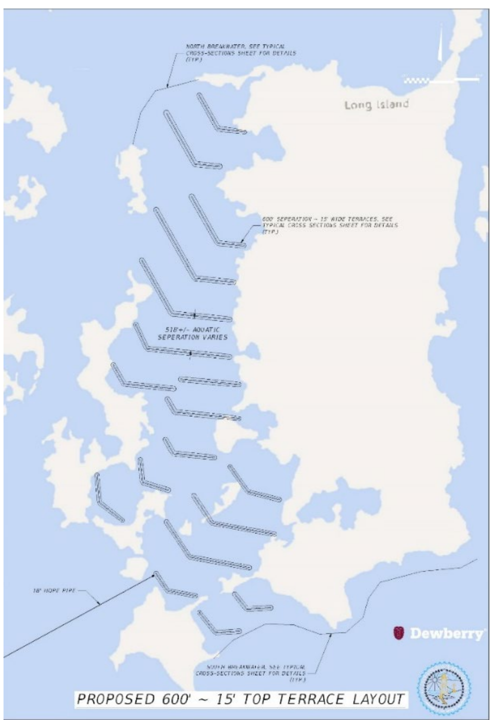

Figure 24: Alternative 2c.

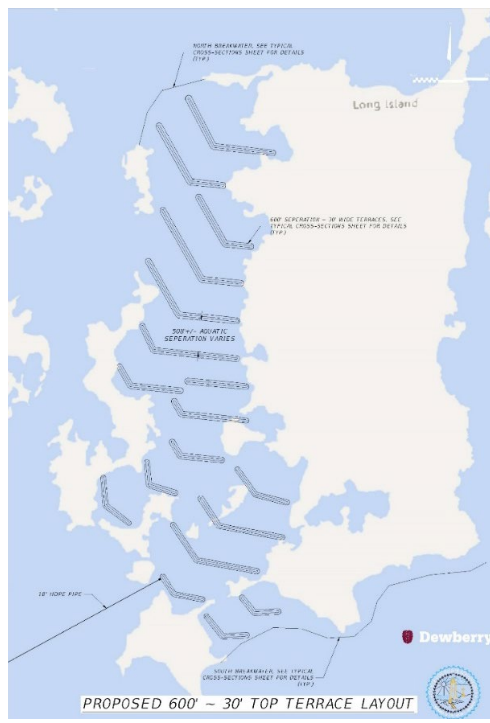

Figure 25: Alternative 2d.

Alternative Terrace Core Material Sources and Transportation – Alternative 3

In the proposed alternative with sand cores, a no-dredging alternative was considered. However, in order to successfully complete the project and establish the vegetation desired, material would need to be sourced, blended, transported, and placed. The City helped identify two potential borrow sources of material: Bow Creek Golf Course (Figure 26) and the Whitehurst Dredged Material Management Area (DMMA) (Figure 27).

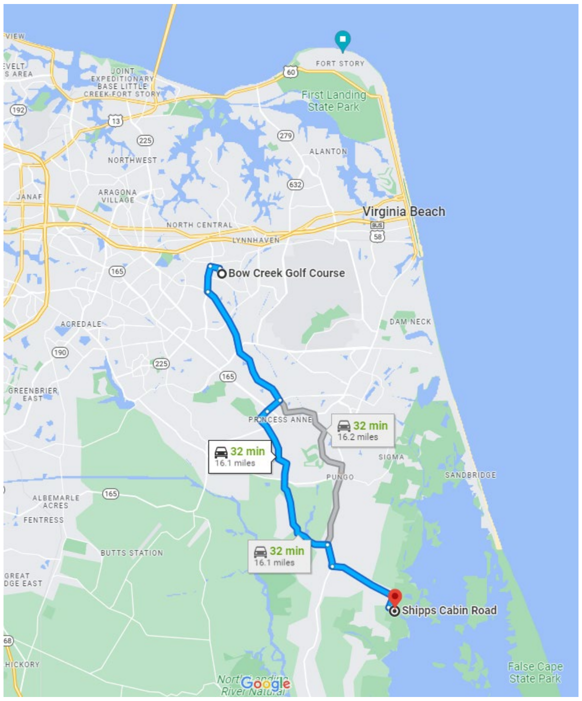

Figure 26: Distance from Bow Creek Golf Course to the proposed Shipps Cabin staging area.

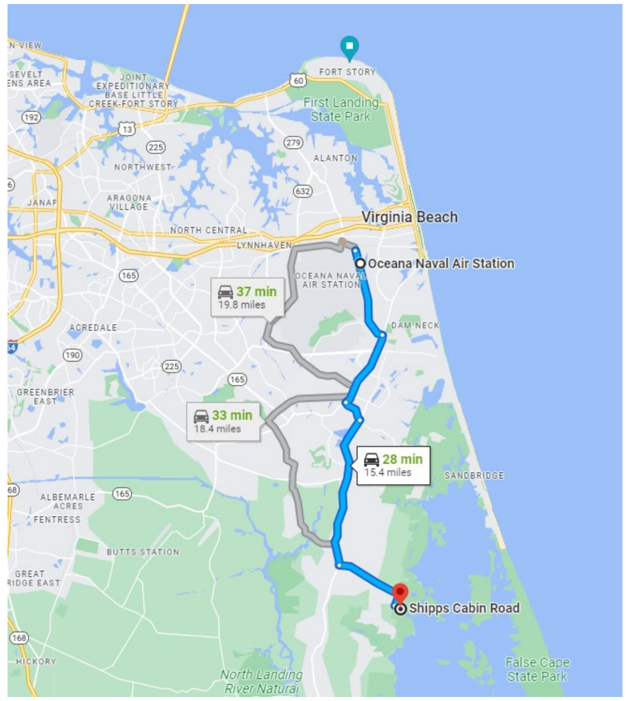

Figure 27: Distance from Whitehurst DMMA to the proposed Shipps Cabin staging area.

Bow Creek Golf Course: Bow Creek Golf Course is located approximately 16 miles from the proposed Shipps Cabin staging area. In the next few years, The Bow Creek Golf Course is scheduled to be converted into a Stormwater Park as one of 21 projects funded by the City's Stormwater Flood Protection Program. Large quantities of materials will be removed from the site for use within the City. The material from Bow Creek would need to be excavated, screened, and tested for foreign seeds and contaminants. Most likely, this material would have to be processed before it could be loaded again on dump trucks and hauled approximately 16 miles to a potential staging area where it would be loaded again on shallow draft barges.

Whitehurst DMMA: The Whitehurst DMMA is a similar distance to the proposed Shipps Cabin Road Construction Staging Area. The material at Whitehurst may not have to be processed as much; however, it would need to be tested for foreign seeds and contaminants. Because of the organic components in this soil and the need for the material to establish vegetation on the terraces, this material is not able to be hydraulically blended and pumped to the site. Therefore, this material would need to be loaded on shallow draft barges and then

placed by mechanical means. Further, the amount of material needed to cap the proposed terraces is approximately 110,000 cubic yards which equates to roughly 5,500 quad-axle dump trucks traveling city streets and damaging other infrastructure.

Barging of all materials was considered. Dewberry conducted meetings, site investigations, and talked with both industry leaders in maritime construction and locals who know the water in Back Bay. A typical 35-foot by 95-foot construction barge drafts approximately 7 feet. This type of barge is not able to be trucked to the landing site, nor is it able to be brought into Back Bay. There are truckable barges, but again the drafts of those barges can be in the 4 to 5 feet range when loaded and would require dredging a channel for access. Shallow draft barges can be used in Back Bay that only draft 1 to 3 feet, and they would need to be off-loaded from a staging site. To bring any materials such as stone, sandy fill, or terrace cap material by barge around Knotts Island is not feasible. The actual channel into the southern point of Back Bay has a height restriction due to the causeway serving Knotts Island.

Continuous Marsh Platform – Alternative 4

A continuous marsh platform to fill in the areas of historical marsh would help to restore this eroded habitat but would not provide conditions suitable for SAV establishment or optimize the wave/flow velocity attenuation through the project area. Furthermore, for a single marsh platform across Bonney Cove, the amount of material required would be more than 3 or 4 million cubic yards of material. To achieve that volume of material by dredging, significant areas of existing SAV present in Back Bay would need to be impacted. As the geotechnical report indicated, the existing material of the project site and surrounding areas is not capable of supporting itself in a constructed arrangement and would slough off back into the water. Further, providing this amount of material without dredging would require bringing external sediment sources into Back Bay, which could introduce invasive species. Finally, while the platform will reclaim marshland, it is not anticipated to establish extensive areas appropriate for SAV reestablishment and would eliminate deeper water areas preferred by some endemic wildlife species.

Goals and Objectives

The overarching goal of this project is to construct the City's first nature-based adaptation project in the Southern Rivers Watershed and one of the CRMP's exemplary nature-based projects. This project aims to stabilize two critically eroding marsh islands from further degradation, decrease turbidity to promote the growth of aquatic vegetation and provide flood risk reduction benefits through increased friction and wave attenuation. The following section summarizes the objectives through which this goal will be realized.

Objective 1 – Create a Construction Access and Staging Area

The project's first objective is to employ a construction approach that is compatible with the shallow nature of Back Bay and the large quantity of material required to build the marsh terraces. The engineering team performed a constructability review of suitable landing sites to

stage construction operations for the terraces. A property located at the end of Shipps Cabin Road (Figure 28) was identified as the preferred staging and construction access location for the following reasons:

- Shipps Cabin Road Construction Staging Area Proximity to site (2 miles).
- Shipps Cabin Road Construction Staging Area Proximity to sand borrow sources.
- Shipps Cabin Road between Muddy Creek Road and the Construction Staging Area is in disrepair and was identified as an opportunity to improve the condition of the road as part of the construction activities.

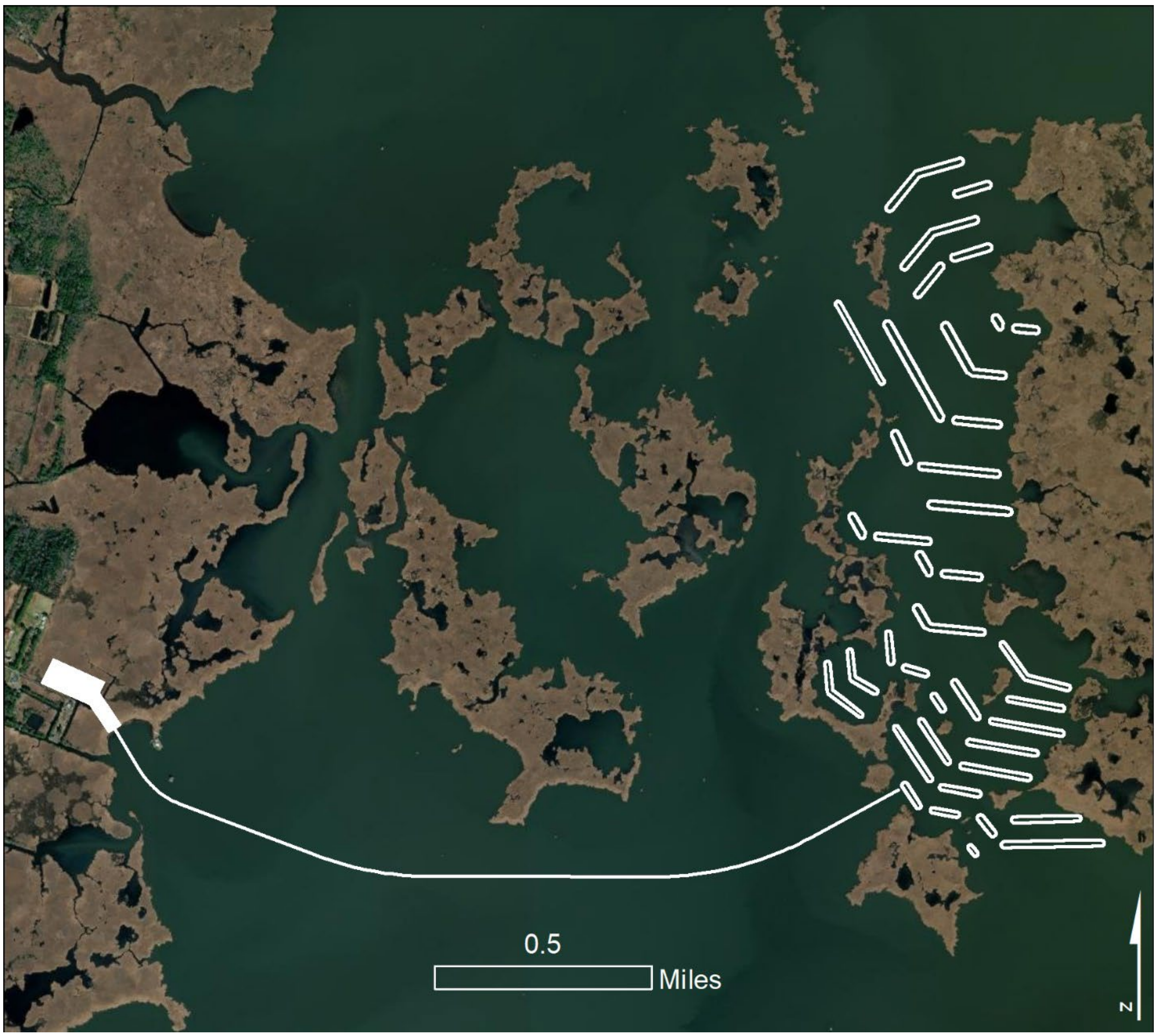

Figure 28: Proposed Construction Access.

On completion of the project, the City plans to retain the staging area for future monitoring and maintenance needs for the project. This future use is consistent with the sentiments of local stakeholders, as communicated during public engagement meetings for the study.

Expected Benefits:

- Enables constructability of the marsh terraces.
- Enable access to the project for post-construction monitoring and future marsh restoration projects.

Objective 2 – Restore Marsh and Aquatic Vegetation

The second objective of the project is to restore marsh and aquatic vegetation for habitat and flood resilience. Specifically, the City's construction of the marsh terraces will result in the restoration of approximately 46 acres of habitat within Back Bay, consisting of:

- 10 acres of low marsh habitat; low marsh plantings would include Big Cordgrass (*Spartina cynosuroides*) and Saltmarsh Cordgrass (*Spartina alterniflora*).
- 6 acres of high marsh habitat; high marsh plantings would include Black Needlerush (*Juncus roemerianus*) and Salt Meadow Hay (*Spartina patens*).
- 14 acres of upland vegetated habitat; upland vegetation would include Arrow-leaf Tearthumb (*Persicaria sagittate*), Groundsel Tree (*Baccharis halimifolia*), Wax Myrtle (*Myrica cerifera*), and Bald Cypress (*Taxodium distichum*).
- 16 acres of submerged terrace habitat anticipated to create suitable conditions for the emergence of SAV.

Additionally, approximately 310 acres of open water SAV habitat would remain between the proposed marsh terraces, and it is anticipated that construction of the terraces would create conditions within the project area favorable to the re-establishment of SAV populations.

Expected Benefits:

- Reduce wave heights, flow velocities, and wind sheer stress within the project area to protect marsh islands from continued erosion.
- Restore the natural buffer that helps protect low-lying neighborhoods and critical access roads from wind-driven flooding.
- Improved water quality by removing excess nutrients.
- Lowered transport of suspended sediment and prevention of resuspension of fine sediments in the water.
- Reduced flow velocity and absorbing wave/wind energy to reduce shoreline erosion.
- Creation of habitat (nursery and feeding areas) for fish (such as Largemouth Bass, Bluegill Yellow Perch, Striped, Blueback Herring, Alewife, and American Eel), migratory waterfowl (such as the Canvasback Duck [*Aythya vallisineria*]), and other aquatic animals.

Objective 3 – Engage Stakeholders and Disseminate Effective Practices

The City is committed to continued meaningful engagement with project partners and external stakeholders throughout the restoration and monitoring phases to ensure transferability to other sites in the region and state.

Expected Benefits:

- Ensure that the lessons from this project can be transferred and scaled to other sites in the state or region.

Approach, Milestones, and Deliverables

The following approach, milestones, and deliverables lay out a plan of action. The milestone schedule follows in *Section B: Milestone Schedule*.

Approach & Deliverables

Activity 1 – Construction Staging Area Preparation and Construction

Activity 1 involves preparing the Shipps Cabin Road property as a construction staging area. Construction activities will include stabilization of the road, laying geotextile to stabilize the ground under the construction staging area, filling with material for the construction staging area, adding fencing, creating bridge abutments and installing a temporary bridge and ramp for waterfront construction access, construction of slurry basins, and establishment of traffic flagging stations.

In the final step, the contractor will install pipe to pump the slurry material from the Shipps Cabin staging area to Bonney Cove. The pipe will be floated with subaqueous tie-downs at channels and certain points of access to maintain boat crossings. Those subaqueous locations will be marked by a buoy every 10 feet and temporary signage as reasonable. The contractor will install two booster stations along the alignment, one approximately half-way between the landing and Bonney Cove, and one at the edge of Bonney Cove. These booster stations will consist of a pontoon-mounted diesel engine pump capable of moving the sand slurry from the construction staging area to the site. It is estimated that 150 CY per hour of sand slurry would be pumped through the pipe in a 60:40 ratio. Additional booster stations may be required for manifolding and supplying slurry stations to individual terraces.

Relevant Objective(s): Objective 1

Deliverables:

- Conduct daily inspections to monitor construction progress of the Shipps Cabin Road Construction Staging Area preparation.

Assumptions:

- It is anticipated that the Shipps Cabin Road Construction Staging Area construction activities can occur simultaneously with material production in Year 1 (2024).

Activity 2 – Marsh Terrace Construction

Once the Shipps Cabin Construction Staging Area preparation is complete, marsh terrace construction activities can commence. The contractor will construct the terraces according to the 100% Final PS&E documents. The most recent engineering designs and design report are available upon request; they are not included as an attachment to this proposal due to file size. Figure 29 shows the overall layout of the terraces, and Figure 30 and Figure 31 show the project renderings. Terrace construction will begin in the northern extent of the project site at Terrace #100, noted in Figure 29, and the contractor will work south towards Terrace #140. The contractor will complete each terrace (including installation of plants) before moving onto the next.

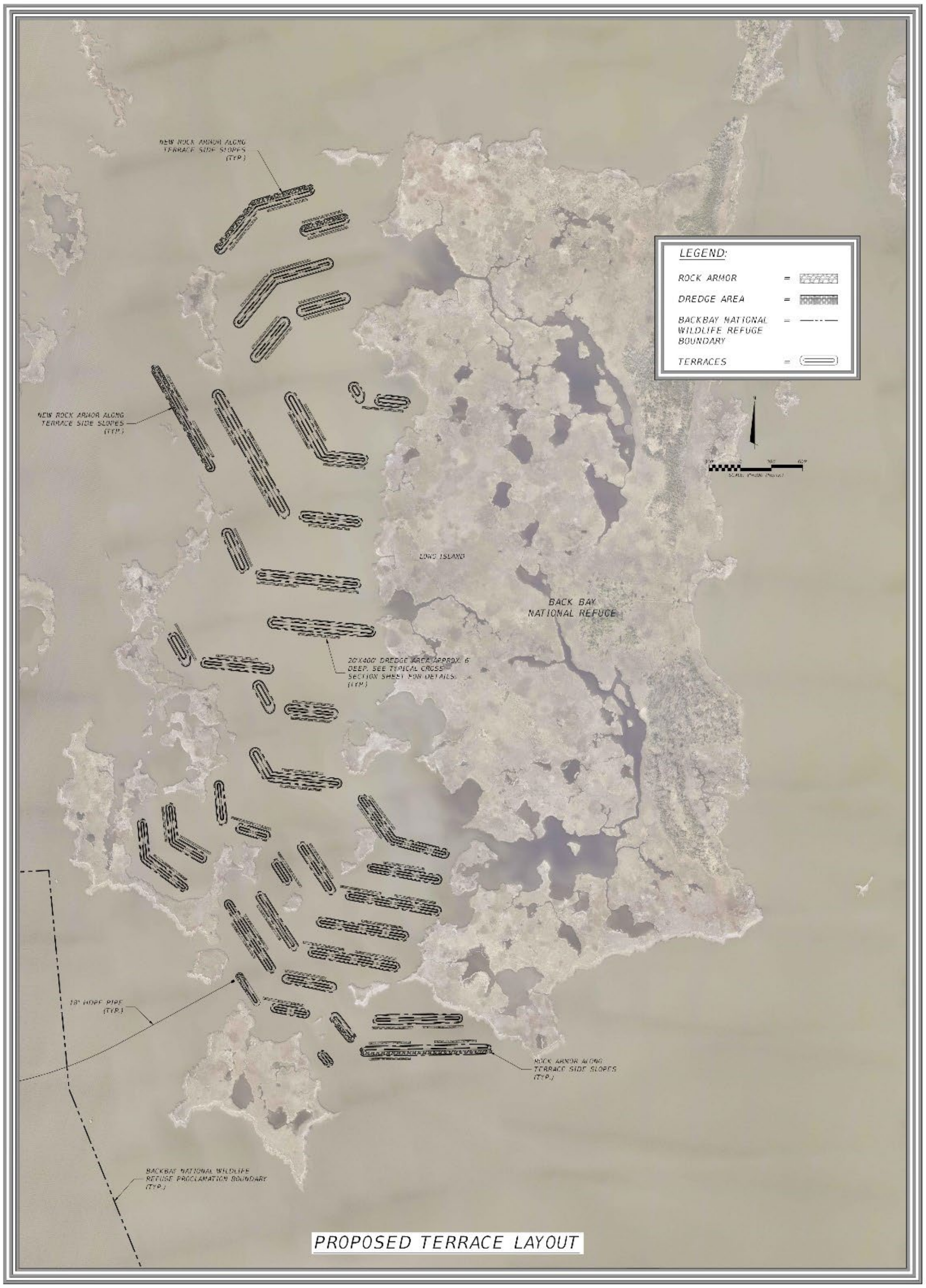

Figure 29: Marsh terrace layout across Bonney Cove.

Figure 30: Marsh terrace design rendering.

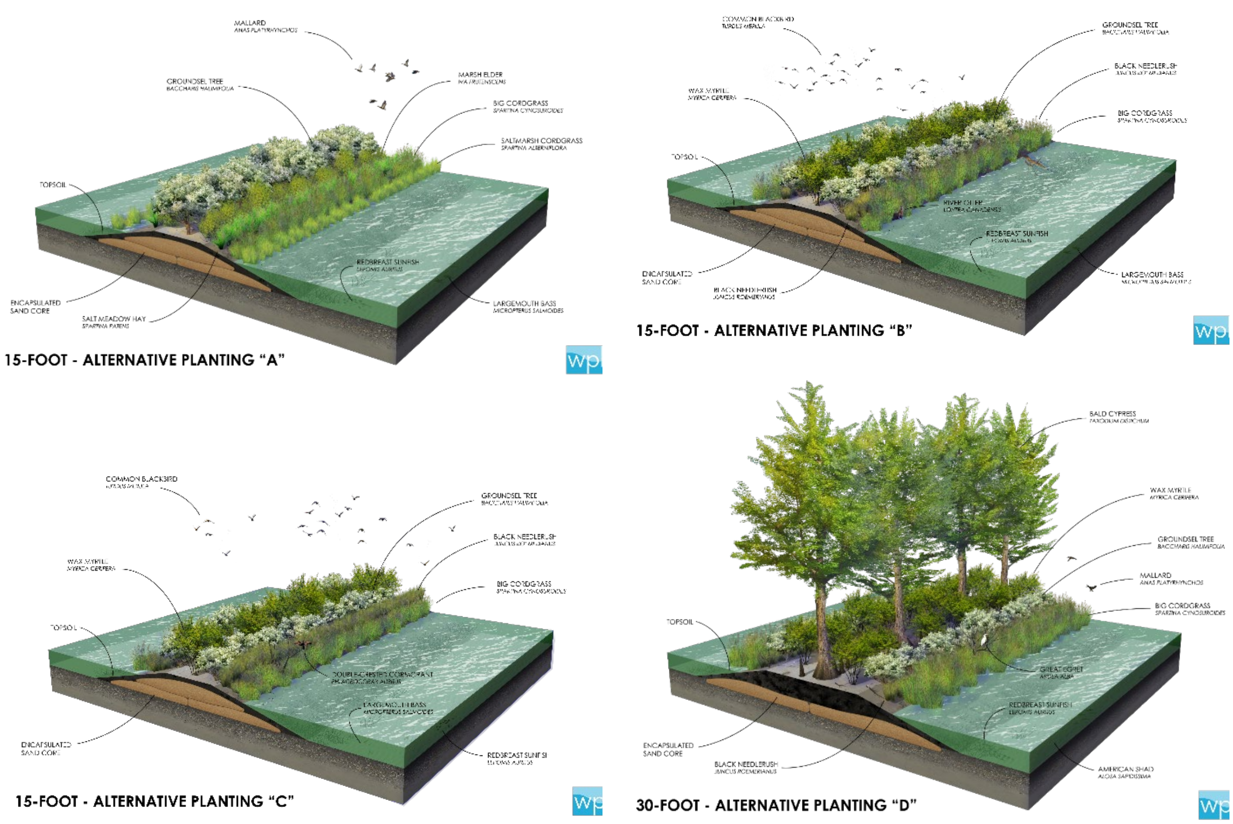

Figure 31: Marsh terrace cross-section design renderings.

The following section provides a high-level description of the proposed design and

construction approach.

Terrace Orientation:

The orientation of the terraces will be perpendicular to the predominant wind direction (south-southwest) to maximize wave energy reduction. The terraces in the northern extent of the project site will be angled perpendicular to a north-northwest wind direction. The terraces would be segmented in a chevron pattern (duck-wing pattern) to provide the most favorable fish and swimming crustacean (termed "nekton") habitat while also allowing adequate circulation to promote sedimentation and maintaining navigability throughout the project area. The terraces would not be connected to the adjacent marsh; this gap, or physical open water barrier, is intended to deter the invasion of Common Reed (*Phragmites australis*) stands from adjacent marshes.

Spacing:

The terraces would be spaced at approximately 300-foot intervals in the northern and southern quarters, and then 600-foot or greater intervals in the center. This arrangement aims to lessen the open water and subsequent wave action at the northern and southern ends of the site and allow adequate construction space for marine-based construction equipment.

Terrace Elevation and Width:

To achieve a sustainable marsh elevation throughout the project life, the marsh terraces would initially be built to a higher elevation during construction and allowed to settle to the desired target elevation over time. Taller terraces improve the functionality and resiliency of the system while also providing diversified habitat for fish and wildlife. The goal is that, by the end of the 30-year design life and with 1.5 feet of relative sea level rise, the terraces will be at or above the elevation of a moderate wind tide event (when Back Bay water levels are anticipated to reach +3.0 feet NAVD88 over the design water level). This threshold was determined to ensure the terraces would not be fully overtopped during a future wind tide event and maintain resiliency to anticipated sea level rise. The 1.5 feet sea level rise scenario is consistent with the near-term planning scenarios identified in the City's Resilience Plan to represent conditions from 2035 to 2050 and adopted by the Hampton Roads Planning District Commission (HRPDC) as part of resolution number 2018-01.

The terraces would have a top width of 15 or 30 feet and be built to an elevation of +4.5 to +5.0 feet NAVD88, depending on the width of the crest, underlying soils, and local bottom depth, with side slopes of 4 horizontal to 1 vertical (4H:1V). The +4.5- to +5.0-foot elevation is calculated based on a target elevation of +3.0 feet NAVD88 or higher at the end of the project's 30-year design life and an estimated settlement of approximately 1 to 2 feet, depending on where the terrace is located. The geotechnical investigation revealed that terraces in the site's southern portion are expected to experience greater settlement than those to the north.

Terrace Composition:

The terraces would consist of a sand-filled core that is encapsulated by a high-strength blend of woven and non-woven geotextile fabrics. The sand for this material will come from nearby offsite sources and be pumped through the 1-inch diameter pipe described in Activity 2. Once the cores are in place, long-reach excavators would travel along the tops of the terraces and begin to shape the cross slopes. Existing adjacent material devoid of SAV would be mechanically dredged and placed over the sand-filled cores. The marsh terraces would be covered with 1 to 3 feet of suitable fill, depending on crest widths, and then planted with native emergent and brackish plant species to stabilize the terraces and provide wind-driven flood reduction benefits.

Relevant Objective(s): Objective 2

Deliverables:

- Conduct daily inspections to monitor construction progress of the marsh terraces.

Assumptions:

- It is anticipated that construction of the terraces will occur in two phases over two years from 2025 through 2026, with the following assumptions:
    - Construction activities are not permitted within BBNWR from October 31 through February 28, annually, to limit disturbance to wintering waterfowl and migration during those months.

Activity 3 – Stakeholder Engagement and Lessons-Learned Dissemination

As the first large scale terracing project on the Atlantic coast, the City recognizes the importance of documenting lessons learned and effective practices during each of the proposed activities: contractor procurement, construction, and post-construction monitoring. The City plans to develop a set of project marketing materials (PowerPoint presentations, StoryMap, information flyers, etc.) to cover key topics, such as:

- Lessons learned during contractor procurement, construction, and post-construction monitoring.
- Effective practices for contractor procurement, bid development, and evaluation. This project is expected to require a highly specialized contractor given the complexity of the project, very shallow water depths, and distance of the site from available construction access and staging areas.
- Guidance for identifying the best sources for local and regional materials for building the terraces and developing a project construction schedule with enough lead time for producing the quantity of material needed for large-scale marsh creation projects.
- Effective practices for developing a post-construction monitoring plan for marsh terraces that a) aligns with permitting, grant, and other requirements and b) enables quantification of project benefits and areas for improvement.

- Effective practices for communicating project benefits based on a combination of field data collection, numerical modeling, and post-construction monitoring.

The City plans to leverage the materials to facilitate dissemination to key stakeholders to increase likelihood of transferability of the approach to other areas in the region and state. The City's plan for engagement is summarized in the following table. In addition to these efforts, the City is committed to collaborating with DCR to identify any additional opportunities to help socialize the project's innovative design and lessons learned.

Table 8: Summary of opportunities for City, regional, state, and national stakeholder engagement; expected benefits.

	Description of Proposed Outreach Activities
CITY	• Facilitate internal municipal awareness, coordination, and approval to gain budgetary approval for funding to expand the approach to other sites in Back Bay (such as "The Great Narrows", Mackay Island and Princess Anne Wildlife Management Areas, and Ragged Island) through presentations to the: o Virginia Beach City Council o City Manager Working Group for SLR and Recurrent Flooding, comprised of representatives from all City departments, to facilitate awareness, coordination, and action to advance the project to the restoration phase. • City of Virginia Beach Management Leadership Team (MLT), which includes the City Manager, Deputy City Managers, and Department heads from across the City.
REGION	• Collaborate with the National Audubon Society and Albemarle-Pamlico National Estuarine Partnership (APNEP) to: o Highlight the marsh terrace project as a success story in the next iteration of the Currituck Sound Coalition Marsh Conservation Plan. o Explore opportunities for marsh terrace projects in the Knotts Island Channel, a key flood pathway into Back Bay, as well as other locations in the Currituck and Albemarle-Pamlico Sound. • Share lessons learned to regional and state stakeholders, improving knowledge-based, awareness, and capacity for future efforts through presentations to: o Hampton Roads Adaptation Forum – a regional dialogue for academics, non-profits, consultants, and municipalities committed to resilience measures. o The Hampton Roads Planning District Commission (HRPDC) Coastal Resiliency Committee . o Regional conferences on green infrastructure, coastal resilience, and SLR adaptation. • Collaborate with Wetlands Watch, a regional non-profit organization committed to the protection of wetlands using nature-based solutions, to socialize the project and disseminate lessons learned.

	Description of Proposed Outreach Activities

STATE	• Continue to coordinate with the Virginia Department of Conservation and Recreation (DCR) to:
	  o Promote the project as a success story for the State Coastal Master Plan (CRMP), which highlighted the project as an "exemplary" resilience project that aligns with the Commonwealth's objective to protect and enhance the state's natural infrastructure.
	  o Incorporate project updates and lessons learned on the CRMP website is an excellent mechanism for dissemination to all coastal Planning District Commissions (PDCs)/Regional Commissions (RCs) across the state.
	• Continue to collaborate with The Nature Conservancy (TNC), a national player in guiding the implementation of nature-based strategies, to help disseminate lessons learned on project implementation. The City has engaged in early discussions with TNC about partnering to host a state-level workshop that would draw from the network of TNC's local and regional chapters
	• Presentations at state-level conferences on water resources, floodplain management, and resilience, such as hosted by Resilient Virginia and Virginia Lakes and Watersheds Association.

NATION	• Disseminate lessons learned/effective practices through presentations at 1-2 relevant national conferences such as Restore America's Estuaries, Association of State Floodplain Managers, or the American Shore and Beach Preservation Association, etc. • Leverage working relationships and existing contract work with the U.S. Army Corps of Engineers and partners to integrate lessons learned into the International Natural and Nature-Based Feature Design Guidelines to promote consideration of marsh terraces within similar Back Bay environments (for example, in North Carolina, Maryland, New Jersey, and New York).

Relevant Objective(s): Objective 3

Deliverables:

- Project marketing materials.
- Records documenting number of stakeholders engaged during outreach activities.

Activities Not Included Under this Grant

Submerged Aquatic Vegetation Transplant Plan: The City will evaluate opportunities for restoring native submerged aquatic vegetation populations in Back Bay, such as Wild Celery (*Vallisneria americana*), through consultations with subject matter experts. After terrace construction, the City will formulate a plan for planting submerged aquatic vegetation in between the terraces in coordination with identified partners and the construction contractor.

Post-Construction Monitoring: Post-construction monitoring and inspections will occur for a minimum of five (5) years following construction. Given the period of performance for the CFPF grant, post-construction monitoring activities have not been included in this application.

Milestone Schedule

The scope of work proposed in this grant application are scheduled to occur between June 2024 and June 2027. Work activities are anticipated to complete in December 2026; however, the proposed schedule extends through June 2027 for contingency. The project's expected progression is shown in the following milestone schedule, noting deliverables for each milestone:

2024 Activities

- *1st Quarter* ***(pre-grant period activities):***
  - 100% Final PS&E
  - Submit Bid Documents
- *2nd Quarter (pre-grant period activities):*
  - Final Bid Coordination/Acceptance
  - Construction NTP
- ***Begin Year 1 Grant Activities – 2nd Quarter 2024:***
  - Mobilization for Shipps Cabin Road Construction Staging Area
  - Initiation of Marsh Terrace Material Production
- *3rd Quarter:*
  - Construction NTP and Mobilization for Slurry Basin Installation
- *4th Quarter:*
  - Completion of Shipps Cabin Road Construction Staging Area and Slurry Basin Construction

2025

- *1st Quarter*
  - Completion of Marsh Terrace Material Production
  - Construction Mobilization for Marsh Terraces (beginning on March 1, 2025)
  - Oversight, Management, and Inspection Services of Slurry Basin Installation
- ***Begin Year 2 Grant Activities - 2nd Quarter 2025***
  - Construction of Marsh Terraces #100 – 105
- *3rd Quarter*
  - Construction of Marsh Terraces #106 – 114
- *4th Quarter*
  - Construction of Marsh Terraces #115 – 119
  - Marsh Terrace Construction Demobilization (to accommodate break in construction period from October 31, 2025 – February 28, 2026)

2026

- *1st Quarter*
  - Construction Re-Mobilization for Marsh Terraces (beginning on March 1, 2026)
- ***Begin Year 3 Grant Activities - 2nd Quarter 2026***

- Construction of Marsh Terraces #120 – 134
- *3rd Quarter*
    - Construction of Marsh Terraces #135 – 140
- *4th Quarter*
    - Shipps Cabin Road Construction Staging Area Final Improvements & Demobilization

2027

- *1st and 2nd Quarter*
    - *Contingency for any delays experienced through end of 2026*

End Year 3 Grant Activities

Project Partners

The following table highlights the specific project partners, their roles, and their capabilities concerning the proposed project.

Table 9: Potential Project Partners.

Entity	Role	Description
U.S. Fish and Wildlife Service, Back Bay National Wildlife Refuge	Project Partner / Advisor / Adjacent Land Owner	BBNWR owns the land adjacent to the project footprint and monitors migratory bird hunting within Presidential Proclamation boundaries. BBNWR has coordinated with the City on project design and will continue to be involved during project construction as a stakeholder and advisor.
Virginia Department of Wildlife Resources	Project Advisory / Stakeholder	The City has coordinated closely with VDWR on project design. Furthermore, VDWR has been monitoring SAV distribution in Back Bay for decades and will be a critical partner for identifying native seagrass species and techniques for restoration based on extensive experience from previous SAV restoration projects in Back Bay.
Virginia Beach Department of Planning & Community Development	Permit Compliance	The City's Department of Public Works has been in close coordination with the City's Department of Planning & Community Development throughout the design and permitting process. Continued involvement and coordination during construction and post-construction monitoring is anticipated.
Dewberry	Engineering Contractor	Engineering consultant to support the City with contractor procurement and construction administration.
To be Determined	Construction Contractors	Construction contractor for the Shipps Cabin Road Construction Staging Area and marsh terrace construction activities.

Entity	Role	Description
Friends of Back Bay	Project Advisory / Stakeholder	Friends of Back Bay was formed in the 1980s to lead efforts to expand and conserve BBNWR, including securing millions in funding to support the Refuge's expansion. The City has coordinated with the BBNWR Society throughout the design and permitting process and will continue this coordination through construction and post-construction monitoring.
Back Bay National Wildlife Refuge Society	Project Advisory / Stakeholder	The Back Bay National Wildlife Refuge Society (BBNWR Society) is an independent, 501(c)(3) non-profit group dedicated to supporting the mission of the USFWS National Wildlife Refuge System and specifically promoting awareness of the BBNWR through education and participation. The City has coordinated with BBNWR Society throughout the design and permitting process and will continue this coordination through construction and post-construction monitoring.
Back Bay Restoration Foundation	Project Advisory / Stakeholder	Back Bay Restoration Foundation (BBRF) is an independent, 501(c)(3) non-profit group focusing on growing concerns about issues such as recurrent flooding, sea level rise, and development in the Southern Rivers Watershed. The group aims to serve as an advocate for the Bay and surrounding residents. The City has coordinated with BBRF throughout the design and permitting process and will continue this coordination through construction and post-construction monitoring.

Relationship to Other Projects

This project represents the first nature-based project in the Southern Rivers Watershed to advance to design and construction to implement the City's Wise Resilience Plan. The project is also an aspect of the Stormwater Green Infrastructure aspect of the City's Flood Protection Plan. The City has received a $3M award from the CFPF to support another project in the Stormwater Green Infrastructure element of the Flood Protection Program – the Elizabeth River Wetland and Floodplain Restoration Project (Round 1 CFPF Grant Awards).

The City has also received two NFWF NRCF grants from the Marsh Restoration in Back Bay project. Approximately $135,000 in NFWF NRCF funding was awarded in 2020 for the previous phase (design and permitting) for the project. The City continues to meet the obligations and period of performance of this NFWF grant. In 2022, the NFWF NRCF awarded $9,886,400 to support construction activities.

In its Resilience Plan, Virginia Beach identifies an adaptation approach for the Southern Rivers Watershed that emphasizes natural mitigation methods and integrated systems of defenses. As a natural mitigation strategy, the marsh terrace project aims to serve as a first line of defense during flood events, reducing wind-driven fetch, wave energy, and flow velocities to protect the important marsh buffer surrounding the shorelines of Back Bay. Other projects are also needed to provide multi-layered flood protection to northern Back Bay communities (Figure 32). Several

of these projects are highlighted below. It should be noted that the projects described below are either not yet funded or will be funded in the future through the City's Capital Improvement Program.

Figure 32: Southern Rivers Watershed Adaptation Vision.

Marsh island restoration serves as a critical first line of defense of the multi-layered protection system in the Southern Rivers Watershed. The following map (Figure 33) shows the structural adaptation projects proposed for the Southern Rivers Watershed, including the Muddy Creek Road and Sandbridge flood defense systems. The City's numerical modeling shows that, if implemented, there is potential for small increases in flooding outside of these structural protection systems.[14] This emphasizes the need for complimentary measures, including the marsh terrace project, land acquisition, and conservation efforts, to mitigate this residual risk.

[14] City of Virginia Beach (2020). City-wide Structural Alternatives for Coastal Flood Protection (PDF).

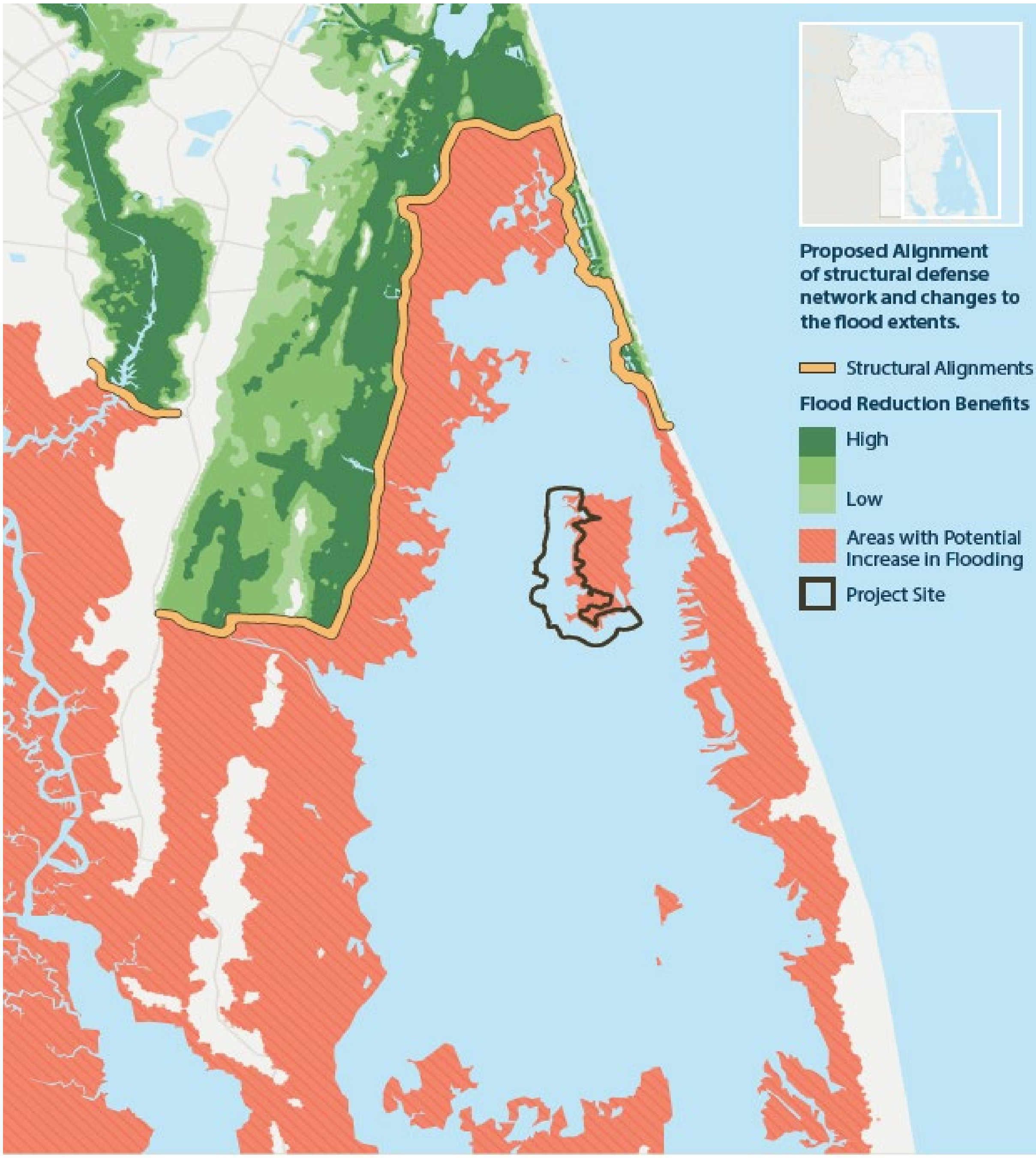

Figure 33: Structural adaptation projects proposed for the Southern Rivers Watershed, including the Muddy Creek Road and Sandridge flood defense systems.

Backside of Sandbridge Flood Defense System

Protection of the Sandbridge resort community from increasing coastal flood hazards would require a complex and expensive structural protection system because of the manufactured land configuration on the backside of Sandbridge. The proposed protection system includes elevating Sandbridge Road and constructing a network of seawalls, levees, and gates along the Back Bay shoreline of Sandbridge. This project does not have designated funding at this time.

Hell Point Creek Flood Defense System

As part of the integrated Sandbridge City-Wide flood defense network, a storm surge barrier across Hell Point Creek could block flood waters originating from Back Bay. Sandbridge Road would also need to be raised to ensure floodwaters could not flank the system. This project does not have designated funding at this time.

Sandbridge/New Bridge Intersection Improvements

Road and shoulder improvements are planned to increase safety at the New Bridge Road/Sandbridge Road intersection and reduce the need for road closures due to flooding from the adjacent Ashville Creek.

Muddy Creek Road Flood Defense System

Muddy Creek Road provides access to important rural and agricultural communities and Back Bay and the Wildlife Refuge. Muddy Creek Road is one of the lowest-lying roadways in all of Virginia Beach and frequently floods. This City-Wide Structural Alternative Flood Protection analysis identified this roadway as a critical location to provide flood protection. The proposed system, known as the Muddy Creek Road Alignment, would transform much of Muddy Creek Road into a levee, with the road on the top. The City's numerical modeling effort shows that the Muddy Creek Road Flood Defense System could potentially increase flood risk to the east of Muddy Creek Road, as shown in Figure 33. Therefore, the implementation of nature-based strategies suitable to the low-lying shorelines of Back Bay is essential to mitigate these impacts. This project does not have designated funding at this time.

Voluntary Acquisition Program

Virginia Beach City Council has recently funded a $2.0 million City-wide voluntary acquisition program to encourage flood-prone property owners to apply for a buyout. Parcels acquired by the City, in the Southern Rivers Watershed, would then be converted to open space to serve as flood storage and a marsh migration buffer.

Stormwater Master Plan

The City Council initiated an update of the City's Stormwater Master Plan in 2014. This effort is interchanging information with aspects of the City's Resilience Plan to account for the impact of sea level rise on the stormwater system's performance. Specific stormwater drainage improvement projects are included within the Lower Southern Rivers Watershed Drainage Basin.

Virginia Coastal Resilience Master Plan

The CRMP highlighted the marsh terrace project as an exemplary nature-based resilience project. The CRMP emphasizes Virginia Beach's strategic use of multiple funding streams to implement a large-scale nature-based project. DCR’s contribution to the project’s construction could be highlighted as a success story for implementation of the CRMP.

Audubon North Carolina Currituck Sound Coalition Marsh Conservation Plan

In coordination with Audubon North Carolina, the Currituck Sounds Coalition identified marsh restoration priorities based on criteria for siting restoration projects, including vulnerability to sea level rise, historic increase in surface water, and distance to hardened shorelines. This assessment identified Virginia Beach's marsh terrace project site as a high-priority area for restoration. There is an opportunity to highlight this project as a success story in the next iteration of the Audubon's Marsh Conservation Plan, which is slated to be updated every three years.

Maintenance Plan

Standard maintenance measures have been defined as part of the draft Annual Monitoring Plan and Post-Construction Monitoring Report developed for this project. See Attachment 5 for a copy of the draft report.

Subsequent to the monitoring period, project maintenance will be addressed by the City's Public Works Stormwater Operations Group, who will also respond to any maintenance issues identified by the monitoring effort or other observers. The City intends to maintain the construction staging area to support future project maintenance needs. The City will perform inspections every 2-5 years and make any repairs needed for the life of the project after completion of the initial monitoring program.

As described by the draft Annual Monitoring Plan and Post-Construction Monitoring Report, maintenance measures include the replacement of plantings (including upland, marsh and SAV plantings), the removal of debris from the terraces, the removal of invasive vegetation identified in the planting areas, the addition of sediment to eroding areas of the terraces, and the replacement of waterfowl barriers as necessary. In addition, structural maintenance measures that might be identified and prescribed during monitoring efforts include replacement of dislodged stones, addition of stone to address structure settlement, and general repair of sand cores or other structural elements. As proposed, these measures would become conditions of the wetland permits required for this project, in addition to standard commitments and requirements defined by the permitting agencies.

In addition to the commitments made in the monitoring plan, and those anticipated to be defined during the permitting process, it is the assumption that the placement of the proposed marsh terrace structures in state waters (subaqueous bottoms) will require the City to maintain the marsh terraces in perpetuity. As previously defined through coordination with VMRC, the City would obtain a compensable interest in the property that has been filled on top of state-owned subaqueous bottomlands (i.e. the terraces). As such, the City would be responsible for maintaining the proposed marsh terraces structures to ensure they fulfill their intended functions, as defined in the objectives and indicators of success previously defined in this proposal.

Criteria

The project receives a total score of **65 Points**. An explanation of how the project meets each

of the applicable scoring criteria contained in Appendix D is provided below.

Eligible Project (Type)

Category/Points: Wetland/floodplain restoration, Living shorelines and vegetated buffers (25 Points)

Explanation: Marsh terraces are considered a type of wetland restoration or a component of a living shoreline project:

- Wetland Restoration: Wetland restoration aims to reestablish or enhance natural wetland ecosystems. Marsh terraces can be constructed in areas where wetlands have been degraded or lost, and they help to recreation or support wetland functions. They provide habitat for various species, improve water quality, and can contribute to the overall health and resilience of a wetland ecosystem.
- Living Shoreline Project: Living shorelines are designed to protect shorelines from erosion while also promoting ecological and environmental benefits. Marsh terraces are often used as a component of living shoreline projects. They can serve as a buffer against wave action, stabilize shorelines, and create suitable habitat for marsh and aquatic species.

Social Vulnerability Index Score

Category/Points: Low Social Vulnerability (0 Points)

Explanation: Based on the Virginia Flood Risk Information System (VFRIS) Social Vulnerability Index Layer, the Social Vulnerability Index scores of the communities located in the two census block groups adjacent to Back Bay near the project site are -1.07 and -0.43 (an average of -0.75), which falls into the Low Social Vulnerability category.

Community Scale Benefits

Category/Points: More than one census block group (30 Points)

Explanation: As documented in the *Supporting Documentation - Project Information – Population* section of this document, the project is anticipated to benefit two census block groups (518100454.121 and 518100464.001).

Expected Lifespan of Project

Category/Points: Over 20 Years (10 Points)

Explanation: As documented in the *Supporting Documentation – Approach, Milestones, and Deliverables – Activity 3 (Marsh Terrace Construction)* section, the marsh terraces have a 30-year design life.

Budget Narrative

The following budget narrative details the proposed project expenditures. See Appendix B for completed budget spreadsheet.

Estimated Total Project Cost

The current estimated total project cost is **$53,378,490.** This estimate includes design, site acquisition for the construction staging area, construction, inspections and support, implementation, and contingencies, as shown in the below table. The design engineer's opinion of probable cost for construction is provided

Project Activity	Capital Improvement Program Estimate
Design	$276,800
Site Acquisition	$50,000
Construction	$41,839,900
Inspections and Support	$5,609,200
Implementation	$750,000
Contingencies	$4,852,590
Total:	$53,378,490

Funds Requested from the Fund

The City is requesting a total of **$5,000,000.00** in funding from the CFPF Round 4. These funds will support contractual services of the engineering consultant and construction contractor to execute Activity 2 (Construction Staging Area Preparation and Construction) and Activity 3 (Marsh Terrace Construction). No support is requested for City personnel.

These funds will be used to support ongoing construction activities through 2024-2026. Example activities include contractor construction services, mobilization/demobilization, construction staging area construction, slurry pipe installation, portions of the terrace materials, and waterfowl barriers. Construction costs are based on a detailed estimate from the design engineer that includes detailed breakdown of estimated quantities and costs from the 95% design package using industry standards for the anticipated aspects of the project construction. The City has withheld the detailed estimate as it provides information that would affect bidding on the construction.

Amount of Funds Available

The City as prime recipient is providing a cash match of $38,356,966 from funds fully programmed and available from the City's Flood Protection Program Capital Improvement Program to support the project. The Flood Protection Program is supported by a related bond referendum that provided $567.5M to fund more than 40 projects identified for Phase 1 of the Program. The program is tightly managed by the City, an independent contractor, and has a resident oversight board. The City is fully confident these funds will be available for constructing this project.

The City's dedicated funds will provide cash match to cover contractual services to support Activity 1 (Construction Staging Area Preparation and Construction), Activity 2 (Marsh Terrace Construction), Activity 3 (Stakeholder Engagement and Dissemination), and all related City support and direct overhead costs related for the project.

The National Fish and Wildlife Foundation is also supporting the project through two grant awards from the National Coastal Resilience Fund. This includes an initial award of $135,124 in 2020 for design and a second award of $9,886,400 in 2022 to support construction. The 2022 grant funds are dedicated to purchasing the native vegetation and a portion of the materials needed to build the marsh terraces.

A summary of project costs, funds available, and funds requested is provided below:

Item	Amount
Project Cost:	$53,378,490.00
Funding Sources Available	
NFWF Grant:	$10,021,524.00
CFPF Grant Request:	$5,000,000
City Funds Available:	$38,356,96600
Total Project Funding:	**$53,378,490.00**

Authorization to Request for Funding

Please refer to *attachment* for the documentation authorizing the funding request.

Attachment 1: Virginia Beach Resilience Plan DCR Approval

Matthew J. Strickler
Secretary of Natural Resources

Clyde E. Cristman
Director

COMMONWEALTH *of* VIRGINIA
DEPARTMENT OF CONSERVATION AND RECREATION

Rochelle Altholz
Deputy Director of Administration and Finance

Russell W. Baxter
Deputy Director of Dam Safety & Floodplain Management and Soil & Water Conservation

Nathan Burrell
Deputy Director of Government and Community Relations

Thomas L. Smith
Deputy Director of Operations

July 20, 2021

Toni Utterback, P.E.
Department of Public Works
2875 Sabre Street, Suite 250
Virginia Beach, VA 23452

RE: Virginia Beach Resilience Plan Second Submission - CFPF

Dear Ms. Utterback:

Thank you for the resubmission of the Sea Level Wise Adaptation Plan for City of Virginia Beach. After careful review and consideration, the Virginia Department of Conservation and Recreation has deemed the Plan complete and meets all the criteria outlined in the June 2021 Community Flood Preparedness Grant Manual. This approval will remain in effect for a period of three years, ending on July 31, 2024.

The following elements were evaluated as part of this review:

1. **Element 1: It is project-based with projects focused on flood control and resilience. DCR RESPONSE**

    a. Project-based: Four watersheds—each with a defined geographic area, analysis of community social and environmental characteristics, types of flooding, and a tailored flood resilience strategy with <u>discrete projects identified</u>.

Projects focused on flood control and resilience include:

Neighborhood	Flood Control Project
Elizabeth River	City-wide alignment, living shoreline, marsh restoration, land conservation
Lynnhaven	Chesapeake Bay alignment, Lesner Bridge Neighborhood alignment (East & West), beach & dune nourishment, ecological revetments, shellfish reef restoration, seagrass restoration
Oceanfront	Atlantic Oceanfront alignment, Rudee Heights alignment
Southern Rivers	West Neck Creek city-wide alignment, Muddy Creek Road city-wide alignment, Sandbridge city-wide alignment

**additional projects listed within the Sea Level Wise Adaptation Strategy.*

2. **Element 2: It incorporates nature-based infrastructure to the maximum extent possible. DCR RESPONSE**

   a. Nature-based infrastructure: Flood mitigation projects throughout the city incorporate nature-based solutions and were identified for maximum use within specific watersheds.

3. **Element 3: It includes considerations of all parts of a locality regardless of socioeconomics or race. DCR RESPONSE**
   a. All parts of a locality: Locality divided into four watersheds, covering the entirety of the jurisdictional boundary.
   b. Social vulnerability: Social implications of flood hazards and analysis of populations at-risk documented.
   c. Demographic Analysis: Demographic and Population Vulnerability Analysis conducted by Dewberry and incorporated into the Plan.

4. **Element 4: It includes coordination with other local and inter-jurisdictional projects, plans, and activities and has a clearly articulated timeline or phasing for plan implementation. DCR RESPONSE**
   a. Coordination with other projects, plans, and activities: Contains the planning processes and frameworks which outline local and regional plans used by the City and address resilience; and how they have been integrated for flood adaptation planning.
   b. Clearly articulated timeline or phasing for plan implementation: Program phases clearly articulated and described in detail—Impact assessment, Adaptation research, Strategy development, and Long-term implementation.

5. **Element 5: Is based on the best available science, and incorporates climate change, sea level rise, storm surge (where appropriate), and current flood maps.**
   a. Technically backed water-resources analysis, sea level rise projections, storm surge, and climate change incorporated into strategic approach.

VA DCR looks forward to working with you as you work to make Virginia Beach a more resilient community. If you have questions or need additional assistance, please contact us at cfpf@dcr.virginia.gov. Again, thank you for your interest in the Community Flood Preparedness Fund.

Sincerely,

Wendy Howard Cooper, Director
Dam Safety and Floodplain Management

cc: Darryl Glover, DCR

Attachment 2: Authorization to request funding from the Fund from governing body or chief executive of the local government

City of Virginia Beach

DEPARTMENT OF BUDGET AND MANAGEMENT SERVICES
(757) 385-8234
(757) 385-1857 FAX

VBgov.com
MUNICIPAL CENTER
BUILDING 1, 3RD FLOOR
2401 COURTHOUSE DRIVE
VIRGINIA BEACH, VA 23456-9001

INTER-OFFICE MEMORANDUM

DATE: November 1, 2023

TO: Patrick A. Duhaney, City Manager

FROM: Stuart McCrery, Budget and Policy Analyst KJ for SM

SUBJECT: Application for Virginia Community Flood Preparedness Fund Grant

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The Department of Public Works is requesting permission to apply for the Virginia Community Flood Preparedness Fund Grant from the Virginia Department of Conservation and Recreation. The Virginia Community Flood Preparedness Fund was established in the 2020 session of the General Assembly. Money in this fund comes from the auction of carbon allowances through the Regional Greenhouse Gas Initiative. It was established to provide support to localities across Virginia to reduce the impacts of flooding, including flooding driven by climate change.

Public Works is requesting a total of $5,000,000 to construct marsh terraces in Back Bay to promote wetland restoration and mitigate frequent flooding. The City has already made significant investments into this project through CIP project 100551 "Stormwater Green Infrastructure."

This grant also requires a local match of 30% for projects that implement nature-based solutions; however, the City has more than met this requirement through its current appropriations to CIP project 1000551 "Stormwater Green Infrastructure" which currently total over $49 million from the Referendum and other grant awards.

Budget & Management Services recommends this grant application for approval. Please indicate approval or disapproval below. Applications are due by November 12, 2023.

11/1/2023

Approve (Date) Disapprove (Date)

Attachment 3: Virginia Beach Floodplain Administrator Support Letter

City of Virginia Beach

VBgov.com

DEPARTMENT OF PLANNING & COMMUNITY DEVELOPMENT
PHONE (757) 385-4621
FAX (757) 385-5667
VA Relay Number TTY: 711

2875 SABRE STREET, SUITE 500
VIRGINIA BEACH, VA 23452-7385

November 7, 2023

Division of Dam Safety and Floodplain Management
600 East Main Street, 24th Floor
Richmond, Virginia 23219

RE: Community Flood Preparedness Fund – Marsh Terrace Creation, Back Bay

The proposed project is located in both open water and a Federal Emergency Management Agency (FEMA) mapped Special Flood Hazard Area (SFHA). Hydraulic modeling analysis identified Bonney Cove as a location where marsh restoration has the potential to reduce the propagation of floodwater through key pathways within Back Bay. This project aims to stabilize two critically eroding marsh islands that serve as a key flood pathway into northern Back Bay, promote the growth of aquatic vegetation, and provide flood risk reduction benefits to communities in the surrounding area. Within the two census block groups that would benefit from this project, there are 113 repetitive loss and severe repetitive loss properties.

If I can provide any further information or assistance, please call me at 757-385-4621, or e-mail me at wmcnamar@vbgov.com.

Sincerely,

Whitney McNamara

Whitney McNamara, CFM
Floodplain Administrator and CRS Coordinator

Attachment 4: Letters of Support

Back Bay Restoration Foundation

PO Box 57041 • Virginia Beach, Virginia • 23457• 757-818-4829

November 6, 2023

Department of Conservation and Recreation
Dam Safety and Floodplain Management
600 E. Main St., 24^{th} Floor
Richmond, VA 23219

Re: Virginia Community Flood Preparedness Fund Grant

Grantors:

The Back Bay Restoration Foundation (BBRF), is a 35 year-old non-profit watershed organization, founded in 1986 by a group of local citizens concerned about deterioration of the Back Bay watershed visible then through decreases in Submerged Aquatic Vegetation (SAV), fish, and waterfowl. BBRF is the only voice solely dedicated to conserving and improving Virginia Beach's two Southern Watersheds; namely, the Back Bay and North Landing River watersheds. Our efforts focus on education, stewardship and outreach to conserve the largest watersheds in Virginia Beach. We team with other non-profits, and city, state and federal agencies to work toward best solutions for the future of the Back Bay and North Landing River watersheds. BBRF strives to raise awareness, addressing issues that negatively affect these watersheds such as sea level rise, land subsidence and land use changes.

Back Bay is a historical, nationally significant, watershed. With the Back Bay National Wildlife Refuge (NWR) and significant State conservation lands at its core, the watershed was recognized as an Aquatic Resource of National Importance (ARNI) in 2008 by both the US Fish and Wildlife Service and the US Army Corps of Engineers. Back Bay is a wind-tidal oligohaline estuary and is located at the northern tip of the Albemarle/Pamlico estuarine system, the second largest estuarine complex in the United States. The Albemarle/Pamlico estuarine system was designated as an Estuary of National Significance in 1987 and selected to be studied as part of the Environmental Protection Agency's National Estuary Program. Back Bay is a shallow-water aquatic ecosystem with an average depth of four feet. Winds can influence the water depth by as much as three feet.

BBRF supports the City of Virginia Beach's application for Round 4 of VADCR's Community Flood Preparedness Fund. We were strong advocates of the City's successful applications to the National Fish and Wildlife Foundation (NFWF), and have seen what they accomplished with the initial NFWF funding they received. With the combined funding of NFWF, the City of Virginia Beach, and this application for DCR funding, their project of creating a Marsh Terrace Network to Achieve Restoration and Flood Resilience has overachieved by any measure. From community engagement and the NEPA process to conceptual and preliminary designs as described in the recent Army Corps Public Notice, the City has been productive and completely transparent.

As noted above, the City's community engagement and partnerships with organizations like ours has been transparent and resulted in broad support. Although the current project is localized in its first application, we expect the results will significantly mitigate SLR, land subsidence and wind tides in Back Bay. Similarly, this restoration will provide the biotic building blocks to maintain the watershed's national importance for wildlife. The innovative designs proposed will inform future projects at the landscape level. Although innovative, we believe the project is technically sound based on BBRF's 35 years of experience in habitat restoration.

Please feel free to contact us for further information.

Jared Brandwein

Executive Director
Back Bay Restoration Foundation

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Back Bay National Wildlife Refuge
1324 Sandpiper Road
Virginia Beach, VA 23456

October 30, 2023

Wendy Howard Cooper
Division of Dam Safety and Floodplain Management
600 East Main Street, 24th Floor
Richmond, Virginia 23219

Dear Ms. Cooper,

The City of Virginia Beach is proposing to install marsh terraces in the waters of Back Bay adjacent to Back Bay National Wildlife Refuge. This project is expected to reduce wave energy and thus decrease the speed of erosion of remaining islands in the project area, many of which are managed by the U.S. Fish and Wildlife Service and provide habitat for migratory birds and other species. Additionally, the addition of multiple vegetative structures added to the bay will supplement habitat and provide nesting grounds for multiple species.

The mission of the U.S. Fish and Wildlife Service is *working with others to conserve, protect, and enhance fish, wildlife, plants, and their habitats for the continuing benefit of the American people*. Although much work is conducted on federal property to achieve this mission, the Service equally coordinates with external partners to further mutual goals. The proposed marsh terrace project is an excellent example of local and federal government coordination, and we support the City of Virginia Beach's proposed project.

Megan Reed

Megan Reed
Refuge Manager

Albemarle-Pamlico
National Estuary Partnership

Our mission is to identify, protect, and restore
the significant resources of the Albemarle-Pamlico estuarine system.

October 26, 2023

Wendy Howard Cooper
Virginia Dept. of Conservation and Recreation
Division of Dam Safety and Floodplain Management
600 E. Main St., 24th Floor
Richmond, VA 23219

Dear Wendy,

The Albemarle-Pamlico National Estuary Partnership (APNEP) strongly endorses the City of Virginia Beach and partners' application to Round 4 of The Virginia Community Flood Preparedness Fund (CFPF). The proposal is to support construction of the Back Bay Marsh Terrace Restoration Project.

APNEP relies on regional partnerships and collaboration to implement our 2012-2022 Comprehensive Conservation & Management Plan (CCMP) within the waterways of our congressionally designated "estuary of national significance." The proposed partnership between the City of Virginia Beach and the U.S. Fish and Wildlife Service will also advance our 2020 Memorandum of Understanding between Virginia and North Carolina to protect the ecosystem resources in the shared waterways between our two states. The project also addresses a "high priority" area for restoring and enhancing vulnerable marshes with high flood risk reduction benefits and habitat value, as identified by Audubon's Currituck Sound Coalition Marsh Conservation Plan released in 2021.

The marsh terrace project employs the use of natural features to build resilience to flooding in the Back Bay watershed. The project offers coastal resilience and habitat protection and conservation co-benefits including preserving marsh islands, restoring Submerged Aquatic Vegetation, migratory bird and fish habitat, reducing flow that could exacerbate wind tide flooding in local communities, and filling a gap in prior applied research on predominantly fresh water coastal lagoons. These features support the following CCMP actions:

- A2.3: Support research on adapting to impacts associated with climate change and sea level rise.
- C3.2: Develop and implement a coordinated wetland restoration strategy.
- C3.3: Develop and implement a submerged aquatic vegetation (SAV) restoration strategy.
- D3.3: Provide assistance to state, regional, and local governments to incorporate climate change and sea level rise considerations into their planning processes.

In closing, we strongly support the full funding of the City of Virginia Beach's proposal to Round 4 of The Virginia Community Flood Preparedness Fund (CFPF). Please contact Steve Anderson, Partnership Coordinator, at (919) 707-8743 with questions.

Sincerely,

W. Crowell

William L. Crowell, Jr., Ph.D., AICP, CEE
Director

1601 Mail Service Center, Raleigh, North Carolina 27699-1601
Phone/Fax: 919-707-8633 | www.apnep.org

Attachment 5: Copy of the Current Floodplain Ordinance

ORD-3685

AN ORDINANCE TO AMEND SECTIONS 1.1, 1.2, 1.3, 1.8, 2.1, 2.2, 2.3, 2.4, 2.8, 2.11, 3.1, 4.1, 4.2, 4.3, 4.4, 4.6, 4.8, 4.9, 4.10, 5.1, 6.1, AND 6.3 OF APPENDIX K, FLOODPLAIN ORDINANCE OF THE CITY CODE PERTAINING TO HOUSEKEEPING THE DELETION OF PUBLIC WORKS REQUIREMENTS AND THE ADDITION OF A COASTAL A ZONE AND A COASTAL HIGH HAZARD ZONE

Sections Amended: 1.1, 1.2, 1.3, 1.8, 2.1, 2.2, 2.3, 2.4, 2.8, 2.11, 3.1, 4.1, 4.2, 4.3, 4.4, 4.6, 4.8, 4.9, 4.10, 5.1, 6.1, and 6.3 of Appendix K, Floodplain Ordinance

WHEREAS, the public necessity, convenience, general welfare and good zoning practice so require;

BE IT ORDAINED BY THE CITY COUNCIL OF THE CITY OF VIRGINIA BEACH, VIRGINIA:

That Sections 1.1, 1.2, 1.3, 1.8, 2.1, 2.2, 2.3, 2.4, 2.8, 2.11, 3.1, 4.1, 4.2, 4.3, 4.4, 4.6, 4.8, 4.9, 4.10, 5.1, 6.1, and 6.3 of Appendix K, Floodplain Ordinance is hereby amended and reordained to read as follows:

APPENDIX K FLOODPLAIN ORDINANCE

ARTICLE I. GENERAL PROVISIONS

Sec. 1.1. Statutory authorization and purpose.

A. This ordinance is adopted pursuant to the authority granted to localities by Code of Virginia § ~~10.1-600 et seq~~ 15.2-984.

B. The city council finds the purpose of these provisions is to prevent the loss of life and property, the creation of health and safety hazards, the disruption of commerce and governmental services, the extraordinary and unnecessary expenditure of public funds for flood protection and relief, and the impairment of the tax base by:

1. Regulating uses, activities, and development that, alone or in combination with other existing or future uses, activities, and development, will cause unacceptable increases in flood heights, velocities, and frequencies;

2. Restricting or prohibiting certain uses, activities, and development from locating within districts subject to flooding;
3. Requiring all uses, activities, and developments that do occur in flood-prone districts be protected or flood-proofed against flooding and flood damage;

4. Protecting individuals from buying land and structures that are unsuited for intended purposes because of flood hazards; and

5. Acknowledging that the tide data over the last one hundred (100) years shows that Virginia Beach is facing an increased danger of flooding caused by both sea level rise and subsidence and has adopted the Sea Level Wise Adaptation Report as part of the Comprehensive Plan.

Sec. 1.2. Applicability.

These provisions shall apply to all privately and publicly owned lands within the jurisdiction of the City of Virginia Beach and identified as areas ~~of special flood hazard~~ at risk of flooding by the City of Virginia Beach or shown ~~according to~~ on the Flood Insurance Rate Map (FIRM) or included on the flood insurance study (FIS) that ~~is~~ are provided to the City of Virginia Beach by the Federal Emergency Management Agency (FEMA) and dated January 16, 2015 ~~or identified as floodplains subject to special restrictions in section 4.10 of this ordinance~~.

Sec. 1.3. Definitions.

. . . .

City manager. The City Manager of the City of Virginia Beach, or his designees.

Design Flood Elevation (regulatory flood protection elevation). The base flood elevation plus the freeboard required by this ordinance.

. . . .

Recreational vehicle. A vehicle that is:

1. Built on a single chassis;
2. Four hundred (400) square feet or less when measured at the largest horizontal projection;
3. Designed to be self-propelled or permanently towable by a light duty truck; and
4. Designed primarily not for use as a permanent dwelling but as temporary living quarters for recreational camping, travel, or seasonal use.

~~*Regulatory flood protection elevation (design flood elevation)*. The base flood elevation plus the freeboard required by this ordinance.~~

. . . .

Sec. 1.8. Penalty for violations.

Any person who fails to comply with any of the requirements or provisions of this ordinance or directions of the ~~d~~Directors of ~~p~~Planning ~~or public works~~ or any authorized employee of the City of Virginia Beach shall be guilty of the appropriate violation and subject to the penalties therefore. Any violation of the provision of this ordinance shall be punishable by a fine of not more than one hundred dollars ($100.00). Each person shall be deemed guilty of a separate offense for each and every day or portion thereof during which any violation of any of the provisions of this ordinance is committed.

The Virginia Uniform Statewide Building Code (VA USBC) addresses building code violations and the associated penalties in ~~section 104 and section 115~~ VA USBC § 104 and § 115. Violations and associated penalties of the Zoning Ordinance for the City of Virginia Beach are addressed in § 104 of the Zoning Ordinance.

In addition to the above penalties, all other actions are hereby reserved, including an action in equity for the proper enforcement of this ordinance. The imposition of a fine or penalty for any violation of, or noncompliance with, this ordinance shall not excuse the violation or noncompliance or permit it to continue, and all such persons shall be required to correct or remedy such violations within a reasonable time. Any structure constructed, reconstructed, enlarged, altered, or relocated in noncompliance with this ordinance may be declared by the City of Virginia Beach to be a public nuisance and abatable as such. Flood insurance may be withheld from structures constructed in violation of this ordinance.

ARTICLE II. ADMINISTRATION

Sec. 2.1. Designation of the floodplain administrator.

The City Manager of the City of Virginia Beach is hereby appointed the floodplain administrator to administer and implement this ordinance. The floodplain administrator has delegated the duties and responsibilities set forth in this ordinance to the ~~departments of public works and planning, as specified below~~ Department of Planning and Community Development.

Sec. 2.2. Duties and responsibilities of the ~~department of public works~~ floodplain administrator or his designee.

The duties and responsibilities of the ~~department of public works~~ floodplain administrator of his designee shall include but are not limited to:

A. Interpreting floodplain boundaries and providing available base flood elevation and flood hazard information;

B. Verifying that applicants proposing an alteration of a watercourse have notified adjacent communities, the department of conservation and recreation (division of dam safety and floodplain management), and other appropriate agencies (Virginia Department of Environmental Quality (VADEQ), United States Army Corps of Engineers (USACE), etc.) and have submitted copies of such notifications to FEMA;

C. Advising applicants for new construction or substantial improvement of structures that are located within an area of the coastal barrier resources system established by the Coastal Barrier Resources Act that Federal flood insurance is not available on such structures; areas subject to this limitation are shown on FIRMs as coastal barrier resource system areas or otherwise protected areas;

D. Submitting to FEMA, or requiring applicants to submit to FEMA, data and information necessary to maintain FIRMs, including hydrologic and hydraulic engineering analyses prepared by or for the city, within six (6) months after such data and information becomes available if the analyses indicate changes in base flood elevations;

E. Maintaining and permanently keeping records that are necessary for the administration of these regulations, including:

1. ~~flood~~ Flood insurance studies, FIRMs (including historic studies and maps and current effective studies and maps) and letters of map change; and

2. Documentation supporting issuance and denial of permits, Elevation Certificates, documentation of the elevation (in relation to the datum on the FIRM) to which structures have been floodproofed, inspection records, other required design certifications, variances, and records of enforcement actions taken to correct violations of these regulations.

F. Notifying FEMA when the corporate boundaries of the City of Virginia Beach have been modified and:

1. Providing a map that clearly delineates the new corporate boundaries or the new area for which the authority to regulate pursuant to this ordinance has either been assumed or relinquished through annexation; and

2. If the FIRM for any annexed area includes SFHAs that have flood zones with regulatory requirements that are not set forth in this

ordinance, prepare amendments to this ordinance to adopt the FIRM and appropriate requirements, and submit the amendments to the city council for adoption; such adoption shall take place at the same time as or prior to the date of annexation and a copy of the amended ordinance shall be provided to the department of conservation and recreation (division of dam safety and floodplain management) and FEMA.

G. Upon the request of FEMA, completing and submitting a report concerning participation in the NFIP, which may request information regarding the number of buildings in the SFHA, the number of permits issued for development in the SFHA, and the number of variances issued for development in the SFHA.

<u>H.</u> <u>Reviewing applications for permits to determine whether proposed activities will be located in the SFHA;</u>

<u>I.</u> <u>Reviewing applications to determine whether proposed activities will be reasonably safe from flooding and requiring new construction and substantial improvements to meet the requirements of this ordinance;</u>

<u>J.</u> <u>Reviewing applications to determine whether all necessary permits have been obtained from the federal, state, or local agencies from which prior or concurrent approval is required; in particular, permits from state agencies for any construction, reconstruction, repair, or alteration of a dam, reservoir, or waterway obstruction (including bridges, culverts, structures), any alteration of a watercourse, or any change of the course, current, or cross section of a stream or body of water, including any change to the SFHAs of free-flowing non-tidal waters of the state;</u>

<u>K.</u> <u>Approving applications and issuing permits to develop in flood hazard areas if the provisions of this ordinance have been met, or disapproving applications if the provisions of this ordinance have not been met;</u>

<u>L.</u> <u>Granting administrative variances pursuant to section 6.1 of this ordinance;</u>

<u>M.</u> <u>Inspecting, or causing to be inspected, buildings, structures, and other development for which permits have been issued to determine compliance with this ordinance or to determine if non-compliance has occurred or violations have been committed;</u>

<u>N.</u> <u>Reviewing elevation certificates and requiring incomplete or deficient certificates to be corrected;</u>

O. Maintaining and permanently keeping documentation supporting the issuance and denial of permits, elevation certificates, documentation of the elevation (in relation to the datum on the FIRM) to which structures have been flood proofed, and other required design certifications, variances, and records of enforcement actions taken to correct violations of this ordinance;

P. Enforcing the provisions of this ordinance, investigating violations, issuing notices of violations or stop work orders, and requiring permit holders to take corrective action;

Q. Advising the city council regarding the intent of this ordinance and, for each application for a variance, preparing a staff report and recommendation; and

R. Administering the requirements related to proposed work on existing buildings:

1. Making determinations as to whether buildings and structures that are located in flood hazard areas and that are damaged by any cause have been substantially damaged; and

2. Making reasonable efforts to notify owners of substantially damaged structures of the need to obtain a permit to repair, rehabilitate, or reconstruct, and prohibit the non-compliant repair of substantially damaged buildings except for temporary emergency protective measures necessary to secure a property or stabilize a building or structure to prevent additional damage.

S. Undertaking, as determined appropriate by the floodplain administrator due to the circumstances, other actions that may include but are not limited to: issuing press releases, public service announcements, and other public information materials related to permit requests and repair of damaged structures; coordinating with other federal, state, and local agencies to assist with substantial damage determinations; providing owners of damaged structures information related to the proper repair of damaged structures in SFHAs; and assisting property owners with documentation necessary to file claims for increased cost of compliance coverage under National Flood Insurance Program (NFIP) flood insurance policies; and

T. It is the duty of the city floodplain administrator to take into account flood, mudslide, and flood-related erosion hazards, to the extent that they are known, in all official actions relating to land management and use throughout the entire jurisdictional area of the city, whether or not those

hazards have been specifically delineated geographically (e.g., via mapping or surveying).

~~Sec. 2.3. Duties and responsibilities of the department of planning.~~ Reserved.

~~The duties and responsibilities of the department of planning shall include but are not limited to:~~

~~A.~~ ~~Reviewing applications for permits to determine whether proposed activities will be located in the SFHA;~~

~~B.~~ ~~Reviewing applications to determine whether proposed activities will be reasonably safe from flooding and requiring new construction and substantial improvements to meet the requirements of this ordinance;~~

~~C.~~ ~~Reviewing applications to determine whether all necessary permits have been obtained from the federal, state, or local agencies from which prior or concurrent approval is required; in particular, permits from state agencies for any construction, reconstruction, repair, or alteration of a dam, reservoir, or waterway obstruction (including bridges, culverts, structures), any alteration of a watercourse, or any change of the course, current, or cross section of a stream or body of water, including any change to the SFHAs of free-flowing non-tidal waters of the state;~~

~~D.~~ ~~Approving applications and issuing permits to develop in flood hazard areas if the provisions of this ordinance have been met, or disapproving applications if the provisions of this ordinance have not been met;~~

~~E.~~ ~~Granting administrative variances pursuant to section 6.1 of this ordinance;~~

~~F.~~ ~~Inspecting, or causing to be inspected, buildings, structures, and other development for which permits have been issued to determine compliance with this ordinance or to determine if non-compliance has occurred or violations have been committed;~~

~~G.~~ ~~Reviewing elevation certificates and requiring incomplete or deficient certificates to be corrected;~~

~~H.~~ ~~Maintaining and permanently keeping documentation supporting the issuance and denial of permits, elevation certificates, documentation of the elevation (in relation to the datum on the FIRM) to which structures have been flood proofed, and other required design certifications, variances, and records of enforcement actions taken to correct violations of this ordinance;~~

~~I. Enforcing the provisions of this ordinance, investigating violations, issuing notices of violations or stop work orders, and requiring permit holders to take corrective action;~~

~~J. Advising the city council regarding the intent of this ordinance and, for each application for a variance, preparing a staff report and recommendation; and~~

~~K. Administering the requirements related to proposed work on existing buildings:~~

~~1. Making determinations as to whether buildings and structures that are located in flood hazard areas and that are damaged by any cause have been substantially damaged; and~~
~~2. Making reasonable efforts to notify owners of substantially damaged structures of the need to obtain a permit to repair, rehabilitate, or reconstruct, and prohibit the non-compliant repair of substantially damaged buildings except for temporary emergency protective measures necessary to secure a property or stabilize a building or structure to prevent additional damage.~~

~~Sec. 2.4. Shared duties and responsibilities.~~ Reserved.

~~The duties and responsibilities shared by the departments of public works and Planning shall include but are not limited to:~~

~~A. Undertaking, as determined appropriate by the floodplain administrator due to the circumstances, other actions that may include but are not limited to: issuing press releases, public service announcements, and other public information materials related to permit requests and repair of damaged structures; coordinating with other federal, state, and local agencies to assist with substantial damage determinations; providing owners of damaged structures information related to the proper repair of damaged structures in SFHAs; and assisting property owners with documentation necessary to file claims for increased cost of compliance coverage under National Flood Insurance Program (NFIP) flood insurance policies; and~~

~~B. It is the duty of the city floodplain administrator to take into account flood, mudslide, and flood-related erosion hazards, to the extent that they are known, in all official actions relating to land management and use throughout the entire jurisdictional area of the city, whether or not those hazards have been specifically delineated geographically (e.g., via mapping or surveying).~~

. . . .

Sec. 2.8. Interpretation of district boundaries.

Initial interpretations of the boundaries of the floodplain districts shall be made by the floodplain administrator. Should a dispute arise concerning the boundaries of any of the districts~~, the city council shall make the necessary determination. The person questioning or contesting the location of the district boundary shall be given a reasonable opportunity to present his case to the city council and to submit his own technical evidence if he so desires~~ a surveyor shall provide either an elevation certificate or recent survey showing topographic elevations and delineating the Special Flood Hazard Area.

. . . .

Sec. 2.11. Appeals to decisions made by the floodplain administrator.

It is further provided that any decision of the floodplain administrator or his designee may be modified, reversed, or affirmed by the city council upon appeal by any aggrieved party to such decision, if such appeal is filed with the floodplain administrator within thirty (30) days of such decision through the application for a Floodplain Variance outlined in Section VI of this ordinance.

ARTICLE III. ESTABLISHMENT OF FLOODPLAIN DISTRICTS

Sec. 3.1. Description of floodplain districts.

A. Special flood hazard areas (SFHA). The SFHAs shall include land in the floodplain subject to a one (1) percent or greater chance of being flooded in any given year. The basis for the delineation of these districts shall be the FIS and the FIRM for the City of Virginia Beach prepared by FEMA, Federal Insurance Administration, dated January 16, 2015, and any subsequent revisions or amendments thereto.

The boundaries of the SFHAs are established as shown on the FIRM, which is declared to be a part of this ordinance and shall be kept on file at the City of Virginia Beach Department of ~~Public Works~~ Planning and Community Development, and include the following districts:

1. The Floodway District is in an AE Zone and is delineated, for the purposes of this ordinance, using the criterion that certain areas within the floodplain must be capable of carrying the waters of the one (1) percent annual chance flood without increasing the water surface elevation of that flood more than one (1) foot at any point. The areas included in this district are specifically defined in Table 7 of the above-referenced FIS and shown on the accompanying FIRM.

2. The AE or AH Zones on the FIRM accompanying the FIS shall be those areas for which one (1) percent annual chance flood elevations have been provided and the floodway has not been delineated.

3. The A Zone on the FIRM accompanying the FIS shall be those areas for which no detailed flood profiles or elevations are provided, but the one (1) percent annual chance floodplain boundary has been approximated.

4. The AO Zone on the FIRM accompanying the FIS shall be those areas of shallow flooding identified as AO on the FIRM.

5. ~~Reserved.~~ The Coastal A Zone on the FIRM accompanying the FIS shall be those areas labeled as AE and are located seaward of the limit of moderate wave action (LiMWA) line.

6. The VE or V Zones on FIRMs accompanying the FIS shall be those areas that are known as coastal high hazard areas, extending from offshore to the inland limit of a primary frontal dune along an open coast and any other area subject to high velocity wave action from storm or seismic sources.

B. ~~Floodplain subject to special restrictions~~ *Local Flood Hazard Areas*. The City of Virginia Beach may identify and regulate local flood hazard or ponding areas that are not delineated on the FIRM. These areas are ~~identified in section 4.10 and may be delineated on a map using best available topographic data and locally derived information such as flood of record, historic high water marks, or approximate study methodologies~~ identified as follows:~~.~~

a. *Other areas of flood risk*. The X and the X(Shaded) Zone on the FIRM where the City of Virginia Beach Stormwater Master Plan has identified areas, outside SFHAs delineated on the FIRM, that area susceptible to flooding. The most recent updated version of the modeling shall be used to identify areas that are likely to experience flooding.

b. *Floodplain Subject to Special Restrictions*. The Floodplain Subject to Special Restrictions is identified in section 4.10 and includes areas in the southern part of the city which are characterized by wind tides, low topography, and poorly draining soils.

ARTICLE IV. FLOODPLAIN DISTRICT PROVISIONS

Sec. 4.1. Permit and application requirements.

. . . .

B. Site plans and permit applications. All applications for development within any floodplain district and all building permits issued within ~~the~~ any floodplain district shall incorporate the following information:

1. For any addition, conversion of any non-habitable space to habitable space, or the construction or installation of a new accessory structure that requires a building permit.

   a. A physical survey, performed after the effective date of the FIRM that:

      i. accurately depicts current improvements on the property;
      ii. provides a flood zone determination and BFE or flood depth at the stie; and
      iii. delineates the location of the flood zones on the property.

   b. For structures located in the SFHA delineated on the FIRM, a current elevation certificate sealed by a licensed design professional.

2. For new construction and any substantial improvement of the principal structure:

   a. a proposed site plan sealed by a registered design professional that provides:

      ~~1~~i. The elevation of the base flood at the site;

      ~~2~~ii. The elevation of the lowest floor (including basement) or, in V Zones, the lowest horizontal structural member;

      ~~3~~iii. For structures to be flood-proofed (non-residential only), the elevation to which the structure will be flood-proofed; and

      4iv. Topographic information showing existing and proposed ground elevations.

Sec. 4.2. General standards.

. . . .

5. Electrical, heating, ventilation, plumbing, air conditioning equipment, and other service facilities, including duct work, shall be designed and/or ~~located so as to prevent water from entering or accumulating within the components during conditions of flooding~~ or above the design flood elevation.

6. New and replacement water supply systems shall be designed to minimize or eliminate infiltration of flood waters into the system.

7. New and replacement sanitary sewage systems shall be designed to minimize or eliminate infiltration of flood waters into the systems and discharges from the systems into flood waters.

8. On-site waste disposal systems shall be located and constructed to avoid impairment to them or contamination from them during flooding.

9. No use shall be permitted if such use will increase the amounts of potentially damaging materials, including those likely to be injurious to health, that might be transported in floods.

10. For properties located in SFHAs delineated on the FIRM, an elevation certificate and, if applicable, a flood-proofing certificate shall be provided to the Floodplain Administrator prior to any foundation inspection, final inspections, and the issuance of any certificates of occupancy, in order to assure compliance with these floodplain regulations.

11. Prior to any proposed alteration or relocation of any channels or of any watercourse or stream within the city, a permit shall be obtained from the USACE, VADEQ, the Virginia Marine Resources Commission, and the Wetlands Board through the joint permit application process. Furthermore, notification of the proposal shall be given by the applicant to all affected adjacent jurisdictions, the department of conservation and recreation (division of dam safety and floodplain management), other required agencies, and FEMA.

12. The flood carrying capacity within an altered or relocated portion of any watercourse shall be maintained.

~~B. In all SFHAs, the following additional provisions shall apply:~~

~~1. Prior to any proposed alteration or relocation of any channels or of any watercourse or stream, within the city a permit shall be obtained from the USACE, VADEQ, the Virginia Marine Resources Commission, and the Wetlands Board through the joint permit application process. Furthermore, notification of the proposal shall be given by the applicant to all affected adjacent jurisdictions, the department of conservation and recreation (division of dam safety and floodplain management), other required agencies, and FEMA.~~

~~2. The flood carrying capacity within an altered or relocated portion of any watercourse shall be maintained.~~

~~3. Sand dunes, barrier beaches, and other natural protective barriers shall remain intact to provide protection against wind, waves, and erosion drainage. Any person who desires to use or alter any coastal primary sand dune, other than for the purpose of conducting the activities specified in section 1602 of the Zoning Ordinance of the City of Virginia Beach, shall first obtain a permit from the USACE, VADEQ, the Virginia Marine Resources Commission, and the Wetlands Board through the joint permit application process.~~

Sec. 4.3. Elevation and construction requirements.

In all ~~SFHAs where base flood elevations have been provided in the FIS or generated by a licensed professional in accordance with section 4.6 of this ordinance~~ floodplain districts, with the exception of Coastal A and Coastal High Hazard (VE) zones, the following provisions shall apply:

A. Residential construction requirements. ~~New construction or substantial improvement of any residential structure or manufactured home in Zones AE, AH, and A with detailed base flood elevations shall have the lowest floor, including basement, elevated to a minimum of two (2) feet above the base flood level.~~ The lowest flood, including basement, shall be set to the higher of the following:

i. A minimum of two (2) feet above the base flood elevation established on the most recent FIRM or by the most recent FIS or,

ii. A minimum of one (1) foot above the 100-year HGL elevation measured at the nearest existing or proposed public drainage structure or BMP, in the City Stormwater Master Plan.

B. Non-residential construction requirements. New construction or substantial improvement of any commercial, industrial, or non-residential building or manufactured home shall have the lowest floor, including basement, elevated as ~~minimum of two (2) feet above the base flood level~~ established in Section 4.3 A of this ordinance. Buildings ~~located in AE or AH Zones~~ may be flood-proofed in lieu of being elevated provided that all areas of the building components below the ~~elevation corresponding to the base flood elevation plus a minimum of two (2) feet freeboard~~ design flood elevation are watertight with walls substantially impermeable to the passage of water, and use structural components having the capability of resisting hydrostatic and hydrodynamic loads and the effect of buoyancy. A professional engineer or architect licensed by the Commonwealth of Virginia shall certify that the standards of this subsection are satisfied. Such certification, including the specific elevation (in relation to NAVD88) to which such structures are flood proofed, shall be maintained by the building official.

C. ~~Space below the lowest floor requirements. In Zones A, AE, AH, and AO, f~~Fully enclosed areas of new construction or substantially improved existing structures that are below the ~~regulatory~~ design flood protection elevation shall:

1. Not be designed or used for human habitation, but shall only be used for parking of vehicles, building access, or limited storage of maintenance equipment used in connection with the premises. Access to the enclosed area shall be the minimum necessary to allow for parking of vehicles (garage door), limited storage of maintenance equipment (standard exterior door), or entry to the living area (stairway or elevator).

2. Be constructed entirely of flood resistant materials below the ~~regulatory~~ design flood ~~protection~~ elevation.

3. Space below the lowest floor of SFHAs delineated on the FIRM shall ~~I~~include measures to automatically equalize hydrostatic flood forces on walls by allowing for the entry and exit of floodwaters. To meet this requirement, the openings shall either be certified by a professional engineer or architect licensed by the Commonwealth of Virginia or meet or exceed the following minimum design criteria:

. . . .

Sec. 4.4. Floodway requirements.

. . . .

B. The placement of new or replacement manufactured homes (mobile homes) is prohibited.

~~C. The following uses and structures may be permitted in the floodway district, subject to the requirements of articles III, IV, V, and VI of this ordinance:~~

~~1. Public and private outdoor recreational facilities;~~

~~2. Agricultural uses, including farming, grazing, and the raising of poultry or livestock; provided, that poultry or livestock shall not be housed within five hundred (500) feet of any residential, apartment, or hotel district;~~

~~3. Open uses, such as public and private roadways, off street parking, or loading and unloading areas related to uses in adjoining districts;~~

4. ~~Commercial mining, soil removal, and sand pits subject to regulations applicable to extractive industries as set forth in the conditional use provisions of the Zoning Ordinance of the City of Virginia Beach;~~

5. ~~Public improvements, such as dams, levees and channel improvements, and utilities installations and substations, including temporary storage of materials, except flammable, toxic or noxious materials, and temporary location of maintenance installations; and~~

6. ~~Uses and structures customarily accessory and clearly incidental and subordinate to uses listed above, including in connection with agricultural uses; roadside stands for the sale of agricultural products produced on the premises; provided that:~~

    a. ~~Only one (1) such stand shall be permitted per lot;~~

    b. ~~No such stand shall exceed five hundred (500) square feet in floor area; and~~

    c. ~~No such stand on the street frontage shall be erected within twenty (20) feet of the property line.~~

. . . .

Sec. 4.6. A Zone requirements.

. . . .

B. The floodplain administrator reserves the right to require a hydrologic and hydraulic analysis for any development and to determine the base flood elevation. When such base flood elevation data is utilized, the lowest floor shall be elevated to minimum of two (2) feet above the base flood level. During the permitting process, the floodplain administrator shall obtain:

1. The elevation of the lowest floor (including the basement) of all new and substantially improved structures; and

2. If the structure has been flood-proofed in accordance with the requirements of this ordinance, the elevation (in relation to NAVD88) to which the structure has been flood-proofed.

~~C. When the data is not available from any source, the lowest floor of the structure shall be elevated to not less than two (2) feet above the highest adjacent grade.~~

Sec. 4.8. ~~Reserved~~ X and X(Shaded) Zone requirements. (Other Areas of Flood Risk).

A. *Residential construction requirements*. The lowest floor, including basements, shall be set to a minimum of one (1) foot above the 100-year HGL elevation measured at the nearest existing or proposed public drainage structure or BMP, in the City Stormwater Master Plan.

B. *Non-residential construction requirements*. New construction or substantial improvement of any commercial, industrial, or non-residential building or manufactured home shall have the lowest floor, including basement, elevated as established in Section 4.8 A of this ordinance above. Buildings may be flood-proofed in lieu of being elevated provided that all areas of the building components below the design flood elevation are watertight with walls substantially impermeable to the passage of water, and use structural components having the capability of resisting hydrostatic and hydrodynamic loads and the effect of buoyancy. A professional engineer or architect licensed by the Commonwealth of Virginia shall certify that the standards of this subsection area satisfied. Such certification, including the specific elevation (in relation to NAVD88) to which such structures are flood proofed, shall be maintained by the building official.

Sec. 4.9. – Coastal High Hazard (~~V and~~ VE Zone) requirements.

The following provisions shall apply within ~~V and VE Zones~~ Coastal A Zones and Coastal High Hazard Areas:

A. All new construction and substantial improvements, including to manufactured homes, shall be elevated on pilings or columns so that:

1. The bottom of the lowest horizontal structural member of the lowest floor (excluding the pilings or columns) is elevated to a minimum of ~~two~~ three (~~2~~3) feet above the base flood ~~level~~ elevation; and

2. The pile or column foundation and structure attached thereto is anchored to resist flotation, collapse, and lateral movement due to the effects of wind and water loads acting simultaneously on all building components. Wind and water loading values shall each have a one (1) percent chance of being equaled or exceeded in any given year.

B. A professional engineer or architect licensed by the Commonwealth of Virginia shall develop or review the structural design, specifications, and plans for the construction and shall certify that the design and methods of construction to be used are in accordance with accepted standards of practice for meeting the provisions of article IV, section 4.6 A. A V Zone

Design Certificate shall be submitted to Permits and Inspections with plans for a building permit.

. . . .

I. ~~The man-made alteration of sand dunes, which would increase potential flood damage, is prohibited.~~ Sand dunes, barrier beaches, and other natural protective barriers shall remain intact to provide protection against wind, waves, and erosion drainage. Any person who desires to use or alter any coastal primary sand dune or beaches, other than for the purpose of conducting the activities specified in Article 1600, Section 1602 of the Zoning Ordinance of the City of Virginia Beach, shall first obtain a permit, or authorization, from the USACE, VADEQ, the Virginia Marine Resources Commission, and the Wetlands Board through the joint permit application process.

J. Manufactured homes are prohibited.

Sec. 4.10. Floodplain subject to special restrictions.

A. All ~~FIRM delineated~~ SFHAs that ultimately drain to Back Bay or the Currituck Sound ~~located in the following areas~~ shall be identified as a floodplain subject to special restrictions~~:~~.

~~1. North Landing River and its tributaries south of Lynnhaven Parkway;~~
~~2. West Neck Creek and its tributaries south of Shipps Corner Road, London Bridge Road, and the portion of Dam Neck Road east of its intersection with London Bridge Road; and~~

~~3. Bays, creeks, lakes, guts, coves, wetlands, marshes and swamps and their tributaries comprising the Back Bay and Small Coastal South watersheds south of South Birdneck Road and east of Princess Anne Road and General Booth Boulevard.~~

B. The following provisions shall apply within the floodplain subject to special restrictions:

1. Notwithstanding any provision of this ordinance to the contrary, no filling shall be permitted, including filling with material excavated from the same floodplain except for:

a. The purpose of public roadway or other similar public works construction undertaken by the Department of Public Works or Virginia Department of Transportation, or their agent for

construction. This construction includes flood protection and flood mitigation projects;

b. The maintenance, alteration, or relocation of bona fide agricultural ditches, swales, or agricultural pathways or those ditches required for proper lot drainage;

c. For shoreline stabilization or maintenance projects, such as riprap revetment, bulkheads, or other treatment used to stabilize and protect the banks of waterways, the city manager or his designee may approve the placement of fill provided the following criteria are met:

i. A joint permit application is submitted;

ii. The alignment of the stabilization structure is along the escarpment or in line with adjacent stabilization structures; ~~and~~

iii. If there is an existing shoreline stabilization structure, any proposed replacement structure shall be no more than six (6) inches higher than the existing structure; and

~~iii~~iv. Fill must be the minimum necessary to support the stabilization project.

2. The city manager, or his designee, may approve the placement of fill provided that the following criteria are met:

a. Proposed fill within the floodplain:

i. Shall be mitigated to result in no decrease in flood storage volume on the site;

ii. Shall be mitigated entirely on the same site that will incur the fill;

iii. Shall be contiguous to the existing floodplain that is being filled; and

iv. Shall be limited to the smallest amount of area and volume possible to correct irregularities within the boundary of the project.

b. The combined areas of fill and mitigation shall not exceed five (5) percent of the total area within the floodplain located on the site that will incur the fill.

3. Residential dwelling structures shall not be located within the floodplains subject to special restrictions on lots created after October 23, 2001. Residential dwelling structures located in ~~local flood hazard areas as of~~ a SFHA and constructed prior to October 23, 2001 may be expanded with attached additions to a total footprint of less than one thousand (1,000) square feet; such additions shall also comply with the requirements set forth in article V of this ordinance.

. . . .

ARTICLE V. EXISTING STRUCTURES IN FLOODPLAIN AREAS

Sec. 5.1. Existing structures.

A structure or use of a structure or premises that lawfully existed prior to the adoption of this ordinance, but which is not in conformity with this ordinance, may be continued subject to the following conditions:

A. Any existing structures in the floodway area shall not be expanded or enlarged unless it has been demonstrated through hydrologic and hydraulic analyses performed in accordance with standard engineering practices that the proposed expansion or enlargement would not result in any increase in the base flood elevation.

B. Any modification, alteration, repair, reconstruction, or improvement of any kind to a structure and/or use located in any floodplain ~~areas~~ district to an extent or amount of less than fifty (50) percent of its market value shall conform to the VA USBC and meet the freeboard height in effect at the start of construction for the original structure.

C. Any modification, alteration, repair, reconstruction, or improvement of any kind to a structure and/or use, in any floodplain ~~area~~ district to an extent or amount of fifty (50) percent or more of its market value shall be undertaken only in full compliance with this ordinance and shall require the entire structure to conform to the VA USBC.

ARTICLE VI. VARIANCES AND APPEALS

Sec. 6.1. Administrative variances.

The floodplain administrator shall approve or deny an application requesting an administrative variance after receipt of a complete application. Administrative variances may only be granted for the following uses, development, or redevelopment:

A. As defined in section 4.10, floodplains subject to special restrictions, for filling only.

B. Any structure or use sustaining damage not caused by flood to an extent or amount of fifty (50) percent or more of its market value to allow the structure to be rebuilt to the freeboard height in effect at the start of construction for the original structure. If the structure is a pre-FIRM structure, full compliance with the current VAUSBC freeboard above the base flood elevation is required. Structures that are utilizing an approved land management plan for their on-site waste disposal may be allowed to continue the use of the land management plan as long as it is approved by the city and the health department, even for damage or destruction resulting from flood.

<u>C.</u> <u>As defined in section 4.8 B, X and X(Shaded) Zone requirements. (Other Areas of Flood Risk), and 4.3 A(ii) when the required finished floor is higher than the BFE plus two feet of freeboard, where the floodplain administrator, in consultation with the Development Services Center, has determined that the proposed stormwater engineering design will approximately mitigate any impacts to the finished floor of the nonresidential development.</u>

Sec. 6.3. Application process.

A. Applications for variances from the requirements of this ordinance shall be made to the city council and filed with the director of planning. The fee for such applications shall be ~~six hundred fifty dollars~~ <u>seven hundred eighty</u> ($~~650~~<u>780</u>.00). Such fee shall include all costs of notifications and advertising. Except in cases in which such fee is waived, the director shall not accept any application not accompanied by payment of the required fee. The procedure for the advertising, hearing and determination of applications for floodplain variances shall be in accordance with the requirements pertaining to applications for subdivision variances, as set forth in section 9.4 of the subdivision ordinance. In cases in which a variance application is filed by reason of a natural disaster that is the subject of a federal declaration of emergency, application and associated advertising fees shall be waived and such application shall be given expedited processing to the maximum practical extent.

B. All applications shall be accompanied by the following:

1. A separate map, on a 1″ = 100′ or greater scale, identifying all proposed land disturbance, including fill and mitigation areas, and the limits of the existing and proposed SFHAs, tidal and non-tidal wetlands, Southern Rivers Watershed Management Area Buffer, and CBPA Resource Protection Area Buffer; and

2. A preliminary floodplain study addressing the physical and environmental characteristics of the floodplain located on adjoining properties and in the general area. Such study shall be sufficient to show that the variance, if granted, will meet the standards defined in section 6.~~3~~4 and in addition thereto, shall:

   a. Contain supporting data and calculations required for a Preliminary Stormwater Engineering Analysis as appropriate~~,~~ ~~given the preliminary nature of the floodplain study~~;

   b. Comply with the Public Works Design Standards Manual; and

   c. Be certified by a professional engineer, architect, surveyor, landscape architect or practitioner of a related field having a valid license issued by the Commonwealth of Virginia or who is exempt from licensure pursuant to applicable provisions of the Virginia Code.

Adopted by the Council of the City of Virginia Beach, Virginia, on the 1st day of February, 2022.

Attachment 6: Copy of Monitoring/Maintenance Plan

[DRAFT] Annual Monitoring Plan and Post-Construction Monitoring Report

Marsh Restoration in Back Bay, Virginia Beach, VA

Prepared by: Dewberry Engineers, Inc.

[July 6, 2023]

[REPORT VERSION [DRAFT]]

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INTRODUCTION

This project is intended to implement one of the nature-based projects proposed in Virginia Beach's "Sea Level Wise" (SLW) Adaptation Strategy[1] adopted by the Virginia Beach City Council in June 2020. The SLW Adaptation Strategy presents a holistic framework for addressing flood risks across the City, consisting of four general strategies – natural mitigations, engineered defenses, adapted structures, and prepared communities. These strategies were applied to each major watershed in the City and tailored to their unique characteristics and risk profiles. The adaptation vision for the Lower Southern Rivers Drainage Basin, where the proposed project is located, focuses on employing natural mitigation methodologies to strategically reduce flow into and within Back Bay, along with an integrated system of defense structures and complementary adaptation measures, such as land-use strategies, to improve flood storage and overall coastal resiliency. The Bonney Cove area of Back Bay, where the project site is proposed, is particularly suitable for the use of nature-based strategies given the low elevations of marshlands and documented historic degradation of habitat. Participants at the 'near-neighbor' public engagement meetings held during the SLW Adaptation Strategy development were supportive of these types of strategies.

The City has several dedicated Capital Improvement Program (CIP) initiatives for the Lower Southern Rivers Drainage Basin for implementation of these strategies. The City's Stormwater Green Infrastructure CIP has obligated approximately $421,700 in contracts to support field investigations, environmental assessments, and engineering designs of the project – a true indication of the City's commitment to nature-based approaches and the critical first step in a broader effort. During the General Election on November 2, 2021, Virginia Beach residents voted to authorize $567.5 million dollars in debt to fund the design and construction of 21 Phase 1 projects in the citywide Flood Protection Program. [2] The Back Bay Marsh Terrace project is included under the Stormwater Green Infrastructure Master Project.[3] Other Southern Watershed projects that received funding under the Flood Protection Program include the West Neck Creek Bridge City-Wide Sea Level Rise Strategy, the Pungo Ferry Road Improvements, and the Sandbridge/New Bridge Intersection Improvements projects.

Outside of this project, the Virginia Beach City Council has recently funded a $5.2 million dollar voluntary acquisition program to encourage flood-prone properties to apply for a buyout to enable the City to convert parcels to open space to serve as flood storage and a marsh migration buffer. The City's

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[1] City of Virginia Beach Sea Level Wise Adaptation Strategy webpage: https://www.vbgov.com/government/departments/public-works/comp-sea-level-rise/Pages/default.aspx

[2] City of Virginia Beach Flood Protection Program webpage: https://www.vbgov.com/government/departments/public-works/flood-protection-program/Pages/Flood-Protection-Program.aspx.

[3] Stormwater Green Infrastructure Page: https://www.vbgov.com/government/departments/public-works/flood-protection-program/Pages/Stormwater-Green-Infrastructure-.aspx

Stormwater Green Infrastructure CIP is also supporting the implementation of other natural and nature-based projects across the City, including a wetland and floodplain restoration project along the Eastern Branch of the Elizabeth River.

An assessment of restoration opportunities in the City's Lower Southern Rivers Drainage Basin with dual flood reduction and habitat restoration benefits identified the Bonney Cove area as a potential project site for several reasons. The Bonney Cove site has experienced significant historical ecological degradation. Historical shoreline data from 1869 indicates approximately 50% of present-day open water in Bonney Cove (260 acres) was previously marsh (Figure 1). Loss of the marsh island habitat within Bonney Cove has resulted in the opening of a secondary channel allowing increased flow exchange between the upper and lower bays. In comparison to shore-adjacent restoration, off-shore marsh restoration leveraging hydraulic modeling identified Bonney Cove as a location where marsh restoration has the potential to reduce the propagation of floodwaters through key pathways within Back Bay. The United States Fish and Wildlife Service (USFWS) and the Virginia Department of Wildlife Resources (VDWR) also identified Bonney Cove as a restoration priority as this area serves as an ideal location for Submerged Aquatic Vegetation (SAV) reestablishment and vital habitat for migratory birds and fish.

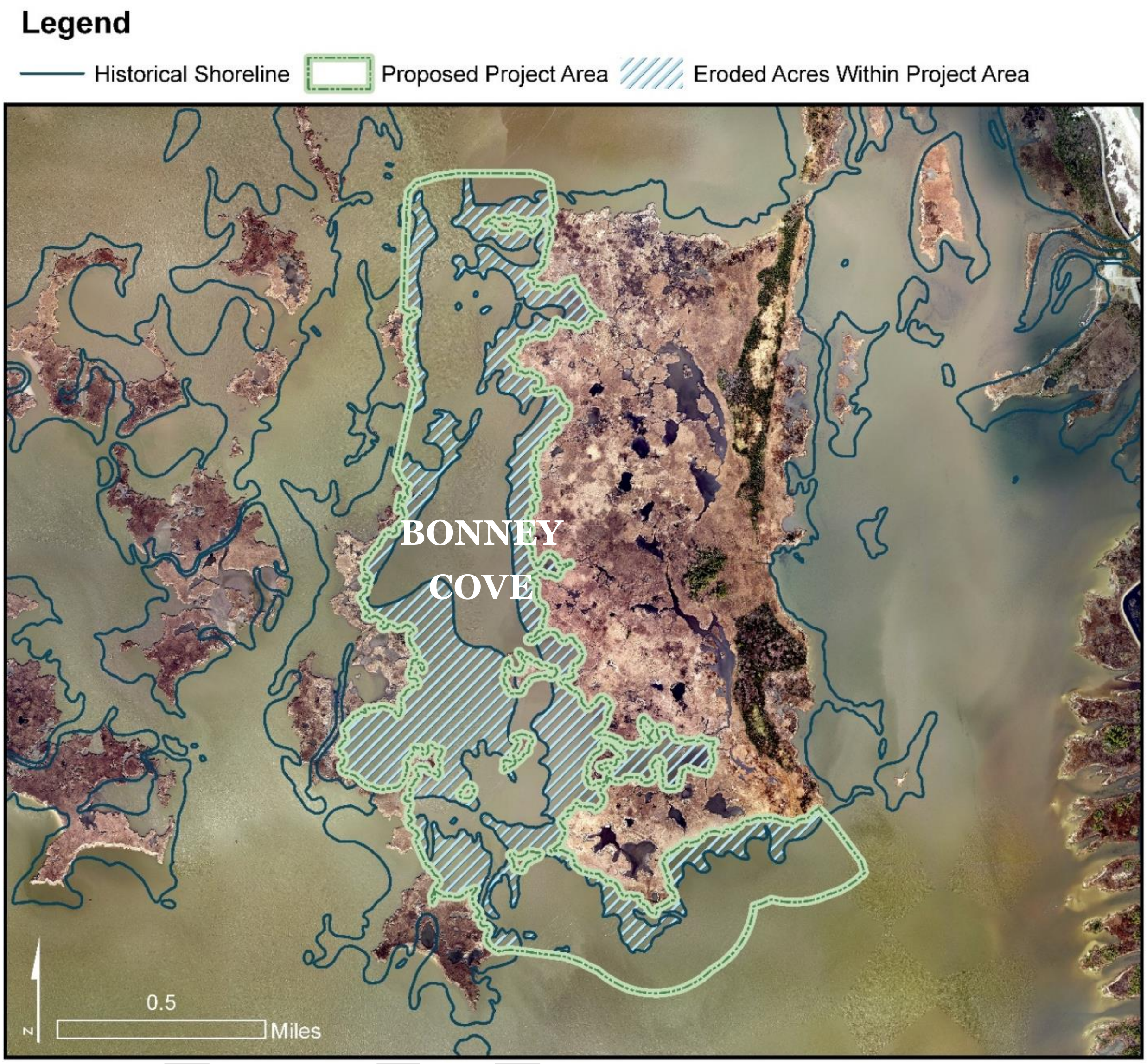

Figure 1: Historical marsh erosion within the project area.

The project is situated within the Bonney Cove area of Back Bay, spanning the western and southern lengths of Long Island, as shown in Figure 1.

Project Background

Marsh island restoration through terracing was identified as a particularly viable solution given Back Bay's shallow bottom and the historical loss of habitat. The marsh terraces are narrow man-made islands that will be arranged across areas that were historically marsh but are now shallow open water. A series of these islands, or terraces, are typically arranged in a chevron pattern. The overall field of terraces dissipates waves and slows down water moving through the area. In turn, the calmer water allows more sunlight to penetrate to the shallow bottom, promoting establishment and growth of marsh

and SAV habitats.   Further, as opposed to one continuous marsh platform, marsh terraces maximize habitat for a variety of fish and wildlife species.

The Preferred Alternative includes the creation of 41 individual marsh terraces totaling approximately 25,000 linear feet (or an approximately 47-acre footprint) across Bonney Cove. These 47 acres of terraces are comprised of approximately 13 acres of emergent (low and high marsh) vegetated habitat, 14 acres of upland vegetated habitat, and 16 acres of submerged terrace habitat. Approximately 310 acres of suitable SAV habitat will remain in between the terraces.

Terrace Construction and Orientation

Terrace construction will begin in the northern extent of the project site, and the contractor will work towards the southern extent of the site. The contractor will complete each terrace, including installing plants, before moving to the next. Marsh terrace construction will occur over two years (2025 to 2026) and will pause annually between October 31st and March 1st to limit disturbance to wintering waterfowl and migration, in accommodation of BBNWR’s requirement. Approximately 20 terraces will be constructed in 2025 ("Phase 1"), and 21 terraces will be constructed in 2026 ("Phase 2"). The following sections summarize the proposed design and construction approach.

Terraces will be generally oriented perpendicular to the predominant wind direction (south-southwest) to maximize wave energy reduction. The terraces will be segmented in a chevron (duck-wing) pattern to create the most favorable fish and swimming crustacean (termed "nekton") habitat, facilitate adequate circulation, and maintain navigability throughout the project area. The terraces will not be connected to the adjacent marsh to maintain a physical open water barrier to deter the invasion of Common Reed (*Phragmites australis*) stands.

The terraces will be spaced at approximately 300-foot intervals in the northern and southern quarters and span 15 feet in width, and at least 600-foot intervals in the center and span 30 feet in width. This arrangement will lessen the amount of open water and subsequent wave action at the northern and southern ends of the site and provide space for marine-based construction equipment. The design team reviewed the final spacing layout of the terraces to ensure navigability of a watercraft through the project site which will be required for post-construction monitoring, any needed maintenance, as well as community recreational access.

The terraces would consist of a sand filled core encapsulated by a high-strength blend of woven and non-woven geotextile fabrics (“geobags”). The sand for this material would need to come from offsite sources. Back Bay is too shallow to accommodate conventional barges for material placement. To avoid extensive impacts to the bottom of the bay, the slurry basin will pump sand for the project from the proposed Shipps Cabin Road staging area to Bonney Cove. The slurry pipeline will consist of approximately 10,424 linear feet of 12” diameter HDPE fused/welded pipeline that will be assembled on land and floated into its proposed alignment within Back Bay. The pipe would be marked by floats

every 5 feet and temporary signage as reasonable. It is anticipated the pipeline will be submerged to the bottom of the bay at channel crossings and adjacent to a duck hunting cabin adjacent to the alignment. By establishing a floating pipeline, it will limit disturbances to the subaqueous bottomlands along the alignment and allow for the retraction of the pipeline during the winter inactive periods and inclement weather events. Booster stations would be placed approximately every mile. These booster stations would consist of a pontoon mounted diesel engine pump capable of moving the sand slurry from the laydown area to the site. Given the distance to the site, four or five of these booster stations are anticipated to be necessary to create the sand cores of the terrace. It is estimated that 450 Gallons Per Minute (GPM) of sand slurry would be pumped through the pipe.

Once the cores are in place, long reach excavators would travel along the tops of the terraces and begin to shape the cross slopes. Appropriate materials for establishing vegetation atop the terraces will be primarily sourced from materials dredged during the Sandbridge Road Nimmo Parkway Phase VII-A project located immediately north of Back Bay (VMRC 15-1564, USACE IP NAO-2015-00151). Materials will be tested and screened to remove organics prior to application to the terraces. As needed, dredging sites adjacent to the proposed terrace locations that are confirmed to be devoid of SAV will be utilized to provide supplemental soil materials to top the proposed terraces[4]. It was determined that the in-situ bay sediment would be suitable for vegetation growth. The marsh terraces would be covered with 1 to 3 feet of suitable fill, depending on crest widths. Jute netting will cover the topsoil to control erosion and promote vegetation establishment. Coir logs will be places along the terrace slope controls to further promote vegetation establishment along the slope.

SAV Plantings

The City has partnered with Virginia Polytechnic Institute and State University ("Virginia Tech") to evaluate opportunities for restoring populations of native Wild Celery (*Vallisneria americana*) in Back Bay. The Virginia Tech research team has developed an innovative technique to grow Wild Celery in an aquaculture center that results in larger, mature plants that can better withstand Back Bay's turbidity. Once transplanted, plants are surrounded by cages to prevent predation. These founder colonies can be used for propagation throughout Back Bay. After terrace construction, the City will transplant Wild Celery in an area adjacent to the site. This founder colony will be used to strategically transplant Wild Celery in between the terraces for 5 years after construction (2026 – 2029) with the ultimate goal of establishing 10 acres of SAV vegetation in between the marsh terraces.

[4] The 60% preliminary design showed preliminary siting of these dredge areas based on avoidance of existing SAV habitat; however, pre-construction surveys of SAV would be required to re-delineate these dredging areas.

Terrace Plantings – Upland and Marsh Vegetation

The terraces' intertidal perimeter will be planted with appropriate emergent estuarine plant species (e.g., Saltmarsh Cordgrass [*Spartina alterniflora*] and Salt Meadow Hay [*Spartina patens*]) and brackish plant species (e.g., Big Cordgrass [*Spartina cynosuroides*]). These plants will be installed as soon as possible after construction to stabilize planting areas and protect the terrace from erosion. In addition to emergent grass, woody growth (i.e., shrubs and trees) within the terrace crest will be incorporated to protect the terraces' surfaces from rain and wind erosion and hold the landform together through substantial root systems.

Appropriate native species were identified based on the review of the reference marshes surrounding the project site and a review of water levels in Back Bay. Since the Bay's water levels are not affected by lunar tides and instead by wind-driven fluctuations, the project team evaluated average water elevations at the U.S. Geological Survey (USGS) Beggars Bridge Creek Gauge (Gauge ID 0204300267) from 2016 – 2021 to determine ranges of inundation to achieve functional marsh elevations throughout the project life, defined as:

- *Mean Low Water (MLW)*: the average low water at the site (10th Percentile: -0.62 ft NAVD88)
- *Mean High Water (MHW)*: the average high water at the site (95th Percentile: 1.22 ft NAVD88)
- *Mean Tide Level (MTL)*: halfway between MLW and MHW (0.3 ft NAVD88)
- *Upper Limit of Wetlands (ULW)*: approximately 1.5 times the mean tide range at the site (2.76 ft NAVD88)

These elevations were correlated to suitability for low marsh, high marsh, and upland species, as shown in Table 1.

Table 1: Proposed planting elevation zones.

Planting Zone	Definition	Elevation Range	Elevation (feet NAVD88)	Percentage of record where water reaches these elevations
Low Marsh	Marsh that is flooded frequently but exposed sometimes	MTL - MHW	0.3 – 1.2 ft	48%
High Marsh	Marsh that is generally only flooded during higher-than average water conditions	MHW – ULW	1.2 to 2.8 ft	7%
Upland Habitat	Habitat that is rarely flooded, only during extreme conditions	> ULW	> 2.8 ft	0%

Five planting schemas were identified to provide the highest possible environmental benefit in terms of erosion control, habitat diversity, and fetch reduction. The wider (30-foot) terraces will be planted with Bald Cypress (*Taxodium districhum*) trees capable of withstanding rising water levels. The full list of species and quantities is provided in the 95% design plan set.

The final engineered design component is the strategic placement of rock on the exposed perimeter terraces on the project site's north, west, and southern extents. The need for the rock armor was determined through analysis of wind data both from NOAA and ASCE-7-10 50-year return period anticipated 3-second gust values. These values were used to calculate fetch-generated waves at the project site. The calculations performed confirmed that armored protection would be required to protect the proposed terraces from the forces created by wave action. The stone sizes required for these features (Class II rip rap) were calculated following the procedures laid out in the USACE Coastal Engineering Manual (CEM) and Virginia Institute of Marine Science (VIMS) Living Shoreline Design Guidelines for Shore Protection in Virginia's Estuarine Environments. Two calculation methods, Hudson (1974) and Van Der Meer (1988), from the CEM were utilized to evaluate the range of acceptable rock armor for the exposed perimeter. These two methods calculate the armor stone size based on several design inputs including initial wave height, allowable damage level, revetment slope, and breaking versus non-breaking waves. The two methods often result in corresponding values that are used by the engineer to make an experienced determination on the final rock armor sizing. The rock armor will serve as a nature-based design element by acting as a substrate for the Wild Celery grass that has proven to be successful for SAV establishment in Back Bay (see Figure 2).

Figure 2: Example Back Bay SAV experiment; photo courtesy of Virginia Tech.

Monitoring Goals and Objectives

Annual post-construction monitoring of the site is required by the Virginia Marine Resource Commission (VMRC) (TBD) Permit (VMRC #XXXX-XXXX) and the U.S. Army Corps of Engineers (USACE) Individual Permit (NOA-20XX-XXXXX). [Insert details of the relevant permits and permit conditions]. The following goals, objectives, and metrics were established to enable consistent tracking of the primary living shoreline project components across each monitoring year.

1. **Monitoring Goal 1**: Establishment of a Sustainable Coastal Marsh Island System
   a. Objective 1a: Establish Emergent Marsh Habitat
      - Metric: For each monitoring year, the project area should maintain or increase the overall coverage of emergent marsh vegetation. There should be no significant signs of herbivory or invasive species establishment.

   b. Objective 1b: Establish Upland Habitat
      - Metric: For each monitoring year, the project area should maintain or increase the overall coverage of upland vegetation. There should be no significant signs of herbivory or invasive species establishment.
2. **Monitoring Goal 2**: Stability of Marsh Terraces
   a. Objective 2: Marsh Terrace Structures
      - Metric: For each monitoring year, the terrace structures should show no significant signs of damage, deterioration or extreme settlement.
3. **Monitoring Goal 3**: Establishment of a Sustainable SAV Community
   a. Objective 3: Establish SAV Communities

- Metric: For each monitoring year, the SAV planting areas should maintain or increase the overall coverage of SAV vegetation. There should be no significant signs of herbivory or invasive species establishment.

MONITORING PLAN

The monitoring plan includes stakeholders, a schedule for the annual monitoring inspections, the monitoring strategy/sampling plan, and approach for addressing any needs for maintenance.

Monitoring Stakeholders

An Environmental Scientist from Dewberry Engineers Inc. will perform the annual monitoring inspections and provide a copy of the monitoring report to the City of Virginia Beach, USACE, VDEQ, VMRC, and the City of Virginia Beach Wetlands Board as necessary. As owners of the project, the City of Virginia Beach will review monitoring recommendations and perform corrective actions as necessary.

Annual Inspection Schedule

Monitoring inspections should be conducted annually, during the peak growing season, which is defined by VMRC as between June and August. To enable consistent tracking of project performance from year to year, annual monitoring inspections will be conducted prior to the end of the growing season in September of each year, with annual reports to be submitted to regulatory stakeholders prior to November 30th [or an annual date defined in the permit conditions] of each year. The following outlines the monitoring inspection schedule and deliverables.

Phase 1 Post-Construction As-Built Report (Date: Prior to December 31st, 2025)

To serve as a baseline for the post-construction annual monitoring, an as-built report for the Phase 1 terraces will be completed following the construction of each phase of terraces and submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following.

- Coordinates and diagrams of established transects, as well as site photographs from photo stations 1-40 as defined in the Methods section.
- Final location of all planted vegetation (upland plantings, high marsh plantings and low marsh plantings).
- Final grade topographic surveys (plan, profile, and cross sections).
- Discussion of the project design versus as-built conditions.

Phase 2 Post-Construction As-Built Report (Date: Prior to December 31st, 2026)

To serve as a baseline for the post-construction annual monitoring, an as-built report for the Phase 2 terraces will be completed following the construction of each phase of terraces and submitted to the

City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following.

- Coordinates and diagrams of established transects, as well as site photographs from photo stations 41-80 as defined in the Methods section.
- Final location of all planted vegetation (upland plantings, high marsh plantings and low marsh plantings).
- Final location and extent of SAV plantings.
- Final grade topographic surveys (plan, profile, and cross sections).
- Discussion of the project design versus as-built conditions.

Year 1a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2026)

At the end of the first full growing season following planting of the Phase 1 terraces, a Year 1a monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 40 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 1 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion; it is anticipated that the wetland planting contractor will provide a one-year post construction maintenance and guarantee period for the wetland plantings.

Year 1b/2a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2027)

At the end of the first full growing season following planting of the Phase 2 terraces following planting, and the second full growing season of the Phase 1 terraces, a Year 1b/2a monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 1 conditions (for Phase 2 terraces) and to Year 2 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).

- Estimated percent cover and change in coverage from planted conditions to Year 1 conditions for SAV planting quadrants
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion; it is anticipated that the wetland planting contractor will provide a one-year post construction maintenance and guarantee period for the wetland plantings.

Year 2b/3a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2028)

At the end of the second full growing season of the Phase 2 terraces following planting, and the third full growing season of the Phase 1 terraces, a Year 2b/3a monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 2 conditions (for Phase 2 terraces) and to Year 3 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- Estimated percent cover and change in coverage from planted conditions to Year 2 conditions for SAV planting quadrants
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

Year 3b/4a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2029)

At the end of the third full growing season of the Phase 2 terraces following planting, and the fourth full growing season of the Phase 1 terraces, a Year 3b/4a monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 3 conditions (for Phase 2 terraces) and to Year 4 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).

- Estimated percent cover and change in coverage from planted conditions to Year 3 conditions for SAV planting quadrants
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

Year 4b/5a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2030)

At the end of the fourth full growing season of the Phase 2 terraces following planting, and the fifth full growing season of the Phase 1 terraces, a Year 4b/Final (Year 5a) monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 4 conditions (for Phase 2 terraces) and to Year 5 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- Estimated percent cover and change in coverage from planted conditions to Year 4 conditions for SAV planting quadrants
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

Year 5b Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2031)

At the end of the fifth full growing season of the Phase 2 terraces following planting, a Final (Year 5b) monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 41 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 5 conditions (for Phase 2 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- Estimated percent cover and change in coverage from planted conditions to Year 5 conditions for SAV planting quadrants

- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

Monitoring Strategy

The monitoring strategy consists of established transects with photo stations and quadrants that cover the area between transects. This approach enables monitoring of the four primary features of the living shoreline: uplands, low-marsh plantings, high-marsh plantings, and SAV*.

*Note: The planting scheme for SAV has not yet been established but it is anticipated that some SAV will be planted along the submerged portions of the marsh terraces. If more suitable planting locations are determined to be between terraces, separate transects will be established and sampled to track SAV survival apart from the proposed terrace transects.

Transects/Photo Points

A total of eighty (80) transects will be established across the project site, with 10 transects located along each of 8 terraces. Transects will span perpendicular to the length of each terrace from the ridge to the edge of the planted/vegetated area. See Figures 3 and 4 for graphic depictions of the proposed transect locations and layouts. Terraces were selected using a random stratified method to ensure representative terraces in each location within the project area (North Interior, North Exterior, South Interior, South Exterior), and of each planting scheme, were represented in the proposed monitoring plan. The selected terraces are as follows:

- North Interior: T-110, T-113
- North Exterior: T-100, T-106
- South Interior: T-124, T-131
- South Exterior: T-123, T-140

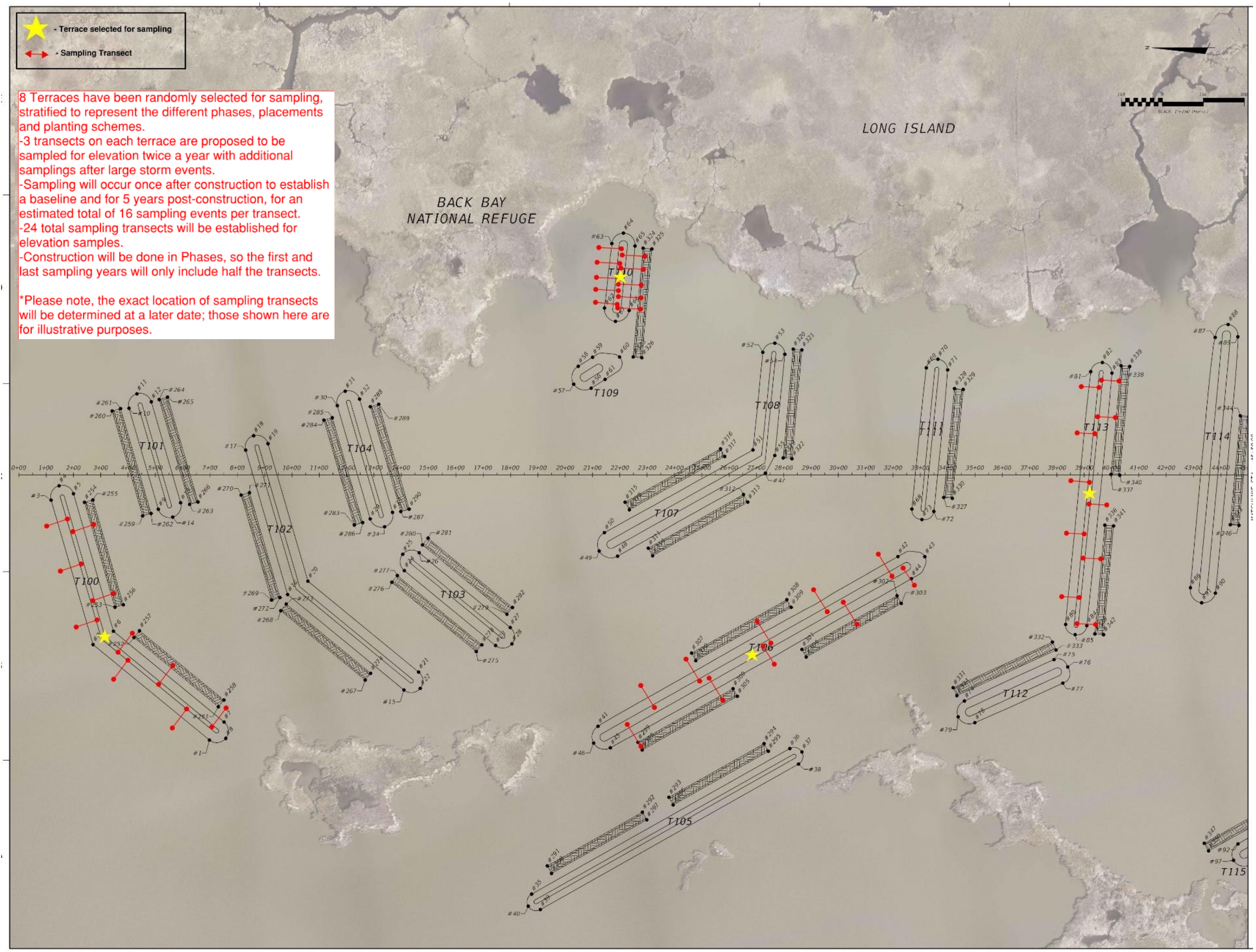

Figure 3: Monitoring design site plan – North Terraces

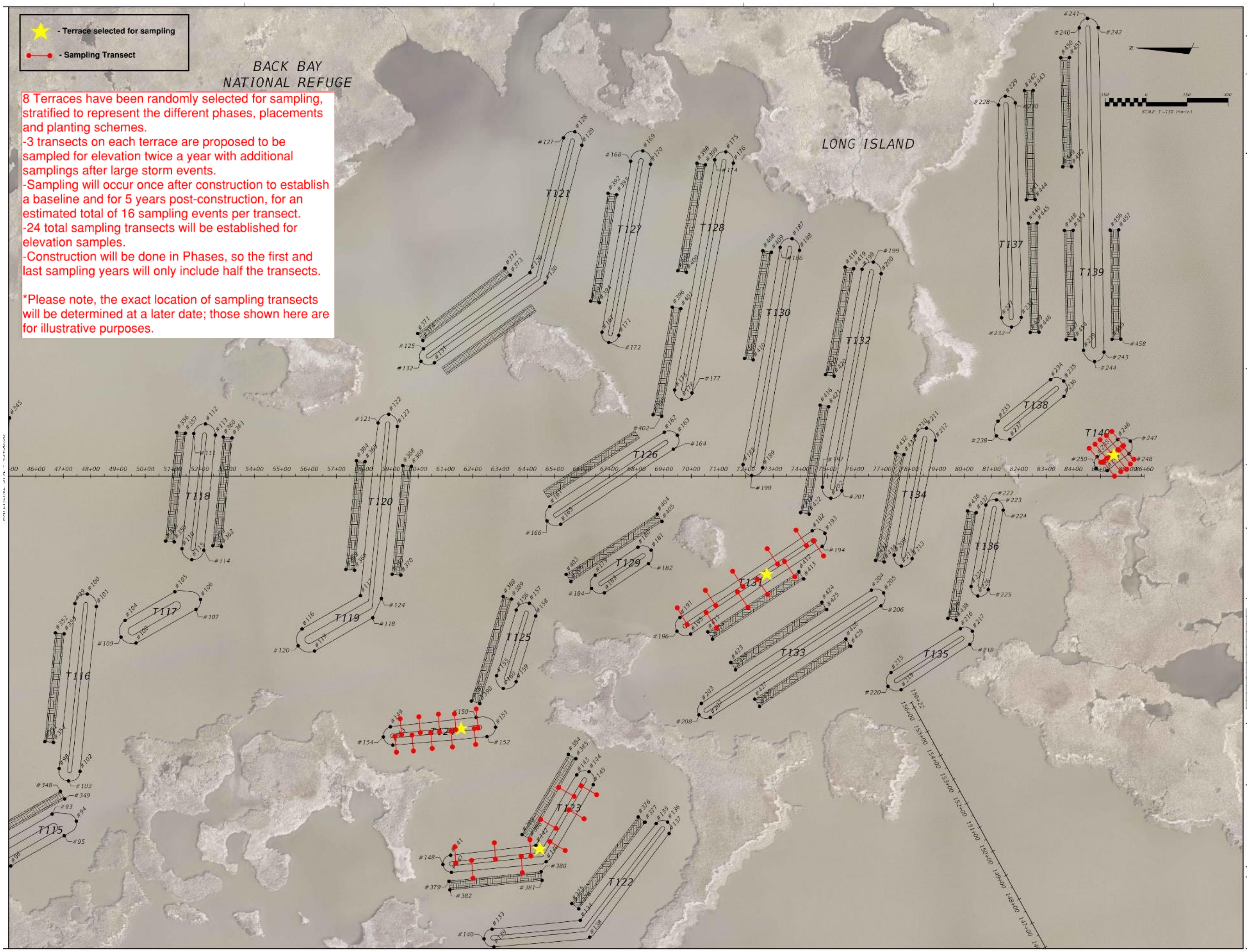

Figure 4: Monitoring design site plan – South Terraces

Permanent photo stations will be established at each quadrant along each transect to capture the design features/established habitats and vegetation. Figure 5 shows the general proposed locations (indicated by the red arrows/labels) for each quadrant and photograph station along each transect. Photos were shot from each photo location on [DATE]. These photos will be collected annually and compiled in Appendix B.

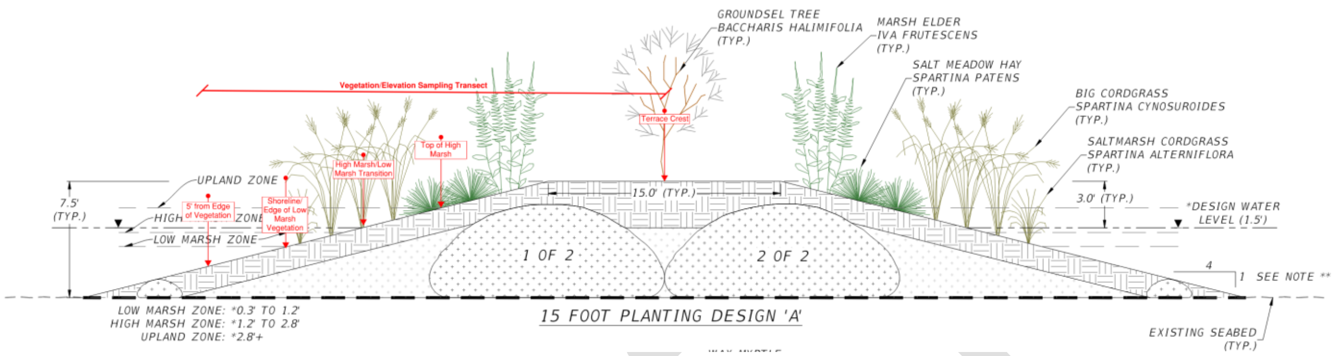

Figure 5: Photo station layout example

Quadrants

To estimate percent cover of vegetation, four (4) quadrants along each of ten (10) transects will be established on the eight selected terraces to allow for estimates of habitat coverage and planting survival. Estimates of coverage and survival were compared to post-construction conditions to evaluate changes.

Further, the following guiding questions were established to monitor overall project performance, presence of invasive species, and identify any needs for maintenance:

1. Are there specific problem areas where plants are dying or appear unhealthy?
2. Were any signs of herbivory observed?
3. Are there any undesirable plant species present?
4. Condition of the terrace structures: Is there any observed settlement, dislodged stone, significant debris etc.?
5. If an updated survey was conducted, are there any significant changes in the profile of the marsh terraces?
6. Does the upland portion of each terrace show any significant signs of erosion or loss of vegetation?

MONITORING RESULTS

Table 2: Low Marsh Vegetation Percent Cover Monitoring Results (Example Table – Terrace 1).

		Estimated Percent Coverage						Percent Change in Coverage (from Baseline)				
Terrace/ Transect	Photo Station Reference	Baseline (2024)	Year 1 (2025)	Year 2 (2026)	Year 3 (2027)	Year 4 (2028)	Year 5 (2029)	Baseline to Year 1	Baseline to Year 2	Baseline to Year 3	Baseline to Year 4	Baseline to Year 5
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Table 3: High Marsh Vegetation Percent Cover Monitoring Results (Example Table – Terrace 1).

		Estimated Percent Coverage						Percent Change in Coverage (from Baseline)				
Terrace/ Transect	Photo Station Reference	Baseline (2024)	Year 1 (2025)	Year 2 (2026)	Year 3 (2027)	Year 4 (2028)	Year 5 (2029)	Baseline to Year 1	Baseline to Year 2	Baseline to Year 3	Baseline to Year 4	Baseline to Year 5
1 - 1	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 2	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 3	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 4	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 5	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 6	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 7	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 8	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 9	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 10	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
Overall		**Choose an item.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**

Table 4: General Observations for Wetland Planting Areas on the Marsh Terraces (Example Table – Terrace 1)

Monitoring Questions	Terrace/Transect									
	1 - 1	1 - 2	1 - 3	1 - 4	1 - 5	1 - 6	1 - 7	1 - 8	1 - 9	1 - 10
Are there specific problem areas where plants are dying or appear unhealthy?	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.
Were any herbivory issues observed?	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.
Are there any undesirable plant species present?	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.
If updated survey was conducted, are there any significant changes in the profile of the living shoreline system?	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.

Table 5: General Observations for the Unplanted Structural Components of the Marsh Terraces (Example Table – Terrace 1)

	Terrace/Transect									
Monitoring Questions	**1 - 1**	**1 - 2**	**1 - 3**	**1 - 4**	**1 - 5**	**1 - 6**	**1 - 7**	**1 - 8**	**1 - 9**	**1 - 10**
Are there any structural issues with the planted terrace structures (e.g. observed settlement, loss of topsoil, etc.)?	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☒ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.
Is there any observed growth in SAV on or adjacent to the marsh terraces?	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☒ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.

Are there any structural issues with the rock armoring on the terraces (e.g. observed settlement, dislodged stone, significant debris, etc.)?	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.

MAINTENANCE RECOMMENDATIONS

The following table outlines the recommendations for maintenance, including estimated quantities and specific guidance, based on the results of the [YEAR] monitoring results.

Table 6: Maintenance Recommendations Checklist

Design Feature/ Monitoring Objective	Maintenance Elements	Location & Estimated Quantity	Specific Guidance
Terrace Upland and Wetland Habitats and Wetland Soils – Monitoring Objectives 1a/1b	☐ Replace plants	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Add new plants	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Remove debris	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Remove invasive vegetation	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Add sand to eroding areas	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Replace waterfowl barrier	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.

Design Feature/ Monitoring Objective	Maintenance Elements	Location & Estimated Quantity	Specific Guidance
Terrace Structures & Stone Armoring, Monitoring Objective 2a/2b	☐ Re-place dislodged stones	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Add additional stone to address settlement	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Remove debris	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Repair sand cores or other structural elements	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
SAV Establishment, Monitoring Objective 3	☐ Replace plants	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Add new plants	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.

APPENDIX A: AS-BUILT PLANS

[Page left intentionally blank; as-built plans will be included in the Year 1 monitoring report]

APPENDIX B: MONITORING PHOTOGRAPHS

Table 7: Terrace 1 Transect 1 Photographs

Photograph from Photo Location 1A	Photograph from Photo Location 1B
Photograph from Photo Location 1C	Additional photos of any problem areas.

Table 8: Terrace 1 Transect 2 Photographs

Photograph from Photo Location 2A	Photograph from Photo Location 2B
Photograph from Photo Location 2C	Additional photos of any problem areas.

Table 9: Terrace 1 Transect 3 Photographs

Photograph from Photo Location 3A	Photograph from Photo Location 3B
Photograph from Photo Location 3C	Additional photos of any problem areas.

Table 10: Terrace 1 Transect 4 Photographs

Photograph from Photo Location 4A	Photograph from Photo Location 4B
Photograph from Photo Location 4C	Additional photos of any problem areas.

Table 11: Terrace 1 Transect 5 Photographs

Photograph from Photo Location 5A	Photograph from Photo Location 5B
Photograph from Photo Location 5C	Additional photos of any problem areas.

Table 12: Terrace 1 Transect 6 Photographs

Photograph from Photo Location 6A	Photograph from Photo Location 6B
Photograph from Photo Location 6C	Additional photos of any problem areas.

Table 13: Terrace 1 Transect 7 Photographs

Photograph from Photo Location 7A	Photograph from Photo Location 7B
Photograph from Photo Location 7C	Additional photos of any problem areas.

Table 14: Terrace 1 Transect 7 Photographs

Photograph from Photo Location 7A	Photograph from Photo Location 7B
Photograph from Photo Location 7C	Additional photos of any problem areas.

Table 15: Terrace 1 Transect 8 Photographs

Photograph from Photo Location 8A	Photograph from Photo Location 8B
Photograph from Photo Location 8C	Additional photos of any problem areas.

Table 16: Terrace 1 Transect 9 Photographs

Photograph from Photo Location 9A	Photograph from Photo Location 9B
Photograph from Photo Location 9C	Additional photos of any problem areas.

Table 17: Terrace 1 Transect 10 Photographs

Photograph from Photo Location 9A	Photograph from Photo Location 9B
Photograph from Photo Location 9C	Additional photos of any problem areas.

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2023 Virginia Community Flood Preparedness Fund

Marsh Restoration in Back Bay, Virginia Beach

CITY OF VIRGINIA BEACH

Table of Contents

Appendix A – Application Form

Applicants must have prior approval from the Department to submit <u>applications, forms, and supporting documents by mail in lieu of the WebGrants portal.</u>

Appendix A: Application Form for Grant and Loan Requests for All Categories

Virginia Department of Conservation and Recreation
Virginia Community Flood Preparedness Fund Grant Program

Name of Local Government:

Category Being Applied for (check one):

☐ **Capacity Building/Planning**

☑ **Project**

☐ **Study**

NFIP/DCR Community Identification Number (CID) 515531

Name of Authorized Official and Title: Toni Utterback, Stormwater Engineering Center Administrator

Signature of Authorized Official: Katie E Shannon for Toni Utterback

Mailing Address (1): 2875 Sabre Street, Suite 250

Mailing Address (2): ____________

City: Virginia Beach **State:** Virginia **Zip:** 23452

Telephone Number: (757) 385-8746 **Cell Phone Number:** (____) ____________

Email Address: TPUtterback@vbgov.com

Contact and Title (If different from authorized official): C.J. Bodnar, Technical Services Program Manager

Type text here

Mailing Address (1): 2875 Sabre Street, Suite 250

Mailing Address (2): ______________________________

City: Virginia Beach **State:** Virginia **Zip:** 23452

Telephone Number: (757) 385-8430 **Cell Phone Number:** (____) ________________

Email Address: CBodnar@vbgov.com

Is the proposal in this application intended to benefit a low-income geographic area as defined in the Part 1 Definitions? Yes ____ No ✓

Categories (select applicable activities that will be included in the project and used for scoring criterion):

Capacity Building and Planning Grants

☐ Floodplain Staff Capacity.

☐ Resilience Plan Development

- ☐ Revisions to existing resilience plans and modifications to existing comprehensive and hazard mitigation plans.
- ☐ Resource assessments, planning, strategies, and development.
  - o Policy management and/or development.
  - o Stakeholder engagement and strategies.

☐ Other: ______________________________

Study Grants (Check All that Apply)

☐ Studies to aid in updating floodplain ordinances to maintain compliance with the NFIP, or to incorporate higher standards that may reduce the risk of flood damage. This must include establishing processes for implementing the ordinance, including but not limited to, permitting, record retention, violations, and variances. This may include revising a floodplain ordinance when the community is getting new Flood Insurance Rate Maps (FIRMs), updating a floodplain ordinance to include floodplain setbacks, freeboard, or other

higher standards, RiskMAP public noticing requirements, or correcting issues identified in a Corrective Action Plan.

- ☐ Revising other land use ordinances to incorporate flood protection and mitigation goals, standards, and practices.
- ☐ Conducting hydrologic and hydraulic (H&H) studies of floodplains. *Changes to the base flood, as demonstrated by the H&H must be submitted to FEMA within 6 months of the data becoming available.*
- ☐ Studies and Data Collection of Statewide and Regional Significance.
- ☐ Revisions to existing resilience plans and modifications to existing comprehensive and hazard.
- ☐ Other relevant flood prevention and protection project or study.

Project Grants and Loans (Check All that Apply – Hybrid Solutions will include items from both the "Nature-Based" and "Other" categories)

Nature-based solutions

- ☐ Acquisition of property (or interests therein) and/or structures for purposes of allowing floodwater inundation, strategic retreat of existing land uses from areas vulnerable to flooding; the conservation or enhancement of natural flood resilience resources; or acquisition of structures, provided the acquired property will be protected in perpetuity from further development, <u>and where the flood mitigation benefits will be achieved as a part of the same project as the property acquisition.</u>
- ☑ Wetland restoration.
- ☐ Floodplain restoration.
- ☐ Construction of swales and settling ponds.
- ☑ Living shorelines and vegetated buffers.
- ☐ Permanent conservation of undeveloped lands identified as having flood resilience value by *ConserveVirginia* Floodplain and Flooding Resilience layer or a similar data driven analytic tool, or the acquisition of developed land for future conservation.
- ☐ Dam removal.
- ☐ Stream bank restoration or stabilization.
- ☐ Restoration of floodplains to natural and beneficial function.

Other Projects

- ☐ Structural floodwalls, levees, berms, flood gates, structural conveyances.
- ☐ Storm water system upgrades.
- ☐ Medium and large-scale Low Impact Development (LID) in urban areas.

- ☐ Developing flood warning and response systems, which may include gauge installation, to notify residents of potential emergency flooding events.
- ☐ Dam restoration.
- ☐ Beneficial reuse of dredge materials for flood mitigation purposes
- ☐ Removal or relocation of structures from flood-prone areas where the land will not be returned to open space.
- ☐ Acquisition of property (or interests therein) and/or structures for purposes of allowing floodwater inundation, strategic retreat of existing land uses from areas vulnerable to flooding; the conservation or enhancement of natural flood resilience resources; or acquisition of structures, provided the acquired property will be protected in perpetuity from further development, <u>and where the flood mitigation benefits will **not be** achieved as a part of the same project as the property acquisition.</u>
- ☐ Other project identified in a DCR-approved Resilience Plan.

Location of Project or Activity (Include Maps): Bonney Cove in Back Bay, Virginia Beach

NFIP Community Identification Number (CID#) : 515531

Is Project Located in an NFIP Participating Community? ☑ Yes ☐ No

Is Project Located in a Special Flood Hazard Area? ☑ Yes ☐ No

Flood Zone(s) (If Applicable): Zone VE (EL 5 Feet), Zone AE (EL 4 Feet), Zone Open Water

Flood Insurance Rate Map Number(s) (If Applicable): 5155310215G and 5155310220G

Total Cost of Project: $53,378,490

Total Amount Requested $5,000,000

Amount Requested as Grant $5,000,000

Amount Requested as Project Loan (not including short-term loans for up-front costs) ___________________

Amount Requested as Short-Term loan for Up-Front Costs (not to exceed 20% of amount requested as Grant) ___________________________

For projects, planning, capacity building, and studies in low-income geographic areas: Are you requesting that match be waived? □ Yes □ No

Additional Information for Loan Requests
Requested Loan Security: _______________________________

(General Obligation, Lease, Revenue, Special Fund Revenue, and/or Moral obligation from other government entity)

Desired loan term: ____________________________________

Since the date of your latest financial statements, did the applicant issue any new debt? ______
(If yes, provide details)

Is there any pending or potential litigation by or against the applicant? _______________

Attach five years of current audited financial statements (FY18-22) or refer to website if posted
(Not necessary for existing VRA borrowers)

Attach FY2024 adopted budget or refer to website

Attach current Capital Improvement Plan

Attach adopted Financial Policies

Attach a list of the ten largest employers in the Applicant's jurisdiction.

Attach a list of the ten largest taxpayers in the Applicant's jurisdiction

Appendix B: Budget Form

Appendix B: Budget Narrative Template

Applicant Name:
Community Flood Preparedness Fund &
Resilient Virginia Revolving Loan Fund
Detailed Budget Narrative
Period of Performance: June 2024 through June 2027
Submission Date: November 12, 2023

	Grand Total State Funding Request	$ 5,000,000
	Grand Total Local Share of Project	$ 38,356,966
National Fish and Wildlife Foundation Grants	Federal Funding (if applicable)	$ 10,021,524
	Project Grand Total	$ 53,378,490
	Locality Cost Match	% 71.85

Breakout By Cost Type	Personnel	Fringe	Travel	Equipment	Supplies	Contracts	Indirect Costs	Other Costs	Total
Federal Share (if applicable)								10,021,524	10,021,524
Local Share								37,330,166	37,330,166
State Share								5,000,000	5,000,000
Pre-Award/Startup								276,800	276,800
Maintenance								750,000	750,000
Total	$	$	$	$	$	$	$	$53,378,490	$ 53,378,490

1. Federal Share represents National Fish and Wildlife Foundation (NFWF) Grants. NFWF is not a federal agency.
2. Local Share represents the total project cost less design and implementation (monitoring and initial maintenance) costs.
3. State Share represents the CFPF grant request.
4. Pre-Award costs represent project design costs.
5. Maintenance costs represent implementation (monitoring and initial maintenance costs).

Scope of Work Narrative

Introduction

The City of Virginia Beach ("City") is pleased to submit the Marsh Restoration in Back Bay project for consideration under the Flood Prevention and Protection Projects category in the 2023 Virginia Community Flood Preparedness Fund. The City has made significant investments in the study of historical flooding data, current and future hydrology, and the projected increase in flood frequency due to changing rainfall patterns and sea level rise. These studies culminated in Virginia Beach's Resilience Plan, socialized as "Sea Level Wise,"[1] which includes a conceptual suite of projects focused on flood control and resilience. The Virginia Beach Resilience Plan leverages four overarching adaptation strategies to identify actionable projects for each of the City's four unique major watersheds. This project represents the first adaptation project to advance to construction to implement the City's Resilience Plan.

The adaptation strategy for the Southern Rivers Watershed, which includes Back Bay, is presented in Figure 1. The strategy focuses on employing natural mitigation methods, an integrated system of defense structures, and complementary measures, such as land-use strategies. Collectively these approaches are designed to strategically reduce flow into and within Back Bay and improve flood storage and overall coastal resiliency. Marsh restoration was identified as a key resilience-building strategy as part of an extensive evaluation of structural and non-structural alternatives. Marsh restoration provides multiple benefits of flood risk reduction, enhanced habitat, and improved water quality.

As part of the Virginia Coastal Resilience Master Planning Framework, a precursor to the first phase of the Virginia Coastal Resilience Master Plan (CRMP), the Commonwealth of Virginia identified guiding principles for a statewide resilience strategy. One of these guiding principles is recognizing the importance of protecting and enhancing natural infrastructure and prioritizing nature-based infrastructure.[2] The City's marsh restoration project aligns with this principle and was highlighted as an exemplary nature-based project in the CRMP (refer to pages 178-179).[3]

---

[1] City of Virginia Beach (2020). Virginia Beach Sea Level Wise Adaptation Strategy (Website).

[2] Office of Governor Ralph S. Northam Commonwealth of Virginia. (2020). Virginia Coastal Resilience Master Planning Framework (PDF).

[3] Office of Governor Ralph S. Northam Commonwealth of Virginia. (2021). Virginia Coastal Resilience Master Plan Phase 1 (PDF).

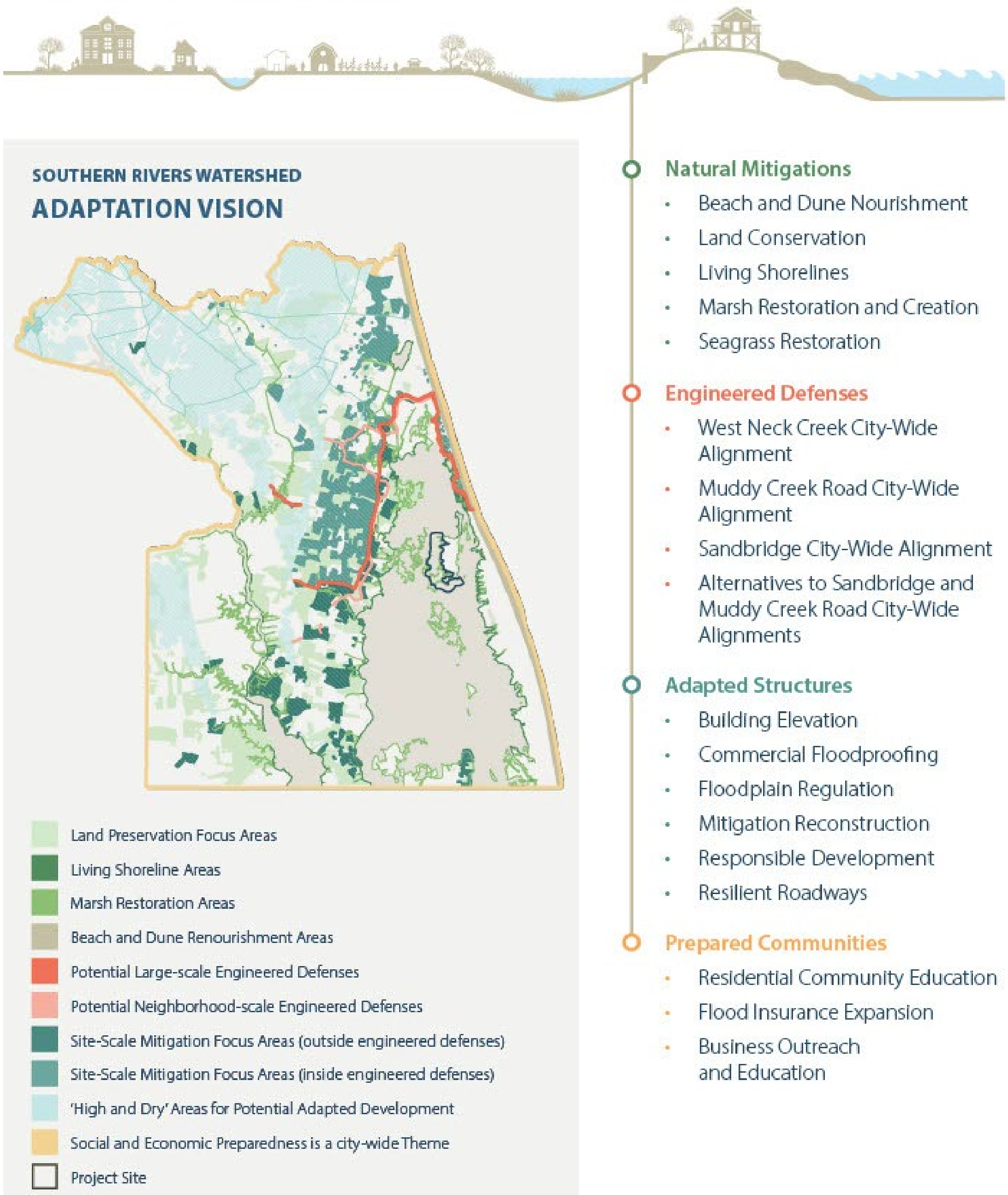

Figure 1: Adaptation Vision for the Southern Rivers Watershed.

Hydraulic modeling analysis identified Bonney Cove as a location where marsh restoration has the potential to reduce the propagation of floodwater through key pathways within Back Bay (Figure 2). The City prioritized this project as the first to advance to construction due to its significant benefits to community and habitat resilience.

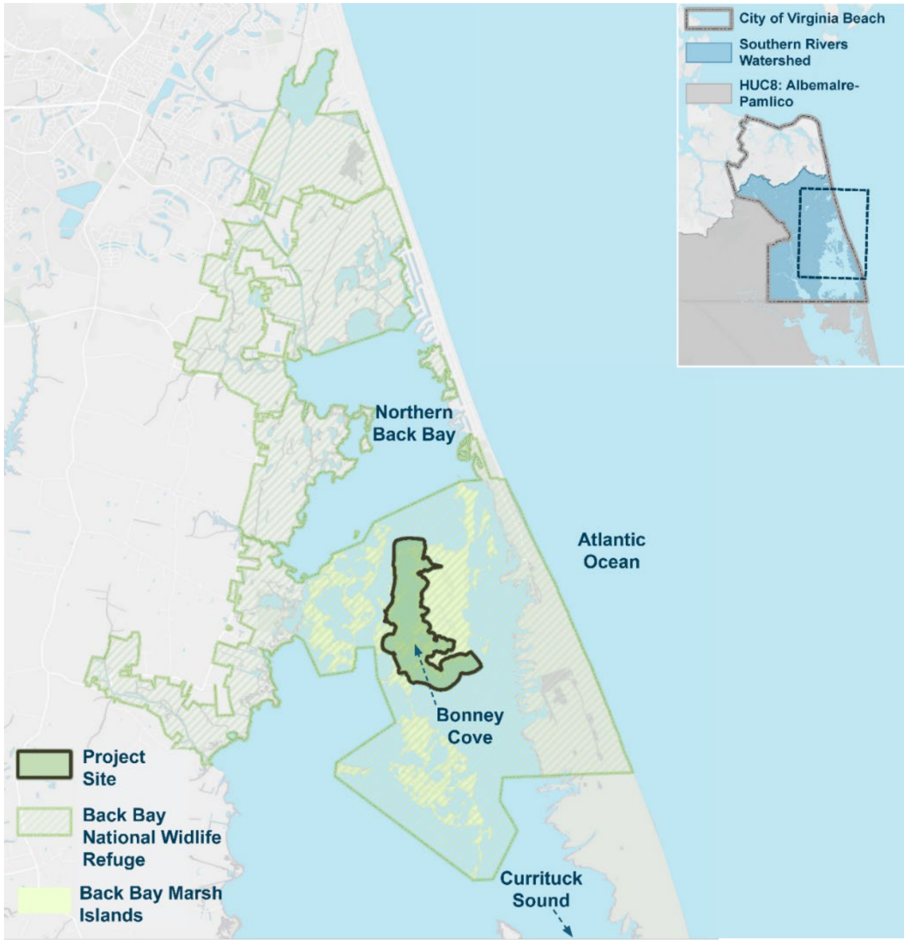

Figure 2: Project site location map.

This project represents a collaborative effort between the City's Department of Public Works alongside other City departments, public constituents, local nonprofits, and state and federal agencies. In selecting the project location and developing the design approach, the City has coordinated closely with the Back Bay National Wildlife Refuge (BBNWR), part of the U.S. Fish and Wildlife Service (USFWS), and the Virginia Department of Wildlife Resources (VDWR). Environmental organizations committed to stewardship of Back Bay have also contributed input throughout the design process, including the Back Bay Restoration Foundation (BBRF), Friends of Back Bay, the Back Bay National Wildlife Refuge Society, and the Albemarle-Pamlico National Estuary Partnership (APNEP). Project field investigations involved local support from Old Dominion University (ODU) and others, and outside expertise from Louisiana. The National Fish and Wildlife Foundation (NFWF) provided grant funding under the National Coastal Resilience Fund (NCRF) to support design, permitting, and environmental assessments. Broad support of the project is demonstrated by contributions from the organizations noted above along with other stakeholders engaged in the restoration effort.

Needs and Problems

Specific Problem Being Solved – Habitat Degradation and "Wind Tide" Flooding

Marshes are vital to the Southern Rivers Watershed for the ecological and flood reduction benefits they provide. The Southern Rivers Watershed contains 90% of the City's land area under an elevation of three feet, making this area particularly susceptible to flood impacts. As illustrated in Figure 3, sustained southerly winds push water up from the Albemarle-Pamlico Sound through the Currituck Sound and into Back Bay, creating a phenomenon referred to locally as "wind tide flooding". Marsh habitat loss has contributed to the opening of a secondary channel in Bonney Cove that has increased water flow during wind tide and other flood events to areas with high community exposure.

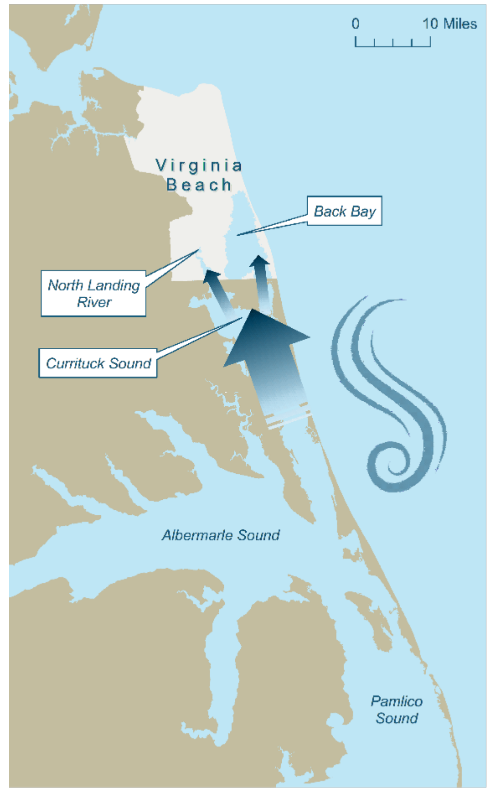

Figure 3: Flood pathways in the Southern Rivers Watershed.

Within today's marsh system, it takes between two to five days of sustained southerly winds to cause flooding, depending on the wind speed and direction. Over the last four years, more than five wind tide flooding events have occurred in this area. The increasing frequency of flooding events is primarily attributed to a foot of relative sea level rise in the last 50 years and degradation of marsh and seagrass habitat.

This marsh restoration project aims to address the challenges of habitat degradation and "wind tide" flooding by stabilizing two critically eroding marsh islands, decreasing turbidity to promote the growth of aquatic vegetation, and providing flood risk reduction benefits through increased friction and wave attenuation.

Factors Contributing to the Identified Problem

This growing flood risk in the Southern Rivers Watershed can be attributed mainly to the reduced friction in the water column from the increased water depth and eroded vegetation, which allows water to move more quickly through key hydraulic pathways. Another term for this is "fetch", which is defined as the open water distance over which a given wind can blow and generate higher waves without obstruction. Unmitigated, the continued loss of these marsh island systems and aquatic vegetation is expected to result in more frequent and intense wind tide flooding events.

Emergent Marsh Degradation

Approximately 50% of former marshland at the site (260 acres) has eroded into open water leading to the opening of a wide secondary channel ("Bonney Cove") that is about two miles

long and half a mile wide (Figure 4). The southern exposed edge of the adjacent marsh islands is exposed to approximately 1.5 miles of fetch in the predominant wind direction.

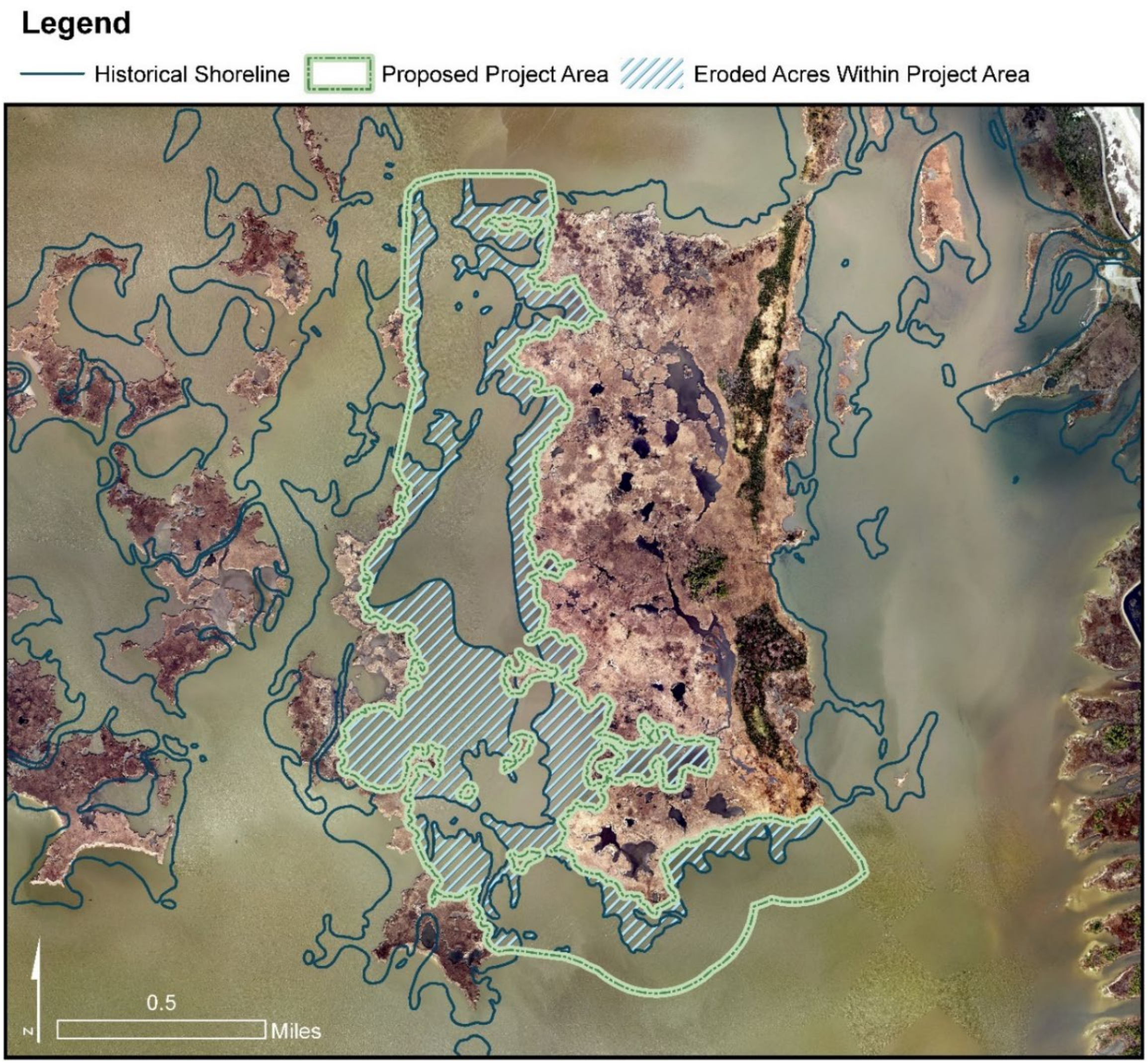

Figure 4: Historical marsh erosion within the project area.

Submerged Aquatic Vegetation (SAV) Loss

SAV used to be abundant at the site (around 45% coverage, overall) but is now extremely sparse, ranging from 0% to 10% coverage across the site, on average. Field studies conducted by the VDWR show that wind-driven waves and high flow velocities are the primary drivers of this loss, particularly in the last 5 years as shown in Figure 5.

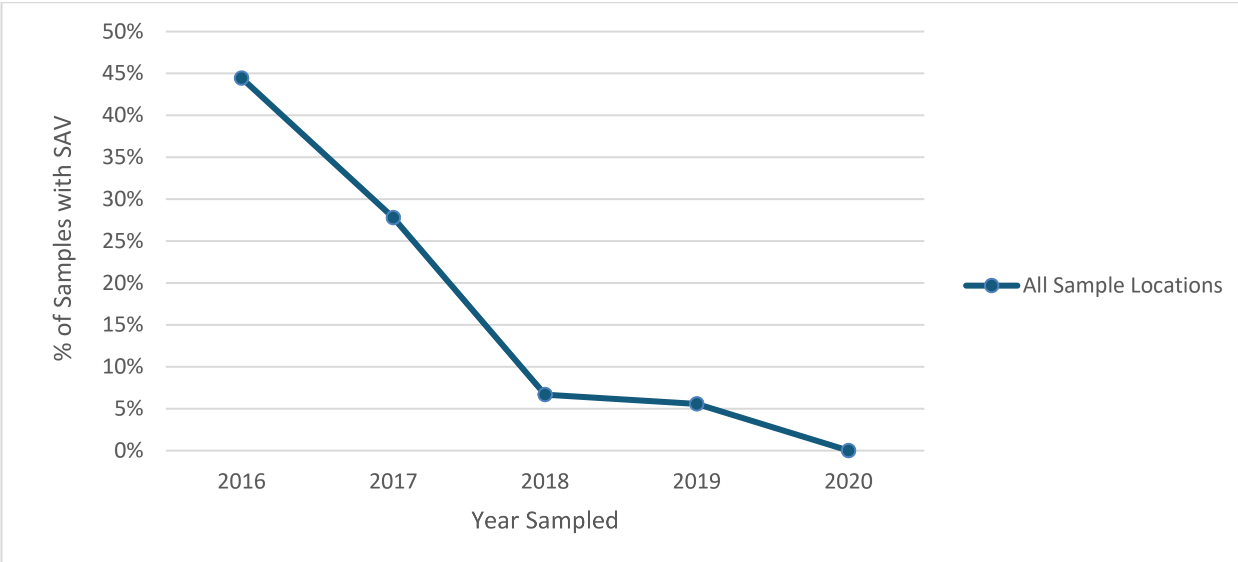

Figure 5: SAV sampling data from VDWR within the project vicinity.

Why is the Project Needed Locally/Regionally?

Pilot Project

The City's design concept for the marsh restoration project leverages "marsh terracing," an innovative coastal engineering technique widely used in Texas and Louisiana to convert shallow subtidal bottom to marsh. This technique has not yet been implemented along the U.S. East Coast and has not yet been implemented in the Mid-Atlantic region. Through the export of proven expertise from successful marsh terraces, this project would lay the foundation for future projects in the region, Virginia, and other states along the East Coast. The project would document detailed cost estimates, demonstrate effective construction practices for large-scale marsh creation projects, identify best sources for local/regional materials, and establish partnerships with permitting officials at various levels of government. The City has outlined a preliminary sequencing plan for marsh island restoration projects in Back Bay to strategically close hydraulic pathways and address priority restoration areas as shown in Figure 6. Some of these projects would require coordination with the State of North Carolina to realize its broader resilience efforts.

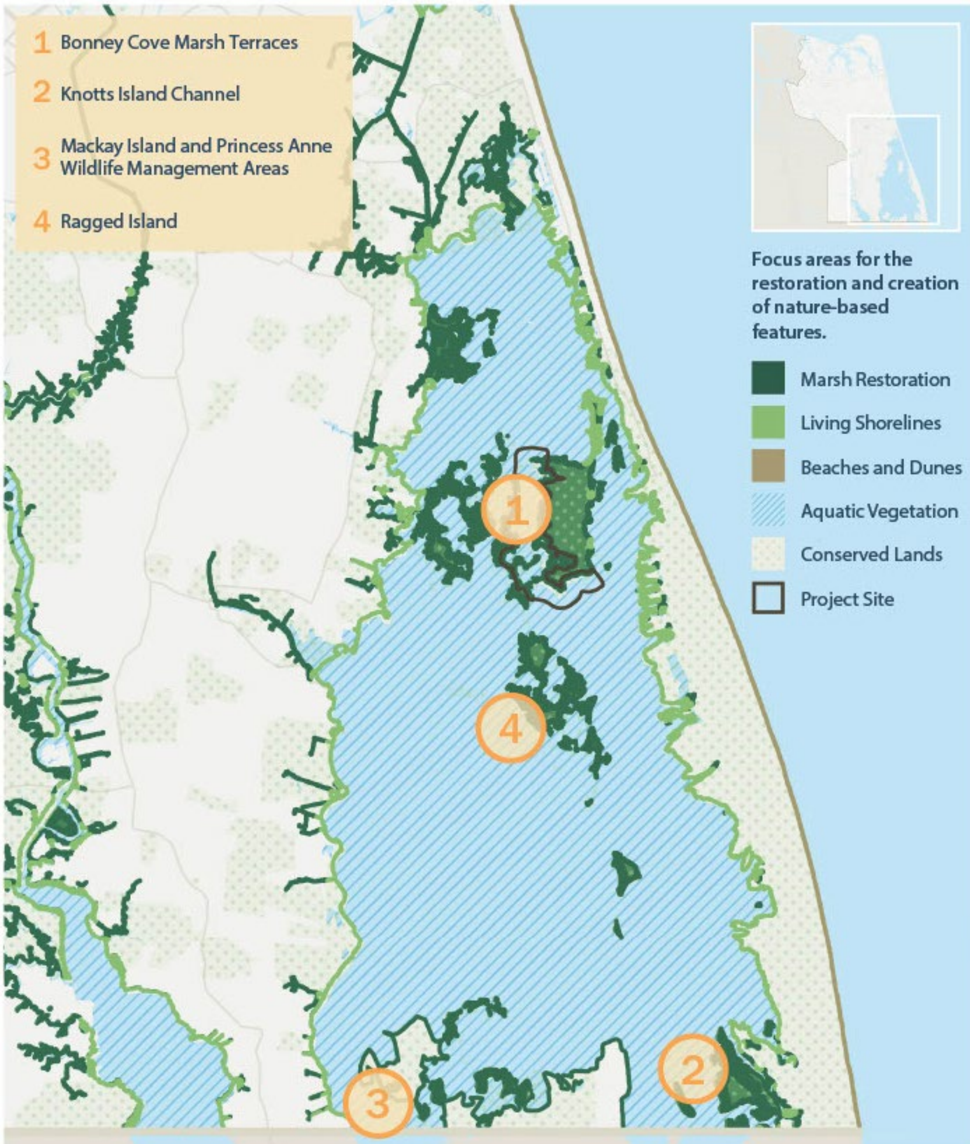

Figure 6: Preliminary Sequencing Restoration Plan.

Virginia Coastal Resilience Master Plan Exemplary Project

The CRMP impact assessment shows a high vulnerability of nature-based features to coastal flood hazards that is consistent with the City's analysis. In the Hampton Roads region, the CRMP impact assessment estimates a decrease from 40,600 acres to 2,940 acres of tidal wetlands by 2080, representing a 93% decline in tidal wetlands.[4] Back Bay was identified as a hotspot for tidal wetland loss, emphasizing the critical location of the City's marsh restoration effort. Specifically, the Virginia CRMP impact assessment shows that portions of tidal wetlands within the project area have "High" and "Very High" impact levels, which indicates areas of tidal marsh

[4] Office of Governor Ralph S. Northam Commonwealth of Virginia and Virginia Department of Conservation and Recreation (2021). Virginia Coastal Resilience Master Plan Phase 1 (PDF).

that are anticipated to be lost through inundation causing conversion to open water (Figure 7).

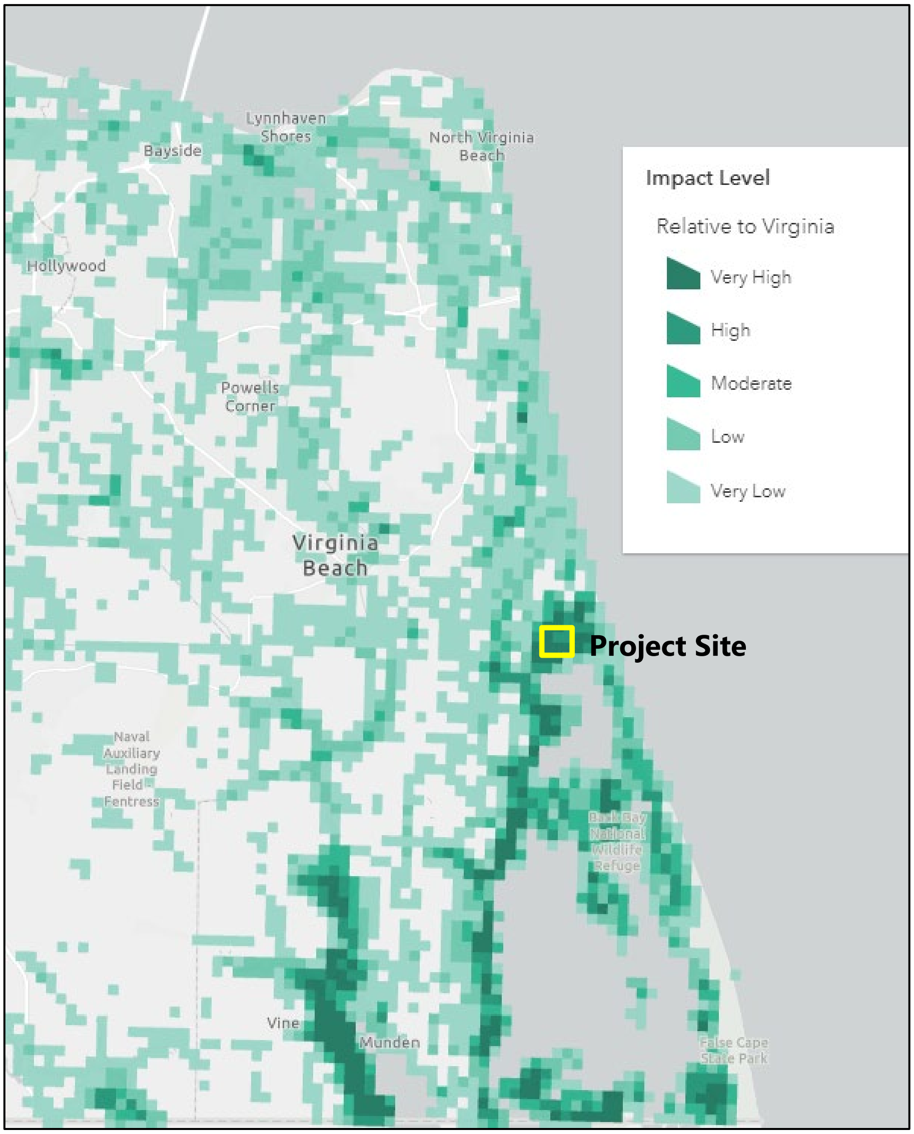

Figure 7: Virginia CRMP Impact Assessment for Tidal Wetlands.

Currituck Sound Coalition High Priority Area

In coordination with Audubon North Carolina, the Currituck Sounds Coalition designated the project site as a High Priority Area for restoring and enhancing vulnerable and degraded marshes with "high flood risk reduction benefits and habitat value" as shown in Figure 8[5].

[5] Audubon North Carolina. (2021). Currituck Sound Coalition Marsh Conservation Plan. (PDF)

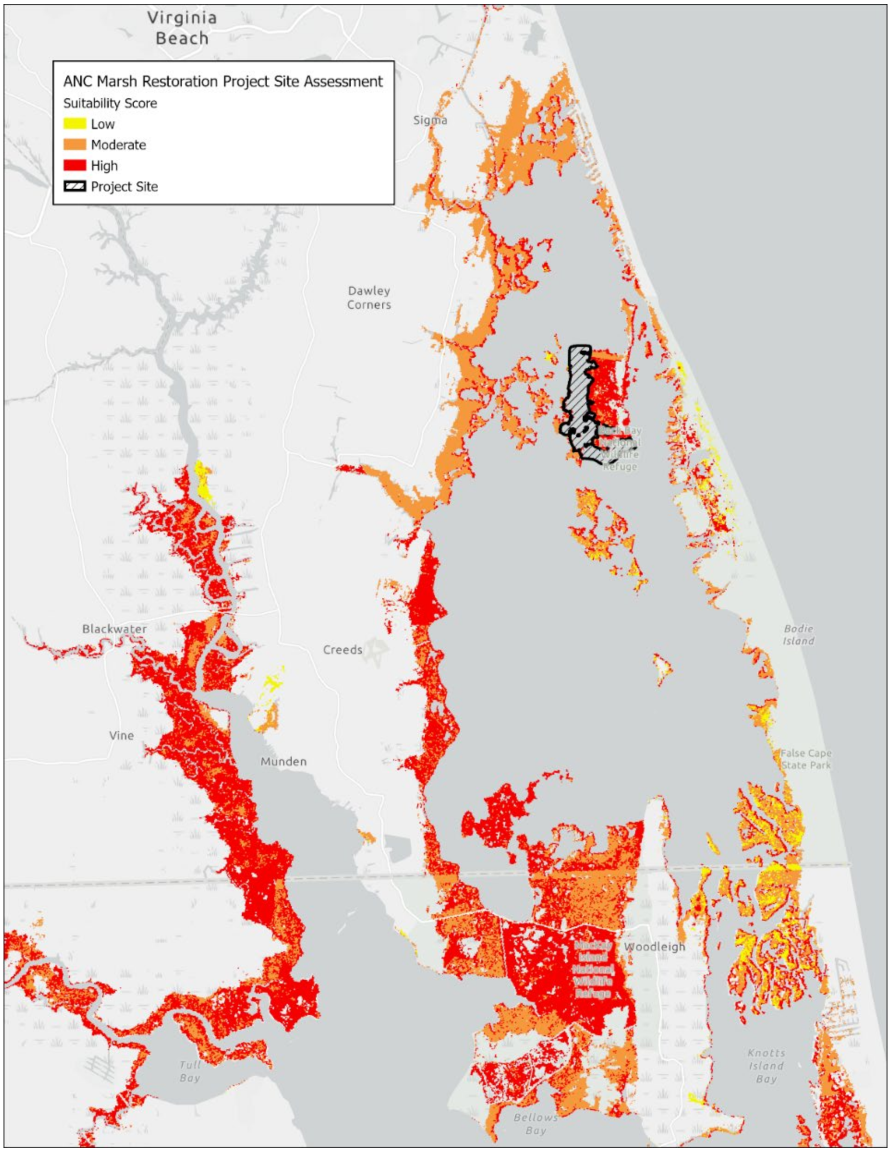

Figure 8: Audubon North Carolina Marsh Restoration Project Site Assessment

Ecological Core for Flood Resilience

The Virginia Department of Conservation and Recreation Natural Heritage Data Explorer provides data from ConserveVirginia v3.0 and other data to support conservation planning. The following map in Figure 9 displays Ecological Cores and the Floodplains and Flooding Resilience Category layer (blue polygon) from ConserveVirginia. The project area contains "High" (C3) and "General" (C5) Ecological Cores and is within the boundaries of the Floodplain and Flooding Resilience area.

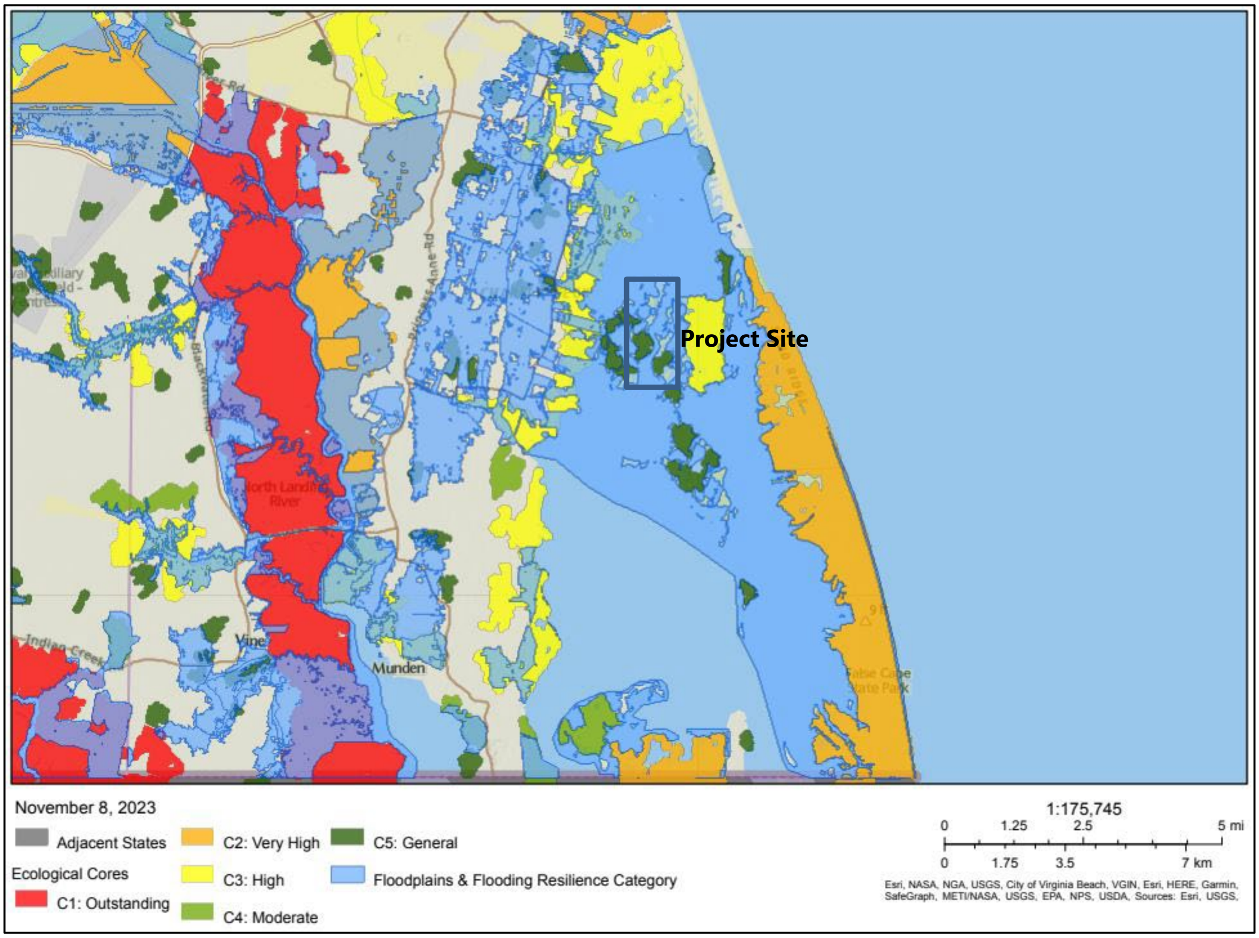

Figure 9: Virginia Natural Heritage Data Explorer Ecological Cores and ConserveVirginia Data.

The safety threats, or environmental concerns related to flood risk.

The City's risk assessment forecasts that approximately 70% of the remaining marsh (730 acres) surrounding the project site will convert to open water with three feet of sea level rise if unmitigated. Fragmentation of this adjacent marsh would result in about eight miles of fetch acting on the southern extent of the site in the predominant wind direction. Without these central marsh islands, the northern shorelines of Back Bay would be exposed to 12 miles of fetch from the Knotts Island Channel at the Virginia-North Carolina boundary. This condition would leave the fringing marshes highly vulnerable to accelerated erosion.

How does the project decrease the risk to public safety through flood risk reduction?

Construction of the forty-one individual marsh terraces, totaling 27,000 linear feet (a 51-acre footprint), across Bonney Cove offers a nature-based technique that will stabilize and protect the marsh island in the center of the bay and reduce erosion of the fringing marsh systems to the north. Numerical modeling was leveraged to quantify specific erosion reduction benefits of the project for wave heights and flow velocities:

- **Wave Height Reduction**: The marsh terraces are expected to reduce wave heights within the project site by approximately 45%. This reduction is consistent with other field studies, which have found that average wave heights within two terraced sites were 37% to 48% lower than those observed at the reference site (Brasher 2015). Wave energy reduction is anticipated to increase the potential for sediment deposition on the terraces' leeward side, leading to the growth of new emergent marsh and reducing erosion of adjacent marsh. Approximately five miles of marsh island shoreline around Bonney Cove will benefit directly from the erosion reduction associated with the computed wave attenuation.
- **Flow Velocity Reduction**: The marsh terraces reduce flow velocity within the project area. This reduction in velocity will reduce bottom shear stress, decrease turbidity, increase light penetration into the water column and promote the growth of SAV. Reducing bottom shear stress will make conditions more suitable for SAV growth between the terraces. Field studies of marsh terraces in Texas and Louisiana document an approximately 45% to 56% reduction in turbidity and the emergence of SAV in the years following terrace construction (Brasher 2015).
- **Wind Shear Stress Reduction**: Although not included as a parameter within the numerical modeling effort, the bald cypress trees planted on the terraces within the middle of the site are expected to reduce wind speed within the project site. This will further reduce wind-generated waves within the project site on the terraces' leeward and windward sides. Research shows that trees that grow to at least 30 feet at maturity result in lower wind speeds of up to 60 to 150 ft on the windward side and up to 900 ft on the leeward side (USDA).

How does the project protect or conserve natural resources?

The proposed project aims to restore marsh island communities in Bonney Cove that have historically provided environmental and flood reduction benefits to the communities in northern Back Bay. As illustrated in Figure 10, when an intact marsh begins to fragment and convert to open water, fetch increases and enables greater wave energy, increasing marsh erosion rates, and ultimately accelerating conversion to an ever-expanding body of open water. Strategic marsh restoration and creation in Bonney Cove would help mitigate the cycle of marsh island erosion and loss of SAV currently occurring in Back Bay, thereby protecting the remaining marsh islands and reducing fetch and wave energy.

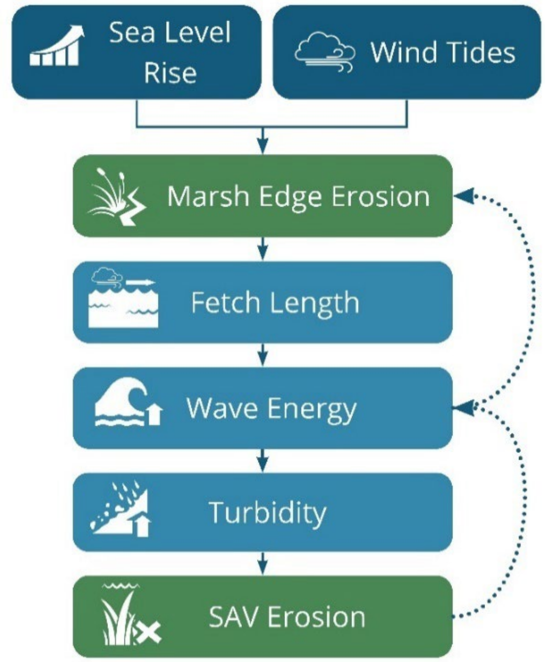

Figure 10: Cycle of marsh erosion, SAV loss, and increased wind-driven flooding.

The primary objective of this project is to create a sustainable coastal marsh island system in Back Bay through reclamation of historically lost marsh habitat and protection of existing marsh complexes from erosion. This restoration effort aims to provide multiple benefits of reduced flood impacts, enhanced fish and wildlife habitat, and improved water quality. The project is designed to achieve the following outcomes:

- Decrease turbidity to create conditions that promote the growth of emergent vegetation and aquatic grasses;
- Maximize habitat value for ecologically important fish and wildlife populations (e.g. Largemouth Bass, Bluegill, Yellow Perch, Striped Bass, Blueback Herring, Alewife, American Eel, etc.); and,
- Reduce fetch, wave heights, and flow velocities to mitigate erosion of fringing marsh systems that provide a buffer for the low-lying neighborhoods and roads that experience frequent flooding in northern Back Bay.

The City selected marsh terracing as the preferred restoration approach because the design is compatible with Back Bay's shallow bottom and the historical loss of habitat. Marsh terraces are narrow, man-made islands placed in shallow open water to restore previous marsh environments. Typically arranged in a chevron pattern, the overall field of marsh terraces dissipates waves, decreases turbidity, and slows down the moving water. The resulting calmer water conditions allow more sunlight to penetrate to the shallow bottom, promoting the establishment and growth of marsh seagrass and ultimately improving habitat quality for fish and wildlife. Further, as opposed to one continuous marsh platform, marsh terraces maximize habitat for a variety of fish and wildlife species, as illustrated in Figure 11.

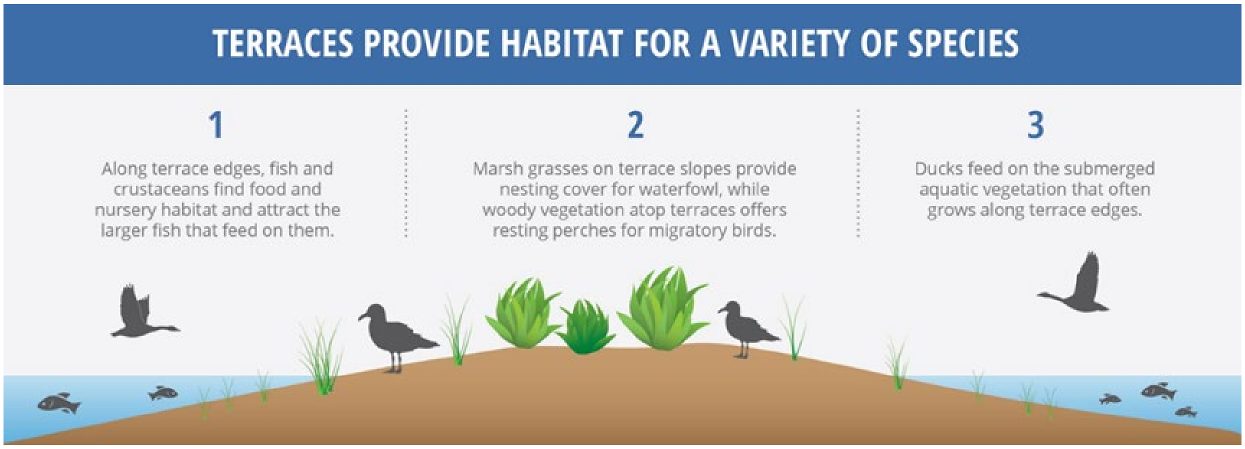

Figure 11: Conceptual diagram of marsh terraces.

Groups to be targeted who might directly benefit from this flood risk reduction effort.

The northern Back Bay communities adjacent to the project area and interested stakeholders have been engaged in the planning effort through public meetings. These meetings provided an opportunity for the community to provide feedback on the 30% and 95% designs and artistic renderings. We anticipate the project to benefit properties and infrastructure assets in northern Back Bay, including the following:

- **Reduce erosion rates along approximately 8 miles of shoreline by reducing wind and wave energy north of the project site.** Most of the properties along this reach of shoreline are not protected by traditional erosion risk reduction measures, such as bulkheads. Maintaining a naturalized shoreline while protecting fringe marsh is a priority of the City and its project partners. This approach will ensure that these marsh systems can migrate landward in response to sea level rise.
- **Reduce flood risk to commercial and residential properties north of the project site.** There are approximately 70 commercial and 2,350 residential structures within the two census block groups surrounding the project site. Around 635 of those structures are vulnerable to flooding during a 50-year event today. With three feet of sea level rise, approximately 2,060 structures are expected to be vulnerable to flooding during a 50-year return period event, representing about 85% of the residential structures within the project vicinity. These numbers underscore the importance of implementing the proposed project alongside complimentary flood risk reduction projects.
- **Reduce the magnitude and duration of flooding along critical access roads and critical facilities.** In addition to Muddy Creek Road, two other critical access roads are anticipated to benefit from delayed flooding. This includes Shipps Cabin Road (intersecting with Muddy Creek Road) and Sandpiper Road, which runs parallel to the eastern bank of Back Bay and provides ingress/egress out of the Sandbridge community (Figure 12).

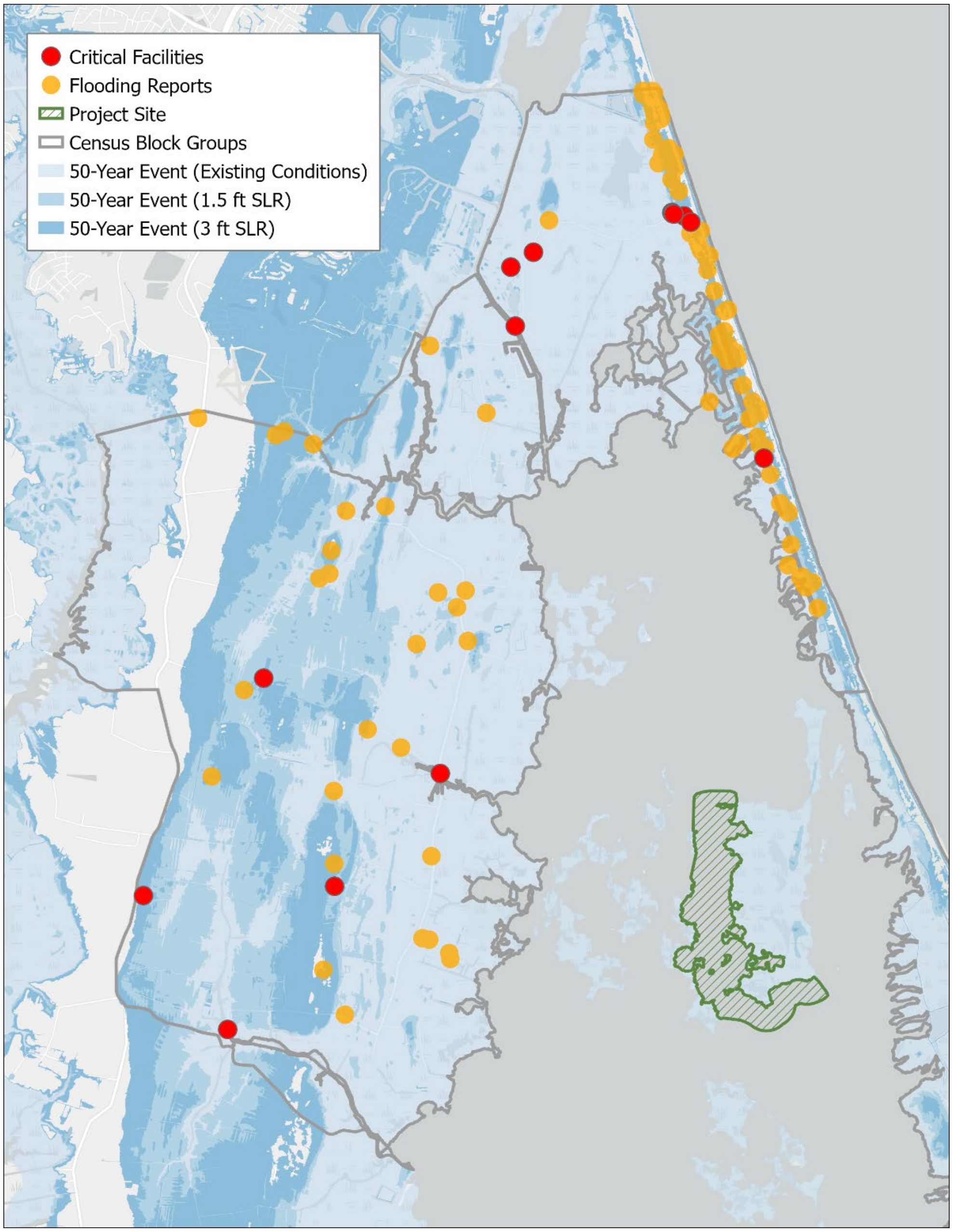

Figure 12: Critical facilities and flooding reports within project vicinity.

What would happen (or not happen) if the applicant does not receive funding?

If this project does not advance from design to construction, erosion of the adjacent marsh would continue to occur, resulting in fragmented habitat lacking the capacity to reduce wave action and slow water velocities. It is anticipated that wind-driven flooding events will continue to increase in frequency, resulting in increasing flooding of the low-lying properties and roadways surrounding northern Back Bay.

Alternatives Analysis

The proposed project offers the best approach for addressing the needs and problem statement outlined in this Scope of Work narrative. The project would result in the creation of 46.5 acres of marsh terraces, which would produce a net gain of approximately 16 acres of low/high marsh habitat by the end of the project construction compared to the No Action Alternative. The integrated system of marsh terrace ridges and perimeter rock armoring would stabilize the two critically eroding marsh islands (Long Island to the east, and a series of smaller unnamed islands to the west) from continued degradation. The tall terrace design improves the functionality and resiliency of the marsh system while also providing diversified habitat for fish and wildlife in the form of increased marsh edge as sea level rises. Numerical modeling of the preferred alternative demonstrated that the project would decrease wave heights and decrease the overall flow velocity of water moving through the project site, reducing water exchange in Back Bay during flooding events, encouraging sediment deposition, mitigating wave effects and consequent erosion, and result in localized water quality benefits. The proposed terraces would not only create a platform for vegetation growth within the marsh, but also reduce wave fetch in these large open water areas. The reduction in wave energy would lead to improved water clarity to promote the growth of SAV in the area between the terraces (approximately 310 acres).

Dredging in between the terraces to obtain sediment for the terrace cap would ensure no invasive vegetation is introduced into Back Bay, which is a high priority of the USFWS and VRMC. The dredging areas would also create valuable fish habitat to attract signature Back Bay fish and wildlife populations such as Largemouth Bass. The proposed dredging areas in between the terraces was evaluated and not anticipated to increase erosion of the adjacent marsh system. Furthermore, dredging in-situ material for building terraces is a widely accepted approach in Gulf Coast region marsh creation/terracing projects, as determined through conversations with project owners in Louisiana. Some terrace cap material will also be obtained from the Nimmo VII-A project. Through export of proven expertise from successful marsh terracing projects, this project would lay the foundation for future similar projects in the region through the development of detailed cost estimates, identification of best sources for local/regional materials, and establishment of partnerships with permitting officials at various levels of government.

Goals and Objectives

The overarching goal of this project is to construct the City's first nature-based adaptation project in the Southern Rivers Watershed and one of the CRMP's exemplary nature-based projects. This project aims to stabilize two critically eroding marsh islands from further degradation, decrease turbidity to promote the growth of aquatic vegetation, and provide flood risk reduction benefits through increased friction and wave attenuation. Table 1 below provides a high-level overview of the specific objectives established to solve the problem/need identified – specifically habitat degradation and wind tide flooding along with measure(s) of success. A more detailed description of these objectives is provided in the Supporting Documentation section.

Table 1: Overview of Project Objectives.

Objectives	Description	Measure(s) of Success	Timing of Measures
Objective 1	Create a Construction Access and Staging Area	a. Secured permits for construction. b. Contractor Selection. c. Construction of Staging Area.	a. December 2023 b. April-May 2023 c. June 2023 -February 2024
Objective 2	Restore Marsh and Aquatic Vegetation	a. Secured permits for construction. b. Restoration of 46.5 acres of habitat.	a. December 2023 b. March - October 2025 and March – October 2026
Objective 3	Engage Stakeholders and Disseminate Effective Practices	Number of people meaningfully engaged in the process of the project within the agreement period.	Continuous through period of performance.

Work Plan

Current Status and Ongoing Activities

The marsh terrace project design is progressing and will be ready for construction in the CFPF grant timeline. Table 2 summarizes ongoing tasks related to the project and an anticipated schedule for completion.

Table 2: Completed, ongoing, and anticipated activities leading up to construction.

Activity	Description	Schedule
Stakeholder Scoping Workshop	In November 2020, the City hosted a virtual workshop to receive initial input from project stakeholders.	Completed (Fall 2020)
Site Characterization and Vegetation Survey	In fall 2020, a site characterization and vegetation survey within Bonney Cove was conducted under a USFWS Special Use Permit (SUP). The purpose of the survey was to document existing emergent marsh and submerged aquatic vegetation (SAV) species composition and percent coverage within the proposed project area. MAP Environmental, Inc. conducted a literature review of marsh terracing projects in the Gulf Coast region to identify effective practices for project planning and design.	Completed (Fall 2020)
Bathymetric Survey	An updated bathymetric survey of Bonney Cove, also covered under a USFWS SUP, was completed in March 2021. This data serves as an input to identify appropriate design elevations to determine quantities of materials necessary to build the proposed marsh terraces and for numerical modeling of project alternatives.	Completed (Spring 2021)
Geotechnical Investigation	A geotechnical investigation of Bonney Cove was conducted in the spring of 2021. The permitted survey, (Virginia Marine Resources Commission (VMRC) Permit No. 2020-2286, U.S. Army Corps of Engineers (USACE) Permit No. 2020-02439, and USFWS SUP) included the collection of 10 soil borings in locations that avoided aquatic vegetation habitat. The soil samples were retrieved by drilling with a specialized airboat-mounted drill rig which was essential for drilling in shallow areas as it avoids disruption to bottom habitat. The soil samples were analyzed to determine the suitability and physical characteristics of the soils within the project area. Additional soil analysis was conducted to determine the suitability of Back Bay sediments for building components of the marsh terraces.	Completed (Spring 2021)

Activity	Description	Schedule
Water Quality and Hydrodynamic Survey	ODU conducted a water quality and hydrodynamic survey of Bonney Cove in the spring of 2021. The USFWS permitted survey collected water samples and deployment/retrieval of hydrodynamic sensors (pressure sensors, acoustic Doppler current profilers, and optical backscatter sensors) at three sampling points in Bonney Cove. Sensor equipment was deployed for two one-month periods (3/10/2021 – 4/12/2021 and 5/19/2021 – 6/8/2021). The water level, wave, and current data served as an input to the numerical model calibration. The water quality parameters (including pH, salinity, temperature, dissolved oxygen, chlorophyll, and turbidity) will serve as a reference to compare pre-and post-construction water quality conditions.	Completed (Summer 2021)
30% Design	Dewberry leveraged the field-collected data to establish design criteria for the project to ensure that it will be resilient in the face of changing future conditions during wind-tide events. Artistic design renderings were developed to enable stakeholders to visualize the implemented project.	Completed (Fall 2021)
Public Engagement – 30% Design	The City held a public information meeting on October 14, 2021, at Creeds Elementary School. The project team delivered a 10-minute presentation of the proposed project followed by an open-format discussion where participants reviewed the preliminary (30%) designs and artistic renderings and submitted comments regarding environmental and community impacts.	Completed (Fall 2021)
Numerical Modeling	Numerical modeling has been completed to evaluate the proposed project's impact on water levels, wave heights, and flow velocities within and surrounding the project area. Potential water quality impacts were also evaluated. The numerical modeling effort involved the development of an XBeach model, which is a nearshore model that accounts for wave-vegetation interactions based on field-derived drag coefficients.	Completed (Winter 2021)
Environmental Assessment and Scoping	In coordination with the USFWS and with technical assistance from Dewberry, the City evaluated the potential environmental impacts of the project. The draft environmental assessment document was distributed to key stakeholders with jurisdictional authority or a vested interest in the project for review and comment.	Completed (Summer 2023)

Activity	Description	Schedule
60% Design	After numerical modeling and stakeholder review of the 30% design, the engineering design plans were advanced from 30% to 60%.	Completed (Spring 2023)
95% Design and Public Engagement	The engineering design team prepared 95% engineering design plans to address comments on the 60% plan set. The City held a second public information meeting from 6:00 – 7:30 p.m. on July 13, 2023, at the Senior Resource Center in Virginia Beach where the project team delivered a 10-minute presentation of the proposed project followed by an open-format discussion where participants reviewed the 95% designs, updated artistic renderings, and submitted comments.	Completed (Fall 2023)
Construction Permit Applications Submitted	The City submitted the Joint Permit Applications for the proposed project, including the initial post-construction monitoring plan, to VMRC and the USACE in August 2023.	Completed (Summer 2023)
Modeling of Potential Adverse Impacts	In response to public concerns, the City performed additional numerical modeling of both northerly and southerly wind events and reviewed water level responses at locations in Back Bay for any potential adverse impacts. No adverse impacts were found for either type of event.	Completed (Fall 2023)
Publication of Frequently Asked Questions	The City will be publishing findings for the potential adverse impacts modeling, along with other responses to public concerns raised at the question in a Frequently Asked Questions webpage in November 2023.	In Progress (Fall 2023)
100% Design	The engineering design team prepared and submitted the 100% engineering design plans to the City for review. The plans will be finalized on receipt of any comments from the permitting process, anticipated to occur by end of 2023.	In Progress (Fall 2023)
Contractor Procurement	The engineering team will provide final plans, specifications, and construction estimates (PS&E). The City will prepare the bid Request for Proposal (RFP), provide Bid Packages, and review bids obtained, and select a construction contractor.	Planned (Winter 2023 - Spring 2024

What are the major activities and tasks?

The key activities and tasks to be competed under the agreement period are summarized in Table 3. Please refer to the Supporting Documentation section for a more detailed description of these activities and tasks.

Table 3: Overview of Activities and Tasks.

Activities	Description	Tasks
Activity 1	Construction Staging Area Preparation and Construction	1. Mobilize equipment 2. Stabilize road, establish construction staging area, abutments, install pre-engineered bridge, construct ramp to water and slurry basins. 3. Establish traffic flagging stations. 4. Install pipe and booster stations.
Activity 2	Marsh Terrace Construction	1. Construct 41 terraces (2-phased approach). 2. Demobilize equipment.
Activity 3	Stakeholder Engagement	1. Develop project marketing materials. 2. Attend and document engagement activities.

Who is responsible for completing the activities and tasks?

Responsibility for completing the project's activities and tasks lies with a collaborative effort led by the City's Department of Public Works. To ensure the successful execution of the project, the City has assembled a diverse team of consultants, advisors and subject matter experts. For a comprehensive understanding of the specific roles and responsibilities of each entity involved in carrying out the proposed scope of work, please refer to the *Supporting Documentation – Approach, Milestones, and Deliverables – Project Partner*s section of this report, which provides a detailed description of how each team member contributes to the project's overall success.

What is the timeframe for accomplishing activities and tasks?

An overview of the planned project timeline is shown in Figure 13. Grant activities will initiated in Summer 2024 with construction of the staging area and material acquisition. Please refer to the S*upporting Documentation – Approach, Milestones, and Deliverables –Milestone Schedule* section of this report for a detailed outline for each activity and associated deliverables.

Figure 13. Timeline overview for project implementation.

Identify the required partners to ensure success and where they are represented in the workplan.

A diverse team of consultants, advisors, and subject matter experts, led by the City's Department of Public Works, has been assembled to complete the project's activities and tasks. Please refer to the *Supporting Documentation – Approach, Milestones, and Deliverables – Project Partner*s section of this report for a detailed description of each team member's role, responsibilities, and contribution to the project's overall success.

Deliverables

An overview of the project deliverables is provided in Table 4. Please refer to the *Supporting Documentation – Approach, Milestones, and Deliverables* section of this report for more detail.

Table 4: Summary of Deliverables.

Activities	Deliverables
Activity 1: Construction Staging Area Preparation and Construction	1. Material acquisition. 2. Progression and completion of the construction staging area, with daily inspections to monitor progress. 3. Documented progress and completion through quarterly reports to DCR.
Activity 2: Marsh Terrace Construction	1. Progression and completion of the 2025 and 2026 construction phases, including plantings, with daily inspections to monitor progress. 2. Demobilization and removal of equipment from construction staging area. 3. Documented progress and completion through quarterly reports to DCR.
Activity 3: Stakeholder Engagement and Lessons-Learned Dissemination	1. Project marketing materials. 2. Records documenting number of stakeholders engaged during the outreach activities.

Maintenance plan tied to the identified viability of the project. Plan for sustaining the project after the agreement period (if applicable)

The City has developed a draft Annual Monitoring Plan and Post-Construction Monitoring Report that was submitted along with the Joint Permit Application for the project. See Attachment 5 for a copy of the draft report.

Project maintenance will be addressed by the City of Virginia Beach's Public Works Stormwater Operations Group. Any maintenance issues identified by the monitoring effort or other observers will be flagged to the Operations Group to address. The City intends to maintain the construction staging area to support future project maintenance needs. After completion of the monitoring program, the City will perform inspections every 2-5 years and make any repairs needed for the life of the project.

Evaluation

Indicators of Success

Indicators of success for this project have been identified during the development of the monitoring plan. Three (3) indicators of success were defined in relation to the primary objectives of the project (as defined elsewhere in this document), and include:

- The establishment of a sustainable coastal marsh island system.
- Stability of the marsh terrace structures.
- Establishment of a sustainable SAV community.

What data will be collected and how will it be used to measure success?

Data collection for the project has been detailed in the proposed monitoring plan and includes two sets of data: one set associated with as-built surveys to establish baseline reference conditions for subsequent monitoring efforts, and monitoring data to assess the success of the project in meeting the indicators defined above. Baseline and monitoring data will be compiled in an annual report and distributed to permitting agencies, and stakeholders as appropriate, to fulfill monitoring requirements and ensure success criteria are being met and maintenance needs are addressed.

Baseline data, which is proposed to be collected after the completion of each of two phases of terrace installation, will include the following data:

- Coordinates and diagrams of established transects, as well as site photographs from photo stations established along each sampling transect, as defined in the Methods section of the monitoring plan.
- Final location of all planted vegetation (upland plantings, high marsh plantings and low marsh plantings).
- Final location and extent of SAV plantings.
- Final grade topographic surveys (plan, profile, and cross sections).
- Discussion of the project design versus as-built conditions.

Monitoring data will be collected at the end of the full growing season during each monitoring year and include the following:

- Site photographs from photo stations defined in the Methods section of the monitoring report.
- Estimated percent cover and change in coverage from the as-built conditions to sampling year conditions for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- Estimated percent cover and change in coverage from planted conditions to sampling year conditions for SAV planting quadrants

- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

This monitoring data will be used to define success by tracking the establishment of the proposed vegetative communities on and between the proposed marsh terraces as well as the structural integrity of the marsh terrace structures themselves. Vegetation cover thresholds for each year will be defined to ensure planted communities are appropriately established on each marsh terrace. Acceptable measures of deviation will be defined for structural elements to ensure design requirements are met. Maintenance and mitigation measures defined in the monitoring plan will be implemented as required if success criteria are not met during any particular monitoring year.

How was cost effectiveness evaluated and measured against the expected outcomes?

Through a BCA approach using FEMA methods and ecosystem service valuations, a BCR of 1.17 was calculated for the project. This BCR is greater than 1, indicating the project can be considered cost-effective. The project also provides an additional $9.2M in value over the current estimated project costs.

A description of the BCA analysis and methods is provided in the following Benefit Cost Analysis Section.

What products, services, meetings, outreach efforts etc. will be conducted and how will success be measured?

The City is firmly dedicated to fostering meaningful engagement with project partners and external stakeholders throughout the project, with the goal of raising awareness about the project's approach and its benefits and enhancing the likelihood of its successful adoption in other areas within the region and the state.

Activity 4, titled "Stakeholder Engagement and Lessons-Learned Dissemination," provides a comprehensive outline of the City's outreach strategy, encompassing proposed deliverables and outreach endeavors. This strategic plan entails the development of project marketing materials, along with the facilitation of presentations and meetings with local and regional stakeholders, as well as participation in state and national-level conferences.

To gauge the effectiveness of our efforts, the City will employ metrics to track and document the number of individuals engaged throughout the project. This information will be regularly communicated to DCR to serve as a key performance indicator for project success.

For a more detailed breakdown of the tasks and deliverables associated with Activity 4, please refer to the Supporting Documentation section of this application.

Project Progress Monitoring Plan

The City's Project Progress Monitoring Plan is designed to guarantee the seamless and effective execution of the project. We have established a robust internal system to oversee the entire project lifecycle, ensuring that all key stakeholders are aligned with the project's objectives, activities, deliverables, and schedule.

The process commences with a kickoff meeting involving all project partners, where we collectively set the stage for the project. During this meeting, we thoroughly review the project's objectives and scope, ensuring that everyone is on the same page. This initial step is instrumental in fostering a shared understanding of the project's vision and goals among all involved parties.

In addition to the kickoff meeting, we place a strong emphasis on quality assurance and control. We meticulously assess each contractor's quality management system to ensure that well-defined procedures are in place to maintain the highest standards of quality throughout the project. This dedication to quality is paramount to delivering a successful project that meets the City's standards and the expectations of our stakeholders.

The City is committed to ongoing and transparent communication with our design and construction contractors, as well as our advisory stakeholders. Regular meetings will be held to monitor progress, address any potential challenges, and ensure the project adheres to the proposed milestone schedule and deliverables as outlined in this grant application. This proactive approach to project monitoring allows us to stay on track, identify and address issues promptly, and uphold our commitment to the successful completion of the project.

Supporting Documentation

Project Information

The following sections provide details regarding the project site and highlight the impacted population, residential and commercial structures, and critical facilities. This section also provides an overview of the historical, existing, and projected flood conditions in and around the project site.

Population

As shown in Figure 14, two census block groups (518100454.121 and 518100464.001) adjacent to Back Bay are within the extent of the anticipated project benefits. The total population of these two block groups is 3,531.[6] The residential population has grown approximately 1.8% in the past two decades. The median household income in 2021 dollars is $99,078. There are approximately 2,500 residential housing units, of which 43.1% are owner-occupied, 11.4% are renter-occupied, and 45.5% are vacant. The high percentage of vacant housing units can likely be attributed to seasonal rentals within the Sandbridge Resort Area. The race and ethnicity demographics of the community are 94.4% White, 1.4% Black, 3.4% Hispanic, and less than 1% Asian and American Indian.

[6] Population, household income, housing units, and demographic data obtained from Esri ArcGIS Community Analyst (2022). Esri forecasts for 2021 based on U.S. Census Bureau 2010 data.

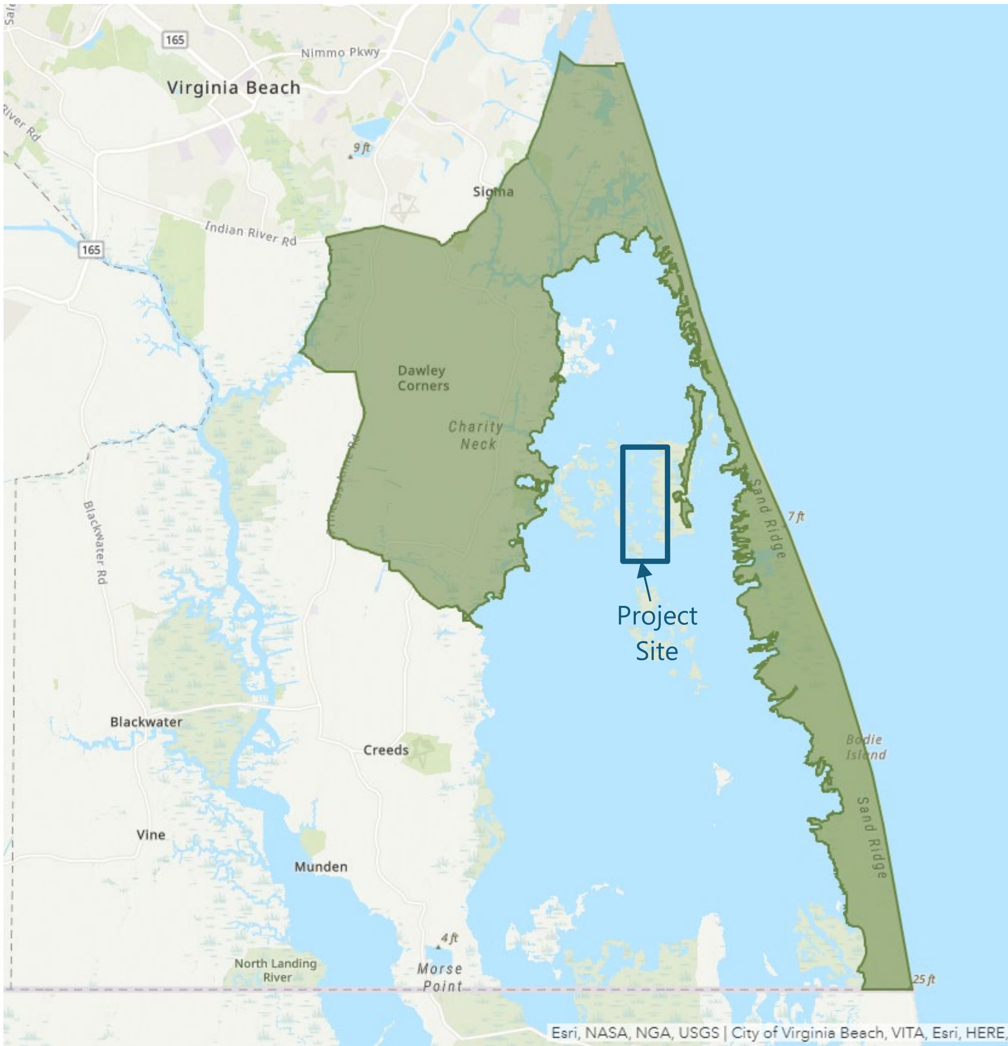

Figure 14: Census block groups selected for population estimates.

Historic Flooding Data and Hydrologic Studies Projecting Flood Frequency

Historical and Existing Flood Data

The project is located within a Federal Emergency Management Agency (FEMA) mapped Special Flood Hazard Area (SFHA), as shown in Figure 15 and Figure 16. Based on the City's current flood maps (effective January 16, 2015), the project site's flood zones are VE, AE, and Open Water. Portions of the site are within Otherwise Protected areas.

The following maps provide an overview of the existing flood hazards for the project area, including the northern boundary (Figure 15) and southern boundary (Figure 16). Based on the City's current flood maps (effective January 16, 2015), the project site contains VE and AE flood zones and Open Water.

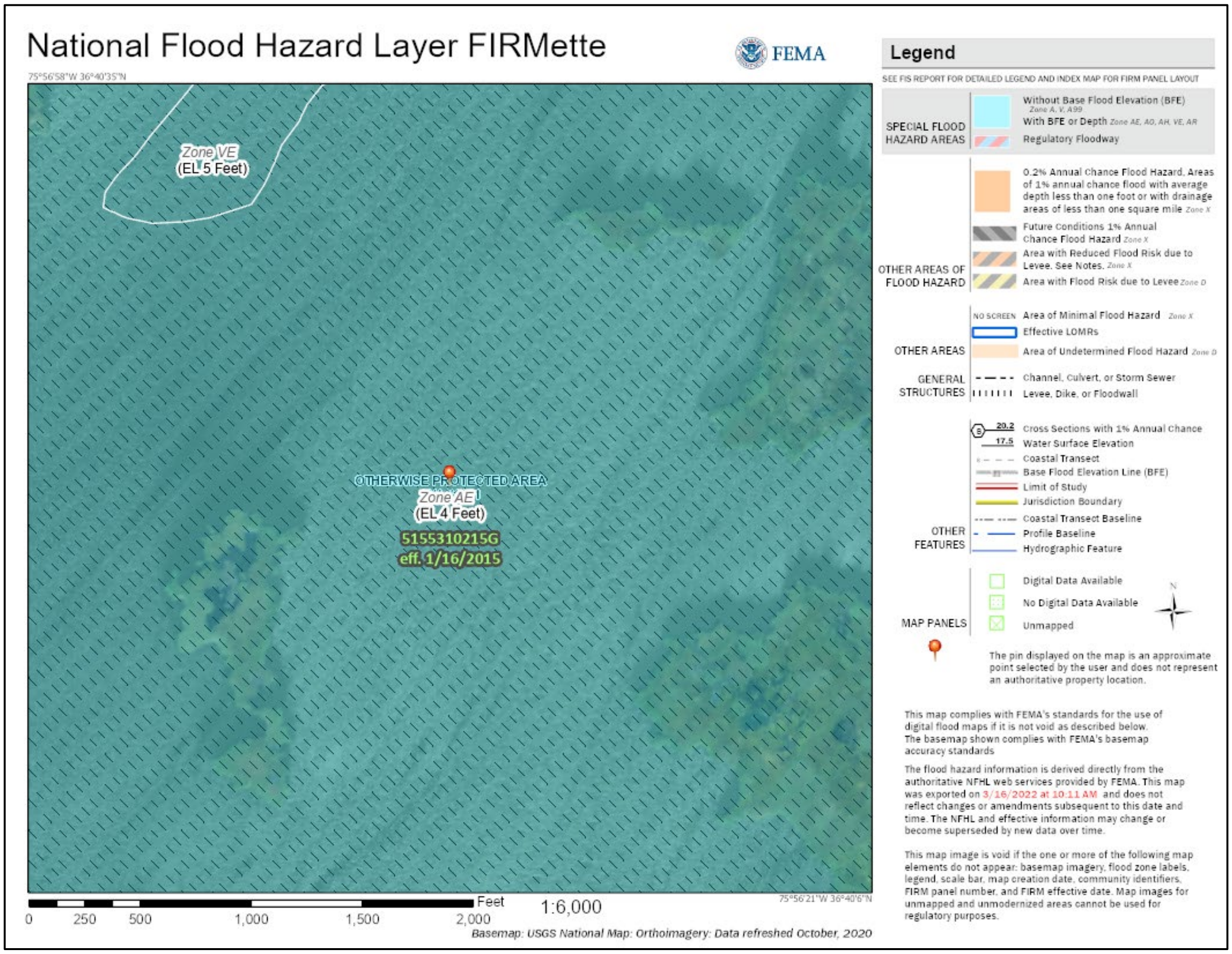

Figure 15: FIRMette for the project area (northern boundary).

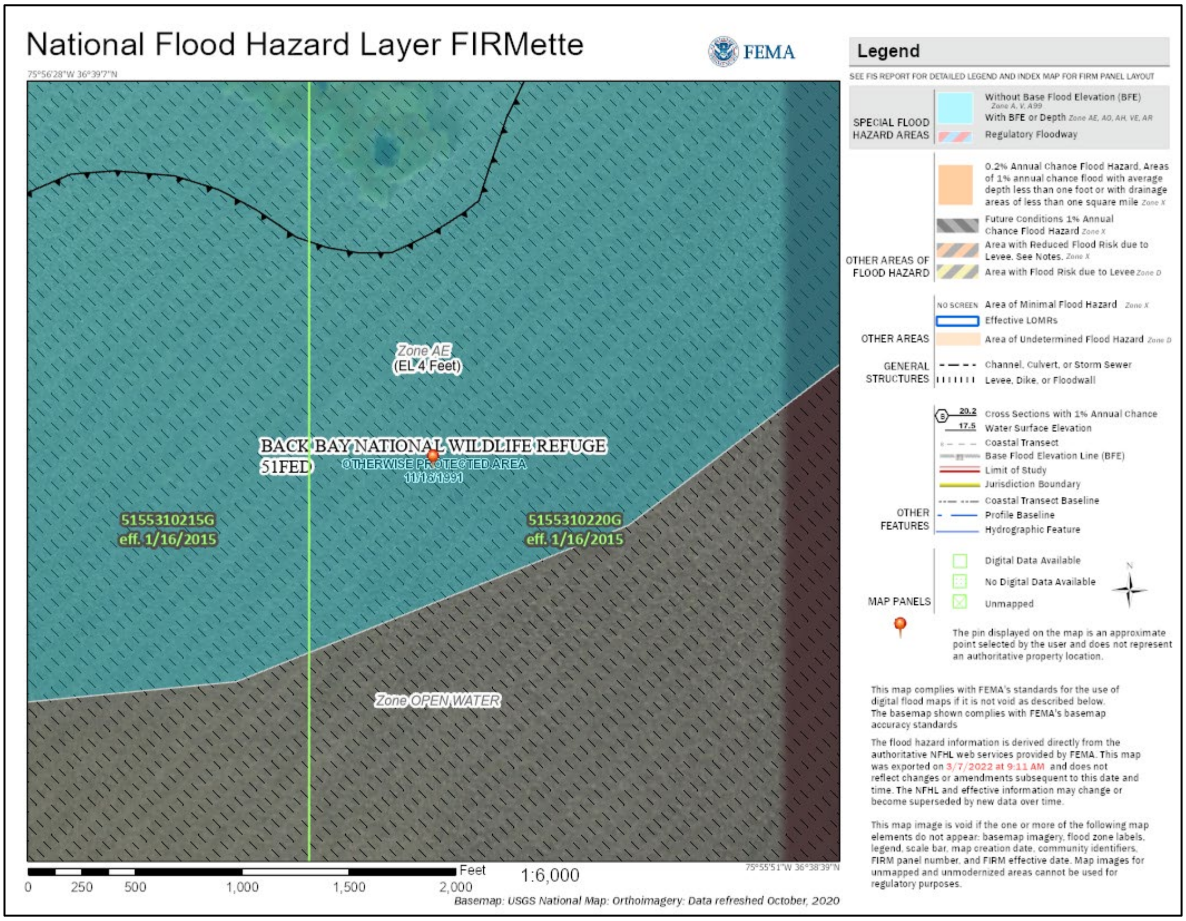

Figure 16: FIRMette for the project area (southern boundary).

The City maintains records of where residents report flood issues and what type of flooding is causing the issue. Residents regularly report flood issues through a hotline, which are then recorded in a flood event database. The census block groups adjacent to the project area reported 111 flood issues associated with heavy rain or high tide between 2001 and 2019. Critical facilities and flood incidences are relatively concentrated in the Sandbridge Resort Area.

Projected Flood Frequency

The USFWS, the City, and other stakeholders have made significant investments in detailed assessments, sophisticated computer models, and water level gauges to better understand historical and future wind tide flooding. Figure 17 displays the projected flood pathways under the 10-year and 100-year storm event under a 3 feet sea level rise scenario surrounding the project site.

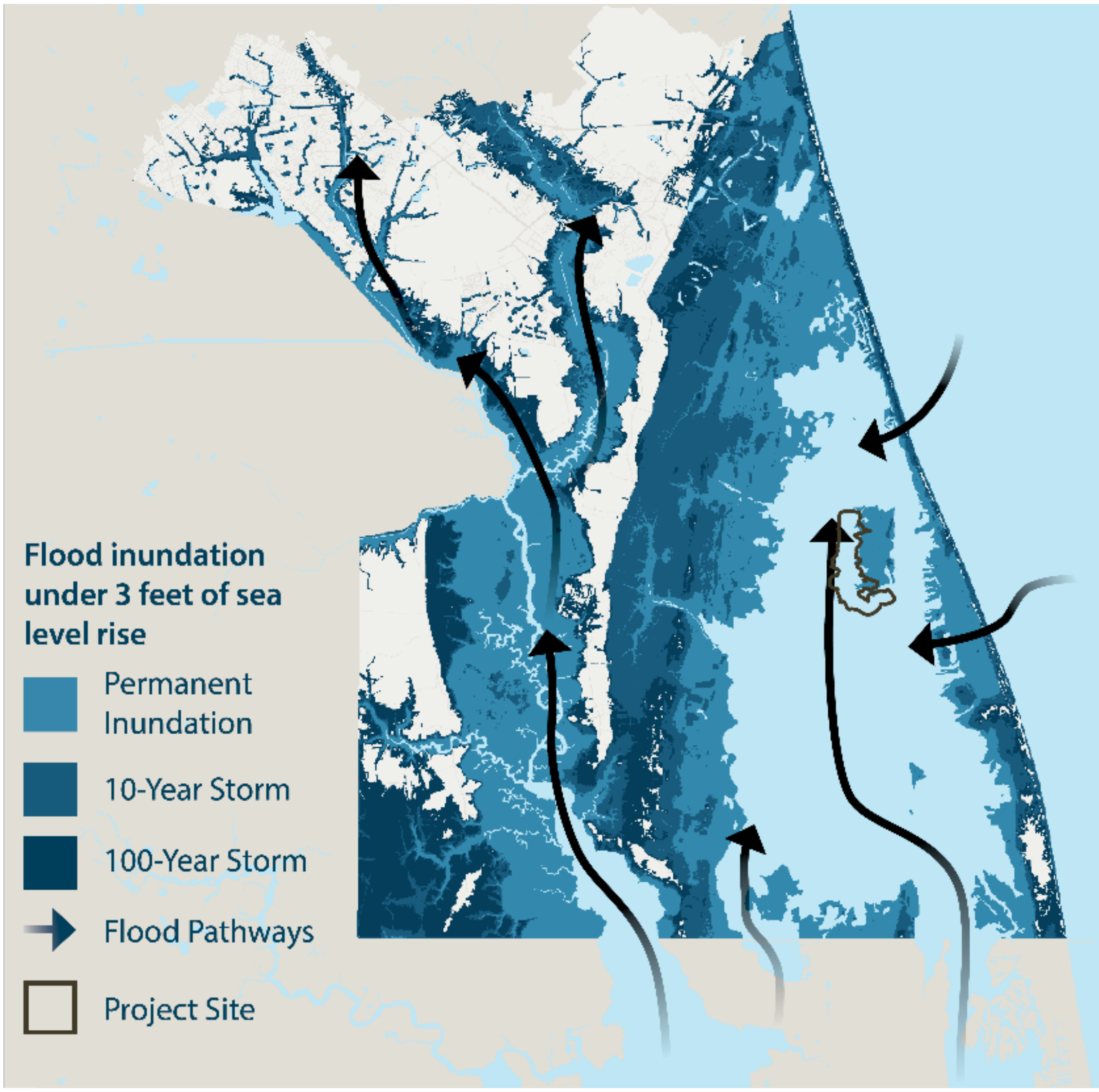

Figure 17: Flood pathways into the Southern Rivers Watershed with 3 feet of sea level rise.

Numerical modeling also shows that as sea levels continue to rise, a shorter duration wind event will produce more wind-induced flooding in less time. The three lines in Figure 18 represent the water level response to a sustained 15-mph wind for each sea level rise scenario. With the existing marsh system today (blue line), it takes approximately five days of sustained southerly wind to cause flooding. With 1.5 feet (yellow line) and 3 feet (red line) of sea level rise, the peak water level could be reached two to three days sooner, respectively. Model simulations showed that marsh island creation across Back Bay would help delay the onset of flooding by several days, which would allow the City and residents more preparation time[7].

[7] City of Virginia Beach. (2018). Analysis of Marsh Response to Sea Level Rise (PDF).

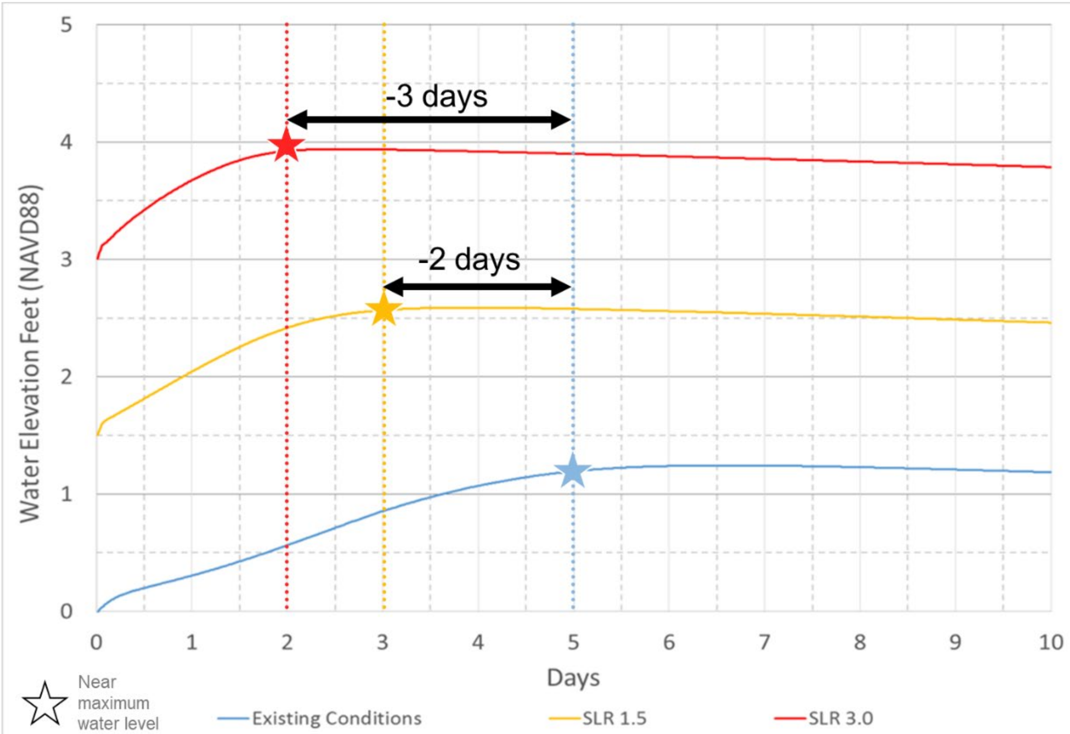

Figure 18: Water-level response under sustained 15-mph southerly wind.

The City analyzed future marsh conditions using the Sea Level Affecting Marshes Model (SLAMM).[7] Figure 19 illustrates areas likely to experience accelerated degradation of marsh in Back Bay due to rising water levels. If no action is taken, substantial marsh loss is projected in Bonney Cove under 3 feet of sea level rise. Within a 1-mile radius of Bonney Cove, the City's SLAMM model predicts that approximately 730 additional acres could be eroded into open water in response to sea level rise. This represents more than a 70% reduction as compared to the existing marsh system surrounding Bonney Cove today. It is also presumed that open water areas would continue to experience high levels of turbidity, which will continue to negatively affect SAV communities in Back Bay.

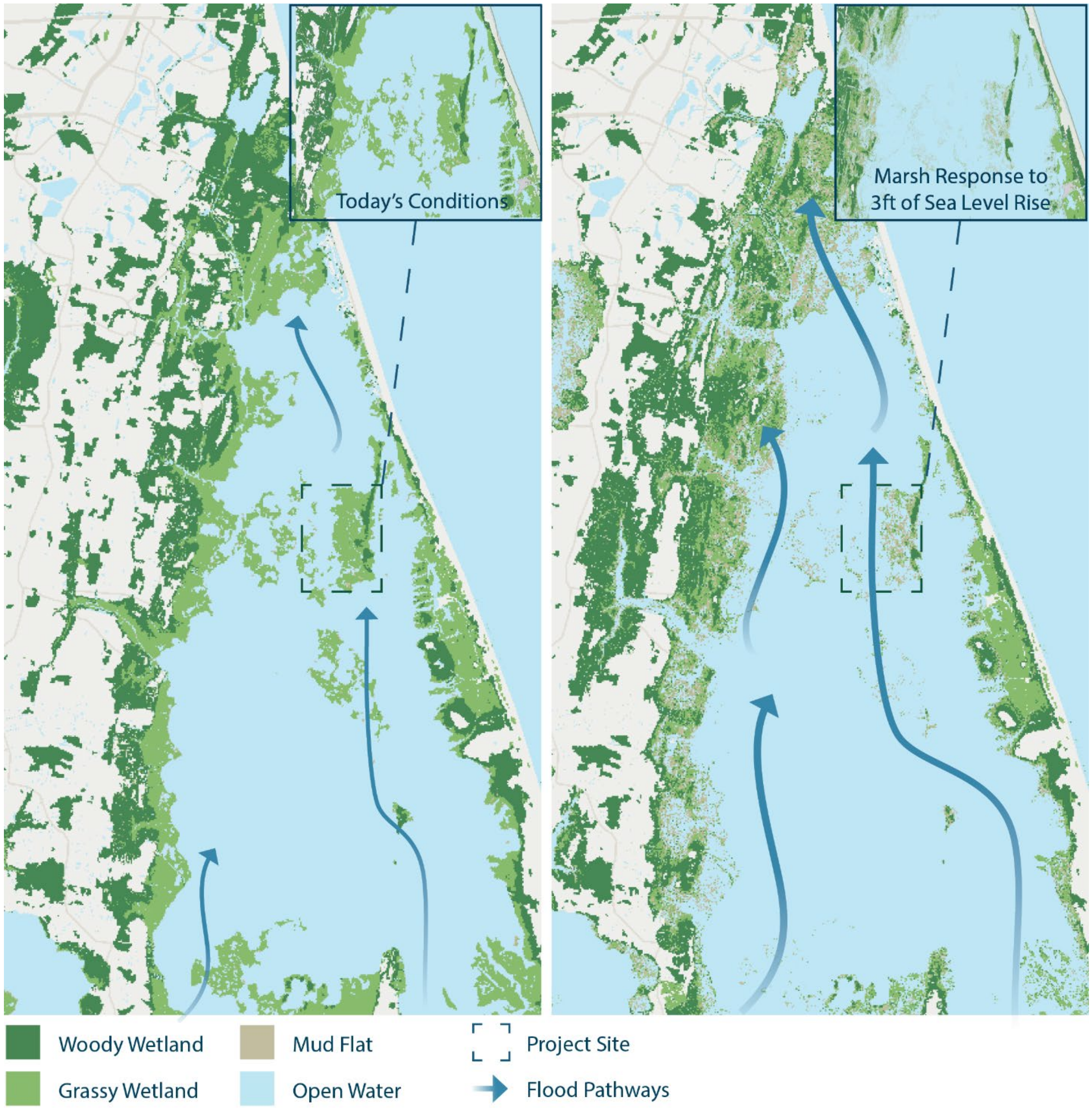

Figure 19: Comparison of current marsh conditions to future marsh conditions with 3 feet of sea level rise.

The proposed project site in Bonney Cove has a predominant south-southwest wind direction, which contributes to significant wave generation in the large unobstructed open-water areas and provides a continuous source of scouring and erosion in those areas. Marsh loss is likely to continue in the project area, creating a negative feedback cycle as continued fragmentation of the marsh would further deteriorate the remaining stands of healthy marsh and increase fetch. Today, the site faces low to medium fetch exposure, but in the future, the site could experience high to very high fetch exposure, as defined by the Virginia Institute of Marine Science (VIMS)

Shoreline Design Guidelines for Shore Protection in Virginia's Estuarine Environments.[8] Projections of increasing fetch at the site, along with the transects used for the wind fetch analysis, are summarized in Figure 20.

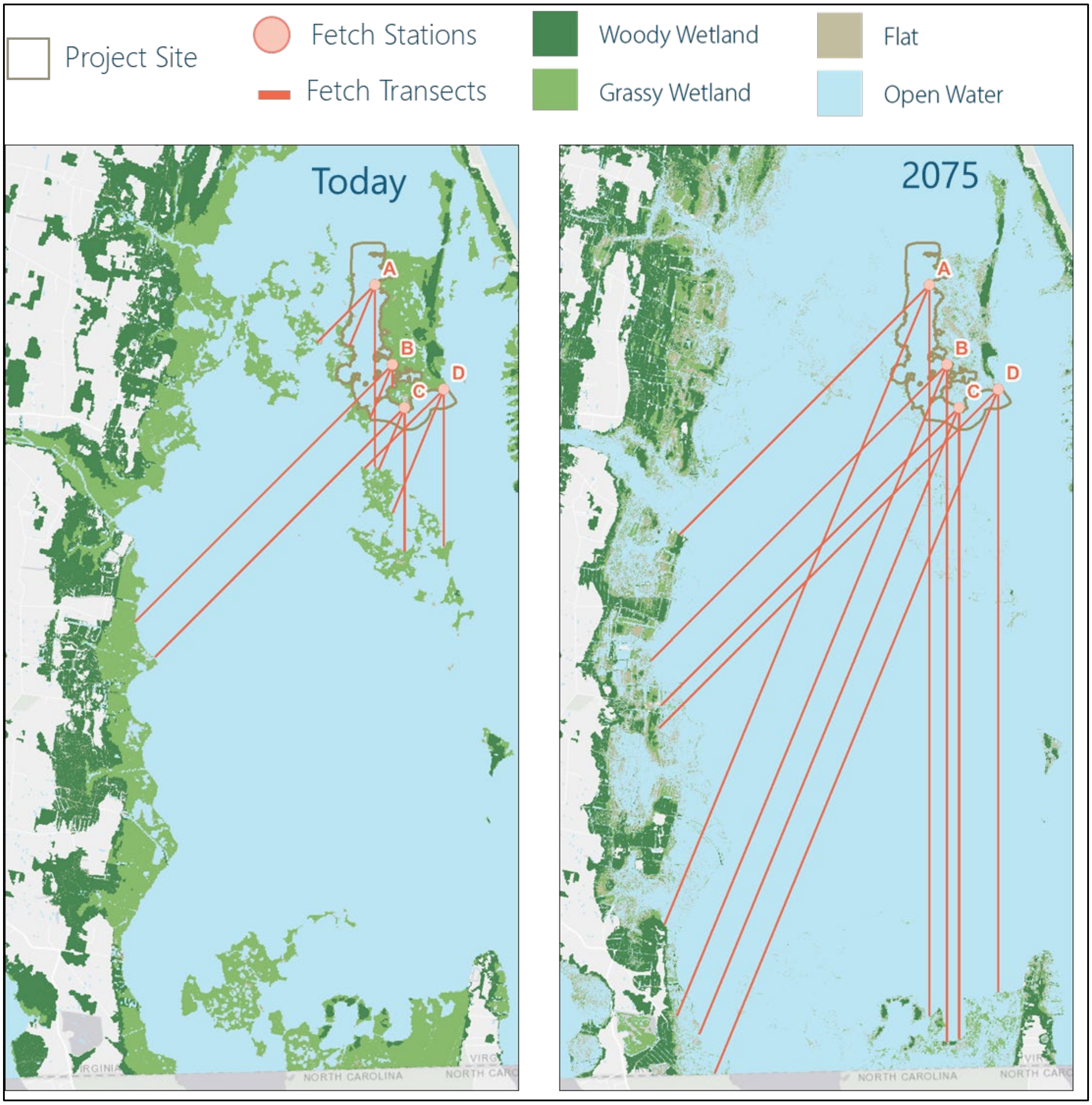

Figure 20: Wind fetch analysis of project area.

The following table displays specific values of fetch distances and classifications that correspond with the transects displayed in Figure 20 above.

[8] Virginia Institute of Marine Science. (2010). Living Shoreline Design Guidelines for Shore Protection in Virginia's Estuarine Environments; Version 1.2 (PDF).

Table 5: Measurements of fetch transects referenced in Figure 20.

Fetch Transect	Length, Miles (Today)	Classification	Length, Miles (3 feet SLR)	Classification
A-SW	0.9	Low	3.7	High
A-SSW	0.7	Low	7.3	Very High
A-S	1.9	Medium	7.7	Very High
B-SW	3.8	Medium	4.4	High
B-SSW	0.6	Low	7.4	Very High
B-S	0.2	Very Low	7.2	Very High
C-SW	3.7	Medium	4.4	High
C-SSW	0.7	Low	7.2	Very High
C-S	1.5	Medium	6.7	Very High
D-SW	1.2	Medium	5.1	Very High
D-SSW	1.4	Medium	7.8	Very High
D-S	1.7	Medium	6.4	Very High

No Adverse Impact

The City conducted additional hydraulic numerical modeling to identify any potential adverse impacts in response to concerns raised during a public meeting in July 2023. The City utilized a Danish Hydraulic Institute MIKE FLOOD model developed for stormwater master planning activities in Lower Southern Rivers Watershed of Virginia Beach. This model encompasses the entirety of Back Bay and extends into North Carolina's Currituck Sound. Model performance has been validated against observations from multiple flood events.

The effort looked at water level and velocities in response to a historical southerly wind tide flood in May 2017 and a northerly wind event associated with Tropical Storm Ophelia in September 2022. These events were ran with model grids depicting with- and without project conditions, considering the 100% project design specifications. The northerly wind event was

included to address concerns from residents of Knott's Island, at the southern end of Back Bay. Both the terrace field and the construction staging area were included in the with-project condition. The modeling found that there were no increases in water levels to areas within Back Bay or to Knotts Island. Negligible changes in water velocity (0.2 ft/s or less) were observed in the channel to the west of the terrace field. No increases in water levels were observed in the area of the construction staging area.

Local Government to Provide its Share of the Cost

The City of Virginia Beach is fully prepared to cover the cost share of the proposed project, as highlighted in the attached budget narrative, "Amount of Cash Funds Available." The funding for the grant match is contained within the City budget.

Benefit-Cost Analysis

FEMA recognizes the economic value of restoration projects and has provided ecosystem service economic valuations for benefit cost considerations. The approach and values used here are consistent with FEMA Benefit-Cost-Assessment (BCA) toolkit approaches and ecosystem service valuations published in "FEMA Ecosystem Service Value Updates, June 2022[9]." The 2022 FEMA guidance provides methods and values for various nature-based projects, including coastal wetlands. The valuations recognize ecosystem services for coastal wetlands including aesthetic value, climate regulation (carbon sequestration), flood and storm hazard reduction, habitat, recreation/tourism, water filtration and supply benefits of coastal wetland features.

Feasibility and Effectives Criteria

The project meets FEMA's Feasibility and Effectives Criteria for a Coastal Wetland as defined in the 2022 guidance, including:

- Land cover associated with the project is a "Estuarine and Marine Wetland" as classified for NWI for remaining marsh within and adjacent to the study area. The area of the project is also a historical marsh.
- The project demonstrates "ecosystem restoration" by using the terrace approach to recover degraded, damaged, and destroyed wetlands and submerged aquatic vegetation in the Back Bay ecosystem.
- The project meetings EPA concepts of restoration through direct creation of marshes (the terraces themselves) and enhancement of the ecosystem (reduction of water turbidity to enhance growth of submerged aquatic vegetation).
- The project will result in notable increased health and function of the local ecosystem in the "after mitigation" scenario through reduction of wave heights, water flow, and significantly decreased turbidity within the project area, as well as reduction of wave heights to adjacent areas.

[9] FEMA Ecosystem Service Value Updates, June 2022 (PDF).

- The project approach was aligned with established principles and techniques on wetland restoration, as outlined in the Coastal Wetlands and Tidal Flats section of the International Guidelines on Natural and Nature-base Features for Flood Risk Management10.

Design Life

As mentioned, the project useful life is 30-years. The FEMA 2022 guidance allows 50-years a typical lifespan; however, as stated in the project description, the elevation of the terraces was set based on a 30-year design life and estimated settlement.

Ecosystem Services Valuation

- The 2022 guidance values ecosystem services for coastal wetlands at $8,955 in 2021 U.S. dollars (USD), per acre, per year.
- The project will restore 46.5 acres of intertidal and upland marsh through direct creation of the marsh terraces. The project will also promote the growth of SAV in between the terraces, an area estimated at 310 acres. This provide for a total project benefit area of (46.5 + 310) = 356.5 acres.
- Project benefits occur over a period of time into the future; while most of the project costs are incurred up front and in the present. FEMA conducts its BCAs on a net present value basis, meaning the present value of the benefits gained from the project over the life of the project are compared to the total project cost to establish the BCR. Because project benefits accumulate over time, project benefits are calculated on an average annual basis ("annualized") and then multiplied by a Present Value Coefficient (PVC) to determine the present value of the annualized benefits.
- The present value coefficient is calculate as follows:

$$PVC = \left[\frac{1-(1-r)^{-T}}{r}\right]$$

  where *r* is the discount rate and *T* is the useful life of the project. The CFPF 2023 Grant Manual does not specify a discount rate for the benefits calculation; therefore, the latest FEMA program grant guidance was reviewed. For the 2023 FEMA Building Resilient Infrastructure and Communities (BRIC) and Floodplain Mitigation Assistance Grant Program (FMA) cycles FEMA has established a set discount rate of 3%[11]. The 3% discount rate provides for a PVC of 19.60 for a 30-year lifecycle for the project.
- Project benefits were calculated by:

$$Benefits = PVC \times Project\ Area \times Coastal\ Wetland\ Benefits$$

- The benefit cost ratio (BCR) was calculated as:

[10] International Guidelines on Natural and Nature-Based Features for Flood Risk Management - Engineering With Nature (dren.mil)

[11] FEMA Fact Sheet. Notice of Funding Opportunity for Fiscal Year 2023 Building Resilient Infrastructure and Communities Program (PDF).

$$BCR = \frac{Benefits}{Costs}.$$

A summary of the calculated values is provided in the below table:

Table 6. Summary of BCA parameters and results.

Project Area	Benefits (acre / year, 2021 USD)	Project Lifespan	Benefits, 3% discount rate	Project Cost	BCR, 3% discount rate
356.5	8,954	30	$62,566,588	$53,378,490	1.17

The calculated BCR for the project was 1.17, based on the FEMA ecosystem services valuation approach. This BCR is greater than 1, indicating the project can be considered cost-effective. The project also provides an additional $9.19M in value over the project cost.

Local Floodplain Management Regulations

The City recognizes the vital importance of floodplains in the natural movement of water through the community. Appendix K of the Virginia Beach Code of Ordinances regulates development in the community's floodplains. The City requires that a permit is obtained for any construction or development in the Special Flood Hazard Area. For more information and details regarding the City's floodplain management and ordinances, please refer to the following:

- Link to current floodplain ordinance: Virginia Beach Floodplain Ordinance.

In addition, a copy of the current floodplain ordinance has been included in *Part IV, Section E5*. For further information regarding the City's hazard mitigation and comprehensive planning, please refer to the following:

- Link to current hazard mitigation plan: Regional Hazard Mitigation Planning.
- Link to current comprehensive plan: Virginia Beach Comprehensive Planning.

Other Necessary Information to Establish Project Priority

Repetitive Loss and/or Severe Repetitive Loss Properties

The repetitive loss database shows 113 repetitive loss and severe repetitive loss properties within the two census block groups (518100454.121 and 518100464.001) associated with the project area.

Residential and/or Commercial Structures

A detailed economic flood loss assessment presented in the City's Resilience Plan showed that approximately 45% of the entire future risk exposure in the City is concentrated in the Southern Rivers watershed. Of that risk, 65% is concentrated in three communities north of Back Bay

(Figure 21).[12] Under a "no action" scenario, average annualized flood losses would increase from $974 thousand, representing present day conditions, to $6 million with 1.5 feet of sea level rise as anticipated by 2050. This figure equals an increase of six times present day conditions. With 3 feet of sea level rise as anticipated by 2080, annualized losses are expected to drastically increase to $80 million, more than 80 times today's conditions.

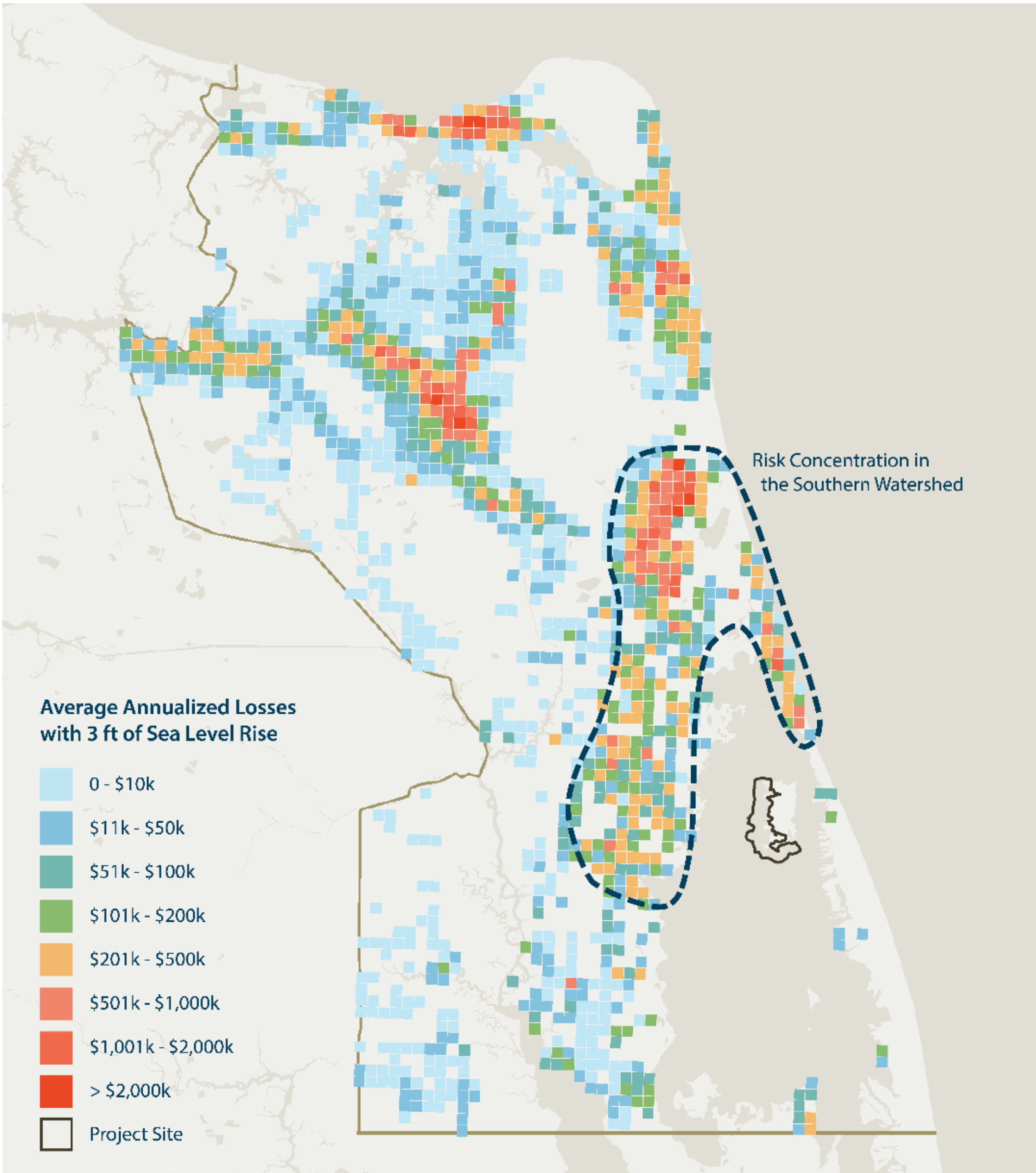

Figure 21: Concentration of average annualized losses estimated with 3 feet of sea level rise under a "no action" scenario presented in the City's Resilience Plan.

[12] City of Virginia Beach. (2020). Coastal Flooding and Economic Loss Analysis (PDF).

Within the two census block groups adjacent to Back Bay near the project area, there are approximately 70 commercial structures and 2,350 residential structures. Of those structures, approximately 635 structures are vulnerable to flooding during a 50-year event today. With 3 feet of sea level rise, approximately 2,060 structures are expected to be vulnerable during a 50-year event, representing approximately 85% of the residential structures within the project vicinity. These numbers underscore the importance of implementing the proposed project alongside complimentary flood risk reduction projects.

Critical Facilities

The two census block groups near the project site include 10 critical facilities. Table 7 summarizes critical facilities by type, total number, and the number of facilities exposed to the 50-year storm scenario under current and future "no action" scenarios. Under current 50-year storm conditions, 2 communication facilities and 1 electric power station would be exposed to flooding. With 3 feet of sea level rise, the number of critical facilities exposed to flooding increases to 9 total facilities.

Table 7: Summary of critical facilities located in the selected census block groups and flood hazard exposure to the 50-year storm event under current conditions and with 1.5 feet and 3 feet of sea level rise.

Type of Facility	Number of Facilities	Current 50-year storm	50-year storm with 1.5 feet sea level rise	50-year storm with 3 feet sea level rise
Communication	3	2 (66%)	2 (66%)	3 (100%)
Electric Power	1	1 (100%)	1 (100%)	1 (100%)
Fire Station	1	0	0	0
Potable Water	2	0	2 (100%)	2 (100%)
School	1	0	0	1 (100%)
Wastewater Treatment	2	0	0	2 (100%)

Need for Assistance

The City of Virginia Beach has invested significant time, money, and staff resources in understanding, communicating, and planning for the threats of sea level rise and recurrent flooding to the community. The City is ready to begin the implementation of adaptation measures, and the marsh terrace project is the first project to advance to construction from the City's Resilience Plan. The project represents the first step in restoring Back Bay and the larger Albemarle-Pamlico estuary, and serves as a pilot for additional restoration projects. Virginia Beach understands that flood mitigation costs are substantial and is seeking funds to support project implementation alongside dedicated resources procured by the City. The City's

Department of Public Works Stormwater Engineering Center has closely coordinated with the City's Department of Planning & Community Development throughout the design and permitting process. The Department of Public Works will oversee the construction of the marsh terrace project, including providing construction inspectors to monitor that the project is built to the City's design standards and technical specifications. Additionally, the City has access to necessary software, including AutoCAD and ArcGIS Desktop, and support from consultants to augment the City's technical capabilities.

Examples of City staff who will support the project include the following:

- Program Manager for the Technical Services Division of the Stormwater Engineering Center.
- Project Manager for Green Infrastructure Projects for the Technical Services Division of the Stormwater Engineering Center.
- Environmental Planner / Certified Floodplain Manager from the Wetlands & Shoreline Construction Team of the Planning Administration Division of the Department of Planning & Community Development.
- Planning Evaluation Coordinator from the Chesapeake Bay Preservation Area & Southern Rivers Watershed Team of the Planning Administration Division of the Department of Planning & Community Development.
- Full-time Construction Inspector assigned exclusively to this project from the City's Construction Bureau or under contract with the City Public Works Engineering Division.
- Grant Coordinator from the City's Public Works Engineering Division.

Additional staffing will be provided as needed to ensure project success.

This project benefits communities in northern Back Bay with a high concentration of flood losses (as shown in Figure 21). These communities contribute significantly to Virginia Beach's rural economy, including agriculture, forestry, fishing, hunting, and eco-tourism. In Hampton Roads, these industries contribute a combined $100 million in gross domestic product.[13] Protection of vulnerable natural infrastructure, such as the marshes in Back Bay, is critical to ensuring these industries can continue to thrive within the region.

Alternatives

Several other alternatives were considered but not advanced due to technical and environmental limitations. These alternatives are briefly summarized below.

[13] Office of Governor Ralph S. Northam Commonwealth of Virginia and Virginia Department of Conservation and Recreation. (2021). Virginia Coastal Resilience Master Plan Phase 1 (PDF); data referenced sourced from the US Bureau of Economic Analysis. (2019).

Alternative 1 - No Action Alternative

Under this alternative, no action would be taken to restore marsh habitat in the shallow open water channel of Bonney Cove. Erosion of the adjacent marsh would continue to occur, resulting in fragmented habitat lacking the capacity to reduce wave action and slow water velocities. It is anticipated that wind-driven flooding events will continue to increase in frequency, resulting in increasing flooding of the low-lying properties and roadways surrounding northern Back Bay.

Alternative 2 - Alternative Terrace Configuration Design(s)

Several configuration alternatives for the terraces were considered during the design process. These included four alternative layouts with different spacing and terrace top widths:

- **Alternative 2a** (Figure 22): Terraces would be spaced at approximately 300-foot intervals and have a top width of 15 feet. Between the base of the terraces, there would be approximately 220 feet for potential establishment of SAV habitat.
- **Alternative 2b** (Figure 23): Terraces would be spaced at approximately 300-foot intervals and have a top width of 30 feet. Between the base of the terraces, there would be approximately 200 feet for potential establishment of SAV habitat.
- **Alternative 2c** (Figure 24): Terraces would be spaced at approximately 600-foot intervals and have a top width of 15 feet. Between the base of the terraces, there would be approximately 520 feet for potential establishment of SAV habitat.
- **Alternative 2d** (Figure 25): Terraces would be spaced at approximately 600-foot intervals and have a top width of 30 feet. Between the base of the terraces, there would be approximately 500 feet for potential establishment of SAV habitat.

A common feature across all of these design alternatives was a breakwater that spanned the entire length of the southern extent of Long Island and a northern breakwater that spanned the northern exposed section of the project site.
Alternative 2a and 2b were eliminated due to constructability concerns regarding the quantity of sediment that would be required and due to the limited amount of room for SAV establishment in between the terraces (approximately 220- and 200- feet of potential SAV habitat between terraces for Alternative 2a and 2b, respectively).

Alternatives 2c and 2d were discussed extensively amongst the project team; however, it was ultimately determined that they did not maximize the opportunity for species diversity (by including both smaller and larger terraces). These alternatives were combined to form the preferred alternative presented in this document. Additional refinements that were made to these alternatives include the removal of the perimeter breakwater, as the proposed design elevation evaluated in the geotechnical analysis revealed stability issues with these large features.

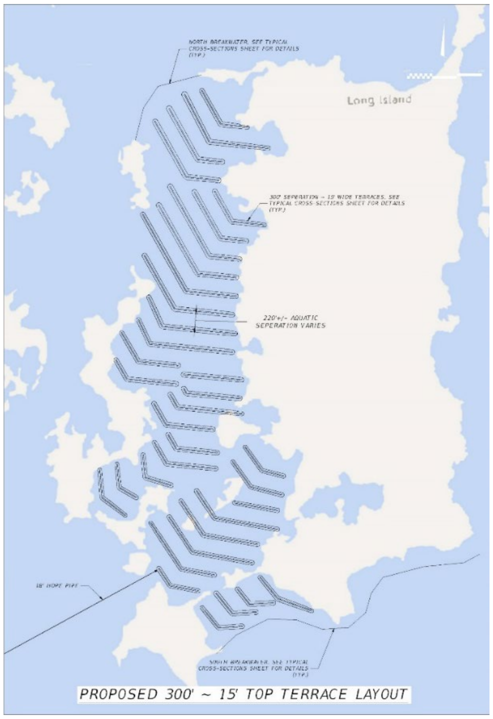

Figure 22: Alternative 2a.

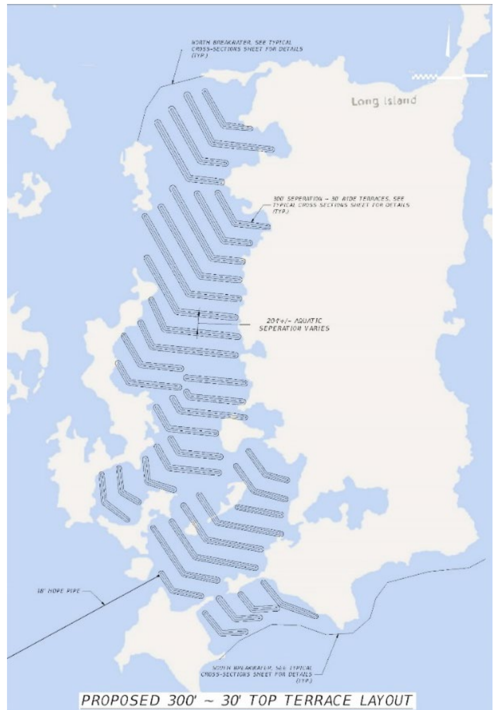

Figure 23: Alternative 2b.

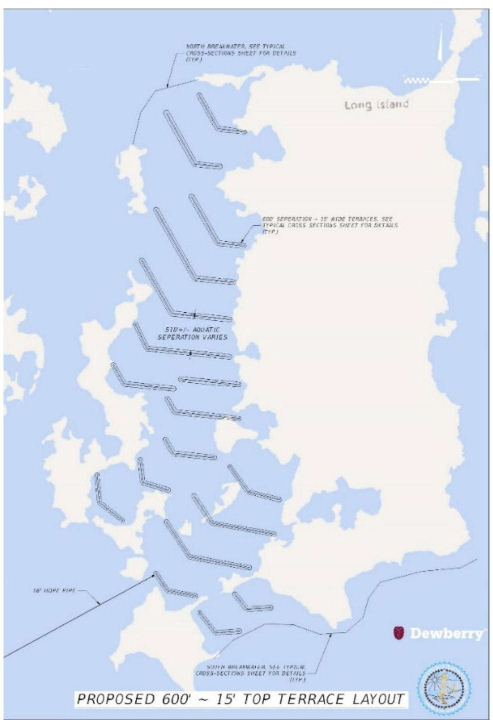

Figure 24: Alternative 2c.

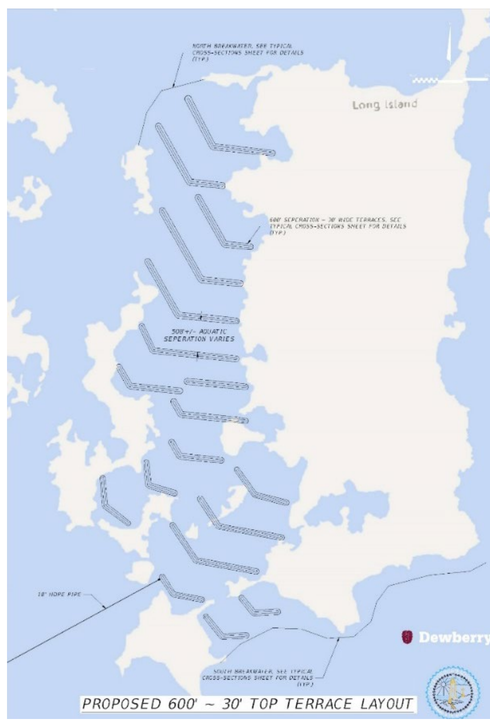

Figure 25: Alternative 2d.

Alternative Terrace Core Material Sources and Transportation – Alternative 3

In the proposed alternative with sand cores, a no-dredging alternative was considered. However, in order to successfully complete the project and establish the vegetation desired, material would need to be sourced, blended, transported, and placed. The City helped identify two potential borrow sources of material: Bow Creek Golf Course (Figure 26) and the Whitehurst Dredged Material Management Area (DMMA) (Figure 27).

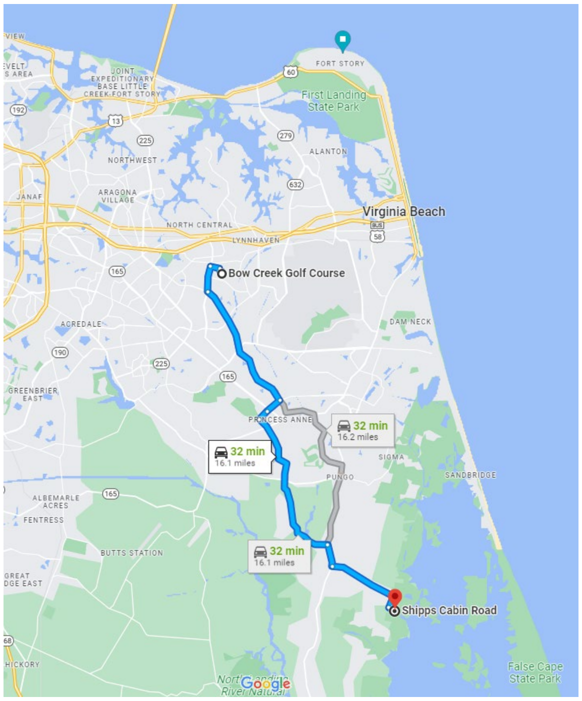

Figure 26: Distance from Bow Creek Golf Course to the proposed Shipps Cabin staging area.

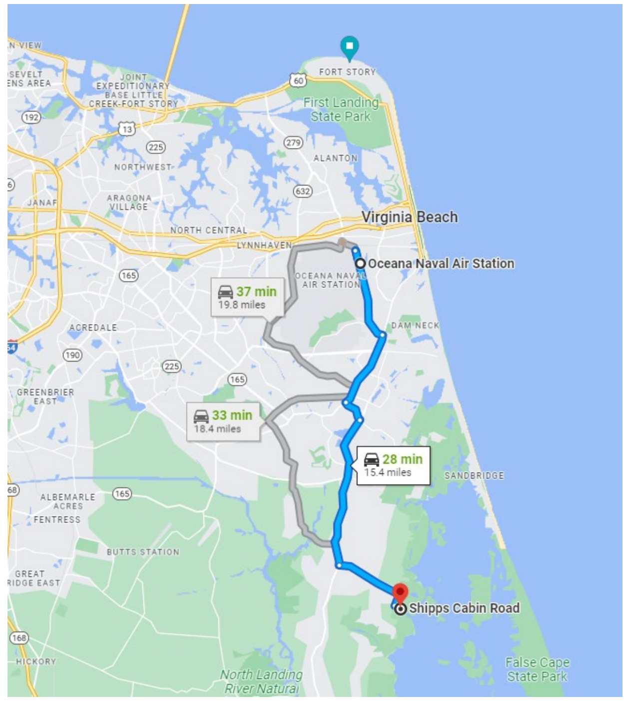

Figure 27: Distance from Whitehurst DMMA to the proposed Shipps Cabin staging area.

Bow Creek Golf Course: Bow Creek Golf Course is located approximately 16 miles from the proposed Shipps Cabin staging area. In the next few years, The Bow Creek Golf Course is scheduled to be converted into a Stormwater Park as one of 21 projects funded by the City's Stormwater Flood Protection Program. Large quantities of materials will be removed from the site for use within the City. The material from Bow Creek would need to be excavated, screened, and tested for foreign seeds and contaminants. Most likely, this material would have to be processed before it could be loaded again on dump trucks and hauled approximately 16 miles to a potential staging area where it would be loaded again on shallow draft barges.

Whitehurst DMMA: The Whitehurst DMMA is a similar distance to the proposed Shipps Cabin Road Construction Staging Area. The material at Whitehurst may not have to be processed as much; however, it would need to be tested for foreign seeds and contaminants. Because of the organic components in this soil and the need for the material to establish vegetation on the terraces, this material is not able to be hydraulically blended and pumped to the site. Therefore, this material would need to be loaded on shallow draft barges and then

placed by mechanical means. Further, the amount of material needed to cap the proposed terraces is approximately 110,000 cubic yards which equates to roughly 5,500 quad-axle dump trucks traveling city streets and damaging other infrastructure.

Barging of all materials was considered. Dewberry conducted meetings, site investigations, and talked with both industry leaders in maritime construction and locals who know the water in Back Bay. A typical 35-foot by 95-foot construction barge drafts approximately 7 feet. This type of barge is not able to be trucked to the landing site, nor is it able to be brought into Back Bay. There are truckable barges, but again the drafts of those barges can be in the 4 to 5 feet range when loaded and would require dredging a channel for access. Shallow draft barges can be used in Back Bay that only draft 1 to 3 feet, and they would need to be off-loaded from a staging site. To bring any materials such as stone, sandy fill, or terrace cap material by barge around Knotts Island is not feasible. The actual channel into the southern point of Back Bay has a height restriction due to the causeway serving Knotts Island.

Continuous Marsh Platform – Alternative 4

A continuous marsh platform to fill in the areas of historical marsh would help to restore this eroded habitat but would not provide conditions suitable for SAV establishment or optimize the wave/flow velocity attenuation through the project area. Furthermore, for a single marsh platform across Bonney Cove, the amount of material required would be more than 3 or 4 million cubic yards of material. To achieve that volume of material by dredging, significant areas of existing SAV present in Back Bay would need to be impacted. As the geotechnical report indicated, the existing material of the project site and surrounding areas is not capable of supporting itself in a constructed arrangement and would slough off back into the water. Further, providing this amount of material without dredging would require bringing external sediment sources into Back Bay, which could introduce invasive species. Finally, while the platform will reclaim marshland, it is not anticipated to establish extensive areas appropriate for SAV reestablishment and would eliminate deeper water areas preferred by some endemic wildlife species.

Goals and Objectives

The overarching goal of this project is to construct the City's first nature-based adaptation project in the Southern Rivers Watershed and one of the CRMP's exemplary nature-based projects. This project aims to stabilize two critically eroding marsh islands from further degradation, decrease turbidity to promote the growth of aquatic vegetation and provide flood risk reduction benefits through increased friction and wave attenuation. The following section summarizes the objectives through which this goal will be realized.

Objective 1 – Create a Construction Access and Staging Area

The project's first objective is to employ a construction approach that is compatible with the shallow nature of Back Bay and the large quantity of material required to build the marsh terraces. The engineering team performed a constructability review of suitable landing sites to

stage construction operations for the terraces. A property located at the end of Shipps Cabin Road (Figure 28) was identified as the preferred staging and construction access location for the following reasons:

- Shipps Cabin Road Construction Staging Area Proximity to site (2 miles).
- Shipps Cabin Road Construction Staging Area Proximity to sand borrow sources.
- Shipps Cabin Road between Muddy Creek Road and the Construction Staging Area is in disrepair and was identified as an opportunity to improve the condition of the road as part of the construction activities.

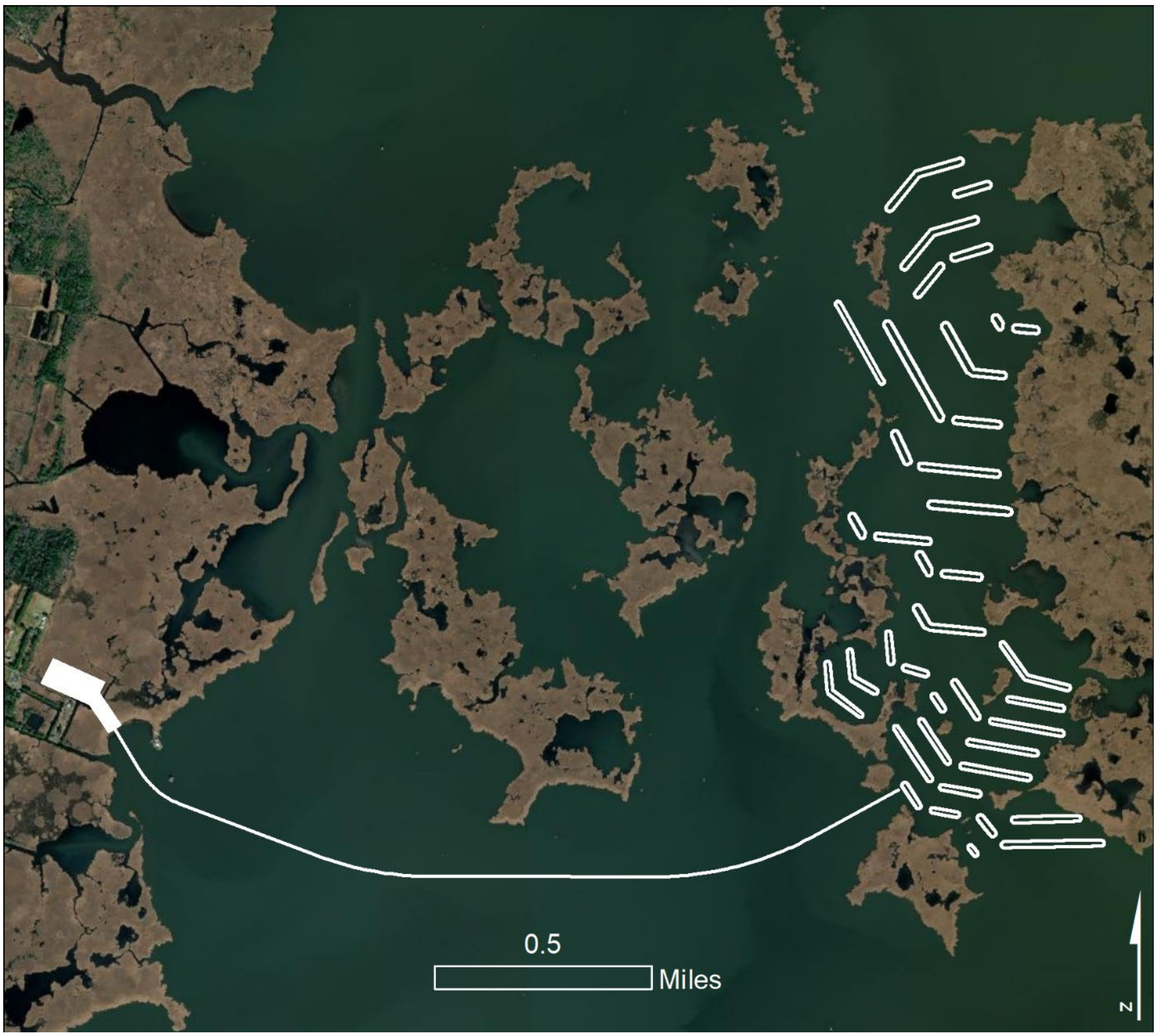

Figure 28: Proposed Construction Access.

On completion of the project, the City plans to retain the staging area for future monitoring and maintenance needs for the project. This future use is consistent with the sentiments of local stakeholders, as communicated during public engagement meetings for the study.

Expected Benefits:

- Enables constructability of the marsh terraces.
- Enable access to the project for post-construction monitoring and future marsh restoration projects.

Objective 2 – Restore Marsh and Aquatic Vegetation

The second objective of the project is to restore marsh and aquatic vegetation for habitat and flood resilience. Specifically, the City's construction of the marsh terraces will result in the restoration of approximately 46 acres of habitat within Back Bay, consisting of:

- 10 acres of low marsh habitat; low marsh plantings would include Big Cordgrass (*Spartina cynosuroides*) and Saltmarsh Cordgrass (*Spartina alterniflora*).
- 6 acres of high marsh habitat; high marsh plantings would include Black Needlerush (*Juncus roemerianus*) and Salt Meadow Hay (*Spartina patens*).
- 14 acres of upland vegetated habitat; upland vegetation would include Arrow-leaf Tearthumb (*Persicaria sagittate*), Groundsel Tree (*Baccharis halimifolia*), Wax Myrtle (*Myrica cerifera*), and Bald Cypress (*Taxodium distichum*).
- 16 acres of submerged terrace habitat anticipated to create suitable conditions for the emergence of SAV.

Additionally, approximately 310 acres of open water SAV habitat would remain between the proposed marsh terraces, and it is anticipated that construction of the terraces would create conditions within the project area favorable to the re-establishment of SAV populations.

Expected Benefits:

- Reduce wave heights, flow velocities, and wind sheer stress within the project area to protect marsh islands from continued erosion.
- Restore the natural buffer that helps protect low-lying neighborhoods and critical access roads from wind-driven flooding.
- Improved water quality by removing excess nutrients.
- Lowered transport of suspended sediment and prevention of resuspension of fine sediments in the water.
- Reduced flow velocity and absorbing wave/wind energy to reduce shoreline erosion.
- Creation of habitat (nursery and feeding areas) for fish (such as Largemouth Bass, Bluegill Yellow Perch, Striped, Blueback Herring, Alewife, and American Eel), migratory waterfowl (such as the Canvasback Duck [*Aythya vallisineria*]), and other aquatic animals.

Objective 3 – Engage Stakeholders and Disseminate Effective Practices

The City is committed to continued meaningful engagement with project partners and external stakeholders throughout the restoration and monitoring phases to ensure transferability to other sites in the region and state.

Expected Benefits:

- Ensure that the lessons from this project can be transferred and scaled to other sites in the state or region.

Approach, Milestones, and Deliverables

The following approach, milestones, and deliverables lay out a plan of action. The milestone schedule follows in *Section B: Milestone Schedule*.

Approach & Deliverables

Activity 1 – Construction Staging Area Preparation and Construction

Activity 1 involves preparing the Shipps Cabin Road property as a construction staging area. Construction activities will include stabilization of the road, laying geotextile to stabilize the ground under the construction staging area, filling with material for the construction staging area, adding fencing, creating bridge abutments and installing a temporary bridge and ramp for waterfront construction access, construction of slurry basins, and establishment of traffic flagging stations.

In the final step, the contractor will install pipe to pump the slurry material from the Shipps Cabin staging area to Bonney Cove. The pipe will be floated with subaqueous tie-downs at channels and certain points of access to maintain boat crossings. Those subaqueous locations will be marked by a buoy every 10 feet and temporary signage as reasonable. The contractor will install two booster stations along the alignment, one approximately half-way between the landing and Bonney Cove, and one at the edge of Bonney Cove. These booster stations will consist of a pontoon-mounted diesel engine pump capable of moving the sand slurry from the construction staging area to the site. It is estimated that 150 CY per hour of sand slurry would be pumped through the pipe in a 60:40 ratio. Additional booster stations may be required for manifolding and supplying slurry stations to individual terraces.

Relevant Objective(s): Objective 1

Deliverables:

- Conduct daily inspections to monitor construction progress of the Shipps Cabin Road Construction Staging Area preparation.

Assumptions:

- It is anticipated that the Shipps Cabin Road Construction Staging Area construction activities can occur simultaneously with material production in Year 1 (2024).

Activity 2 – Marsh Terrace Construction

Once the Shipps Cabin Construction Staging Area preparation is complete, marsh terrace construction activities can commence. The contractor will construct the terraces according to the 100% Final PS&E documents. The most recent engineering designs and design report are available upon request; they are not included as an attachment to this proposal due to file size. Figure 29 shows the overall layout of the terraces, and Figure 30 and Figure 31 show the project renderings. Terrace construction will begin in the northern extent of the project site at Terrace #100, noted in Figure 29, and the contractor will work south towards Terrace #140. The contractor will complete each terrace (including installation of plants) before moving onto the next.

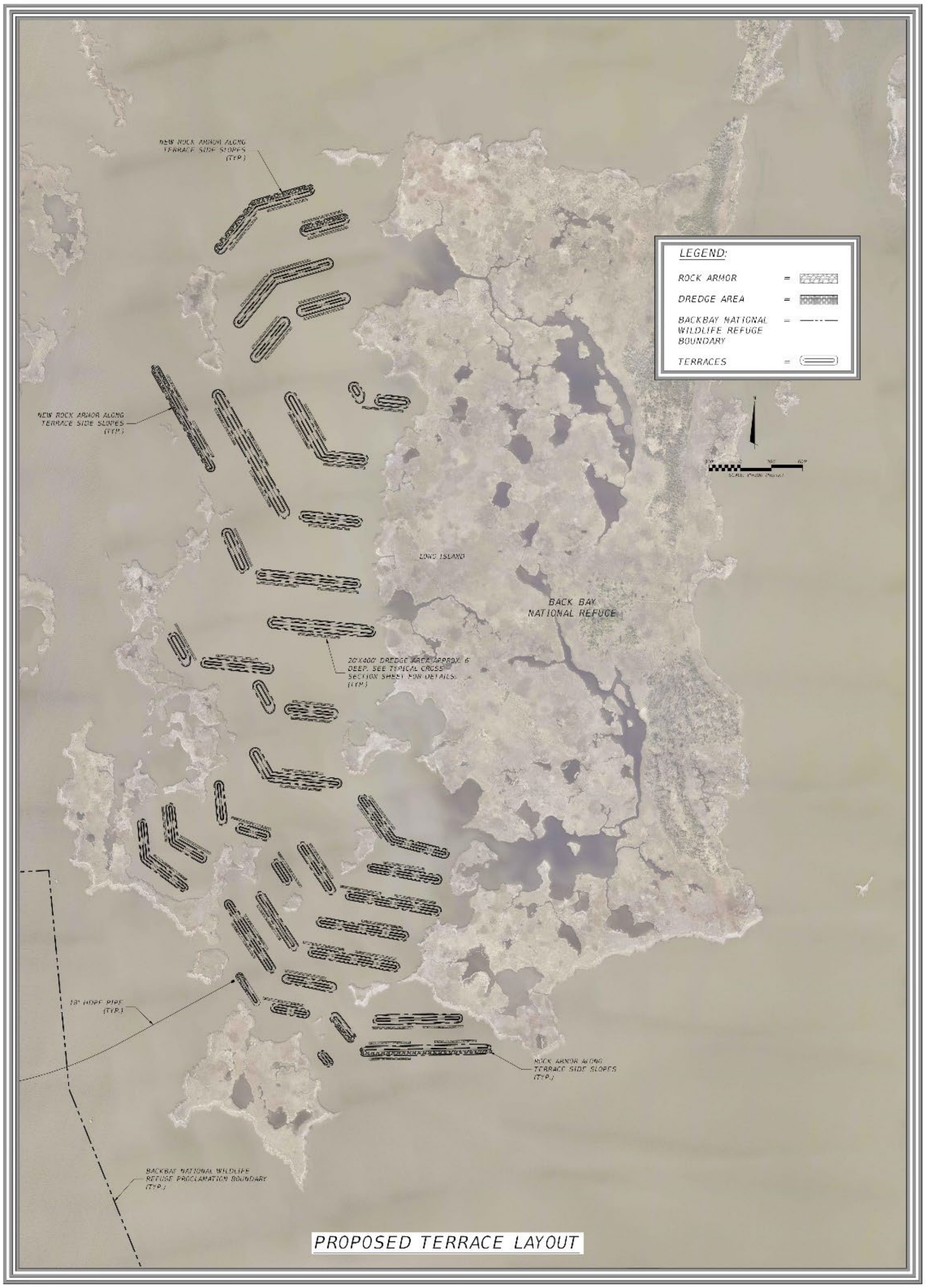

Figure 29: Marsh terrace layout across Bonney Cove.

Figure 30: Marsh terrace design rendering.

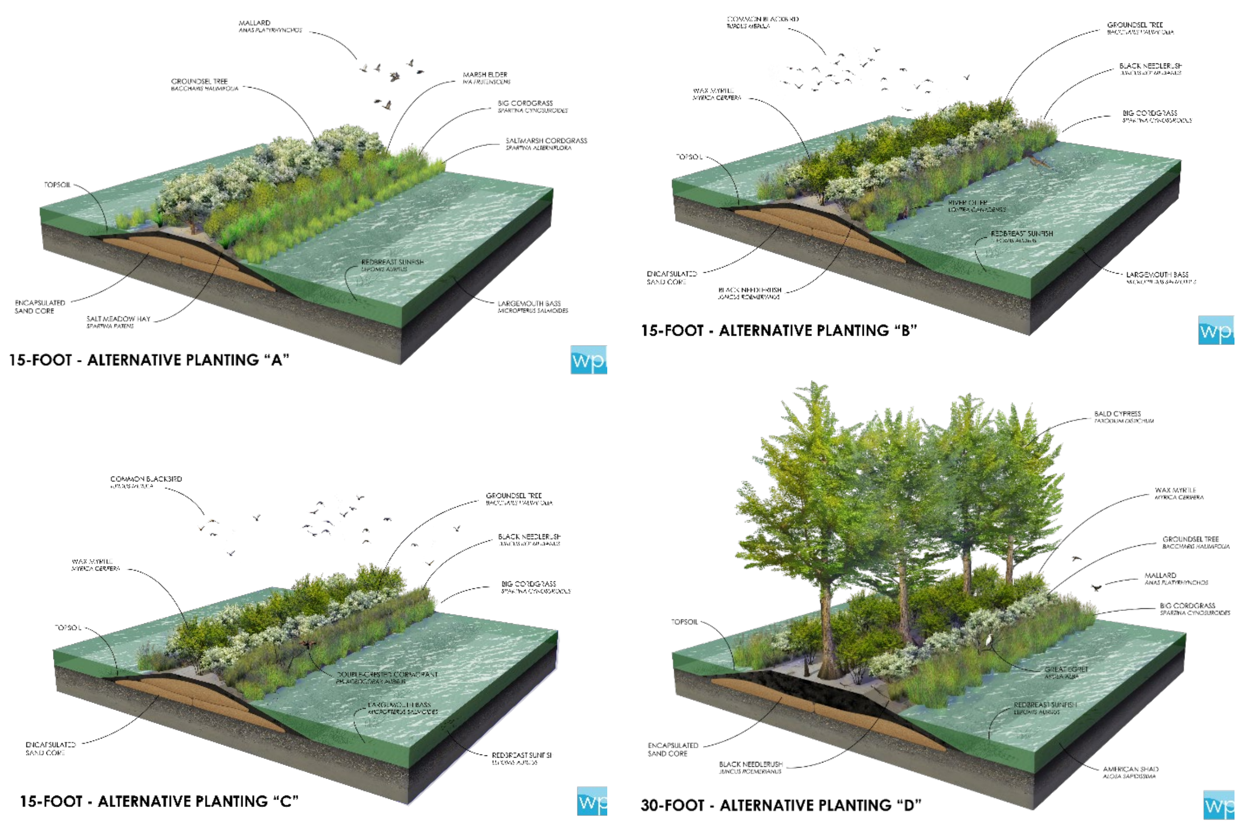

Figure 31: Marsh terrace cross-section design renderings.

The following section provides a high-level description of the proposed design and

construction approach.

Terrace Orientation:

The orientation of the terraces will be perpendicular to the predominant wind direction (south-southwest) to maximize wave energy reduction. The terraces in the northern extent of the project site will be angled perpendicular to a north-northwest wind direction. The terraces would be segmented in a chevron pattern (duck-wing pattern) to provide the most favorable fish and swimming crustacean (termed "nekton") habitat while also allowing adequate circulation to promote sedimentation and maintaining navigability throughout the project area. The terraces would not be connected to the adjacent marsh; this gap, or physical open water barrier, is intended to deter the invasion of Common Reed (*Phragmites australis*) stands from adjacent marshes.

Spacing:

The terraces would be spaced at approximately 300-foot intervals in the northern and southern quarters, and then 600-foot or greater intervals in the center. This arrangement aims to lessen the open water and subsequent wave action at the northern and southern ends of the site and allow adequate construction space for marine-based construction equipment.

Terrace Elevation and Width:

To achieve a sustainable marsh elevation throughout the project life, the marsh terraces would initially be built to a higher elevation during construction and allowed to settle to the desired target elevation over time. Taller terraces improve the functionality and resiliency of the system while also providing diversified habitat for fish and wildlife. The goal is that, by the end of the 30-year design life and with 1.5 feet of relative sea level rise, the terraces will be at or above the elevation of a moderate wind tide event (when Back Bay water levels are anticipated to reach +3.0 feet NAVD88 over the design water level). This threshold was determined to ensure the terraces would not be fully overtopped during a future wind tide event and maintain resiliency to anticipated sea level rise. The 1.5 feet sea level rise scenario is consistent with the near-term planning scenarios identified in the City's Resilience Plan to represent conditions from 2035 to 2050 and adopted by the Hampton Roads Planning District Commission (HRPDC) as part of resolution number 2018-01.

The terraces would have a top width of 15 or 30 feet and be built to an elevation of +4.5 to +5.0 feet NAVD88, depending on the width of the crest, underlying soils, and local bottom depth, with side slopes of 4 horizontal to 1 vertical (4H:1V). The +4.5- to +5.0-foot elevation is calculated based on a target elevation of +3.0 feet NAVD88 or higher at the end of the project's 30-year design life and an estimated settlement of approximately 1 to 2 feet, depending on where the terrace is located. The geotechnical investigation revealed that terraces in the site's southern portion are expected to experience greater settlement than those to the north.

Terrace Composition:

The terraces would consist of a sand-filled core that is encapsulated by a high-strength blend of woven and non-woven geotextile fabrics. The sand for this material will come from nearby offsite sources and be pumped through the 1-inch diameter pipe described in Activity 2. Once the cores are in place, long-reach excavators would travel along the tops of the terraces and begin to shape the cross slopes. Existing adjacent material devoid of SAV would be mechanically dredged and placed over the sand-filled cores. The marsh terraces would be covered with 1 to 3 feet of suitable fill, depending on crest widths, and then planted with native emergent and brackish plant species to stabilize the terraces and provide wind-driven flood reduction benefits.

Relevant Objective(s): Objective 2

Deliverables:

- Conduct daily inspections to monitor construction progress of the marsh terraces.

Assumptions:

- It is anticipated that construction of the terraces will occur in two phases over two years from 2025 through 2026, with the following assumptions:
    - Construction activities are not permitted within BBNWR from October 31 through February 28, annually, to limit disturbance to wintering waterfowl and migration during those months.

Activity 3 – Stakeholder Engagement and Lessons-Learned Dissemination

As the first large scale terracing project on the Atlantic coast, the City recognizes the importance of documenting lessons learned and effective practices during each of the proposed activities: contractor procurement, construction, and post-construction monitoring. The City plans to develop a set of project marketing materials (PowerPoint presentations, StoryMap, information flyers, etc.) to cover key topics, such as:

- Lessons learned during contractor procurement, construction, and post-construction monitoring.
- Effective practices for contractor procurement, bid development, and evaluation. This project is expected to require a highly specialized contractor given the complexity of the project, very shallow water depths, and distance of the site from available construction access and staging areas.
- Guidance for identifying the best sources for local and regional materials for building the terraces and developing a project construction schedule with enough lead time for producing the quantity of material needed for large-scale marsh creation projects.
- Effective practices for developing a post-construction monitoring plan for marsh terraces that a) aligns with permitting, grant, and other requirements and b) enables quantification of project benefits and areas for improvement.

- Effective practices for communicating project benefits based on a combination of field data collection, numerical modeling, and post-construction monitoring.

The City plans to leverage the materials to facilitate dissemination to key stakeholders to increase likelihood of transferability of the approach to other areas in the region and state. The City's plan for engagement is summarized in the following table. In addition to these efforts, the City is committed to collaborating with DCR to identify any additional opportunities to help socialize the project's innovative design and lessons learned.

Table 8: Summary of opportunities for City, regional, state, and national stakeholder engagement; expected benefits.

	Description of Proposed Outreach Activities

CITY	• Facilitate internal municipal awareness, coordination, and approval to gain budgetary approval for funding to expand the approach to other sites in Back Bay (such as "The Great Narrows", Mackay Island and Princess Anne Wildlife Management Areas, and Ragged Island) through presentations to the:
	  o Virginia Beach City Council
	  o City Manager Working Group for SLR and Recurrent Flooding, comprised of representatives from all City departments, to facilitate awareness, coordination, and action to advance the project to the restoration phase.
	• City of Virginia Beach Management Leadership Team (MLT), which includes the City Manager, Deputy City Managers, and Department heads from across the City.

REGION	• Collaborate with the National Audubon Society and Albemarle-Pamlico National Estuarine Partnership (APNEP) to:
	  o Highlight the marsh terrace project as a success story in the next iteration of the Currituck Sound Coalition Marsh Conservation Plan.
	  o Explore opportunities for marsh terrace projects in the Knotts Island Channel, a key flood pathway into Back Bay, as well as other locations in the Currituck and Albemarle-Pamlico Sound.
	• Share lessons learned to regional and state stakeholders, improving knowledge-based, awareness, and capacity for future efforts through presentations to:
	  o Hampton Roads Adaptation Forum – a regional dialogue for academics, non-profits, consultants, and municipalities committed to resilience measures.
	  o The Hampton Roads Planning District Commission (HRPDC) Coastal Resiliency Committee .
	  o Regional conferences on green infrastructure, coastal resilience, and SLR adaptation.
	• Collaborate with Wetlands Watch, a regional non-profit organization committed to the protection of wetlands using nature-based solutions, to socialize the project and disseminate lessons learned.

	Description of Proposed Outreach Activities
STATE	• Continue to coordinate with the Virginia Department of Conservation and Recreation (DCR) to: o Promote the project as a success story for the State Coastal Master Plan (CRMP), which highlighted the project as an "exemplary" resilience project that aligns with the Commonwealth's objective to protect and enhance the state's natural infrastructure. o Incorporate project updates and lessons learned on the CRMP website is an excellent mechanism for dissemination to all coastal Planning District Commissions (PDCs)/Regional Commissions (RCs) across the state. • Continue to collaborate with The Nature Conservancy (TNC), a national player in guiding the implementation of nature-based strategies, to help disseminate lessons learned on project implementation. The City has engaged in early discussions with TNC about partnering to host a state-level workshop that would draw from the network of TNC's local and regional chapters • Presentations at state-level conferences on water resources, floodplain management, and resilience, such as hosted by Resilient Virginia and Virginia Lakes and Watersheds Association.
NATION	• Disseminate lessons learned/effective practices through presentations at 1-2 relevant national conferences such as Restore America's Estuaries, Association of State Floodplain Managers, or the American Shore and Beach Preservation Association, etc. • Leverage working relationships and existing contract work with the U.S. Army Corps of Engineers and partners to integrate lessons learned into the International Natural and Nature-Based Feature Design Guidelines to promote consideration of marsh terraces within similar Back Bay environments (for example, in North Carolina, Maryland, New Jersey, and New York).

Relevant Objective(s): Objective 3

Deliverables:

- Project marketing materials.
- Records documenting number of stakeholders engaged during outreach activities.

Activities Not Included Under this Grant

Submerged Aquatic Vegetation Transplant Plan: The City will evaluate opportunities for restoring native submerged aquatic vegetation populations in Back Bay, such as Wild Celery (*Vallisneria americana*), through consultations with subject matter experts. After terrace construction, the City will formulate a plan for planting submerged aquatic vegetation in between the terraces in coordination with identified partners and the construction contractor.

Post-Construction Monitoring: Post-construction monitoring and inspections will occur for a minimum of five (5) years following construction. Given the period of performance for the CFPF grant, post-construction monitoring activities have not been included in this application.

Milestone Schedule

The scope of work proposed in this grant application are scheduled to occur between June 2024 and June 2027. Work activities are anticipated to complete in December 2026; however, the proposed schedule extends through June 2027 for contingency. The project's expected progression is shown in the following milestone schedule, noting deliverables for each milestone:

2024 Activities

- *1st Quarter* ***(pre-grant period activities):***
  - 100% Final PS&E
  - Submit Bid Documents
- *2nd Quarter (pre-grant period activities):*
  - Final Bid Coordination/Acceptance
  - Construction NTP
- ***Begin Year 1 Grant Activities – 2nd Quarter 2024:***
  - Mobilization for Shipps Cabin Road Construction Staging Area
  - Initiation of Marsh Terrace Material Production
- *3rd Quarter:*
  - Construction NTP and Mobilization for Slurry Basin Installation
- *4th Quarter:*
  - Completion of Shipps Cabin Road Construction Staging Area and Slurry Basin Construction

2025

- *1st Quarter*
  - Completion of Marsh Terrace Material Production
  - Construction Mobilization for Marsh Terraces (beginning on March 1, 2025)
  - Oversight, Management, and Inspection Services of Slurry Basin Installation
- ***Begin Year 2 Grant Activities - 2nd Quarter 2025***
  - Construction of Marsh Terraces #100 – 105
- *3rd Quarter*
  - Construction of Marsh Terraces #106 – 114
- *4th Quarter*
  - Construction of Marsh Terraces #115 – 119
  - Marsh Terrace Construction Demobilization (to accommodate break in construction period from October 31, 2025 – February 28, 2026)

2026

- *1st Quarter*
  - Construction Re-Mobilization for Marsh Terraces (beginning on March 1, 2026)
- ***Begin Year 3 Grant Activities - 2nd Quarter 2026***

- Construction of Marsh Terraces #120 – 134

- *3rd Quarter*
  - Construction of Marsh Terraces #135 – 140
- *4th Quarter*
  - Shipps Cabin Road Construction Staging Area Final Improvements & Demobilization

2027

- *1st and 2nd Quarter*
  - *Contingency for any delays experienced through end of 2026*

End Year 3 Grant Activities

Project Partners

The following table highlights the specific project partners, their roles, and their capabilities concerning the proposed project.

Table 9: Potential Project Partners.

Entity	Role	Description
U.S. Fish and Wildlife Service, Back Bay National Wildlife Refuge	Project Partner / Advisor / Adjacent Land Owner	BBNWR owns the land adjacent to the project footprint and monitors migratory bird hunting within Presidential Proclamation boundaries. BBNWR has coordinated with the City on project design and will continue to be involved during project construction as a stakeholder and advisor.
Virginia Department of Wildlife Resources	Project Advisory / Stakeholder	The City has coordinated closely with VDWR on project design. Furthermore, VDWR has been monitoring SAV distribution in Back Bay for decades and will be a critical partner for identifying native seagrass species and techniques for restoration based on extensive experience from previous SAV restoration projects in Back Bay.
Virginia Beach Department of Planning & Community Development	Permit Compliance	The City's Department of Public Works has been in close coordination with the City's Department of Planning & Community Development throughout the design and permitting process. Continued involvement and coordination during construction and post-construction monitoring is anticipated.
Dewberry	Engineering Contractor	Engineering consultant to support the City with contractor procurement and construction administration.
To be Determined	Construction Contractors	Construction contractor for the Shipps Cabin Road Construction Staging Area and marsh terrace construction activities.

Entity	Role	Description
Friends of Back Bay	Project Advisory / Stakeholder	Friends of Back Bay was formed in the 1980s to lead efforts to expand and conserve BBNWR, including securing millions in funding to support the Refuge's expansion. The City has coordinated with the BBNWR Society throughout the design and permitting process and will continue this coordination through construction and post-construction monitoring.
Back Bay National Wildlife Refuge Society	Project Advisory / Stakeholder	The Back Bay National Wildlife Refuge Society (BBNWR Society) is an independent, 501(c)(3) non-profit group dedicated to supporting the mission of the USFWS National Wildlife Refuge System and specifically promoting awareness of the BBNWR through education and participation. The City has coordinated with BBNWR Society throughout the design and permitting process and will continue this coordination through construction and post-construction monitoring.
Back Bay Restoration Foundation	Project Advisory / Stakeholder	Back Bay Restoration Foundation (BBRF) is an independent, 501(c)(3) non-profit group focusing on growing concerns about issues such as recurrent flooding, sea level rise, and development in the Southern Rivers Watershed. The group aims to serve as an advocate for the Bay and surrounding residents. The City has coordinated with BBRF throughout the design and permitting process and will continue this coordination through construction and post-construction monitoring.

Relationship to Other Projects

This project represents the first nature-based project in the Southern Rivers Watershed to advance to design and construction to implement the City's Wise Resilience Plan. The project is also an aspect of the Stormwater Green Infrastructure aspect of the City's Flood Protection Plan. The City has received a $3M award from the CFPF to support another project in the Stormwater Green Infrastructure element of the Flood Protection Program – the Elizabeth River Wetland and Floodplain Restoration Project (Round 1 CFPF Grant Awards).

The City has also received two NFWF NRCF grants from the Marsh Restoration in Back Bay project. Approximately $135,000 in NFWF NRCF funding was awarded in 2020 for the previous phase (design and permitting) for the project. The City continues to meet the obligations and period of performance of this NFWF grant. In 2022, the NFWF NRCF awarded $9,886,400 to support construction activities.

In its Resilience Plan, Virginia Beach identifies an adaptation approach for the Southern Rivers Watershed that emphasizes natural mitigation methods and integrated systems of defenses. As a natural mitigation strategy, the marsh terrace project aims to serve as a first line of defense during flood events, reducing wind-driven fetch, wave energy, and flow velocities to protect the important marsh buffer surrounding the shorelines of Back Bay. Other projects are also needed to provide multi-layered flood protection to northern Back Bay communities (Figure 32). Several

of these projects are highlighted below. It should be noted that the projects described below are either not yet funded or will be funded in the future through the City's Capital Improvement Program.

Figure 32: Southern Rivers Watershed Adaptation Vision.

Marsh island restoration serves as a critical first line of defense of the multi-layered protection system in the Southern Rivers Watershed. The following map (Figure 33) shows the structural adaptation projects proposed for the Southern Rivers Watershed, including the Muddy Creek Road and Sandbridge flood defense systems. The City's numerical modeling shows that, if implemented, there is potential for small increases in flooding outside of these structural protection systems.[14] This emphasizes the need for complimentary measures, including the marsh terrace project, land acquisition, and conservation efforts, to mitigate this residual risk.

[14] City of Virginia Beach (2020). City-wide Structural Alternatives for Coastal Flood Protection (PDF).

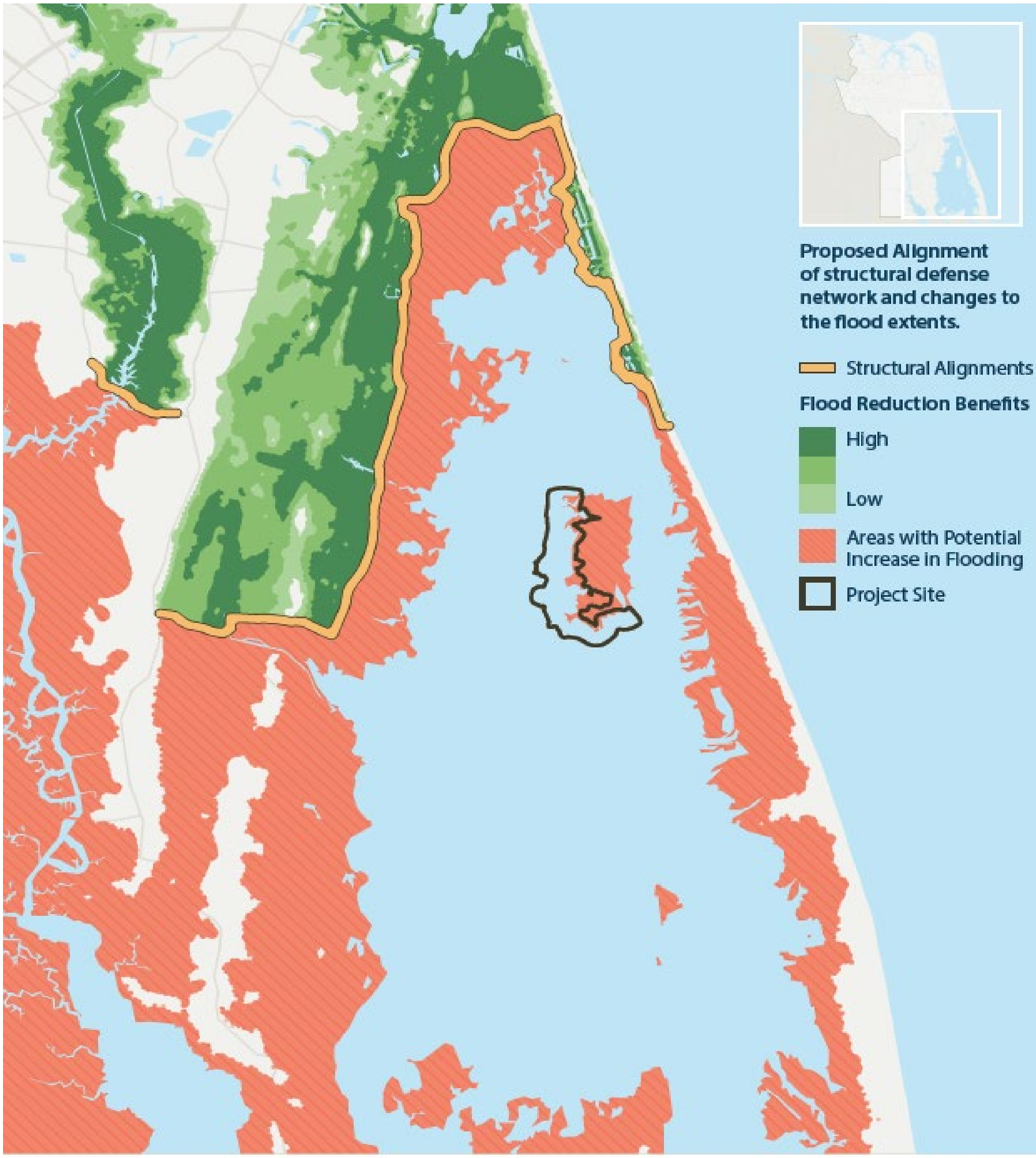

Figure 33: Structural adaptation projects proposed for the Southern Rivers Watershed, including the Muddy Creek Road and Sandridge flood defense systems.

Backside of Sandbridge Flood Defense System

Protection of the Sandbridge resort community from increasing coastal flood hazards would require a complex and expensive structural protection system because of the manufactured land configuration on the backside of Sandbridge. The proposed protection system includes elevating Sandbridge Road and constructing a network of seawalls, levees, and gates along the Back Bay shoreline of Sandbridge. This project does not have designated funding at this time.

Hell Point Creek Flood Defense System

As part of the integrated Sandbridge City-Wide flood defense network, a storm surge barrier across Hell Point Creek could block flood waters originating from Back Bay. Sandbridge Road would also need to be raised to ensure floodwaters could not flank the system. This project does not have designated funding at this time.

Sandbridge/New Bridge Intersection Improvements

Road and shoulder improvements are planned to increase safety at the New Bridge Road/Sandbridge Road intersection and reduce the need for road closures due to flooding from the adjacent Ashville Creek.

Muddy Creek Road Flood Defense System

Muddy Creek Road provides access to important rural and agricultural communities and Back Bay and the Wildlife Refuge. Muddy Creek Road is one of the lowest-lying roadways in all of Virginia Beach and frequently floods. This City-Wide Structural Alternative Flood Protection analysis identified this roadway as a critical location to provide flood protection. The proposed system, known as the Muddy Creek Road Alignment, would transform much of Muddy Creek Road into a levee, with the road on the top. The City's numerical modeling effort shows that the Muddy Creek Road Flood Defense System could potentially increase flood risk to the east of Muddy Creek Road, as shown in Figure 33. Therefore, the implementation of nature-based strategies suitable to the low-lying shorelines of Back Bay is essential to mitigate these impacts. This project does not have designated funding at this time.

Voluntary Acquisition Program

Virginia Beach City Council has recently funded a $2.0 million City-wide voluntary acquisition program to encourage flood-prone property owners to apply for a buyout. Parcels acquired by the City, in the Southern Rivers Watershed, would then be converted to open space to serve as flood storage and a marsh migration buffer.

Stormwater Master Plan

The City Council initiated an update of the City's Stormwater Master Plan in 2014. This effort is interchanging information with aspects of the City's Resilience Plan to account for the impact of sea level rise on the stormwater system's performance. Specific stormwater drainage improvement projects are included within the Lower Southern Rivers Watershed Drainage Basin.

Virginia Coastal Resilience Master Plan

The CRMP highlighted the marsh terrace project as an exemplary nature-based resilience project. The CRMP emphasizes Virginia Beach's strategic use of multiple funding streams to implement a large-scale nature-based project. DCR’s contribution to the project’s construction could be highlighted as a success story for implementation of the CRMP.

Audubon North Carolina Currituck Sound Coalition Marsh Conservation Plan

In coordination with Audubon North Carolina, the Currituck Sounds Coalition identified marsh restoration priorities based on criteria for siting restoration projects, including vulnerability to sea level rise, historic increase in surface water, and distance to hardened shorelines. This assessment identified Virginia Beach's marsh terrace project site as a high-priority area for restoration. There is an opportunity to highlight this project as a success story in the next iteration of the Audubon's Marsh Conservation Plan, which is slated to be updated every three years.

Maintenance Plan

Standard maintenance measures have been defined as part of the draft Annual Monitoring Plan and Post-Construction Monitoring Report developed for this project. See Attachment 5 for a copy of the draft report.

Subsequent to the monitoring period, project maintenance will be addressed by the City's Public Works Stormwater Operations Group, who will also respond to any maintenance issues identified by the monitoring effort or other observers. The City intends to maintain the construction staging area to support future project maintenance needs. The City will perform inspections every 2-5 years and make any repairs needed for the life of the project after completion of the initial monitoring program.

As described by the draft Annual Monitoring Plan and Post-Construction Monitoring Report, maintenance measures include the replacement of plantings (including upland, marsh and SAV plantings), the removal of debris from the terraces, the removal of invasive vegetation identified in the planting areas, the addition of sediment to eroding areas of the terraces, and the replacement of waterfowl barriers as necessary. In addition, structural maintenance measures that might be identified and prescribed during monitoring efforts include replacement of dislodged stones, addition of stone to address structure settlement, and general repair of sand cores or other structural elements. As proposed, these measures would become conditions of the wetland permits required for this project, in addition to standard commitments and requirements defined by the permitting agencies.

In addition to the commitments made in the monitoring plan, and those anticipated to be defined during the permitting process, it is the assumption that the placement of the proposed marsh terrace structures in state waters (subaqueous bottoms) will require the City to maintain the marsh terraces in perpetuity. As previously defined through coordination with VMRC, the City would obtain a compensable interest in the property that has been filled on top of state-owned subaqueous bottomlands (i.e. the terraces). As such, the City would be responsible for maintaining the proposed marsh terraces structures to ensure they fulfill their intended functions, as defined in the objectives and indicators of success previously defined in this proposal.

Criteria

The project receives a total score of **65 Points**. An explanation of how the project meets each

of the applicable scoring criteria contained in Appendix D is provided below.

Eligible Project (Type)

Category/Points: Wetland/floodplain restoration, Living shorelines and vegetated buffers (25 Points)

Explanation: Marsh terraces are considered a type of wetland restoration or a component of a living shoreline project:

- Wetland Restoration: Wetland restoration aims to reestablish or enhance natural wetland ecosystems. Marsh terraces can be constructed in areas where wetlands have been degraded or lost, and they help to recreation or support wetland functions. They provide habitat for various species, improve water quality, and can contribute to the overall health and resilience of a wetland ecosystem.
- Living Shoreline Project: Living shorelines are designed to protect shorelines from erosion while also promoting ecological and environmental benefits. Marsh terraces are often used as a component of living shoreline projects. They can serve as a buffer against wave action, stabilize shorelines, and create suitable habitat for marsh and aquatic species.

Social Vulnerability Index Score

Category/Points: Low Social Vulnerability (0 Points)

Explanation: Based on the Virginia Flood Risk Information System (VFRIS) Social Vulnerability Index Layer, the Social Vulnerability Index scores of the communities located in the two census block groups adjacent to Back Bay near the project site are -1.07 and -0.43 (an average of -0.75), which falls into the Low Social Vulnerability category.

Community Scale Benefits

Category/Points: More than one census block group (30 Points)

Explanation: As documented in the *Supporting Documentation - Project Information – Population* section of this document, the project is anticipated to benefit two census block groups (518100454.121 and 518100464.001).

Expected Lifespan of Project

Category/Points: Over 20 Years (10 Points)

Explanation: As documented in the *Supporting Documentation – Approach, Milestones, and Deliverables – Activity 3 (Marsh Terrace Construction)* section, the marsh terraces have a 30-year design life.

Budget Narrative

The following budget narrative details the proposed project expenditures. See Appendix B for completed budget spreadsheet.

Estimated Total Project Cost

The current estimated total project cost is **$53,378,490.** This estimate includes design, site acquisition for the construction staging area, construction, inspections and support, implementation, and contingencies, as shown in the below table. The design engineer's opinion of probable cost for construction is provided

Project Activity	Capital Improvement Program Estimate
Design	$276,800
Site Acquisition	$50,000
Construction	$41,839,900
Inspections and Support	$5,609,200
Implementation	$750,000
Contingencies	$4,852,590
Total:	$53,378,490

Funds Requested from the Fund

The City is requesting a total of **$5,000,000.00** in funding from the CFPF Round 4. These funds will support contractual services of the engineering consultant and construction contractor to execute Activity 2 (Construction Staging Area Preparation and Construction) and Activity 3 (Marsh Terrace Construction). No support is requested for City personnel.

These funds will be used to support ongoing construction activities through 2024-2026. Example activities include contractor construction services, mobilization/demobilization, construction staging area construction, slurry pipe installation, portions of the terrace materials, and waterfowl barriers. Construction costs are based on a detailed estimate from the design engineer that includes detailed breakdown of estimated quantities and costs from the 95% design package using industry standards for the anticipated aspects of the project construction. The City has withheld the detailed estimate as it provides information that would affect bidding on the construction.

Amount of Funds Available

The City as prime recipient is providing a cash match of $38,356,966 from funds fully programmed and available from the City's Flood Protection Program Capital Improvement Program to support the project. The Flood Protection Program is supported by a related bond referendum that provided $567.5M to fund more than 40 projects identified for Phase 1 of the Program. The program is tightly managed by the City, an independent contractor, and has a resident oversight board. The City is fully confident these funds will be available for constructing this project.

The City's dedicated funds will provide cash match to cover contractual services to support Activity 1 (Construction Staging Area Preparation and Construction), Activity 2 (Marsh Terrace Construction), Activity 3 (Stakeholder Engagement and Dissemination), and all related City support and direct overhead costs related for the project.

The National Fish and Wildlife Foundation is also supporting the project through two grant awards from the National Coastal Resilience Fund. This includes an initial award of $135,124 in 2020 for design and a second award of $9,886,400 in 2022 to support construction. The 2022 grant funds are dedicated to purchasing the native vegetation and a portion of the materials needed to build the marsh terraces.

A summary of project costs, funds available, and funds requested is provided below:

Item	Amount
Project Cost:	$53,378,490.00
Funding Sources Available	
NFWF Grant:	$10,021,524.00
CFPF Grant Request:	$5,000,000
City Funds Available:	$38,356,96600
Total Project Funding:	**$53,378,490.00**

Authorization to Request for Funding

Please refer to *attachment* for the documentation authorizing the funding request.

Attachment 1: Virginia Beach Resilience Plan DCR Approval

Matthew J. Strickler
Secretary of Natural Resources

Clyde E. Cristman
Director

Rochelle Altholz
Deputy Director of Administration and Finance

Russell W. Baxter
Deputy Director of Dam Safety & Floodplain Management and Soil & Water Conservation

Nathan Burrell
Deputy Director of Government and Community Relations

Thomas L. Smith
Deputy Director of Operations

COMMONWEALTH *of* VIRGINIA
DEPARTMENT OF CONSERVATION AND RECREATION

July 20, 2021

Toni Utterback, P.E.
Department of Public Works
2875 Sabre Street, Suite 250
Virginia Beach, VA 23452

RE: Virginia Beach Resilience Plan Second Submission - CFPF

Dear Ms. Utterback:

Thank you for the resubmission of the Sea Level Wise Adaptation Plan for City of Virginia Beach. After careful review and consideration, the Virginia Department of Conservation and Recreation has deemed the Plan complete and meets all the criteria outlined in the June 2021 Community Flood Preparedness Grant Manual. This approval will remain in effect for a period of three years, ending on July 31, 2024.

The following elements were evaluated as part of this review:

1. **Element 1: It is project-based with projects focused on flood control and resilience. DCR RESPONSE**

    a. Project-based: Four watersheds—each with a defined geographic area, analysis of community social and environmental characteristics, types of flooding, and a tailored flood resilience strategy with <u>discrete projects identified</u>.

Projects focused on flood control and resilience include:

Neighborhood	Flood Control Project
Elizabeth River	City-wide alignment, living shoreline, marsh restoration, land conservation
Lynnhaven	Chesapeake Bay alignment, Lesner Bridge Neighborhood alignment (East & West), beach & dune nourishment, ecological revetments, shellfish reef restoration, seagrass restoration
Oceanfront	Atlantic Oceanfront alignment, Rudee Heights alignment
Southern Rivers	West Neck Creek city-wide alignment, Muddy Creek Road city-wide alignment, Sandbridge city-wide alignment

**additional projects listed within the Sea Level Wise Adaptation Strategy.*

2. **Element 2: It incorporates nature-based infrastructure to the maximum extent possible. DCR RESPONSE**

   a. Nature-based infrastructure: Flood mitigation projects throughout the city incorporate nature-based solutions and were identified for maximum use within specific watersheds.

3. **Element 3: It includes considerations of all parts of a locality regardless of socioeconomics or race. DCR RESPONSE**
   a. All parts of a locality: Locality divided into four watersheds, covering the entirety of the jurisdictional boundary.
   b. Social vulnerability: Social implications of flood hazards and analysis of populations at-risk documented.
   c. Demographic Analysis: Demographic and Population Vulnerability Analysis conducted by Dewberry and incorporated into the Plan.

4. **Element 4: It includes coordination with other local and inter-jurisdictional projects, plans, and activities and has a clearly articulated timeline or phasing for plan implementation. DCR RESPONSE**
   a. Coordination with other projects, plans, and activities: Contains the planning processes and frameworks which outline local and regional plans used by the City and address resilience; and how they have been integrated for flood adaptation planning.
   b. Clearly articulated timeline or phasing for plan implementation: Program phases clearly articulated and described in detail—Impact assessment, Adaptation research, Strategy development, and Long-term implementation.

5. **Element 5: Is based on the best available science, and incorporates climate change, sea level rise, storm surge (where appropriate), and current flood maps.**
   a. Technically backed water-resources analysis, sea level rise projections, storm surge, and climate change incorporated into strategic approach.

VA DCR looks forward to working with you as you work to make Virginia Beach a more resilient community. If you have questions or need additional assistance, please contact us at cfpf@dcr.virginia.gov. Again, thank you for your interest in the Community Flood Preparedness Fund.

Sincerely,

Wendy Howard Cooper

Wendy Howard Cooper, Director
Dam Safety and Floodplain Management

cc: Darryl Glover, DCR

Attachment 2: Authorization to request funding from the Fund from governing body or chief executive of the local government

City of Virginia Beach

DEPARTMENT OF BUDGET AND MANAGEMENT SERVICES
(757) 385-8234
(757) 385-1857 FAX

VBgov.com

MUNICIPAL CENTER
BUILDING 1, 3RD FLOOR
2401 COURTHOUSE DRIVE
VIRGINIA BEACH, VA 23456-9001

INTER-OFFICE MEMORANDUM

DATE: November 1, 2023

TO: Patrick A. Duhaney, City Manager

FROM: Stuart McCrery, Budget and Policy Analyst KJ for SM

SUBJECT: Application for Virginia Community Flood Preparedness Fund Grant

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The Department of Public Works is requesting permission to apply for the Virginia Community Flood Preparedness Fund Grant from the Virginia Department of Conservation and Recreation. The Virginia Community Flood Preparedness Fund was established in the 2020 session of the General Assembly. Money in this fund comes from the auction of carbon allowances through the Regional Greenhouse Gas Initiative. It was established to provide support to localities across Virginia to reduce the impacts of flooding, including flooding driven by climate change.

Public Works is requesting a total of $5,000,000 to construct marsh terraces in Back Bay to promote wetland restoration and mitigate frequent flooding. The City has already made significant investments into this project through CIP project 100551 "Stormwater Green Infrastructure."

This grant also requires a local match of 30% for projects that implement nature-based solutions; however, the City has more than met this requirement through its current appropriations to CIP project 1000551 "Stormwater Green Infrastructure" which currently total over $49 million from the Referendum and other grant awards.

Budget & Management Services recommends this grant application for approval. Please indicate approval or disapproval below. Applications are due by November 12, 2023.

11/1/2023

Approve (Date) Disapprove (Date)

Attachment 3: Virginia Beach Floodplain Administrator Support Letter

City of Virginia Beach

VBgov.com

DEPARTMENT OF PLANNING & COMMUNITY DEVELOPMENT
PHONE (757) 385-4621
FAX (757) 385-5667
VA Relay Number TTY: 711

2875 SABRE STREET, SUITE 500
VIRGINIA BEACH, VA 23452-7385

November 7, 2023

Division of Dam Safety and Floodplain Management
600 East Main Street, 24th Floor
Richmond, Virginia 23219

RE: Community Flood Preparedness Fund – Marsh Terrace Creation, Back Bay

The proposed project is located in both open water and a Federal Emergency Management Agency (FEMA) mapped Special Flood Hazard Area (SFHA). Hydraulic modeling analysis identified Bonney Cove as a location where marsh restoration has the potential to reduce the propagation of floodwater through key pathways within Back Bay. This project aims to stabilize two critically eroding marsh islands that serve as a key flood pathway into northern Back Bay, promote the growth of aquatic vegetation, and provide flood risk reduction benefits to communities in the surrounding area. Within the two census block groups that would benefit from this project, there are 113 repetitive loss and severe repetitive loss properties.

If I can provide any further information or assistance, please call me at 757-385-4621, or e-mail me at wmcnamar@vbgov.com.

Sincerely,

Whitney McNamara

Whitney McNamara, CFM
Floodplain Administrator and CRS Coordinator

Attachment 4: Letters of Support

Back Bay
Restoration
Foundation

PO Box 57041 • Virginia Beach, Virginia • 23457• 757-818-4829

November 6, 2023

Department of Conservation and Recreation
Dam Safety and Floodplain Management
600 E. Main St., 24th Floor
Richmond, VA 23219

Re: Virginia Community Flood Preparedness Fund Grant

Grantors:

The Back Bay Restoration Foundation (BBRF), is a 35 year-old non-profit watershed organization, founded in 1986 by a group of local citizens concerned about deterioration of the Back Bay watershed visible then through decreases in Submerged Aquatic Vegetation (SAV), fish, and waterfowl. BBRF is the only voice solely dedicated to conserving and improving Virginia Beach's two Southern Watersheds; namely, the Back Bay and North Landing River watersheds. Our efforts focus on education, stewardship and outreach to conserve the largest watersheds in Virginia Beach. We team with other non-profits, and city, state and federal agencies to work toward best solutions for the future of the Back Bay and North Landing River watersheds. BBRF strives to raise awareness, addressing issues that negatively affect these watersheds such as sea level rise, land subsidence and land use changes.

Back Bay is a historical, nationally significant, watershed. With the Back Bay National Wildlife Refuge (NWR) and significant State conservation lands at its core, the watershed was recognized as an Aquatic Resource of National Importance (ARNI) in 2008 by both the US Fish and Wildlife Service and the US Army Corps of Engineers. Back Bay is a wind-tidal oligohaline estuary and is located at the northern tip of the Albemarle/Pamlico estuarine system, the second largest estuarine complex in the United States. The Albemarle/Pamlico estuarine system was designated as an Estuary of National Significance in 1987 and selected to be studied as part of the Environmental Protection Agency's National Estuary Program. Back Bay is a shallow-water aquatic ecosystem with an average depth of four feet. Winds can influence the water depth by as much as three feet.

BBRF supports the City of Virginia Beach's application for Round 4 of VADCR's Community Flood Preparedness Fund. We were strong advocates of the City's successful applications to the National Fish and Wildlife Foundation (NFWF), and have seen what they accomplished with the initial NFWF funding they received. With the combined funding of NFWF, the City of Virginia Beach, and this application for DCR funding, their project of creating a Marsh Terrace Network to Achieve Restoration and Flood Resilience has overachieved by any measure. From community engagement and the NEPA process to conceptual and preliminary designs as described in the recent Army Corps Public Notice, the City has been productive and completely transparent.

As noted above, the City's community engagement and partnerships with organizations like ours has been transparent and resulted in broad support. Although the current project is localized in its first application, we expect the results will significantly mitigate SLR, land subsidence and wind tides in Back Bay. Similarly, this restoration will provide the biotic building blocks to maintain the watershed's national importance for wildlife. The innovative designs proposed will inform future projects at the landscape level. Although innovative, we believe the project is technically sound based on BBRF's 35 years of experience in habitat restoration.

Please feel free to contact us for further information.

Jared Brandwein

Executive Director
Back Bay Restoration Foundation

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Back Bay National Wildlife Refuge
1324 Sandpiper Road
Virginia Beach, VA 23456

October 30, 2023

Wendy Howard Cooper
Division of Dam Safety and Floodplain Management
600 East Main Street, 24th Floor
Richmond, Virginia 23219

Dear Ms. Cooper,

The City of Virginia Beach is proposing to install marsh terraces in the waters of Back Bay adjacent to Back Bay National Wildlife Refuge. This project is expected to reduce wave energy and thus decrease the speed of erosion of remaining islands in the project area, many of which are managed by the U.S. Fish and Wildlife Service and provide habitat for migratory birds and other species. Additionally, the addition of multiple vegetative structures added to the bay will supplement habitat and provide nesting grounds for multiple species.

The mission of the U.S. Fish and Wildlife Service is *working with others to conserve, protect, and enhance fish, wildlife, plants, and their habitats for the continuing benefit of the American people*. Although much work is conducted on federal property to achieve this mission, the Service equally coordinates with external partners to further mutual goals. The proposed marsh terrace project is an excellent example of local and federal government coordination, and we support the City of Virginia Beach's proposed project.

Megan Reed

Megan Reed
Refuge Manager

Albemarle-Pamlico
National Estuary Partnership

*Our mission is to identify, protect, and restore
the significant resources of the Albemarle-Pamlico estuarine system.*

October 26, 2023

Wendy Howard Cooper
Virginia Dept. of Conservation and Recreation
Division of Dam Safety and Floodplain Management
600 E. Main St., 24th Floor
Richmond, VA 23219

Dear Wendy,

The Albemarle-Pamlico National Estuary Partnership (APNEP) strongly endorses the City of Virginia Beach and partners' application to Round 4 of The Virginia Community Flood Preparedness Fund (CFPF). The proposal is to support construction of the Back Bay Marsh Terrace Restoration Project.

APNEP relies on regional partnerships and collaboration to implement our 2012-2022 Comprehensive Conservation & Management Plan (CCMP) within the waterways of our congressionally designated "estuary of national significance." The proposed partnership between the City of Virginia Beach and the U.S. Fish and Wildlife Service will also advance our 2020 Memorandum of Understanding between Virginia and North Carolina to protect the ecosystem resources in the shared waterways between our two states. The project also addresses a "high priority" area for restoring and enhancing vulnerable marshes with high flood risk reduction benefits and habitat value, as identified by Audubon's Currituck Sound Coalition Marsh Conservation Plan released in 2021.

The marsh terrace project employs the use of natural features to build resilience to flooding in the Back Bay watershed. The project offers coastal resilience and habitat protection and conservation co-benefits including preserving marsh islands, restoring Submerged Aquatic Vegetation, migratory bird and fish habitat, reducing flow that could exacerbate wind tide flooding in local communities, and filling a gap in prior applied research on predominantly fresh water coastal lagoons. These features support the following CCMP actions:

- A2.3: Support research on adapting to impacts associated with climate change and sea level rise.
- C3.2: Develop and implement a coordinated wetland restoration strategy.
- C3.3: Develop and implement a submerged aquatic vegetation (SAV) restoration strategy.
- D3.3: Provide assistance to state, regional, and local governments to incorporate climate change and sea level rise considerations into their planning processes.

In closing, we strongly support the full funding of the City of Virginia Beach's proposal to Round 4 of The Virginia Community Flood Preparedness Fund (CFPF). Please contact Steve Anderson, Partnership Coordinator, at (919) 707-8743 with questions.

Sincerely,

W. Crowell

William L. Crowell, Jr., Ph.D., AICP, CEE
Director

1601 Mail Service Center, Raleigh, North Carolina 27699-1601
Phone/Fax: 919-707-8633 | www.apnep.org

Attachment 5: Copy of the Current Floodplain Ordinance

ORD-3685

AN ORDINANCE TO AMEND SECTIONS 1.1, 1.2, 1.3, 1.8, 2.1, 2.2, 2.3, 2.4, 2.8, 2.11, 3.1, 4.1, 4.2, 4.3, 4.4, 4.6, 4.8, 4.9, 4.10, 5.1, 6.1, AND 6.3 OF APPENDIX K, FLOODPLAIN ORDINANCE OF THE CITY CODE PERTAINING TO HOUSEKEEPING THE DELETION OF PUBLIC WORKS REQUIREMENTS AND THE ADDITION OF A COASTAL A ZONE AND A COASTAL HIGH HAZARD ZONE

Sections Amended: 1.1, 1.2, 1.3, 1.8, 2.1, 2.2, 2.3, 2.4, 2.8, 2.11, 3.1, 4.1, 4.2, 4.3, 4.4, 4.6, 4.8, 4.9, 4.10, 5.1, 6.1, and 6.3 of Appendix K, Floodplain Ordinance

WHEREAS, the public necessity, convenience, general welfare and good zoning practice so require;

BE IT ORDAINED BY THE CITY COUNCIL OF THE CITY OF VIRGINIA BEACH, VIRGINIA:

That Sections 1.1, 1.2, 1.3, 1.8, 2.1, 2.2, 2.3, 2.4, 2.8, 2.11, 3.1, 4.1, 4.2, 4.3, 4.4, 4.6, 4.8, 4.9, 4.10, 5.1, 6.1, and 6.3 of Appendix K, Floodplain Ordinance is hereby amended and reordained to read as follows:

APPENDIX K FLOODPLAIN ORDINANCE

ARTICLE I. GENERAL PROVISIONS

Sec. 1.1. Statutory authorization and purpose.

A. This ordinance is adopted pursuant to the authority granted to localities by Code of Virginia § ~~10.1-600 et seq~~ <u>15.2-984</u>.

B. The city council finds the purpose of these provisions is to prevent the loss of life and property, the creation of health and safety hazards, the disruption of commerce and governmental services, the extraordinary and unnecessary expenditure of public funds for flood protection and relief, and the impairment of the tax base by:

1. Regulating uses, activities, and development that, alone or in combination with other existing or future uses, activities, and development, will cause unacceptable increases in flood heights, velocities, and frequencies;

2. Restricting or prohibiting certain uses, activities, and development from locating within districts subject to flooding;

3. Requiring all uses, activities, and developments that do occur in flood-prone districts be protected or flood-proofed against flooding and flood damage;

4. Protecting individuals from buying land and structures that are unsuited for intended purposes because of flood hazards; and

5. Acknowledging that the tide data over the last one hundred (100) years shows that Virginia Beach is facing an increased danger of flooding caused by both sea level rise and subsidence and has adopted the Sea Level Wise Adaptation Report as part of the Comprehensive Plan.

Sec. 1.2. Applicability.

These provisions shall apply to all privately and publicly owned lands within the jurisdiction of the City of Virginia Beach and identified as areas ~~of special flood hazard~~ at risk of flooding by the City of Virginia Beach or shown ~~according to~~ on the Flood Insurance Rate Map (FIRM) or included on the flood insurance study (FIS) that ~~is~~ are provided to the City of Virginia Beach by the Federal Emergency Management Agency (FEMA) and dated January 16, 2015 ~~or identified as floodplains subject to special restrictions in section 4.10 of this ordinance~~.

Sec. 1.3. Definitions.

. . . .

City manager. The City Manager of the City of Virginia Beach, or his designees.

Design Flood Elevation (regulatory flood protection elevation). The base flood elevation plus the freeboard required by this ordinance.

. . . .

Recreational vehicle. A vehicle that is:

1. Built on a single chassis;
2. Four hundred (400) square feet or less when measured at the largest horizontal projection;
3. Designed to be self-propelled or permanently towable by a light duty truck; and
4. Designed primarily not for use as a permanent dwelling but as temporary living quarters for recreational camping, travel, or seasonal use.

~~*Regulatory flood protection elevation (design flood elevation)*. The base flood elevation plus the freeboard required by this ordinance.~~

. . . .

Sec. 1.8. Penalty for violations.

Any person who fails to comply with any of the requirements or provisions of this ordinance or directions of the ~~d~~<u>D</u>irectors of ~~p~~<u>P</u>lanning ~~or public works~~ or any authorized employee of the City of Virginia Beach shall be guilty of the appropriate violation and subject to the penalties therefore. Any violation of the provision of this ordinance shall be punishable by a fine of not more than one hundred dollars ($100.00). Each person shall be deemed guilty of a separate offense for each and every day or portion thereof during which any violation of any of the provisions of this ordinance is committed.

The Virginia Uniform Statewide Building Code (VA USBC) addresses building code violations and the associated penalties in ~~section 104 and section 115~~ <u>VA USBC § 104 and § 115</u>. <u>Violations and associated penalties of the Zoning Ordinance for the City of Virginia Beach are addressed in § 104 of the Zoning Ordinance.</u>

In addition to the above penalties, all other actions are hereby reserved, including an action in equity for the proper enforcement of this ordinance. The imposition of a fine or penalty for any violation of, or noncompliance with, this ordinance shall not excuse the violation or noncompliance or permit it to continue, and all such persons shall be required to correct or remedy such violations within a reasonable time. Any structure constructed, reconstructed, enlarged, altered, or relocated in noncompliance with this ordinance may be declared by the City of Virginia Beach to be a public nuisance and abatable as such. Flood insurance may be withheld from structures constructed in violation of this ordinance.

ARTICLE II. ADMINISTRATION

Sec. 2.1. Designation of the floodplain administrator.

The City Manager of the City of Virginia Beach is hereby appointed the floodplain administrator to administer and implement this ordinance. The floodplain administrator has delegated the duties and responsibilities set forth in this ordinance to the ~~departments of public works and planning, as specified below~~ <u>Department of Planning and Community Development</u>.

Sec. 2.2. Duties and responsibilities of the ~~department of public works~~ <u>floodplain administrator or his designee</u>.

The duties and responsibilities of the ~~department of public works~~ <u>floodplain administrator of his designee</u> shall include but are not limited to:

A. Interpreting floodplain boundaries and providing available base flood elevation and flood hazard information;

B. Verifying that applicants proposing an alteration of a watercourse have notified adjacent communities, the department of conservation and recreation (division of dam safety and floodplain management), and other appropriate agencies (Virginia Department of Environmental Quality (VADEQ), United States Army Corps of Engineers (USACE), etc.) and have submitted copies of such notifications to FEMA;

C. Advising applicants for new construction or substantial improvement of structures that are located within an area of the coastal barrier resources system established by the Coastal Barrier Resources Act that Federal flood insurance is not available on such structures; areas subject to this limitation are shown on FIRMs as coastal barrier resource system areas or otherwise protected areas;

D. Submitting to FEMA, or requiring applicants to submit to FEMA, data and information necessary to maintain FIRMs, including hydrologic and hydraulic engineering analyses prepared by or for the city, within six (6) months after such data and information becomes available if the analyses indicate changes in base flood elevations;

E. Maintaining and permanently keeping records that are necessary for the administration of these regulations, including:

1. ~~flood~~ Flood insurance studies, FIRMs (including historic studies and maps and current effective studies and maps) and letters of map change; and

2. Documentation supporting issuance and denial of permits, Elevation Certificates, documentation of the elevation (in relation to the datum on the FIRM) to which structures have been floodproofed, inspection records, other required design certifications, variances, and records of enforcement actions taken to correct violations of these regulations.

F. Notifying FEMA when the corporate boundaries of the City of Virginia Beach have been modified and:

1. Providing a map that clearly delineates the new corporate boundaries or the new area for which the authority to regulate pursuant to this ordinance has either been assumed or relinquished through annexation; and

2. If the FIRM for any annexed area includes SFHAs that have flood zones with regulatory requirements that are not set forth in this

ordinance, prepare amendments to this ordinance to adopt the FIRM and appropriate requirements, and submit the amendments to the city council for adoption; such adoption shall take place at the same time as or prior to the date of annexation and a copy of the amended ordinance shall be provided to the department of conservation and recreation (division of dam safety and floodplain management) and FEMA.

G. Upon the request of FEMA, completing and submitting a report concerning participation in the NFIP, which may request information regarding the number of buildings in the SFHA, the number of permits issued for development in the SFHA, and the number of variances issued for development in the SFHA.

<u>H.</u> <u>Reviewing applications for permits to determine whether proposed activities will be located in the SFHA;</u>

<u>I.</u> <u>Reviewing applications to determine whether proposed activities will be reasonably safe from flooding and requiring new construction and substantial improvements to meet the requirements of this ordinance;</u>

<u>J.</u> <u>Reviewing applications to determine whether all necessary permits have been obtained from the federal, state, or local agencies from which prior or concurrent approval is required; in particular, permits from state agencies for any construction, reconstruction, repair, or alteration of a dam, reservoir, or waterway obstruction (including bridges, culverts, structures), any alteration of a watercourse, or any change of the course, current, or cross section of a stream or body of water, including any change to the SFHAs of free-flowing non-tidal waters of the state;</u>

<u>K.</u> <u>Approving applications and issuing permits to develop in flood hazard areas if the provisions of this ordinance have been met, or disapproving applications if the provisions of this ordinance have not been met;</u>

<u>L.</u> <u>Granting administrative variances pursuant to section 6.1 of this ordinance;</u>

<u>M.</u> <u>Inspecting, or causing to be inspected, buildings, structures, and other development for which permits have been issued to determine compliance with this ordinance or to determine if non-compliance has occurred or violations have been committed;</u>

<u>N.</u> <u>Reviewing elevation certificates and requiring incomplete or deficient certificates to be corrected;</u>

O. Maintaining and permanently keeping documentation supporting the issuance and denial of permits, elevation certificates, documentation of the elevation (in relation to the datum on the FIRM) to which structures have been flood proofed, and other required design certifications, variances, and records of enforcement actions taken to correct violations of this ordinance;

P. Enforcing the provisions of this ordinance, investigating violations, issuing notices of violations or stop work orders, and requiring permit holders to take corrective action;

Q. Advising the city council regarding the intent of this ordinance and, for each application for a variance, preparing a staff report and recommendation; and

R. Administering the requirements related to proposed work on existing buildings:

1. Making determinations as to whether buildings and structures that are located in flood hazard areas and that are damaged by any cause have been substantially damaged; and

2. Making reasonable efforts to notify owners of substantially damaged structures of the need to obtain a permit to repair, rehabilitate, or reconstruct, and prohibit the non-compliant repair of substantially damaged buildings except for temporary emergency protective measures necessary to secure a property or stabilize a building or structure to prevent additional damage.

S. Undertaking, as determined appropriate by the floodplain administrator due to the circumstances, other actions that may include but are not limited to: issuing press releases, public service announcements, and other public information materials related to permit requests and repair of damaged structures; coordinating with other federal, state, and local agencies to assist with substantial damage determinations; providing owners of damaged structures information related to the proper repair of damaged structures in SFHAs; and assisting property owners with documentation necessary to file claims for increased cost of compliance coverage under National Flood Insurance Program (NFIP) flood insurance policies; and

T. It is the duty of the city floodplain administrator to take into account flood, mudslide, and flood-related erosion hazards, to the extent that they are known, in all official actions relating to land management and use throughout the entire jurisdictional area of the city, whether or not those

hazards have been specifically delineated geographically (e.g., via mapping or surveying).

~~Sec. 2.3. Duties and responsibilities of the department of planning.~~ Reserved.

~~The duties and responsibilities of the department of planning shall include but are not limited to:~~

~~A. Reviewing applications for permits to determine whether proposed activities will be located in the SFHA;~~

~~B. Reviewing applications to determine whether proposed activities will be reasonably safe from flooding and requiring new construction and substantial improvements to meet the requirements of this ordinance;~~

~~C. Reviewing applications to determine whether all necessary permits have been obtained from the federal, state, or local agencies from which prior or concurrent approval is required; in particular, permits from state agencies for any construction, reconstruction, repair, or alteration of a dam, reservoir, or waterway obstruction (including bridges, culverts, structures), any alteration of a watercourse, or any change of the course, current, or cross section of a stream or body of water, including any change to the SFHAs of free-flowing non-tidal waters of the state;~~

~~D. Approving applications and issuing permits to develop in flood hazard areas if the provisions of this ordinance have been met, or disapproving applications if the provisions of this ordinance have not been met;~~

~~E. Granting administrative variances pursuant to section 6.1 of this ordinance;~~

~~F. Inspecting, or causing to be inspected, buildings, structures, and other development for which permits have been issued to determine compliance with this ordinance or to determine if non-compliance has occurred or violations have been committed;~~

~~G. Reviewing elevation certificates and requiring incomplete or deficient certificates to be corrected;~~

~~H. Maintaining and permanently keeping documentation supporting the issuance and denial of permits, elevation certificates, documentation of the elevation (in relation to the datum on the FIRM) to which structures have been flood proofed, and other required design certifications, variances, and records of enforcement actions taken to correct violations of this ordinance;~~

~~I. Enforcing the provisions of this ordinance, investigating violations, issuing notices of violations or stop work orders, and requiring permit holders to take corrective action;~~

~~J. Advising the city council regarding the intent of this ordinance and, for each application for a variance, preparing a staff report and recommendation; and~~

~~K. Administering the requirements related to proposed work on existing buildings:~~

~~1. Making determinations as to whether buildings and structures that are located in flood hazard areas and that are damaged by any cause have been substantially damaged; and~~
~~2. Making reasonable efforts to notify owners of substantially damaged structures of the need to obtain a permit to repair, rehabilitate, or reconstruct, and prohibit the non-compliant repair of substantially damaged buildings except for temporary emergency protective measures necessary to secure a property or stabilize a building or structure to prevent additional damage.~~

~~Sec. 2.4. Shared duties and responsibilities.~~ Reserved.

~~The duties and responsibilities shared by the departments of public works and Planning shall include but are not limited to:~~

~~A. Undertaking, as determined appropriate by the floodplain administrator due to the circumstances, other actions that may include but are not limited to: issuing press releases, public service announcements, and other public information materials related to permit requests and repair of damaged structures; coordinating with other federal, state, and local agencies to assist with substantial damage determinations; providing owners of damaged structures information related to the proper repair of damaged structures in SFHAs; and assisting property owners with documentation necessary to file claims for increased cost of compliance coverage under National Flood Insurance Program (NFIP) flood insurance policies; and~~

~~B. It is the duty of the city floodplain administrator to take into account flood, mudslide, and flood-related erosion hazards, to the extent that they are known, in all official actions relating to land management and use throughout the entire jurisdictional area of the city, whether or not those hazards have been specifically delineated geographically (e.g., via mapping or surveying).~~

. . . .

Sec. 2.8. Interpretation of district boundaries.

Initial interpretations of the boundaries of the floodplain districts shall be made by the floodplain administrator. Should a dispute arise concerning the boundaries of any of the districts~~, the city council shall make the necessary determination. The person questioning or contesting the location of the district boundary shall be given a reasonable opportunity to present his case to the city council and to submit his own technical evidence if he so desires~~ a surveyor shall provide either an elevation certificate or recent survey showing topographic elevations and delineating the Special Flood Hazard Area.

. . . .

Sec. 2.11. Appeals to decisions made by the floodplain administrator.

It is further provided that any decision of the floodplain administrator or his designee may be modified, reversed, or affirmed by the city council upon appeal by any aggrieved party to such decision, if such appeal is filed with the floodplain administrator within thirty (30) days of such decision through the application for a Floodplain Variance outlined in Section VI of this ordinance.

ARTICLE III. ESTABLISHMENT OF FLOODPLAIN DISTRICTS

Sec. 3.1. Description of floodplain districts.

A. Special flood hazard areas (SFHA). The SFHAs shall include land in the floodplain subject to a one (1) percent or greater chance of being flooded in any given year. The basis for the delineation of these districts shall be the FIS and the FIRM for the City of Virginia Beach prepared by FEMA, Federal Insurance Administration, dated January 16, 2015, and any subsequent revisions or amendments thereto.

The boundaries of the SFHAs are established as shown on the FIRM, which is declared to be a part of this ordinance and shall be kept on file at the City of Virginia Beach Department of ~~Public Works~~ Planning and Community Development, and include the following districts:

1. The Floodway District is in an AE Zone and is delineated, for the purposes of this ordinance, using the criterion that certain areas within the floodplain must be capable of carrying the waters of the one (1) percent annual chance flood without increasing the water surface elevation of that flood more than one (1) foot at any point. The areas included in this district are specifically defined in Table 7 of the above-referenced FIS and shown on the accompanying FIRM.

2. The AE or AH Zones on the FIRM accompanying the FIS shall be those areas for which one (1) percent annual chance flood elevations have been provided and the floodway has not been delineated.

3. The A Zone on the FIRM accompanying the FIS shall be those areas for which no detailed flood profiles or elevations are provided, but the one (1) percent annual chance floodplain boundary has been approximated.

4. The AO Zone on the FIRM accompanying the FIS shall be those areas of shallow flooding identified as AO on the FIRM.

5. ~~Reserved.~~ The Coastal A Zone on the FIRM accompanying the FIS shall be those areas labeled as AE and are located seaward of the limit of moderate wave action (LiMWA) line.

6. The VE or V Zones on FIRMs accompanying the FIS shall be those areas that are known as coastal high hazard areas, extending from offshore to the inland limit of a primary frontal dune along an open coast and any other area subject to high velocity wave action from storm or seismic sources.

B. ~~Floodplain subject to special restrictions~~ *Local Flood Hazard Areas*. The City of Virginia Beach may identify and regulate local flood hazard or ponding areas that are not delineated on the FIRM. These areas are ~~identified in section 4.10 and may be delineated on a map using best available topographic data and locally derived information such as flood of record, historic high water marks, or approximate study methodologies~~ identified as follows:~~.~~

a. *Other areas of flood risk*. The X and the X(Shaded) Zone on the FIRM where the City of Virginia Beach Stormwater Master Plan has identified areas, outside SFHAs delineated on the FIRM, that area susceptible to flooding. The most recent updated version of the modeling shall be used to identify areas that are likely to experience flooding.

b. *Floodplain Subject to Special Restrictions*. The Floodplain Subject to Special Restrictions is identified in section 4.10 and includes areas in the southern part of the city which are characterized by wind tides, low topography, and poorly draining soils.

ARTICLE IV. FLOODPLAIN DISTRICT PROVISIONS

Sec. 4.1. Permit and application requirements.

. . . .

B. Site plans and permit applications. All applications for development within any floodplain district and all building permits issued within ~~the~~ any floodplain district shall incorporate the following information:

1. For any addition, conversion of any non-habitable space to habitable space, or the construction or installation of a new accessory structure that requires a building permit.

   a. A physical survey, performed after the effective date of the FIRM that:

      i. accurately depicts current improvements on the property;
      ii. provides a flood zone determination and BFE or flood depth at the stie; and
      iii. delineates the location of the flood zones on the property.

   b. For structures located in the SFHA delineated on the FIRM, a current elevation certificate sealed by a licensed design professional.

2. For new construction and any substantial improvement of the principal structure:

   a. a proposed site plan sealed by a registered design professional that provides:

      ~~1~~i. The elevation of the base flood at the site;

      ~~2~~ii. The elevation of the lowest floor (including basement) or, in V Zones, the lowest horizontal structural member;

      ~~3~~iii. For structures to be flood-proofed (non-residential only), the elevation to which the structure will be flood-proofed; and

      4iv. Topographic information showing existing and proposed ground elevations.

Sec. 4.2. General standards.

. . . .

5. Electrical, heating, ventilation, plumbing, air conditioning equipment, and other service facilities, including duct work, shall be designed and/or ~~located so as to prevent water from entering or accumulating within the components during conditions of flooding~~ or above the design flood elevation.

6. New and replacement water supply systems shall be designed to minimize or eliminate infiltration of flood waters into the system.

7. New and replacement sanitary sewage systems shall be designed to minimize or eliminate infiltration of flood waters into the systems and discharges from the systems into flood waters.

8. On-site waste disposal systems shall be located and constructed to avoid impairment to them or contamination from them during flooding.

9. No use shall be permitted if such use will increase the amounts of potentially damaging materials, including those likely to be injurious to health, that might be transported in floods.

<u>10.</u> <u>For properties located in SFHAs delineated on the FIRM, an elevation certificate and, if applicable, a flood-proofing certificate shall be provided to the Floodplain Administrator prior to any foundation inspection, final inspections, and the issuance of any certificates of occupancy, in order to assure compliance with these floodplain regulations.</u>

<u>11.</u> <u>Prior to any proposed alteration or relocation of any channels or of any watercourse or stream within the city, a permit shall be obtained from the USACE, VADEQ, the Virginia Marine Resources Commission, and the Wetlands Board through the joint permit application process. Furthermore, notification of the proposal shall be given by the applicant to all affected adjacent jurisdictions, the department of conservation and recreation (division of dam safety and floodplain management), other required agencies, and FEMA.</u>

<u>12.</u> <u>The flood carrying capacity within an altered or relocated portion of any watercourse shall be maintained.</u>

~~B.~~ ~~In all SFHAs, the following additional provisions shall apply:~~

~~1.~~ ~~Prior to any proposed alteration or relocation of any channels or of any watercourse or stream, within the city a permit shall be obtained from the USACE, VADEQ, the Virginia Marine Resources Commission, and the Wetlands Board through the joint permit application process. Furthermore, notification of the proposal shall be given by the applicant to all affected adjacent jurisdictions, the department of conservation and recreation (division of dam safety and floodplain management), other required agencies, and FEMA.~~

~~2.~~ ~~The flood carrying capacity within an altered or relocated portion of any watercourse shall be maintained.~~

~~3. Sand dunes, barrier beaches, and other natural protective barriers shall remain intact to provide protection against wind, waves, and erosion drainage. Any person who desires to use or alter any coastal primary sand dune, other than for the purpose of conducting the activities specified in section 1602 of the Zoning Ordinance of the City of Virginia Beach, shall first obtain a permit from the USACE, VADEQ, the Virginia Marine Resources Commission, and the Wetlands Board through the joint permit application process.~~

Sec. 4.3. Elevation and construction requirements.

In all ~~SFHAs where base flood elevations have been provided in the FIS or generated by a licensed professional in accordance with section 4.6 of this ordinance~~ floodplain districts, with the exception of Coastal A and Coastal High Hazard (VE) zones, the following provisions shall apply:

A. Residential construction requirements. ~~New construction or substantial improvement of any residential structure or manufactured home in Zones AE, AH, and A with detailed base flood elevations shall have the lowest floor, including basement, elevated to a minimum of two (2) feet above the base flood level.~~ The lowest flood, including basement, shall be set to the higher of the following:

i. A minimum of two (2) feet above the base flood elevation established on the most recent FIRM or by the most recent FIS or,

ii. A minimum of one (1) foot above the 100-year HGL elevation measured at the nearest existing or proposed public drainage structure or BMP, in the City Stormwater Master Plan.

B. Non-residential construction requirements. New construction or substantial improvement of any commercial, industrial, or non-residential building or manufactured home shall have the lowest floor, including basement, elevated as ~~minimum of two (2) feet above the base flood level~~ established in Section 4.3 A of this ordinance. Buildings ~~located in AE or AH Zones~~ may be flood-proofed in lieu of being elevated provided that all areas of the building components below the ~~elevation corresponding to the base flood elevation plus a minimum of two (2) feet freeboard~~ design flood elevation are watertight with walls substantially impermeable to the passage of water, and use structural components having the capability of resisting hydrostatic and hydrodynamic loads and the effect of buoyancy. A professional engineer or architect licensed by the Commonwealth of Virginia shall certify that the standards of this subsection are satisfied. Such certification, including the specific elevation (in relation to NAVD88) to which such structures are flood proofed, shall be maintained by the building official.

C. ~~Space below the lowest floor requirements. In Zones A, AE, AH, and AO, f~~Fully enclosed areas of new construction or substantially improved existing structures that are below the ~~regulatory~~ design flood protection elevation shall:

1. Not be designed or used for human habitation, but shall only be used for parking of vehicles, building access, or limited storage of maintenance equipment used in connection with the premises. Access to the enclosed area shall be the minimum necessary to allow for parking of vehicles (garage door), limited storage of maintenance equipment (standard exterior door), or entry to the living area (stairway or elevator).

2. Be constructed entirely of flood resistant materials below the ~~regulatory~~ design flood ~~protection~~ elevation.

3. Space below the lowest floor of SFHAs delineated on the FIRM shall ~~I~~include measures to automatically equalize hydrostatic flood forces on walls by allowing for the entry and exit of floodwaters. To meet this requirement, the openings shall either be certified by a professional engineer or architect licensed by the Commonwealth of Virginia or meet or exceed the following minimum design criteria:

. . . .

Sec. 4.4. Floodway requirements.

. . . .

B. The placement of new or replacement manufactured homes (mobile homes) is prohibited.

~~C.~~ ~~The following uses and structures may be permitted in the floodway district, subject to the requirements of articles III, IV, V, and VI of this ordinance:~~

~~1.~~ ~~Public and private outdoor recreational facilities;~~

~~2.~~ ~~Agricultural uses, including farming, grazing, and the raising of poultry or livestock; provided, that poultry or livestock shall not be housed within five hundred (500) feet of any residential, apartment, or hotel district;~~

~~3.~~ ~~Open uses, such as public and private roadways, off street parking, or loading and unloading areas related to uses in adjoining districts;~~

4. ~~Commercial mining, soil removal, and sand pits subject to regulations applicable to extractive industries as set forth in the conditional use provisions of the Zoning Ordinance of the City of Virginia Beach;~~

5. ~~Public improvements, such as dams, levees and channel improvements, and utilities installations and substations, including temporary storage of materials, except flammable, toxic or noxious materials, and temporary location of maintenance installations; and~~

6. ~~Uses and structures customarily accessory and clearly incidental and subordinate to uses listed above, including in connection with agricultural uses; roadside stands for the sale of agricultural products produced on the premises; provided that:~~

    a. ~~Only one (1) such stand shall be permitted per lot;~~

    b. ~~No such stand shall exceed five hundred (500) square feet in floor area; and~~

    c. ~~No such stand on the street frontage shall be erected within twenty (20) feet of the property line.~~

. . . .

Sec. 4.6. A Zone requirements.

. . . .

B. The floodplain administrator reserves the right to require a hydrologic and hydraulic analysis for any development and to determine the base flood elevation. When such base flood elevation data is utilized, the lowest floor shall be elevated to minimum of two (2) feet above the base flood level. During the permitting process, the floodplain administrator shall obtain:

1. The elevation of the lowest floor (including the basement) of all new and substantially improved structures; and

2. If the structure has been flood-proofed in accordance with the requirements of this ordinance, the elevation (in relation to NAVD88) to which the structure has been flood-proofed.

C. ~~When the data is not available from any source, the lowest floor of the structure shall be elevated to not less than two (2) feet above the highest adjacent grade.~~

Sec. 4.8. ~~Reserved~~ X and X(Shaded) Zone requirements. (Other Areas of Flood Risk).

A. *Residential construction requirements*. The lowest floor, including basements, shall be set to a minimum of one (1) foot above the 100-year HGL elevation measured at the nearest existing or proposed public drainage structure or BMP, in the City Stormwater Master Plan.

B. *Non-residential construction requirements*. New construction or substantial improvement of any commercial, industrial, or non-residential building or manufactured home shall have the lowest floor, including basement, elevated as established in Section 4.8 A of this ordinance above. Buildings may be flood-proofed in lieu of being elevated provided that all areas of the building components below the design flood elevation are watertight with walls substantially impermeable to the passage of water, and use structural components having the capability of resisting hydrostatic and hydrodynamic loads and the effect of buoyancy. A professional engineer or architect licensed by the Commonwealth of Virginia shall certify that the standards of this subsection area satisfied. Such certification, including the specific elevation (in relation to NAVD88) to which such structures are flood proofed, shall be maintained by the building official.

Sec. 4.9. – Coastal High Hazard (~~V and~~ VE Zone) requirements.

The following provisions shall apply within ~~V and VE Zones~~ Coastal A Zones and Coastal High Hazard Areas:

A. All new construction and substantial improvements, including to manufactured homes, shall be elevated on pilings or columns so that:

1. The bottom of the lowest horizontal structural member of the lowest floor (excluding the pilings or columns) is elevated to a minimum of ~~two~~ three (~~2~~3) feet above the base flood ~~level~~ elevation; and

2. The pile or column foundation and structure attached thereto is anchored to resist flotation, collapse, and lateral movement due to the effects of wind and water loads acting simultaneously on all building components. Wind and water loading values shall each have a one (1) percent chance of being equaled or exceeded in any given year.

B. A professional engineer or architect licensed by the Commonwealth of Virginia shall develop or review the structural design, specifications, and plans for the construction and shall certify that the design and methods of construction to be used are in accordance with accepted standards of practice for meeting the provisions of article IV, section 4.6 A. A V Zone

Design Certificate shall be submitted to Permits and Inspections with plans for a building permit.

. . . .

I. ~~The man-made alteration of sand dunes, which would increase potential flood damage, is prohibited.~~ Sand dunes, barrier beaches, and other natural protective barriers shall remain intact to provide protection against wind, waves, and erosion drainage. Any person who desires to use or alter any coastal primary sand dune or beaches, other than for the purpose of conducting the activities specified in Article 1600, Section 1602 of the Zoning Ordinance of the City of Virginia Beach, shall first obtain a permit, or authorization, from the USACE, VADEQ, the Virginia Marine Resources Commission, and the Wetlands Board through the joint permit application process.

J. Manufactured homes are prohibited.

Sec. 4.10. Floodplain subject to special restrictions.

A. All ~~FIRM delineated~~ SFHAs that ultimately drain to Back Bay or the Currituck Sound ~~located in the following areas~~ shall be identified as a floodplain subject to special restrictions~~:~~.

~~1. North Landing River and its tributaries south of Lynnhaven Parkway;~~

~~2. West Neck Creek and its tributaries south of Shipps Corner Road, London Bridge Road, and the portion of Dam Neck Road east of its intersection with London Bridge Road; and~~

~~3. Bays, creeks, lakes, guts, coves, wetlands, marshes and swamps and their tributaries comprising the Back Bay and Small Coastal South watersheds south of South Birdneck Road and east of Princess Anne Road and General Booth Boulevard.~~

B. The following provisions shall apply within the floodplain subject to special restrictions:

1. Notwithstanding any provision of this ordinance to the contrary, no filling shall be permitted, including filling with material excavated from the same floodplain except for:

a. The purpose of public roadway or other similar public works construction undertaken by the Department of Public Works or Virginia Department of Transportation, or their agent for

construction. This construction includes flood protection and flood mitigation projects;

b. The maintenance, alteration, or relocation of bona fide agricultural ditches, swales, or agricultural pathways or those ditches required for proper lot drainage;

c. For shoreline stabilization or maintenance projects, such as riprap revetment, bulkheads, or other treatment used to stabilize and protect the banks of waterways, the city manager or his designee may approve the placement of fill provided the following criteria are met:

i. A joint permit application is submitted;

ii. The alignment of the stabilization structure is along the escarpment or in line with adjacent stabilization structures; ~~and~~

iii. If there is an existing shoreline stabilization structure, any proposed replacement structure shall be no more than six (6) inches higher than the existing structure; and

~~iii~~iv. Fill must be the minimum necessary to support the stabilization project.

2. The city manager, or his designee, may approve the placement of fill provided that the following criteria are met:

a. Proposed fill within the floodplain:

i. Shall be mitigated to result in no decrease in flood storage volume on the site;

ii. Shall be mitigated entirely on the same site that will incur the fill;

iii. Shall be contiguous to the existing floodplain that is being filled; and

iv. Shall be limited to the smallest amount of area and volume possible to correct irregularities within the boundary of the project.

b. The combined areas of fill and mitigation shall not exceed five (5) percent of the total area within the floodplain located on the site that will incur the fill.

3. Residential dwelling structures shall not be located within the floodplains subject to special restrictions on lots created after October 23, 2001. Residential dwelling structures located in ~~local flood hazard areas as of~~ a SFHA and constructed prior to October 23, 2001 may be expanded with attached additions to a total footprint of less than one thousand (1,000) square feet; such additions shall also comply with the requirements set forth in article V of this ordinance.

. . . .

ARTICLE V. EXISTING STRUCTURES IN FLOODPLAIN AREAS

Sec. 5.1. Existing structures.

A structure or use of a structure or premises that lawfully existed prior to the adoption of this ordinance, but which is not in conformity with this ordinance, may be continued subject to the following conditions:

A. Any existing structures in the floodway area shall not be expanded or enlarged unless it has been demonstrated through hydrologic and hydraulic analyses performed in accordance with standard engineering practices that the proposed expansion or enlargement would not result in any increase in the base flood elevation.

B. Any modification, alteration, repair, reconstruction, or improvement of any kind to a structure and/or use located in any floodplain ~~areas~~ district to an extent or amount of less than fifty (50) percent of its market value shall conform to the VA USBC and meet the freeboard height in effect at the start of construction for the original structure.

C. Any modification, alteration, repair, reconstruction, or improvement of any kind to a structure and/or use, in any floodplain ~~area~~ district to an extent or amount of fifty (50) percent or more of its market value shall be undertaken only in full compliance with this ordinance and shall require the entire structure to conform to the VA USBC.

ARTICLE VI. VARIANCES AND APPEALS

Sec. 6.1. Administrative variances.

The floodplain administrator shall approve or deny an application requesting an administrative variance after receipt of a complete application. Administrative variances may only be granted for the following uses, development, or redevelopment:

A. As defined in section 4.10, floodplains subject to special restrictions, for filling only.

B. Any structure or use sustaining damage not caused by flood to an extent or amount of fifty (50) percent or more of its market value to allow the structure to be rebuilt to the freeboard height in effect at the start of construction for the original structure. If the structure is a pre-FIRM structure, full compliance with the current VAUSBC freeboard above the base flood elevation is required. Structures that are utilizing an approved land management plan for their on-site waste disposal may be allowed to continue the use of the land management plan as long as it is approved by the city and the health department, even for damage or destruction resulting from flood.

C. As defined in section 4.8 B, X and X(Shaded) Zone requirements. (Other Areas of Flood Risk), and 4.3 A(ii) when the required finished floor is higher than the BFE plus two feet of freeboard, where the floodplain administrator, in consultation with the Development Services Center, has determined that the proposed stormwater engineering design will approximately mitigate any impacts to the finished floor of the nonresidential development.

Sec. 6.3. Application process.

A. Applications for variances from the requirements of this ordinance shall be made to the city council and filed with the director of planning. The fee for such applications shall be ~~six hundred fifty dollars~~ seven hundred eighty ($~~650~~780.00). Such fee shall include all costs of notifications and advertising. Except in cases in which such fee is waived, the director shall not accept any application not accompanied by payment of the required fee. The procedure for the advertising, hearing and determination of applications for floodplain variances shall be in accordance with the requirements pertaining to applications for subdivision variances, as set forth in section 9.4 of the subdivision ordinance. In cases in which a variance application is filed by reason of a natural disaster that is the subject of a federal declaration of emergency, application and associated advertising fees shall be waived and such application shall be given expedited processing to the maximum practical extent.

B. All applications shall be accompanied by the following:

1. A separate map, on a 1″ = 100′ or greater scale, identifying all proposed land disturbance, including fill and mitigation areas, and the limits of the existing and proposed SFHAs, tidal and non-tidal wetlands, Southern Rivers Watershed Management Area Buffer, and CBPA Resource Protection Area Buffer; and

2. A preliminary floodplain study addressing the physical and environmental characteristics of the floodplain located on adjoining properties and in the general area. Such study shall be sufficient to show that the variance, if granted, will meet the standards defined in section 6.~~3~~4 and in addition thereto, shall:

   a. Contain supporting data and calculations required for a Preliminary Stormwater Engineering Analysis as appropriate~~, given the preliminary nature of the floodplain study~~;

   b. Comply with the Public Works Design Standards Manual; and

   c. Be certified by a professional engineer, architect, surveyor, landscape architect or practitioner of a related field having a valid license issued by the Commonwealth of Virginia or who is exempt from licensure pursuant to applicable provisions of the Virginia Code.

Adopted by the Council of the City of Virginia Beach, Virginia, on the 1st day of February, 2022.

Attachment 6: Copy of Monitoring/Maintenance Plan

[DRAFT] Annual Monitoring Plan and Post-Construction Monitoring Report

Marsh Restoration in Back Bay, Virginia Beach, VA

Prepared by: Dewberry Engineers, Inc.

[July 6, 2023]

[REPORT VERSION [DRAFT]]

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INTRODUCTION

This project is intended to implement one of the nature-based projects proposed in Virginia Beach's "Sea Level Wise" (SLW) Adaptation Strategy[1] adopted by the Virginia Beach City Council in June 2020. The SLW Adaptation Strategy presents a holistic framework for addressing flood risks across the City, consisting of four general strategies – natural mitigations, engineered defenses, adapted structures, and prepared communities. These strategies were applied to each major watershed in the City and tailored to their unique characteristics and risk profiles. The adaptation vision for the Lower Southern Rivers Drainage Basin, where the proposed project is located, focuses on employing natural mitigation methodologies to strategically reduce flow into and within Back Bay, along with an integrated system of defense structures and complementary adaptation measures, such as land-use strategies, to improve flood storage and overall coastal resiliency. The Bonney Cove area of Back Bay, where the project site is proposed, is particularly suitable for the use of nature-based strategies given the low elevations of marshlands and documented historic degradation of habitat. Participants at the 'near-neighbor' public engagement meetings held during the SLW Adaptation Strategy development were supportive of these types of strategies.

The City has several dedicated Capital Improvement Program (CIP) initiatives for the Lower Southern Rivers Drainage Basin for implementation of these strategies. The City's Stormwater Green Infrastructure CIP has obligated approximately $421,700 in contracts to support field investigations, environmental assessments, and engineering designs of the project – a true indication of the City's commitment to nature-based approaches and the critical first step in a broader effort. During the General Election on November 2, 2021, Virginia Beach residents voted to authorize $567.5 million dollars in debt to fund the design and construction of 21 Phase 1 projects in the citywide Flood Protection Program. [2] The Back Bay Marsh Terrace project is included under the Stormwater Green Infrastructure Master Project.[3] Other Southern Watershed projects that received funding under the Flood Protection Program include the West Neck Creek Bridge City-Wide Sea Level Rise Strategy, the Pungo Ferry Road Improvements, and the Sandbridge/New Bridge Intersection Improvements projects.

Outside of this project, the Virginia Beach City Council has recently funded a $5.2 million dollar voluntary acquisition program to encourage flood-prone properties to apply for a buyout to enable the City to convert parcels to open space to serve as flood storage and a marsh migration buffer. The City's

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[1] City of Virginia Beach Sea Level Wise Adaptation Strategy webpage: https://www.vbgov.com/government/departments/public-works/comp-sea-level-rise/Pages/default.aspx

[2] City of Virginia Beach Flood Protection Program webpage: https://www.vbgov.com/government/departments/public-works/flood-protection-program/Pages/Flood-Protection-Program.aspx.

[3] Stormwater Green Infrastructure Page: https://www.vbgov.com/government/departments/public-works/flood-protection-program/Pages/Stormwater-Green-Infrastructure-.aspx

Stormwater Green Infrastructure CIP is also supporting the implementation of other natural and nature-based projects across the City, including a wetland and floodplain restoration project along the Eastern Branch of the Elizabeth River.

An assessment of restoration opportunities in the City's Lower Southern Rivers Drainage Basin with dual flood reduction and habitat restoration benefits identified the Bonney Cove area as a potential project site for several reasons. The Bonney Cove site has experienced significant historical ecological degradation. Historical shoreline data from 1869 indicates approximately 50% of present-day open water in Bonney Cove (260 acres) was previously marsh (Figure 1). Loss of the marsh island habitat within Bonney Cove has resulted in the opening of a secondary channel allowing increased flow exchange between the upper and lower bays. In comparison to shore-adjacent restoration, off-shore marsh restoration leveraging hydraulic modeling identified Bonney Cove as a location where marsh restoration has the potential to reduce the propagation of floodwaters through key pathways within Back Bay. The United States Fish and Wildlife Service (USFWS) and the Virginia Department of Wildlife Resources (VDWR) also identified Bonney Cove as a restoration priority as this area serves as an ideal location for Submerged Aquatic Vegetation (SAV) reestablishment and vital habitat for migratory birds and fish.

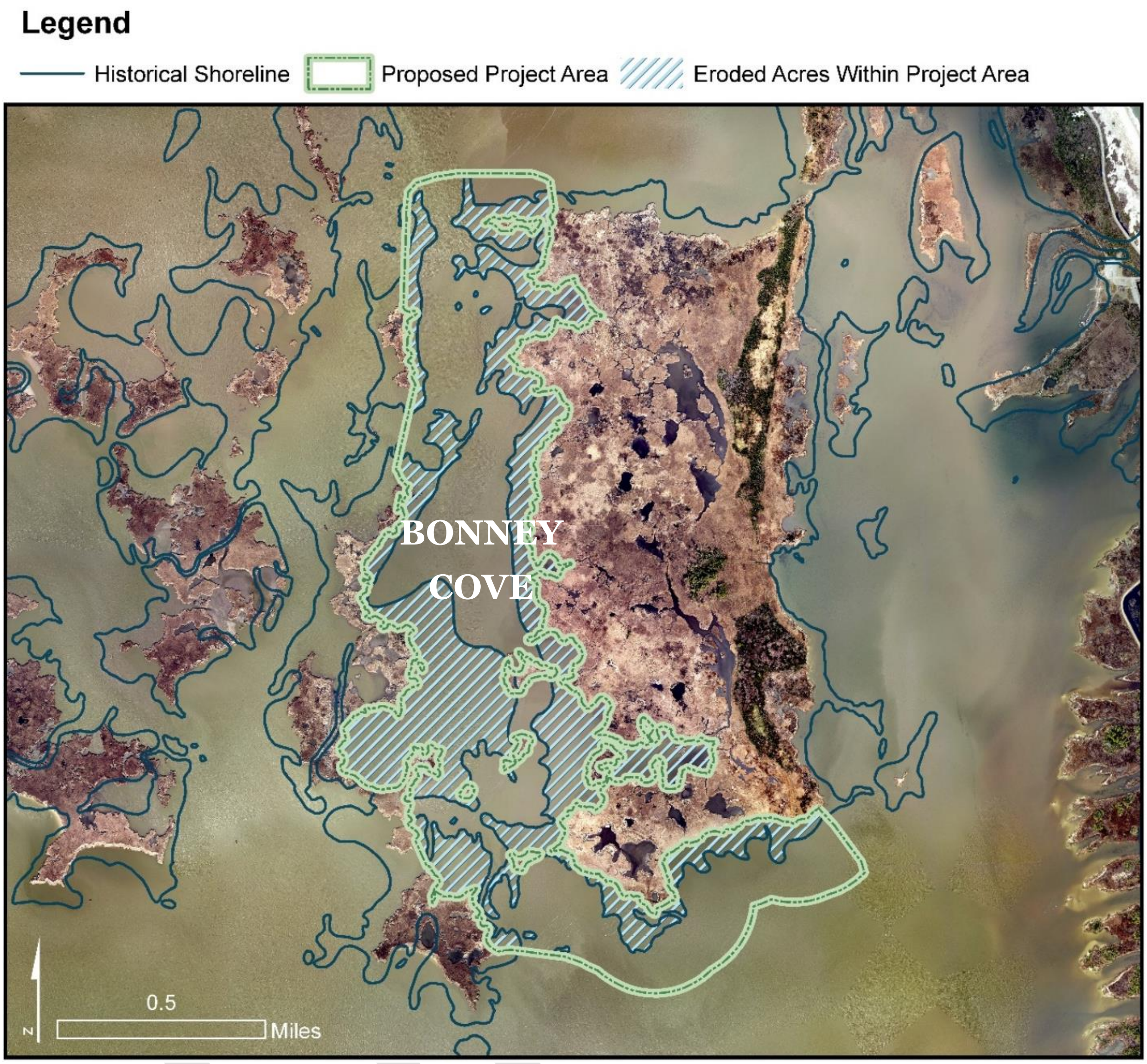

Figure 1: Historical marsh erosion within the project area.

The project is situated within the Bonney Cove area of Back Bay, spanning the western and southern lengths of Long Island, as shown in Figure 1.

Project Background

Marsh island restoration through terracing was identified as a particularly viable solution given Back Bay's shallow bottom and the historical loss of habitat. The marsh terraces are narrow man-made islands that will be arranged across areas that were historically marsh but are now shallow open water. A series of these islands, or terraces, are typically arranged in a chevron pattern. The overall field of terraces dissipates waves and slows down water moving through the area. In turn, the calmer water allows more sunlight to penetrate to the shallow bottom, promoting establishment and growth of marsh

and SAV habitats.   Further, as opposed to one continuous marsh platform, marsh terraces maximize habitat for a variety of fish and wildlife species.

The Preferred Alternative includes the creation of 41 individual marsh terraces totaling approximately 25,000 linear feet (or an approximately 47-acre footprint) across Bonney Cove. These 47 acres of terraces are comprised of approximately 13 acres of emergent (low and high marsh) vegetated habitat, 14 acres of upland vegetated habitat, and 16 acres of submerged terrace habitat. Approximately 310 acres of suitable SAV habitat will remain in between the terraces.

Terrace Construction and Orientation

Terrace construction will begin in the northern extent of the project site, and the contractor will work towards the southern extent of the site. The contractor will complete each terrace, including installing plants, before moving to the next. Marsh terrace construction will occur over two years (2025 to 2026) and will pause annually between October 31st and March 1st to limit disturbance to wintering waterfowl and migration, in accommodation of BBNWR's requirement. Approximately 20 terraces will be constructed in 2025 ("Phase 1"), and 21 terraces will be constructed in 2026 ("Phase 2"). The following sections summarize the proposed design and construction approach.

Terraces will be generally oriented perpendicular to the predominant wind direction (south-southwest) to maximize wave energy reduction. The terraces will be segmented in a chevron (duck-wing) pattern to create the most favorable fish and swimming crustacean (termed "nekton") habitat, facilitate adequate circulation, and maintain navigability throughout the project area. The terraces will not be connected to the adjacent marsh to maintain a physical open water barrier to deter the invasion of Common Reed (*Phragmites australis*) stands.

The terraces will be spaced at approximately 300-foot intervals in the northern and southern quarters and span 15 feet in width, and at least 600-foot intervals in the center and span 30 feet in width. This arrangement will lessen the amount of open water and subsequent wave action at the northern and southern ends of the site and provide space for marine-based construction equipment. The design team reviewed the final spacing layout of the terraces to ensure navigability of a watercraft through the project site which will be required for post-construction monitoring, any needed maintenance, as well as community recreational access.

The terraces would consist of a sand filled core encapsulated by a high-strength blend of woven and non-woven geotextile fabrics ("geobags"). The sand for this material would need to come from offsite sources. Back Bay is too shallow to accommodate conventional barges for material placement. To avoid extensive impacts to the bottom of the bay, the slurry basin will pump sand for the project from the proposed Shipps Cabin Road staging area to Bonney Cove. The slurry pipeline will consist of approximately 10,424 linear feet of 12" diameter HDPE fused/welded pipeline that will be assembled on land and floated into its proposed alignment within Back Bay. The pipe would be marked by floats

every 5 feet and temporary signage as reasonable. It is anticipated the pipeline will be submerged to the bottom of the bay at channel crossings and adjacent to a duck hunting cabin adjacent to the alignment. By establishing a floating pipeline, it will limit disturbances to the subaqueous bottomlands along the alignment and allow for the retraction of the pipeline during the winter inactive periods and inclement weather events. Booster stations would be placed approximately every mile. These booster stations would consist of a pontoon mounted diesel engine pump capable of moving the sand slurry from the laydown area to the site. Given the distance to the site, four or five of these booster stations are anticipated to be necessary to create the sand cores of the terrace. It is estimated that 450 Gallons Per Minute (GPM) of sand slurry would be pumped through the pipe.

Once the cores are in place, long reach excavators would travel along the tops of the terraces and begin to shape the cross slopes. Appropriate materials for establishing vegetation atop the terraces will be primarily sourced from materials dredged during the Sandbridge Road Nimmo Parkway Phase VII-A project located immediately north of Back Bay (VMRC 15-1564, USACE IP NAO-2015-00151). Materials will be tested and screened to remove organics prior to application to the terraces. As needed, dredging sites adjacent to the proposed terrace locations that are confirmed to be devoid of SAV will be utilized to provide supplemental soil materials to top the proposed terraces[4]. It was determined that the in-situ bay sediment would be suitable for vegetation growth. The marsh terraces would be covered with 1 to 3 feet of suitable fill, depending on crest widths. Jute netting will cover the topsoil to control erosion and promote vegetation establishment. Coir logs will be places along the terrace slope controls to further promote vegetation establishment along the slope.

SAV Plantings

The City has partnered with Virginia Polytechnic Institute and State University ("Virginia Tech") to evaluate opportunities for restoring populations of native Wild Celery (*Vallisneria americana*) in Back Bay. The Virginia Tech research team has developed an innovative technique to grow Wild Celery in an aquaculture center that results in larger, mature plants that can better withstand Back Bay's turbidity. Once transplanted, plants are surrounded by cages to prevent predation. These founder colonies can be used for propagation throughout Back Bay. After terrace construction, the City will transplant Wild Celery in an area adjacent to the site. This founder colony will be used to strategically transplant Wild Celery in between the terraces for 5 years after construction (2026 – 2029) with the ultimate goal of establishing 10 acres of SAV vegetation in between the marsh terraces.

[4] The 60% preliminary design showed preliminary siting of these dredge areas based on avoidance of existing SAV habitat; however, pre-construction surveys of SAV would be required to re-delineate these dredging areas.

Terrace Plantings – Upland and Marsh Vegetation

The terraces' intertidal perimeter will be planted with appropriate emergent estuarine plant species (e.g., Saltmarsh Cordgrass [*Spartina alterniflora*] and Salt Meadow Hay [*Spartina patens*]) and brackish plant species (e.g., Big Cordgrass [*Spartina cynosuroides*]). These plants will be installed as soon as possible after construction to stabilize planting areas and protect the terrace from erosion. In addition to emergent grass, woody growth (i.e., shrubs and trees) within the terrace crest will be incorporated to protect the terraces' surfaces from rain and wind erosion and hold the landform together through substantial root systems.

Appropriate native species were identified based on the review of the reference marshes surrounding the project site and a review of water levels in Back Bay. Since the Bay's water levels are not affected by lunar tides and instead by wind-driven fluctuations, the project team evaluated average water elevations at the U.S. Geological Survey (USGS) Beggars Bridge Creek Gauge (Gauge ID 0204300267) from 2016 – 2021 to determine ranges of inundation to achieve functional marsh elevations throughout the project life, defined as:

- *Mean Low Water (MLW)*: the average low water at the site (10th Percentile: -0.62 ft NAVD88)
- *Mean High Water (MHW)*: the average high water at the site (95th Percentile: 1.22 ft NAVD88)
- *Mean Tide Level (MTL)*: halfway between MLW and MHW (0.3 ft NAVD88)
- *Upper Limit of Wetlands (ULW)*: approximately 1.5 times the mean tide range at the site (2.76 ft NAVD88)

These elevations were correlated to suitability for low marsh, high marsh, and upland species, as shown in Table 1.

Table 1: Proposed planting elevation zones.

Planting Zone	Definition	Elevation Range	Elevation (feet NAVD88)	Percentage of record where water reaches these elevations
Low Marsh	Marsh that is flooded frequently but exposed sometimes	MTL - MHW	0.3 – 1.2 ft	48%
High Marsh	Marsh that is generally only flooded during higher-than average water conditions	MHW – ULW	1.2 to 2.8 ft	7%
Upland Habitat	Habitat that is rarely flooded, only during extreme conditions	> ULW	> 2.8 ft	0%

Five planting schemas were identified to provide the highest possible environmental benefit in terms of erosion control, habitat diversity, and fetch reduction. The wider (30-foot) terraces will be planted with Bald Cypress (*Taxodium districhum*) trees capable of withstanding rising water levels. The full list of species and quantities is provided in the 95% design plan set.

The final engineered design component is the strategic placement of rock on the exposed perimeter terraces on the project site's north, west, and southern extents. The need for the rock armor was determined through analysis of wind data both from NOAA and ASCE-7-10 50-year return period anticipated 3-second gust values. These values were used to calculate fetch-generated waves at the project site. The calculations performed confirmed that armored protection would be required to protect the proposed terraces from the forces created by wave action. The stone sizes required for these features (Class II rip rap) were calculated following the procedures laid out in the USACE Coastal Engineering Manual (CEM) and Virginia Institute of Marine Science (VIMS) Living Shoreline Design Guidelines for Shore Protection in Virginia's Estuarine Environments. Two calculation methods, Hudson (1974) and Van Der Meer (1988), from the CEM were utilized to evaluate the range of acceptable rock armor for the exposed perimeter. These two methods calculate the armor stone size based on several design inputs including initial wave height, allowable damage level, revetment slope, and breaking versus non-breaking waves. The two methods often result in corresponding values that are used by the engineer to make an experienced determination on the final rock armor sizing. The rock armor will serve as a nature-based design element by acting as a substrate for the Wild Celery grass that has proven to be successful for SAV establishment in Back Bay (see Figure 2).

Figure 2: Example Back Bay SAV experiment; photo courtesy of Virginia Tech.

Monitoring Goals and Objectives

Annual post-construction monitoring of the site is required by the Virginia Marine Resource Commission (VMRC) (TBD) Permit (VMRC #XXXX-XXXX) and the U.S. Army Corps of Engineers (USACE) Individual Permit (NOA-20XX-XXXXX). [Insert details of the relevant permits and permit conditions]. The following goals, objectives, and metrics were established to enable consistent tracking of the primary living shoreline project components across each monitoring year.

1. **Monitoring Goal 1**: Establishment of a Sustainable Coastal Marsh Island System
   a. Objective 1a: Establish Emergent Marsh Habitat
      - Metric: For each monitoring year, the project area should maintain or increase the overall coverage of emergent marsh vegetation. There should be no significant signs of herbivory or invasive species establishment.

   b. Objective 1b: Establish Upland Habitat
      - Metric: For each monitoring year, the project area should maintain or increase the overall coverage of upland vegetation. There should be no significant signs of herbivory or invasive species establishment.
2. **Monitoring Goal 2**: Stability of Marsh Terraces
   a. Objective 2: Marsh Terrace Structures
      - Metric: For each monitoring year, the terrace structures should show no significant signs of damage, deterioration or extreme settlement.
3. **Monitoring Goal 3**: Establishment of a Sustainable SAV Community
   a. Objective 3: Establish SAV Communities

- Metric: For each monitoring year, the SAV planting areas should maintain or increase the overall coverage of SAV vegetation. There should be no significant signs of herbivory or invasive species establishment.

MONITORING PLAN

The monitoring plan includes stakeholders, a schedule for the annual monitoring inspections, the monitoring strategy/sampling plan, and approach for addressing any needs for maintenance.

Monitoring Stakeholders

An Environmental Scientist from Dewberry Engineers Inc. will perform the annual monitoring inspections and provide a copy of the monitoring report to the City of Virginia Beach, USACE, VDEQ, VMRC, and the City of Virginia Beach Wetlands Board as necessary. As owners of the project, the City of Virginia Beach will review monitoring recommendations and perform corrective actions as necessary.

Annual Inspection Schedule

Monitoring inspections should be conducted annually, during the peak growing season, which is defined by VMRC as between June and August. To enable consistent tracking of project performance from year to year, annual monitoring inspections will be conducted prior to the end of the growing season in September of each year, with annual reports to be submitted to regulatory stakeholders prior to November 30th [or an annual date defined in the permit conditions] of each year. The following outlines the monitoring inspection schedule and deliverables.

Phase 1 Post-Construction As-Built Report (Date: Prior to December 31st, 2025)

To serve as a baseline for the post-construction annual monitoring, an as-built report for the Phase 1 terraces will be completed following the construction of each phase of terraces and submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following.

- Coordinates and diagrams of established transects, as well as site photographs from photo stations 1-40 as defined in the Methods section.
- Final location of all planted vegetation (upland plantings, high marsh plantings and low marsh plantings).
- Final grade topographic surveys (plan, profile, and cross sections).
- Discussion of the project design versus as-built conditions.

Phase 2 Post-Construction As-Built Report (Date: Prior to December 31st, 2026)

To serve as a baseline for the post-construction annual monitoring, an as-built report for the Phase 2 terraces will be completed following the construction of each phase of terraces and submitted to the

City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following.

- Coordinates and diagrams of established transects, as well as site photographs from photo stations 41-80 as defined in the Methods section.
- Final location of all planted vegetation (upland plantings, high marsh plantings and low marsh plantings).
- Final location and extent of SAV plantings.
- Final grade topographic surveys (plan, profile, and cross sections).
- Discussion of the project design versus as-built conditions.

Year 1a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2026)

At the end of the first full growing season following planting of the Phase 1 terraces, a Year 1a monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 40 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 1 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion; it is anticipated that the wetland planting contractor will provide a one-year post construction maintenance and guarantee period for the wetland plantings.

Year 1b/2a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2027)

At the end of the first full growing season following planting of the Phase 2 terraces following planting, and the second full growing season of the Phase 1 terraces, a Year 1b/2a monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 1 conditions (for Phase 2 terraces) and to Year 2 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).

- Estimated percent cover and change in coverage from planted conditions to Year 1 conditions for SAV planting quadrants
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion; it is anticipated that the wetland planting contractor will provide a one-year post construction maintenance and guarantee period for the wetland plantings.

Year 2b/3a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2028)

At the end of the second full growing season of the Phase 2 terraces following planting, and the third full growing season of the Phase 1 terraces, a Year 2b/3a monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 2 conditions (for Phase 2 terraces) and to Year 3 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- Estimated percent cover and change in coverage from planted conditions to Year 2 conditions for SAV planting quadrants
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

Year 3b/4a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2029)

At the end of the third full growing season of the Phase 2 terraces following planting, and the fourth full growing season of the Phase 1 terraces, a Year 3b/4a monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 3 conditions (for Phase 2 terraces) and to Year 4 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).

- Estimated percent cover and change in coverage from planted conditions to Year 3 conditions for SAV planting quadrants
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

Year 4b/5a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2030)

At the end of the fourth full growing season of the Phase 2 terraces following planting, and the fifth full growing season of the Phase 1 terraces, a Year 4b/Final (Year 5a) monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 4 conditions (for Phase 2 terraces) and to Year 5 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- Estimated percent cover and change in coverage from planted conditions to Year 4 conditions for SAV planting quadrants
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

Year 5b Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2031)

At the end of the fifth full growing season of the Phase 2 terraces following planting, a Final (Year 5b) monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 41 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 5 conditions (for Phase 2 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- Estimated percent cover and change in coverage from planted conditions to Year 5 conditions for SAV planting quadrants

- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

Monitoring Strategy

The monitoring strategy consists of established transects with photo stations and quadrants that cover the area between transects. This approach enables monitoring of the four primary features of the living shoreline: uplands, low-marsh plantings, high-marsh plantings, and SAV*.

*Note: The planting scheme for SAV has not yet been established but it is anticipated that some SAV will be planted along the submerged portions of the marsh terraces. If more suitable planting locations are determined to be between terraces, separate transects will be established and sampled to track SAV survival apart from the proposed terrace transects.

Transects/Photo Points

A total of eighty (80) transects will be established across the project site, with 10 transects located along each of 8 terraces. Transects will span perpendicular to the length of each terrace from the ridge to the edge of the planted/vegetated area. See Figures 3 and 4 for graphic depictions of the proposed transect locations and layouts. Terraces were selected using a random stratified method to ensure representative terraces in each location within the project area (North Interior, North Exterior, South Interior, South Exterior), and of each planting scheme, were represented in the proposed monitoring plan. The selected terraces are as follows:

- North Interior: T-110, T-113
- North Exterior: T-100, T-106
- South Interior: T-124, T-131
- South Exterior: T-123, T-140

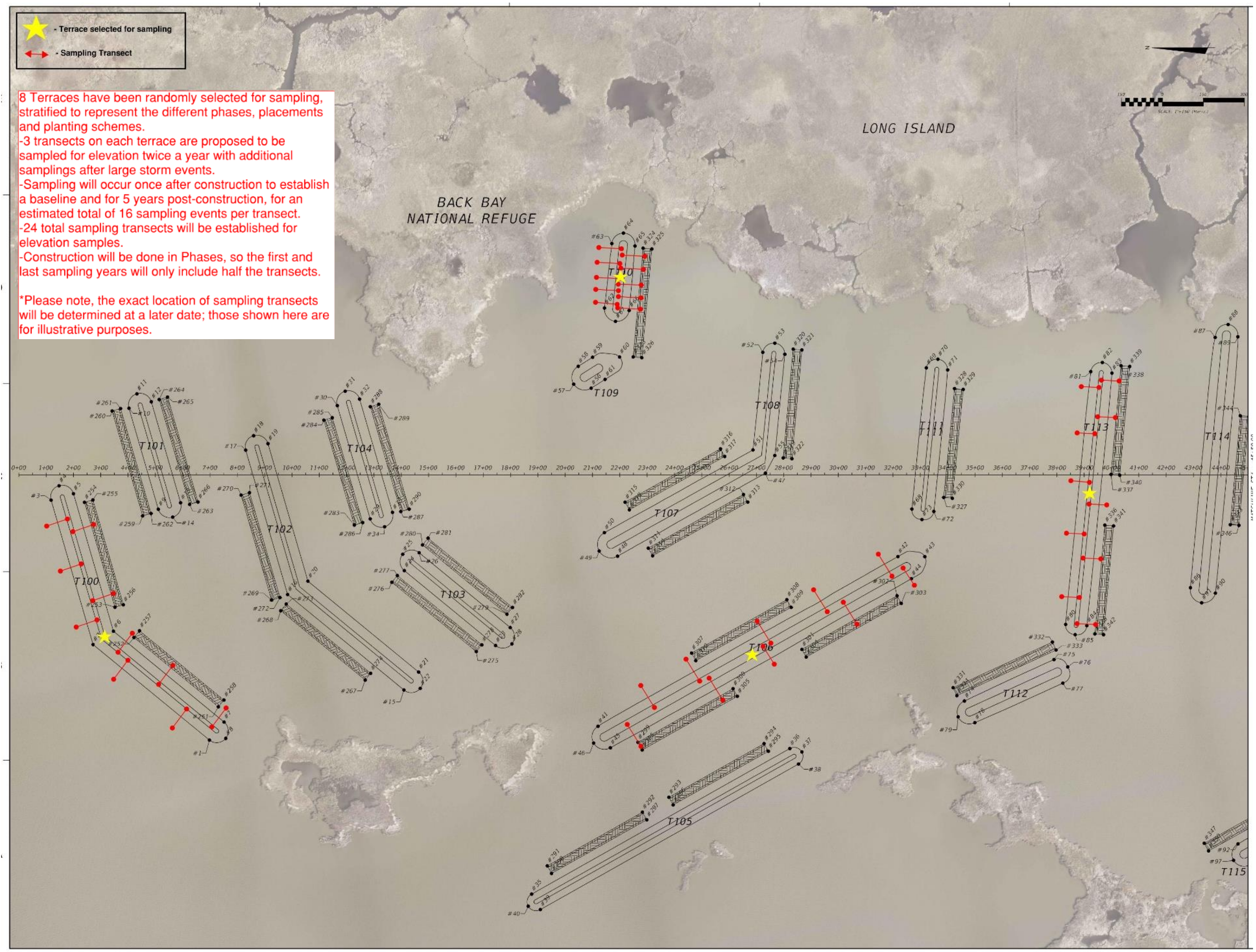

Figure 3: Monitoring design site plan – North Terraces

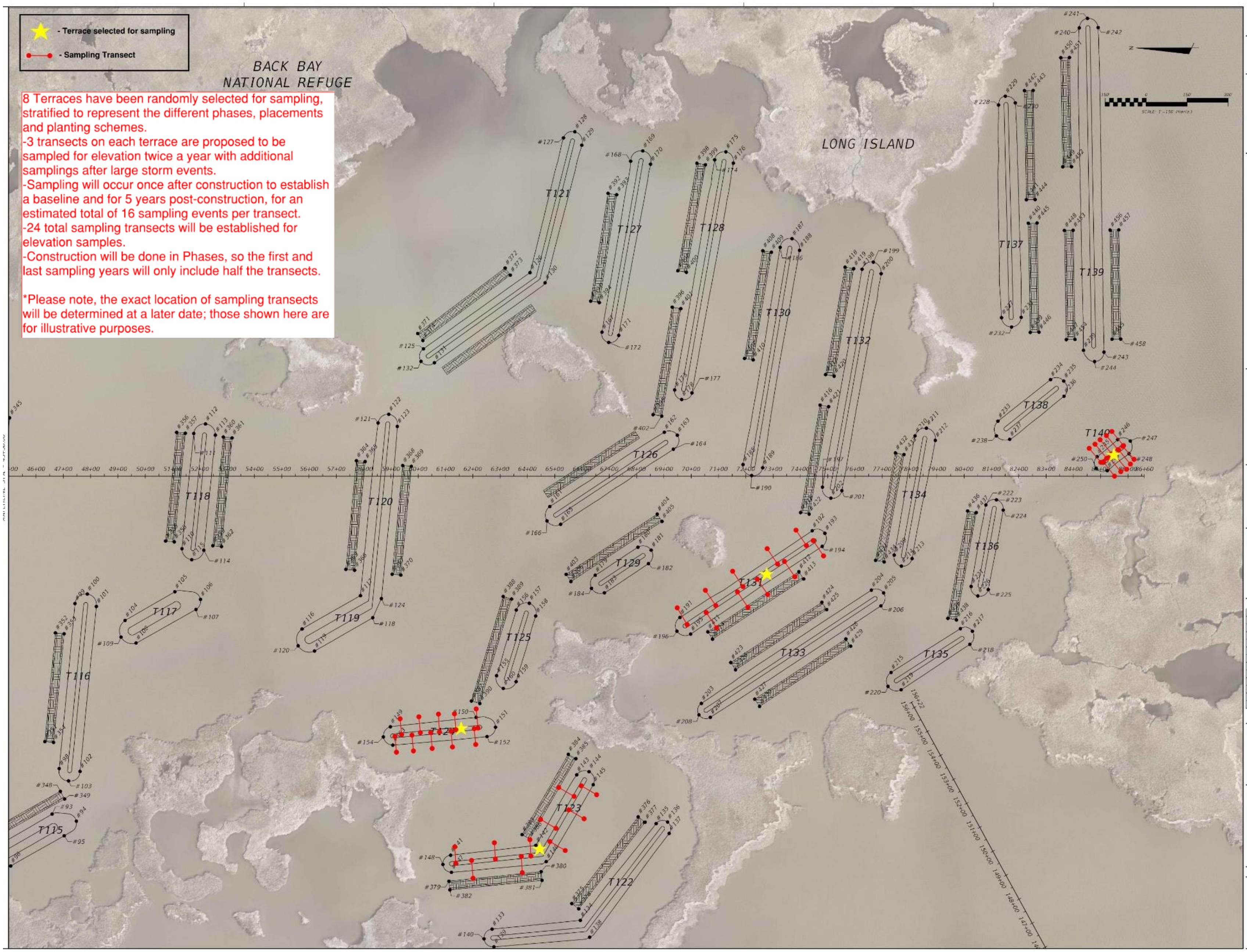

Figure 4: Monitoring design site plan – South Terraces

Permanent photo stations will be established at each quadrant along each transect to capture the design features/established habitats and vegetation. Figure 5 shows the general proposed locations (indicated by the red arrows/labels) for each quadrant and photograph station along each transect. Photos were shot from each photo location on [DATE]. These photos will be collected annually and compiled in Appendix B.

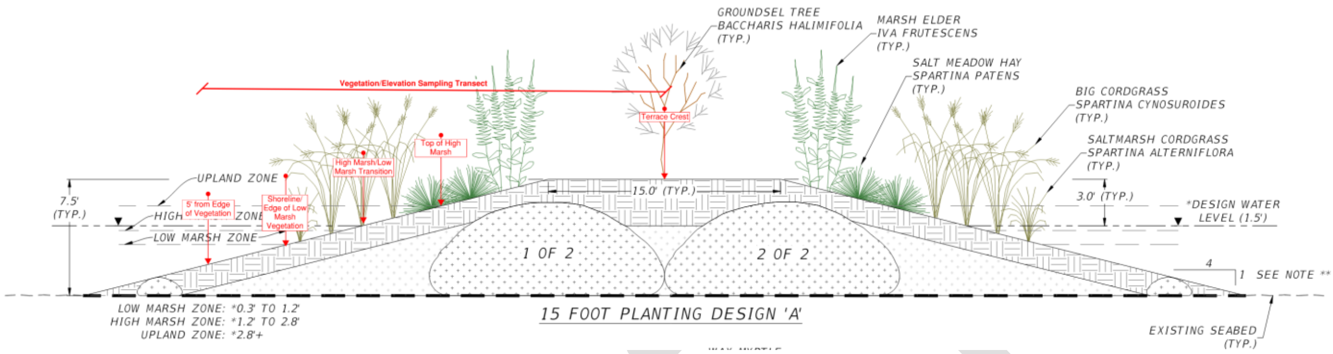

Figure 5: Photo station layout example

Quadrants

To estimate percent cover of vegetation, four (4) quadrants along each of ten (10) transects will be established on the eight selected terraces to allow for estimates of habitat coverage and planting survival. Estimates of coverage and survival were compared to post-construction conditions to evaluate changes.

Further, the following guiding questions were established to monitor overall project performance, presence of invasive species, and identify any needs for maintenance:

1. Are there specific problem areas where plants are dying or appear unhealthy?
2. Were any signs of herbivory observed?
3. Are there any undesirable plant species present?
4. Condition of the terrace structures: Is there any observed settlement, dislodged stone, significant debris etc.?
5. If an updated survey was conducted, are there any significant changes in the profile of the marsh terraces?
6. Does the upland portion of each terrace show any significant signs of erosion or loss of vegetation?

MONITORING RESULTS

Table 2: Low Marsh Vegetation Percent Cover Monitoring Results (Example Table – Terrace 1).

		Estimated Percent Coverage						Percent Change in Coverage (from Baseline)				
Terrace/ Transect	Photo Station Reference	Baseline (2024)	Year 1 (2025)	Year 2 (2026)	Year 3 (2027)	Year 4 (2028)	Year 5 (2029)	Baseline to Year 1	Baseline to Year 2	Baseline to Year 3	Baseline to Year 4	Baseline to Year 5
1 - 1	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 2	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 3	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 4	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 5	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 6	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 7	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 8	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 9	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 10	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
Overall		**Choose an item.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**

Table 3: High Marsh Vegetation Percent Cover Monitoring Results (Example Table – Terrace 1).

		Estimated Percent Coverage						Percent Change in Coverage (from Baseline)				
Terrace/ Transect	Photo Station Reference	Baseline (2024)	Year 1 (2025)	Year 2 (2026)	Year 3 (2027)	Year 4 (2028)	Year 5 (2029)	Baseline to Year 1	Baseline to Year 2	Baseline to Year 3	Baseline to Year 4	Baseline to Year 5
1 - 1	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 2	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 3	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 4	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 5	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 6	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 7	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 8	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 9	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 10	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
Overall		**Choose an item.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**

Table 4: General Observations for Wetland Planting Areas on the Marsh Terraces (Example Table – Terrace 1)

Monitoring Questions	Terrace/Transect									
	1 - 1	1 - 2	1 - 3	1 - 4	1 - 5	1 - 6	1 - 7	1 - 8	1 - 9	1 - 10
Are there specific problem areas where plants are dying or appear unhealthy?	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.
Were any herbivory issues observed?	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.
Are there any undesirable plant species present?	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.
If updated survey was conducted, are there any significant changes in the profile of the living shoreline system?	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.

Table 5: General Observations for the Unplanted Structural Components of the Marsh Terraces (Example Table – Terrace 1)

Terrace/Transect										
Monitoring Questions	1 - 1	1 - 2	1 - 3	1 - 4	1 - 5	1 - 6	1 - 7	1 - 8	1 - 9	1 - 10
Are there any structural issues with the planted terrace structures (e.g. observed settlement, loss of topsoil, etc.)?	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☒ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.
Is there any observed growth in SAV on or adjacent to the marsh terraces?	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☒ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.

Are there any structural issues with the rock armoring on the terraces (e.g. observed settlement, dislodged stone, significant debris, etc.)?	YES ☐ NO ☒ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☒ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.

MAINTENANCE RECOMMENDATIONS

The following table outlines the recommendations for maintenance, including estimated quantities and specific guidance, based on the results of the [YEAR] monitoring results.

Table 6: Maintenance Recommendations Checklist

Design Feature/ Monitoring Objective	Maintenance Elements	Location & Estimated Quantity	Specific Guidance
Terrace Upland and Wetland Habitats and Wetland Soils – Monitoring Objectives 1a/1b	☐ Replace plants	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Add new plants	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Remove debris	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Remove invasive vegetation	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Add sand to eroding areas	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Replace waterfowl barrier	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.

Design Feature/ Monitoring Objective	Maintenance Elements	Location & Estimated Quantity	Specific Guidance
Terrace Structures & Stone Armoring, Monitoring Objective 2a/2b	☐ Re-place dislodged stones	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Add additional stone to address settlement	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Remove debris	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Repair sand cores or other structural elements	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
SAV Establishment, Monitoring Objective 3	☐ Replace plants	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Add new plants	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.

APPENDIX A: AS-BUILT PLANS

[Page left intentionally blank; as-built plans will be included in the Year 1 monitoring report]

APPENDIX B: MONITORING PHOTOGRAPHS

Table 7: Terrace 1 Transect 1 Photographs

Photograph from Photo Location 1A	Photograph from Photo Location 1B
Photograph from Photo Location 1C	Additional photos of any problem areas.

Table 8: Terrace 1 Transect 2 Photographs

Photograph from Photo Location 2A	Photograph from Photo Location 2B
Photograph from Photo Location 2C	Additional photos of any problem areas.

Table 9: Terrace 1 Transect 3 Photographs

Photograph from Photo Location 3A	Photograph from Photo Location 3B
Photograph from Photo Location 3C	Additional photos of any problem areas.

Table 10: Terrace 1 Transect 4 Photographs

Photograph from Photo Location 4A	Photograph from Photo Location 4B
Photograph from Photo Location 4C	Additional photos of any problem areas.

Table 11: Terrace 1 Transect 5 Photographs

Photograph from Photo Location 5A	Photograph from Photo Location 5B
Photograph from Photo Location 5C	Additional photos of any problem areas.

Table 12: Terrace 1 Transect 6 Photographs

Photograph from Photo Location 6A	Photograph from Photo Location 6B
Photograph from Photo Location 6C	Additional photos of any problem areas.

Table 13: Terrace 1 Transect 7 Photographs

Photograph from Photo Location 7A	Photograph from Photo Location 7B
Photograph from Photo Location 7C	Additional photos of any problem areas.

Table 14: Terrace 1 Transect 7 Photographs

Photograph from Photo Location 7A	Photograph from Photo Location 7B
Photograph from Photo Location 7C	Additional photos of any problem areas.

Table 15: Terrace 1 Transect 8 Photographs

Photograph from Photo Location 8A	Photograph from Photo Location 8B
Photograph from Photo Location 8C	Additional photos of any problem areas.

Table 16: Terrace 1 Transect 9 Photographs

Photograph from Photo Location 9A	Photograph from Photo Location 9B
Photograph from Photo Location 9C	Additional photos of any problem areas.

Table 17: Terrace 1 Transect 10 Photographs

Photograph from Photo Location 9A	Photograph from Photo Location 9B
Photograph from Photo Location 9C	Additional photos of any problem areas.

Dewberry®

2023 Virginia Community Flood Preparedness Fund

Marsh Restoration in Back Bay, Virginia Beach

CITY OF VIRGINIA BEACH

Table of Contents

Appendix A – Application Form

Applicants must have prior approval from the Department to submit <u>applications, forms, and supporting documents by mail in lieu of the WebGrants portal.</u>

Appendix A: Application Form for Grant and Loan Requests for All Categories

Virginia Department of Conservation and Recreation
Virginia Community Flood Preparedness Fund Grant Program

Name of Local Government:

Category Being Applied for (check one):

☐ **Capacity Building/Planning**

☑ **Project**

☐ **Study**

NFIP/DCR Community Identification Number (CID) 515531

Name of Authorized Official and Title: Toni Utterback, Stormwater Engineering Center Administrator

Signature of Authorized Official: Katie E Shannon for Toni Utterback

Mailing Address (1): 2875 Sabre Street, Suite 250

Mailing Address (2): ______________________

City: Virginia Beach **State:** Virginia **Zip:** 23452

Telephone Number: (757) 385-8746 **Cell Phone Number:** (____) ______________

Email Address: TPUtterback@vbgov.com

Contact and Title (If different from authorized official): C.J. Bodnar, Technical Services Program Manager

Type text here

Mailing Address (1): 2875 Sabre Street, Suite 250

Mailing Address (2): ______________________________

City: Virginia Beach **State:** Virginia **Zip:** 23452

Telephone Number: (757) 385-8430 **Cell Phone Number:** (____) ________________

Email Address: CBodnar@vbgov.com

Is the proposal in this application intended to benefit a low-income geographic area as defined in the Part 1 Definitions? Yes ____ No ✓

Categories (select applicable activities that will be included in the project and used for scoring criterion):

Capacity Building and Planning Grants

☐ Floodplain Staff Capacity.

☐ Resilience Plan Development

- ☐ Revisions to existing resilience plans and modifications to existing comprehensive and hazard mitigation plans.
- ☐ Resource assessments, planning, strategies, and development.
  - Policy management and/or development.
  - Stakeholder engagement and strategies.

☐ Other: ____

Study Grants (Check All that Apply)

☐ Studies to aid in updating floodplain ordinances to maintain compliance with the NFIP, or to incorporate higher standards that may reduce the risk of flood damage. This must include establishing processes for implementing the ordinance, including but not limited to, permitting, record retention, violations, and variances. This may include revising a floodplain ordinance when the community is getting new Flood Insurance Rate Maps (FIRMs), updating a floodplain ordinance to include floodplain setbacks, freeboard, or other

higher standards, RiskMAP public noticing requirements, or correcting issues identified in a Corrective Action Plan.

- ☐ Revising other land use ordinances to incorporate flood protection and mitigation goals, standards, and practices.
- ☐ Conducting hydrologic and hydraulic (H&H) studies of floodplains. *Changes to the base flood, as demonstrated by the H&H must be submitted to FEMA within 6 months of the data becoming available.*
- ☐ Studies and Data Collection of Statewide and Regional Significance.
- ☐ Revisions to existing resilience plans and modifications to existing comprehensive and hazard.
- ☐ Other relevant flood prevention and protection project or study.

Project Grants and Loans (Check All that Apply – Hybrid Solutions will include items from both the "Nature-Based" and "Other" categories)

Nature-based solutions

- ☐ Acquisition of property (or interests therein) and/or structures for purposes of allowing floodwater inundation, strategic retreat of existing land uses from areas vulnerable to flooding; the conservation or enhancement of natural flood resilience resources; or acquisition of structures, provided the acquired property will be protected in perpetuity from further development, <u>and where the flood mitigation benefits will be achieved as a part of the same project as the property acquisition.</u>
- ☑ Wetland restoration.
- ☐ Floodplain restoration.
- ☐ Construction of swales and settling ponds.
- ☑ Living shorelines and vegetated buffers.
- ☐ Permanent conservation of undeveloped lands identified as having flood resilience value by *ConserveVirginia* Floodplain and Flooding Resilience layer or a similar data driven analytic tool, or the acquisition of developed land for future conservation.
- ☐ Dam removal.
- ☐ Stream bank restoration or stabilization.
- ☐ Restoration of floodplains to natural and beneficial function.

Other Projects

- ☐ Structural floodwalls, levees, berms, flood gates, structural conveyances.
- ☐ Storm water system upgrades.
- ☐ Medium and large-scale Low Impact Development (LID) in urban areas.

- ☐ Developing flood warning and response systems, which may include gauge installation, to notify residents of potential emergency flooding events.
- ☐ Dam restoration.
- ☐ Beneficial reuse of dredge materials for flood mitigation purposes
- ☐ Removal or relocation of structures from flood-prone areas where the land will not be returned to open space.
- ☐ Acquisition of property (or interests therein) and/or structures for purposes of allowing floodwater inundation, strategic retreat of existing land uses from areas vulnerable to flooding; the conservation or enhancement of natural flood resilience resources; or acquisition of structures, provided the acquired property will be protected in perpetuity from further development, <u>and where the flood mitigation benefits will **not be** achieved as a part of the same project as the property acquisition.</u>
- ☐ Other project identified in a DCR-approved Resilience Plan.

Location of Project or Activity (Include Maps): Bonney Cove in Back Bay, Virginia Beach

NFIP Community Identification Number (CID#) : 515531

Is Project Located in an NFIP Participating Community? ☑ Yes ☐ No

Is Project Located in a Special Flood Hazard Area? ☑ Yes ☐ No

Flood Zone(s) (If Applicable): Zone VE (EL 5 Feet), Zone AE (EL 4 Feet), Zone Open Water

Flood Insurance Rate Map Number(s) (If Applicable): 5155310215G and 5155310220G

Total Cost of Project: $53,378,490

Total Amount Requested $5,000,000

Amount Requested as Grant $5,000,000

Amount Requested as Project Loan (not including short-term loans for up-front costs) ___________________

Amount Requested as Short-Term loan for Up-Front Costs (not to exceed 20% of amount requested as Grant) __________________________

For projects, planning, capacity building, and studies in low-income geographic areas: Are you requesting that match be waived? □ Yes □ No

<u>Additional Information for Loan Requests</u>
Requested Loan Security: ______________________________

(General Obligation, Lease, Revenue, Special Fund Revenue, and/or Moral obligation from other government entity)

Desired loan term: __________________________________

Since the date of your latest financial statements, did the applicant issue any new debt? ______
(If yes, provide details)

Is there any pending or potential litigation by or against the applicant? ______________

Attach five years of current audited financial statements (FY18-22) or refer to website if posted
(Not necessary for existing VRA borrowers)

Attach FY2024 adopted budget or refer to website

Attach current Capital Improvement Plan

Attach adopted Financial Policies

Attach a list of the ten largest employers in the Applicant's jurisdiction.

Attach a list of the ten largest taxpayers in the Applicant's jurisdiction

Appendix B: Budget Form

Appendix B: Budget Narrative Template

Applicant Name:
Community Flood Preparedness Fund &
Resilient Virginia Revolving Loan Fund
Detailed Budget Narrative
Period of Performance: June 2024 through June 2027
Submission Date: November 12, 2023

	Grand Total State Funding Request	$ 5,000,000
	Grand Total Local Share of Project	$ 38,356,966
National Fish and Wildlife Foundation Grants	Federal Funding (if applicable)	$ 10,021,524
	Project Grand Total	$ 53,378,490
	Locality Cost Match	% 71.85

Breakout By Cost Type	Personnel	Fringe	Travel	Equipment	Supplies	Contracts	Indirect Costs	Other Costs	Total
Federal Share (if applicable)								10,021,524	10,021,524
Local Share								37,330,166	37,330,166
State Share								5,000,000	5,000,000
Pre-Award/Startup								276,800	276,800
Maintenance								750,000	750,000
Total	$	$	$	$	$	$	$	$53,378,490	$ 53,378,490

1. Federal Share represents National Fish and Wildlife Foundation (NFWF) Grants. NFWF is not a federal agency.
2. Local Share represents the total project cost less design and implementation (monitoring and initial maintenance) costs.
3. State Share represents the CFPF grant request.
4. Pre-Award costs represent project design costs.
5. Maintenance costs represent implementation (monitoring and initial maintenance costs).

Scope of Work Narrative

Introduction

The City of Virginia Beach ("City") is pleased to submit the Marsh Restoration in Back Bay project for consideration under the Flood Prevention and Protection Projects category in the 2023 Virginia Community Flood Preparedness Fund. The City has made significant investments in the study of historical flooding data, current and future hydrology, and the projected increase in flood frequency due to changing rainfall patterns and sea level rise. These studies culminated in Virginia Beach's Resilience Plan, socialized as "Sea Level Wise,"[1] which includes a conceptual suite of projects focused on flood control and resilience. The Virginia Beach Resilience Plan leverages four overarching adaptation strategies to identify actionable projects for each of the City's four unique major watersheds. This project represents the first adaptation project to advance to construction to implement the City's Resilience Plan.

The adaptation strategy for the Southern Rivers Watershed, which includes Back Bay, is presented in Figure 1. The strategy focuses on employing natural mitigation methods, an integrated system of defense structures, and complementary measures, such as land-use strategies. Collectively these approaches are designed to strategically reduce flow into and within Back Bay and improve flood storage and overall coastal resiliency. Marsh restoration was identified as a key resilience-building strategy as part of an extensive evaluation of structural and non-structural alternatives. Marsh restoration provides multiple benefits of flood risk reduction, enhanced habitat, and improved water quality.

As part of the Virginia Coastal Resilience Master Planning Framework, a precursor to the first phase of the Virginia Coastal Resilience Master Plan (CRMP), the Commonwealth of Virginia identified guiding principles for a statewide resilience strategy. One of these guiding principles is recognizing the importance of protecting and enhancing natural infrastructure and prioritizing nature-based infrastructure.[2] The City's marsh restoration project aligns with this principle and was highlighted as an exemplary nature-based project in the CRMP (refer to pages 178-179).[3]

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[1] City of Virginia Beach (2020). Virginia Beach Sea Level Wise Adaptation Strategy (Website).
[2] Office of Governor Ralph S. Northam Commonwealth of Virginia. (2020). Virginia Coastal Resilience Master Planning Framework (PDF).
[3] Office of Governor Ralph S. Northam Commonwealth of Virginia. (2021). Virginia Coastal Resilience Master Plan Phase 1 (PDF).

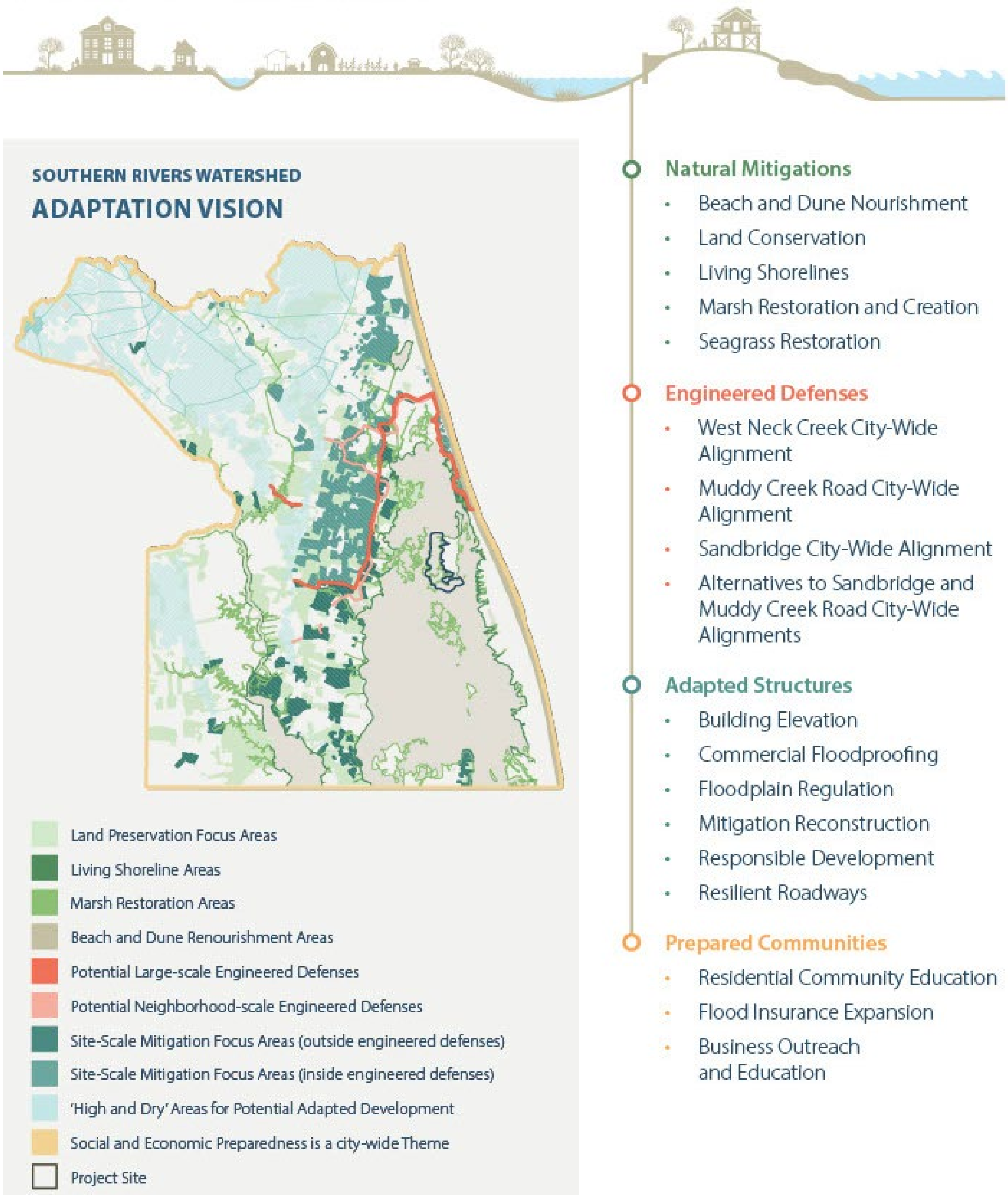

Figure 1: Adaptation Vision for the Southern Rivers Watershed.

Hydraulic modeling analysis identified Bonney Cove as a location where marsh restoration has the potential to reduce the propagation of floodwater through key pathways within Back Bay (Figure 2). The City prioritized this project as the first to advance to construction due to its significant benefits to community and habitat resilience.

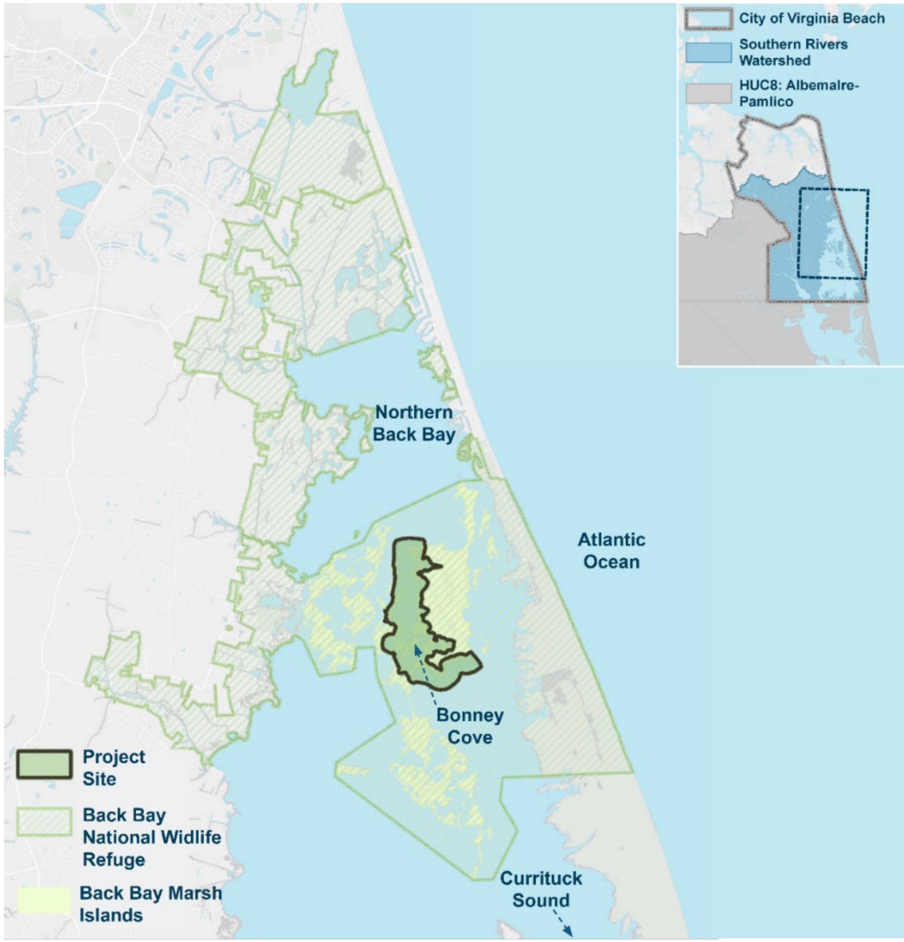

Figure 2: Project site location map.

This project represents a collaborative effort between the City's Department of Public Works alongside other City departments, public constituents, local nonprofits, and state and federal agencies. In selecting the project location and developing the design approach, the City has coordinated closely with the Back Bay National Wildlife Refuge (BBNWR), part of the U.S. Fish and Wildlife Service (USFWS), and the Virginia Department of Wildlife Resources (VDWR). Environmental organizations committed to stewardship of Back Bay have also contributed input throughout the design process, including the Back Bay Restoration Foundation (BBRF), Friends of Back Bay, the Back Bay National Wildlife Refuge Society, and the Albemarle-Pamlico National Estuary Partnership (APNEP). Project field investigations involved local support from Old Dominion University (ODU) and others, and outside expertise from Louisiana. The National Fish and Wildlife Foundation (NFWF) provided grant funding under the National Coastal Resilience Fund (NCRF) to support design, permitting, and environmental assessments. Broad support of the project is demonstrated by contributions from the organizations noted above along with other stakeholders engaged in the restoration effort.

Needs and Problems

Specific Problem Being Solved – Habitat Degradation and "Wind Tide" Flooding

Marshes are vital to the Southern Rivers Watershed for the ecological and flood reduction benefits they provide. The Southern Rivers Watershed contains 90% of the City's land area under an elevation of three feet, making this area particularly susceptible to flood impacts. As illustrated in Figure 3, sustained southerly winds push water up from the Albemarle-Pamlico Sound through the Currituck Sound and into Back Bay, creating a phenomenon referred to locally as "wind tide flooding". Marsh habitat loss has contributed to the opening of a secondary channel in Bonney Cove that has increased water flow during wind tide and other flood events to areas with high community exposure.

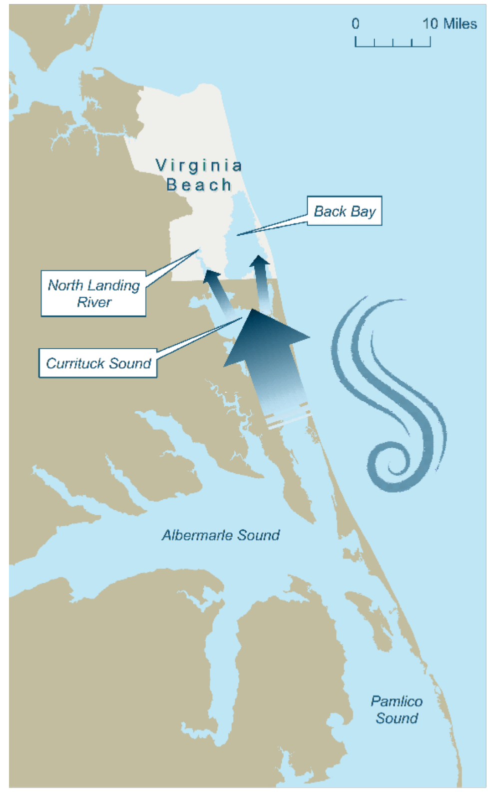

Figure 3: Flood pathways in the Southern Rivers Watershed.

Within today's marsh system, it takes between two to five days of sustained southerly winds to cause flooding, depending on the wind speed and direction. Over the last four years, more than five wind tide flooding events have occurred in this area. The increasing frequency of flooding events is primarily attributed to a foot of relative sea level rise in the last 50 years and degradation of marsh and seagrass habitat.

This marsh restoration project aims to address the challenges of habitat degradation and "wind tide" flooding by stabilizing two critically eroding marsh islands, decreasing turbidity to promote the growth of aquatic vegetation, and providing flood risk reduction benefits through increased friction and wave attenuation.

Factors Contributing to the Identified Problem

This growing flood risk in the Southern Rivers Watershed can be attributed mainly to the reduced friction in the water column from the increased water depth and eroded vegetation, which allows water to move more quickly through key hydraulic pathways. Another term for this is "fetch", which is defined as the open water distance over which a given wind can blow and generate higher waves without obstruction. Unmitigated, the continued loss of these marsh island systems and aquatic vegetation is expected to result in more frequent and intense wind tide flooding events.

Emergent Marsh Degradation

Approximately 50% of former marshland at the site (260 acres) has eroded into open water leading to the opening of a wide secondary channel ("Bonney Cove") that is about two miles

long and half a mile wide (Figure 4). The southern exposed edge of the adjacent marsh islands is exposed to approximately 1.5 miles of fetch in the predominant wind direction.

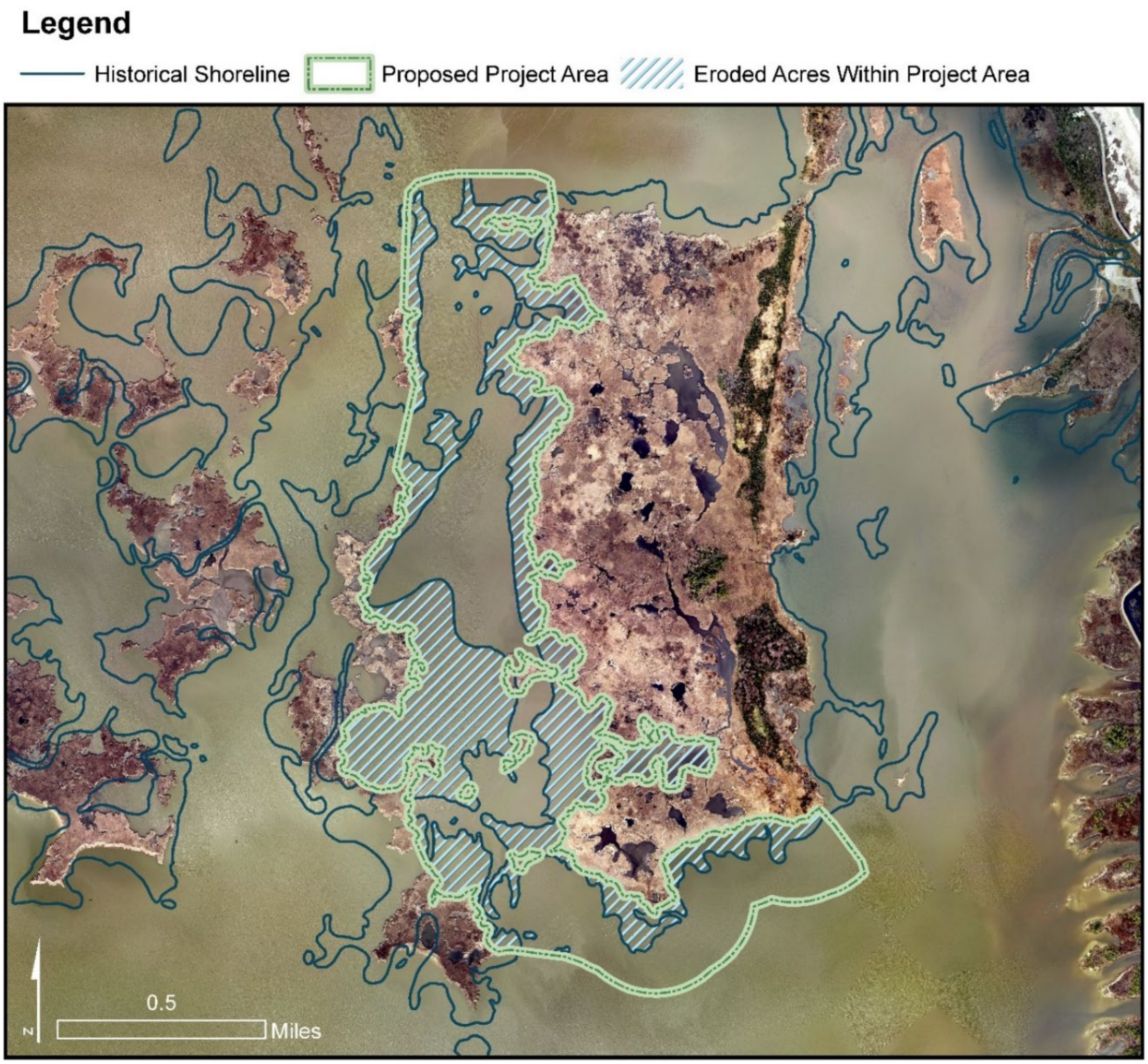

Figure 4: Historical marsh erosion within the project area.

Submerged Aquatic Vegetation (SAV) Loss

SAV used to be abundant at the site (around 45% coverage, overall) but is now extremely sparse, ranging from 0% to 10% coverage across the site, on average. Field studies conducted by the VDWR show that wind-driven waves and high flow velocities are the primary drivers of this loss, particularly in the last 5 years as shown in Figure 5.

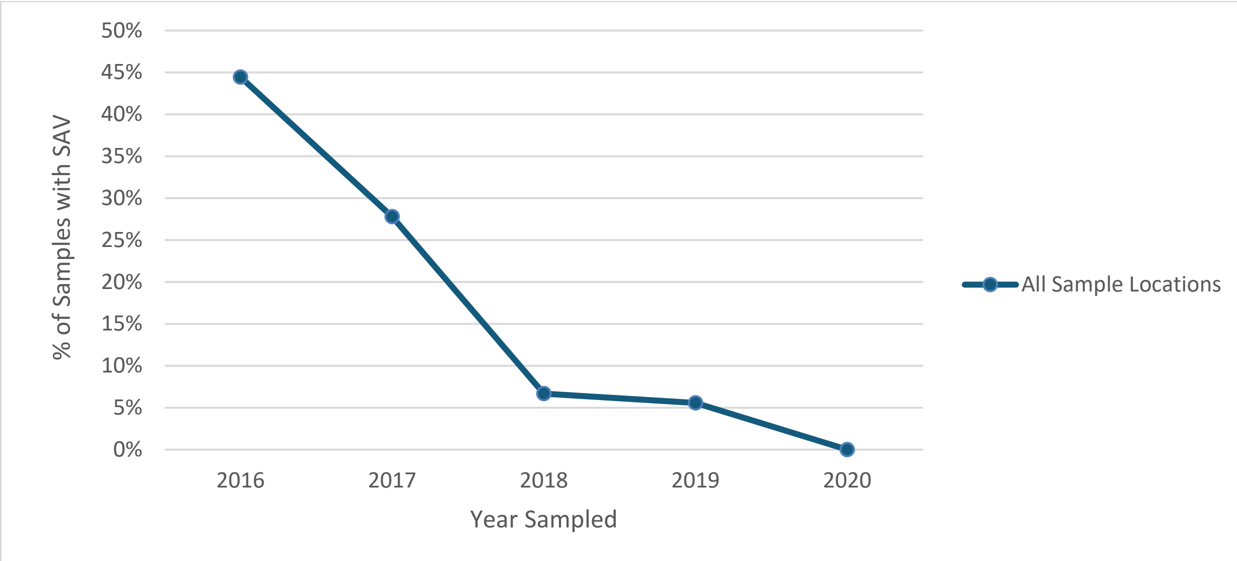

Figure 5: SAV sampling data from VDWR within the project vicinity.

Why is the Project Needed Locally/Regionally?

Pilot Project

The City's design concept for the marsh restoration project leverages "marsh terracing," an innovative coastal engineering technique widely used in Texas and Louisiana to convert shallow subtidal bottom to marsh. This technique has not yet been implemented along the U.S. East Coast and has not yet been implemented in the Mid-Atlantic region. Through the export of proven expertise from successful marsh terraces, this project would lay the foundation for future projects in the region, Virginia, and other states along the East Coast. The project would document detailed cost estimates, demonstrate effective construction practices for large-scale marsh creation projects, identify best sources for local/regional materials, and establish partnerships with permitting officials at various levels of government. The City has outlined a preliminary sequencing plan for marsh island restoration projects in Back Bay to strategically close hydraulic pathways and address priority restoration areas as shown in Figure 6. Some of these projects would require coordination with the State of North Carolina to realize its broader resilience efforts.

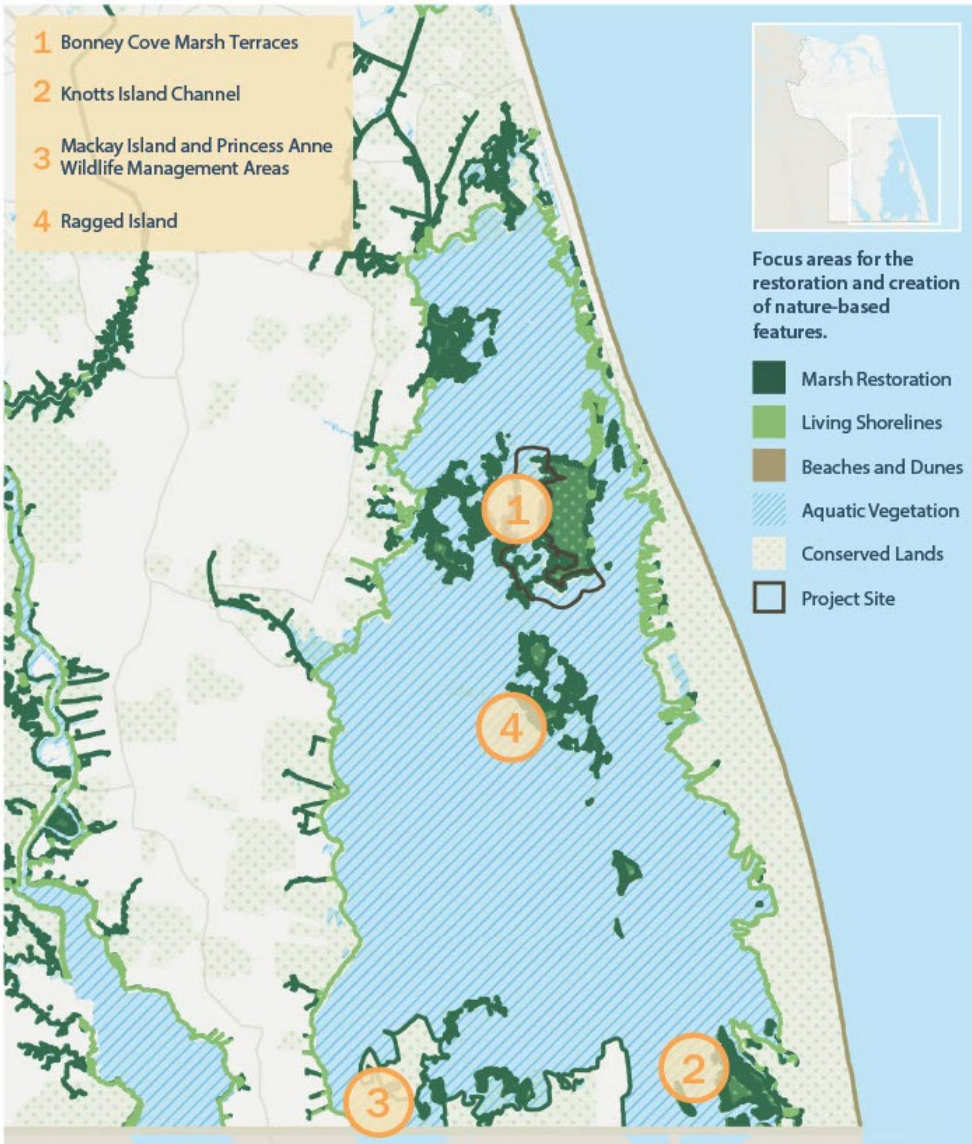

Figure 6: Preliminary Sequencing Restoration Plan.

Virginia Coastal Resilience Master Plan Exemplary Project

The CRMP impact assessment shows a high vulnerability of nature-based features to coastal flood hazards that is consistent with the City's analysis. In the Hampton Roads region, the CRMP impact assessment estimates a decrease from 40,600 acres to 2,940 acres of tidal wetlands by 2080, representing a 93% decline in tidal wetlands.[4] Back Bay was identified as a hotspot for tidal wetland loss, emphasizing the critical location of the City's marsh restoration effort. Specifically, the Virginia CRMP impact assessment shows that portions of tidal wetlands within the project area have "High" and "Very High" impact levels, which indicates areas of tidal marsh

[4] Office of Governor Ralph S. Northam Commonwealth of Virginia and Virginia Department of Conservation and Recreation (2021). Virginia Coastal Resilience Master Plan Phase 1 (PDF).

that are anticipated to be lost through inundation causing conversion to open water (Figure 7).

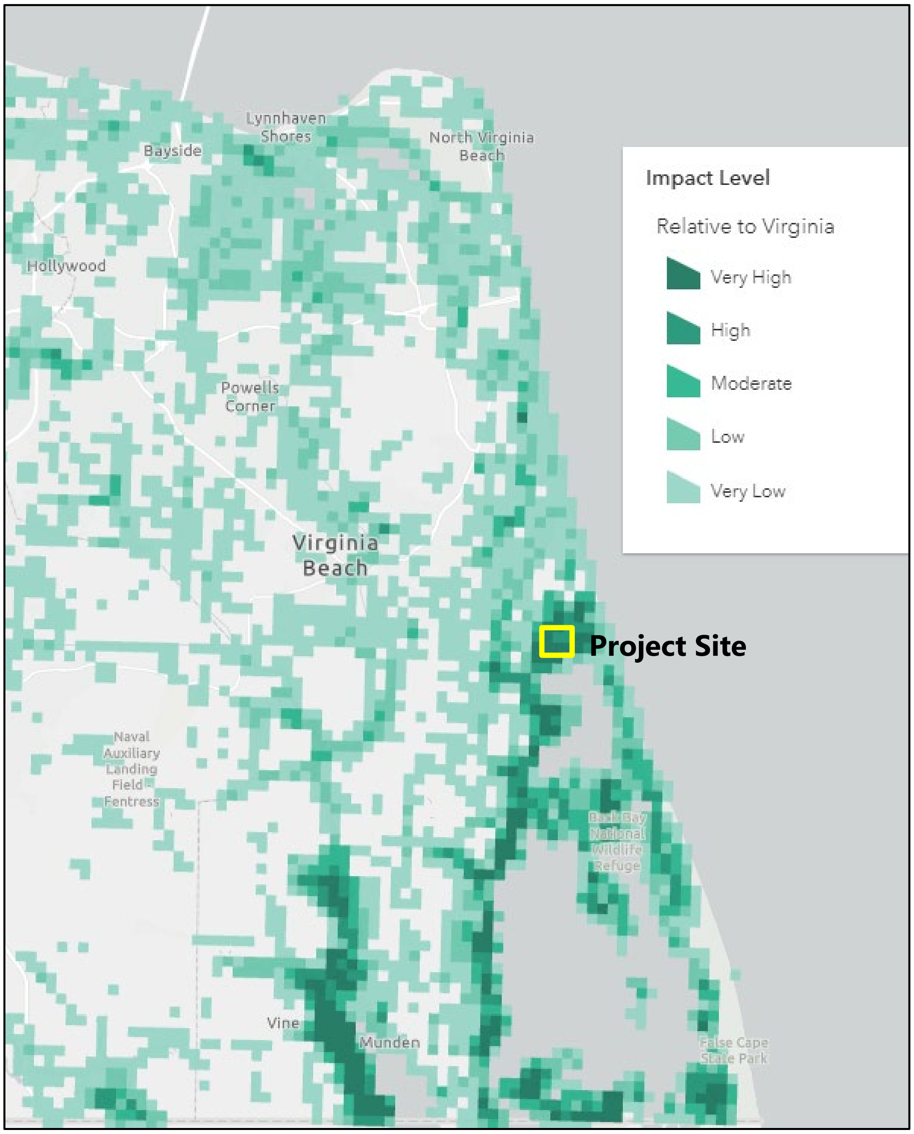

Figure 7: Virginia CRMP Impact Assessment for Tidal Wetlands.

Currituck Sound Coalition High Priority Area

In coordination with Audubon North Carolina, the Currituck Sounds Coalition designated the project site as a High Priority Area for restoring and enhancing vulnerable and degraded marshes with "high flood risk reduction benefits and habitat value" as shown in Figure 8[5].

[5] Audubon North Carolina. (2021). Currituck Sound Coalition Marsh Conservation Plan. (PDF)

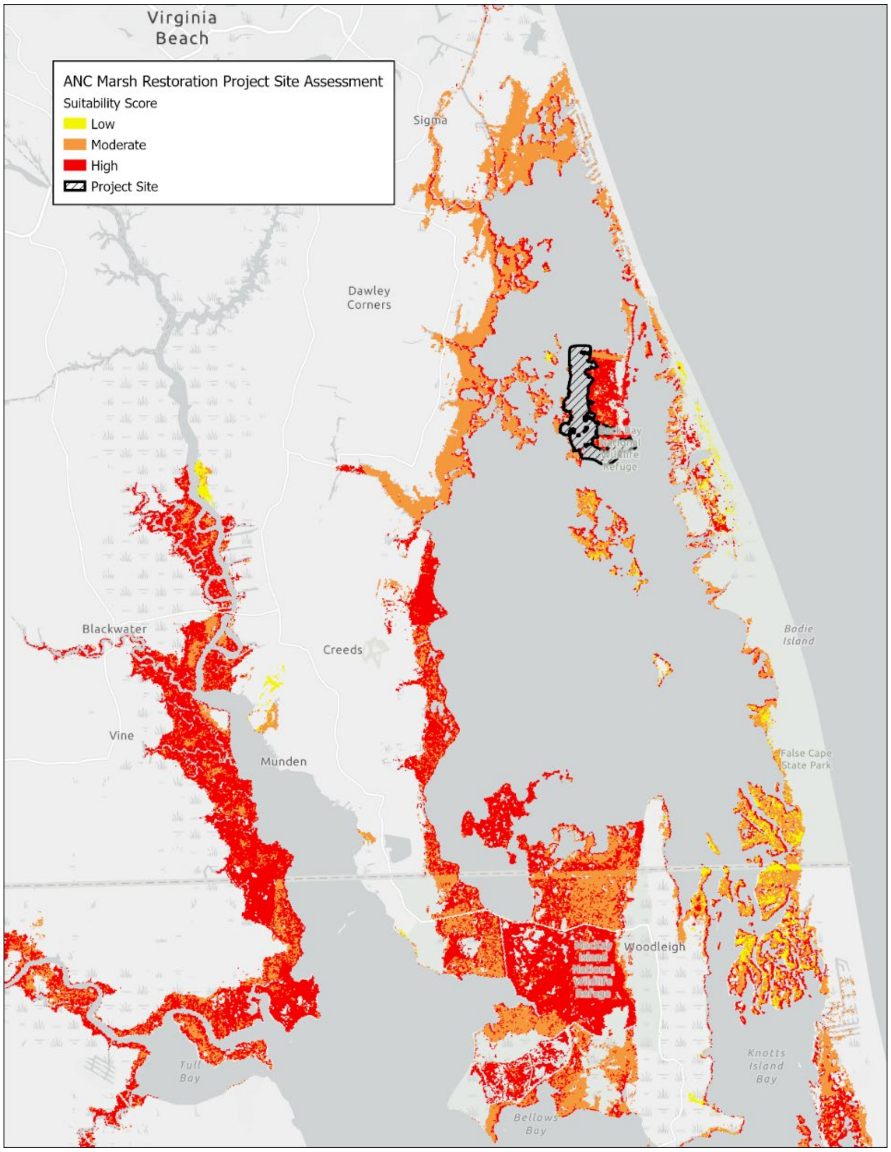

Figure 8: Audubon North Carolina Marsh Restoration Project Site Assessment

Ecological Core for Flood Resilience

The Virginia Department of Conservation and Recreation Natural Heritage Data Explorer provides data from ConserveVirginia v3.0 and other data to support conservation planning. The following map in Figure 9 displays Ecological Cores and the Floodplains and Flooding Resilience Category layer (blue polygon) from ConserveVirginia. The project area contains "High" (C3) and "General" (C5) Ecological Cores and is within the boundaries of the Floodplain and Flooding Resilience area.

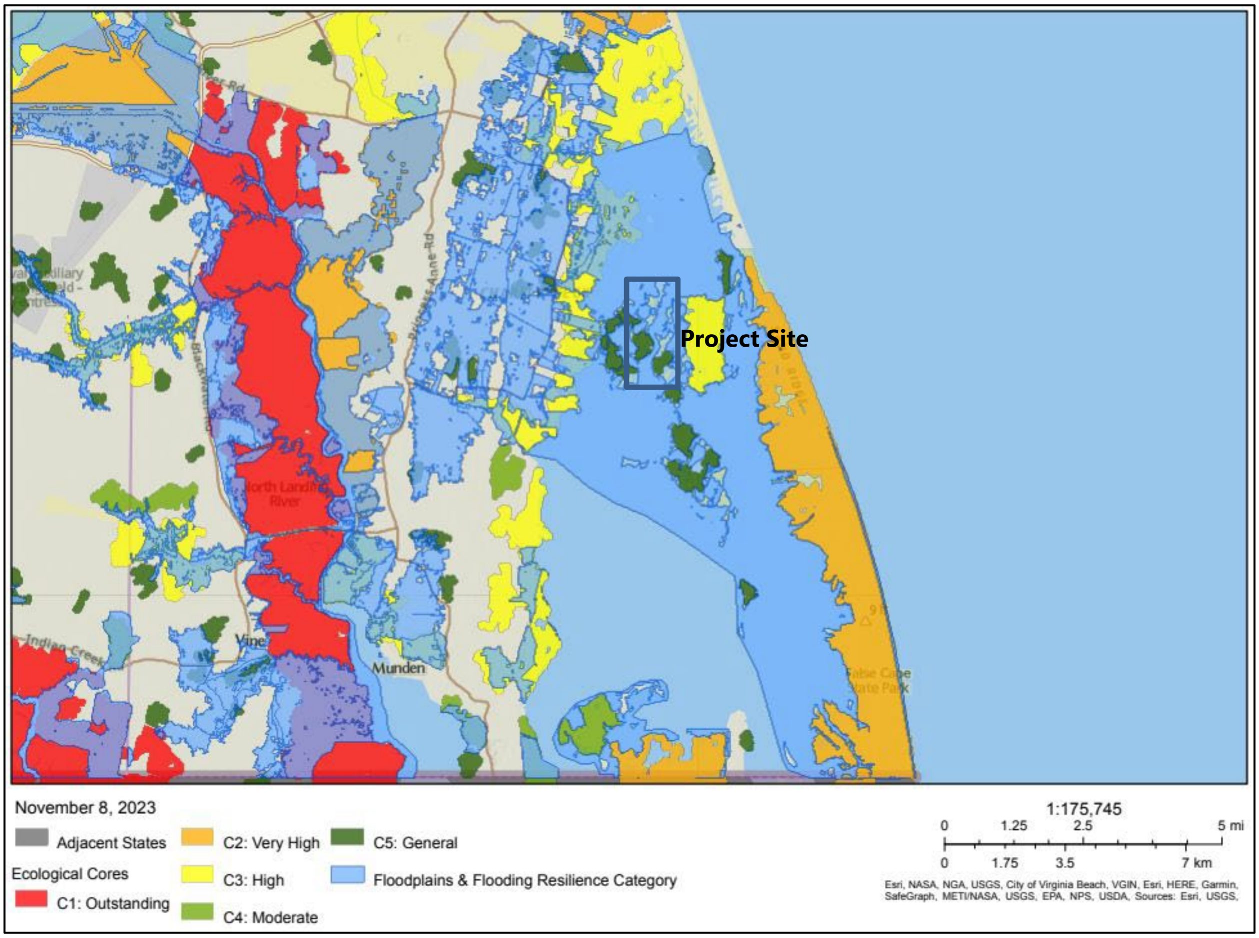

Figure 9: Virginia Natural Heritage Data Explorer Ecological Cores and ConserveVirginia Data.

The safety threats, or environmental concerns related to flood risk.

The City's risk assessment forecasts that approximately 70% of the remaining marsh (730 acres) surrounding the project site will convert to open water with three feet of sea level rise if unmitigated. Fragmentation of this adjacent marsh would result in about eight miles of fetch acting on the southern extent of the site in the predominant wind direction. Without these central marsh islands, the northern shorelines of Back Bay would be exposed to 12 miles of fetch from the Knotts Island Channel at the Virginia-North Carolina boundary. This condition would leave the fringing marshes highly vulnerable to accelerated erosion.

How does the project decrease the risk to public safety through flood risk reduction?

Construction of the forty-one individual marsh terraces, totaling 27,000 linear feet (a 51-acre footprint), across Bonney Cove offers a nature-based technique that will stabilize and protect the marsh island in the center of the bay and reduce erosion of the fringing marsh systems to the north. Numerical modeling was leveraged to quantify specific erosion reduction benefits of the project for wave heights and flow velocities:

- **Wave Height Reduction**: The marsh terraces are expected to reduce wave heights within the project site by approximately 45%. This reduction is consistent with other field studies, which have found that average wave heights within two terraced sites were 37% to 48% lower than those observed at the reference site (Brasher 2015). Wave energy reduction is anticipated to increase the potential for sediment deposition on the terraces' leeward side, leading to the growth of new emergent marsh and reducing erosion of adjacent marsh. Approximately five miles of marsh island shoreline around Bonney Cove will benefit directly from the erosion reduction associated with the computed wave attenuation.
- **Flow Velocity Reduction**: The marsh terraces reduce flow velocity within the project area. This reduction in velocity will reduce bottom shear stress, decrease turbidity, increase light penetration into the water column and promote the growth of SAV. Reducing bottom shear stress will make conditions more suitable for SAV growth between the terraces. Field studies of marsh terraces in Texas and Louisiana document an approximately 45% to 56% reduction in turbidity and the emergence of SAV in the years following terrace construction (Brasher 2015).
- **Wind Shear Stress Reduction**: Although not included as a parameter within the numerical modeling effort, the bald cypress trees planted on the terraces within the middle of the site are expected to reduce wind speed within the project site. This will further reduce wind-generated waves within the project site on the terraces' leeward and windward sides. Research shows that trees that grow to at least 30 feet at maturity result in lower wind speeds of up to 60 to 150 ft on the windward side and up to 900 ft on the leeward side (USDA).

How does the project protect or conserve natural resources?

The proposed project aims to restore marsh island communities in Bonney Cove that have historically provided environmental and flood reduction benefits to the communities in northern Back Bay. As illustrated in Figure 10, when an intact marsh begins to fragment and convert to open water, fetch increases and enables greater wave energy, increasing marsh erosion rates, and ultimately accelerating conversion to an ever-expanding body of open water. Strategic marsh restoration and creation in Bonney Cove would help mitigate the cycle of marsh island erosion and loss of SAV currently occurring in Back Bay, thereby protecting the remaining marsh islands and reducing fetch and wave energy.

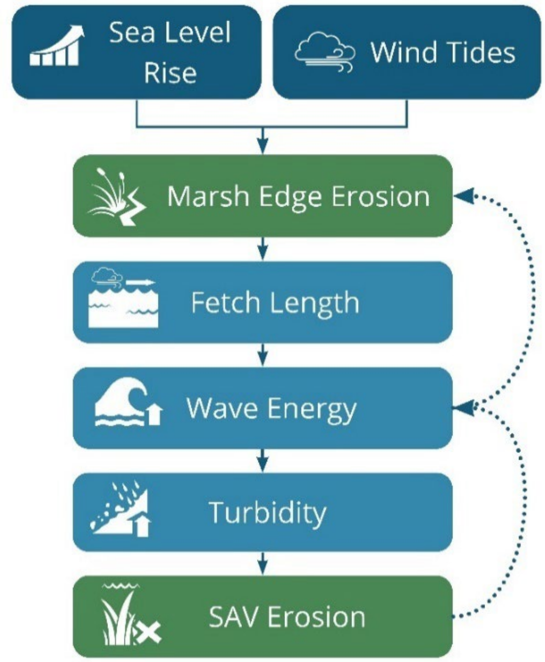

Figure 10: Cycle of marsh erosion, SAV loss, and increased wind-driven flooding.

The primary objective of this project is to create a sustainable coastal marsh island system in Back Bay through reclamation of historically lost marsh habitat and protection of existing marsh complexes from erosion. This restoration effort aims to provide multiple benefits of reduced flood impacts, enhanced fish and wildlife habitat, and improved water quality. The project is designed to achieve the following outcomes:

- Decrease turbidity to create conditions that promote the growth of emergent vegetation and aquatic grasses;
- Maximize habitat value for ecologically important fish and wildlife populations (e.g. Largemouth Bass, Bluegill, Yellow Perch, Striped Bass, Blueback Herring, Alewife, American Eel, etc.); and,
- Reduce fetch, wave heights, and flow velocities to mitigate erosion of fringing marsh systems that provide a buffer for the low-lying neighborhoods and roads that experience frequent flooding in northern Back Bay.

The City selected marsh terracing as the preferred restoration approach because the design is compatible with Back Bay's shallow bottom and the historical loss of habitat. Marsh terraces are narrow, man-made islands placed in shallow open water to restore previous marsh environments. Typically arranged in a chevron pattern, the overall field of marsh terraces dissipates waves, decreases turbidity, and slows down the moving water. The resulting calmer water conditions allow more sunlight to penetrate to the shallow bottom, promoting the establishment and growth of marsh seagrass and ultimately improving habitat quality for fish and wildlife. Further, as opposed to one continuous marsh platform, marsh terraces maximize habitat for a variety of fish and wildlife species, as illustrated in Figure 11.

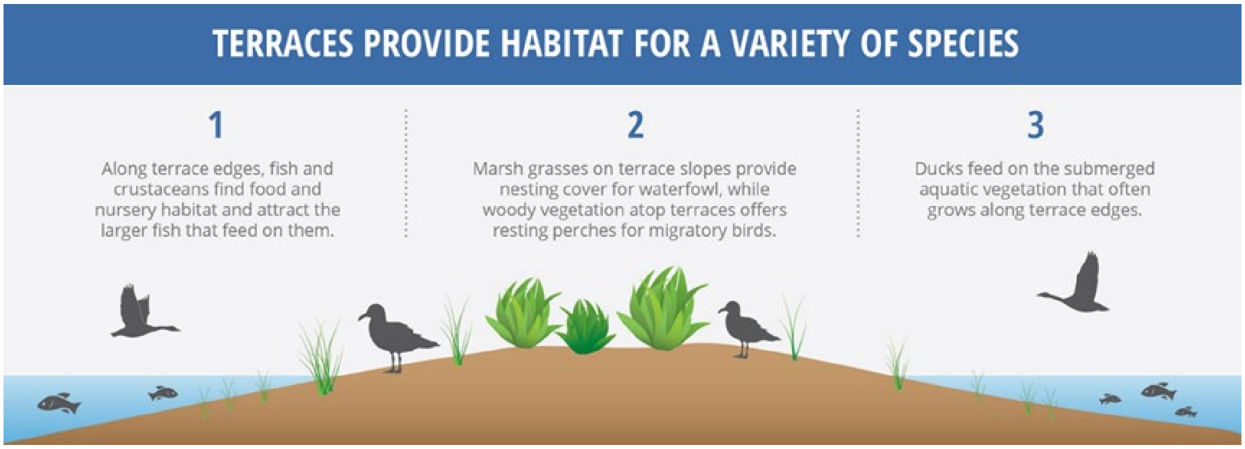

Figure 11: Conceptual diagram of marsh terraces.

Groups to be targeted who might directly benefit from this flood risk reduction effort.

The northern Back Bay communities adjacent to the project area and interested stakeholders have been engaged in the planning effort through public meetings. These meetings provided an opportunity for the community to provide feedback on the 30% and 95% designs and artistic renderings. We anticipate the project to benefit properties and infrastructure assets in northern Back Bay, including the following:

- **Reduce erosion rates along approximately 8 miles of shoreline by reducing wind and wave energy north of the project site.** Most of the properties along this reach of shoreline are not protected by traditional erosion risk reduction measures, such as bulkheads. Maintaining a naturalized shoreline while protecting fringe marsh is a priority of the City and its project partners. This approach will ensure that these marsh systems can migrate landward in response to sea level rise.
- **Reduce flood risk to commercial and residential properties north of the project site.** There are approximately 70 commercial and 2,350 residential structures within the two census block groups surrounding the project site. Around 635 of those structures are vulnerable to flooding during a 50-year event today. With three feet of sea level rise, approximately 2,060 structures are expected to be vulnerable to flooding during a 50-year return period event, representing about 85% of the residential structures within the project vicinity. These numbers underscore the importance of implementing the proposed project alongside complimentary flood risk reduction projects.
- **Reduce the magnitude and duration of flooding along critical access roads and critical facilities.** In addition to Muddy Creek Road, two other critical access roads are anticipated to benefit from delayed flooding. This includes Shipps Cabin Road (intersecting with Muddy Creek Road) and Sandpiper Road, which runs parallel to the eastern bank of Back Bay and provides ingress/egress out of the Sandbridge community (Figure 12).

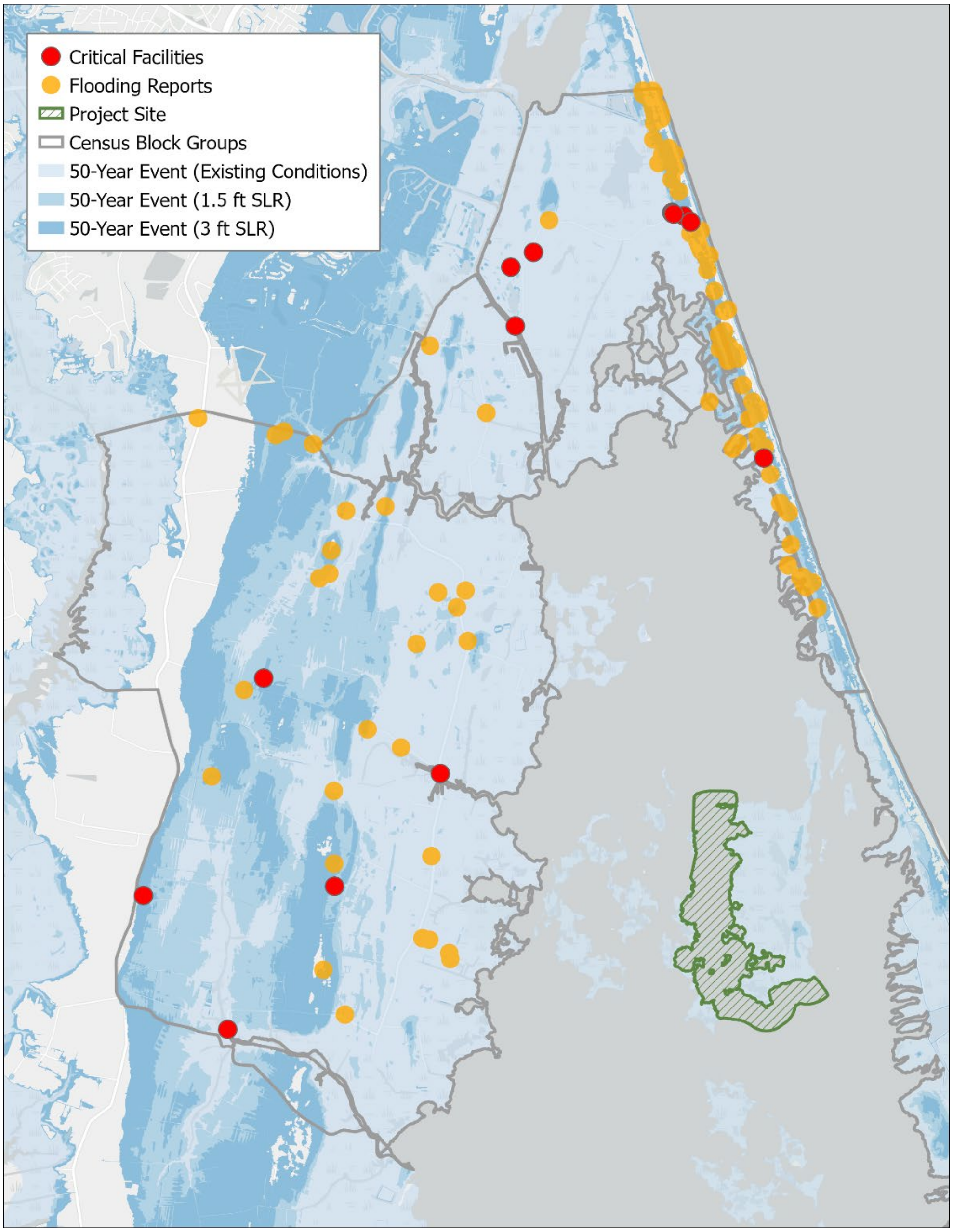

Figure 12: Critical facilities and flooding reports within project vicinity.

What would happen (or not happen) if the applicant does not receive funding?

If this project does not advance from design to construction, erosion of the adjacent marsh would continue to occur, resulting in fragmented habitat lacking the capacity to reduce wave action and slow water velocities. It is anticipated that wind-driven flooding events will continue to increase in frequency, resulting in increasing flooding of the low-lying properties and roadways surrounding northern Back Bay.

Alternatives Analysis

The proposed project offers the best approach for addressing the needs and problem statement outlined in this Scope of Work narrative. The project would result in the creation of 46.5 acres of marsh terraces, which would produce a net gain of approximately 16 acres of low/high marsh habitat by the end of the project construction compared to the No Action Alternative. The integrated system of marsh terrace ridges and perimeter rock armoring would stabilize the two critically eroding marsh islands (Long Island to the east, and a series of smaller unnamed islands to the west) from continued degradation. The tall terrace design improves the functionality and resiliency of the marsh system while also providing diversified habitat for fish and wildlife in the form of increased marsh edge as sea level rises. Numerical modeling of the preferred alternative demonstrated that the project would decrease wave heights and decrease the overall flow velocity of water moving through the project site, reducing water exchange in Back Bay during flooding events, encouraging sediment deposition, mitigating wave effects and consequent erosion, and result in localized water quality benefits. The proposed terraces would not only create a platform for vegetation growth within the marsh, but also reduce wave fetch in these large open water areas. The reduction in wave energy would lead to improved water clarity to promote the growth of SAV in the area between the terraces (approximately 310 acres).

Dredging in between the terraces to obtain sediment for the terrace cap would ensure no invasive vegetation is introduced into Back Bay, which is a high priority of the USFWS and VRMC. The dredging areas would also create valuable fish habitat to attract signature Back Bay fish and wildlife populations such as Largemouth Bass. The proposed dredging areas in between the terraces was evaluated and not anticipated to increase erosion of the adjacent marsh system. Furthermore, dredging in-situ material for building terraces is a widely accepted approach in Gulf Coast region marsh creation/terracing projects, as determined through conversations with project owners in Louisiana. Some terrace cap material will also be obtained from the Nimmo VII-A project. Through export of proven expertise from successful marsh terracing projects, this project would lay the foundation for future similar projects in the region through the development of detailed cost estimates, identification of best sources for local/regional materials, and establishment of partnerships with permitting officials at various levels of government.

Goals and Objectives

The overarching goal of this project is to construct the City's first nature-based adaptation project in the Southern Rivers Watershed and one of the CRMP's exemplary nature-based projects. This project aims to stabilize two critically eroding marsh islands from further degradation, decrease turbidity to promote the growth of aquatic vegetation, and provide flood risk reduction benefits through increased friction and wave attenuation. Table 1 below provides a high-level overview of the specific objectives established to solve the problem/need identified – specifically habitat degradation and wind tide flooding along with measure(s) of success. A more detailed description of these objectives is provided in the Supporting Documentation section.

Table 1: Overview of Project Objectives.

Objectives	Description	Measure(s) of Success	Timing of Measures
Objective 1	Create a Construction Access and Staging Area	a. Secured permits for construction. b. Contractor Selection. c. Construction of Staging Area.	a. December 2023 b. April-May 2023 c. June 2023 -February 2024
Objective 2	Restore Marsh and Aquatic Vegetation	a. Secured permits for construction. b. Restoration of 46.5 acres of habitat.	a. December 2023 b. March - October 2025 and March – October 2026
Objective 3	Engage Stakeholders and Disseminate Effective Practices	Number of people meaningfully engaged in the process of the project within the agreement period.	Continuous through period of performance.

Work Plan

Current Status and Ongoing Activities

The marsh terrace project design is progressing and will be ready for construction in the CFPF grant timeline. Table 2 summarizes ongoing tasks related to the project and an anticipated schedule for completion.

Table 2: Completed, ongoing, and anticipated activities leading up to construction.

Activity	Description	Schedule
Stakeholder Scoping Workshop	In November 2020, the City hosted a virtual workshop to receive initial input from project stakeholders.	Completed (Fall 2020)
Site Characterization and Vegetation Survey	In fall 2020, a site characterization and vegetation survey within Bonney Cove was conducted under a USFWS Special Use Permit (SUP). The purpose of the survey was to document existing emergent marsh and submerged aquatic vegetation (SAV) species composition and percent coverage within the proposed project area. MAP Environmental, Inc. conducted a literature review of marsh terracing projects in the Gulf Coast region to identify effective practices for project planning and design.	Completed (Fall 2020)
Bathymetric Survey	An updated bathymetric survey of Bonney Cove, also covered under a USFWS SUP, was completed in March 2021. This data serves as an input to identify appropriate design elevations to determine quantities of materials necessary to build the proposed marsh terraces and for numerical modeling of project alternatives.	Completed (Spring 2021)
Geotechnical Investigation	A geotechnical investigation of Bonney Cove was conducted in the spring of 2021. The permitted survey, (Virginia Marine Resources Commission (VMRC) Permit No. 2020-2286, U.S. Army Corps of Engineers (USACE) Permit No. 2020-02439, and USFWS SUP) included the collection of 10 soil borings in locations that avoided aquatic vegetation habitat. The soil samples were retrieved by drilling with a specialized airboat-mounted drill rig which was essential for drilling in shallow areas as it avoids disruption to bottom habitat. The soil samples were analyzed to determine the suitability and physical characteristics of the soils within the project area. Additional soil analysis was conducted to determine the suitability of Back Bay sediments for building components of the marsh terraces.	Completed (Spring 2021)

Activity	Description	Schedule
Water Quality and Hydrodynamic Survey	ODU conducted a water quality and hydrodynamic survey of Bonney Cove in the spring of 2021. The USFWS permitted survey collected water samples and deployment/retrieval of hydrodynamic sensors (pressure sensors, acoustic Doppler current profilers, and optical backscatter sensors) at three sampling points in Bonney Cove. Sensor equipment was deployed for two one-month periods (3/10/2021 – 4/12/2021 and 5/19/2021 – 6/8/2021). The water level, wave, and current data served as an input to the numerical model calibration. The water quality parameters (including pH, salinity, temperature, dissolved oxygen, chlorophyll, and turbidity) will serve as a reference to compare pre-and post-construction water quality conditions.	Completed (Summer 2021)
30% Design	Dewberry leveraged the field-collected data to establish design criteria for the project to ensure that it will be resilient in the face of changing future conditions during wind-tide events. Artistic design renderings were developed to enable stakeholders to visualize the implemented project.	Completed (Fall 2021)
Public Engagement – 30% Design	The City held a public information meeting on October 14, 2021, at Creeds Elementary School. The project team delivered a 10-minute presentation of the proposed project followed by an open-format discussion where participants reviewed the preliminary (30%) designs and artistic renderings and submitted comments regarding environmental and community impacts.	Completed (Fall 2021)
Numerical Modeling	Numerical modeling has been completed to evaluate the proposed project's impact on water levels, wave heights, and flow velocities within and surrounding the project area. Potential water quality impacts were also evaluated. The numerical modeling effort involved the development of an XBeach model, which is a nearshore model that accounts for wave-vegetation interactions based on field-derived drag coefficients.	Completed (Winter 2021)
Environmental Assessment and Scoping	In coordination with the USFWS and with technical assistance from Dewberry, the City evaluated the potential environmental impacts of the project. The draft environmental assessment document was distributed to key stakeholders with jurisdictional authority or a vested interest in the project for review and comment.	Completed (Summer 2023)

Activity	Description	Schedule
60% Design	After numerical modeling and stakeholder review of the 30% design, the engineering design plans were advanced from 30% to 60%.	Completed (Spring 2023)
95% Design and Public Engagement	The engineering design team prepared 95% engineering design plans to address comments on the 60% plan set. The City held a second public information meeting from 6:00 – 7:30 p.m. on July 13, 2023, at the Senior Resource Center in Virginia Beach where the project team delivered a 10-minute presentation of the proposed project followed by an open-format discussion where participants reviewed the 95% designs, updated artistic renderings, and submitted comments.	Completed (Fall 2023)
Construction Permit Applications Submitted	The City submitted the Joint Permit Applications for the proposed project, including the initial post-construction monitoring plan, to VMRC and the USACE in August 2023.	Completed (Summer 2023)
Modeling of Potential Adverse Impacts	In response to public concerns, the City performed additional numerical modeling of both northerly and southerly wind events and reviewed water level responses at locations in Back Bay for any potential adverse impacts. No adverse impacts were found for either type of event.	Completed (Fall 2023)
Publication of Frequently Asked Questions	The City will be publishing findings for the potential adverse impacts modeling, along with other responses to public concerns raised at the question in a Frequently Asked Questions webpage in November 2023.	In Progress (Fall 2023)
100% Design	The engineering design team prepared and submitted the 100% engineering design plans to the City for review. The plans will be finalized on receipt of any comments from the permitting process, anticipated to occur by end of 2023.	In Progress (Fall 2023)
Contractor Procurement	The engineering team will provide final plans, specifications, and construction estimates (PS&E). The City will prepare the bid Request for Proposal (RFP), provide Bid Packages, and review bids obtained, and select a construction contractor.	Planned (Winter 2023 - Spring 2024

What are the major activities and tasks?

The key activities and tasks to be competed under the agreement period are summarized in Table 3. Please refer to the Supporting Documentation section for a more detailed description of these activities and tasks.

Table 3: Overview of Activities and Tasks.

Activities	Description	Tasks
Activity 1	Construction Staging Area Preparation and Construction	1. Mobilize equipment 2. Stabilize road, establish construction staging area, abutments, install pre-engineered bridge, construct ramp to water and slurry basins. 3. Establish traffic flagging stations. 4. Install pipe and booster stations.
Activity 2	Marsh Terrace Construction	1. Construct 41 terraces (2-phased approach). 2. Demobilize equipment.
Activity 3	Stakeholder Engagement	1. Develop project marketing materials. 2. Attend and document engagement activities.

Who is responsible for completing the activities and tasks?

Responsibility for completing the project's activities and tasks lies with a collaborative effort led by the City's Department of Public Works. To ensure the successful execution of the project, the City has assembled a diverse team of consultants, advisors and subject matter experts. For a comprehensive understanding of the specific roles and responsibilities of each entity involved in carrying out the proposed scope of work, please refer to the *Supporting Documentation – Approach, Milestones, and Deliverables – Project Partner*s section of this report, which provides a detailed description of how each team member contributes to the project's overall success.

What is the timeframe for accomplishing activities and tasks?

An overview of the planned project timeline is shown in Figure 13. Grant activities will initiated in Summer 2024 with construction of the staging area and material acquisition. Please refer to the *Supporting Documentation – Approach, Milestones, and Deliverables –Milestone Schedule* section of this report for a detailed outline for each activity and associated deliverables.

Figure 13. Timeline overview for project implementation.

Identify the required partners to ensure success and where they are represented in the workplan.

A diverse team of consultants, advisors, and subject matter experts, led by the City's Department of Public Works, has been assembled to complete the project's activities and tasks. Please refer to the *Supporting Documentation – Approach, Milestones, and Deliverables – Project Partner*s section of this report for a detailed description of each team member's role, responsibilities, and contribution to the project's overall success.

Deliverables

An overview of the project deliverables is provided in Table 4. Please refer to the *Supporting Documentation – Approach, Milestones, and Deliverables* section of this report for more detail.

Table 4: Summary of Deliverables.

Activities	Deliverables
Activity 1: Construction Staging Area Preparation and Construction	1. Material acquisition. 2. Progression and completion of the construction staging area, with daily inspections to monitor progress. 3. Documented progress and completion through quarterly reports to DCR.
Activity 2: Marsh Terrace Construction	1. Progression and completion of the 2025 and 2026 construction phases, including plantings, with daily inspections to monitor progress. 2. Demobilization and removal of equipment from construction staging area. 3. Documented progress and completion through quarterly reports to DCR.
Activity 3: Stakeholder Engagement and Lessons-Learned Dissemination	1. Project marketing materials. 2. Records documenting number of stakeholders engaged during the outreach activities.

Maintenance plan tied to the identified viability of the project. Plan for sustaining the project after the agreement period (if applicable)

The City has developed a draft Annual Monitoring Plan and Post-Construction Monitoring Report that was submitted along with the Joint Permit Application for the project. See Attachment 5 for a copy of the draft report.

Project maintenance will be addressed by the City of Virginia Beach's Public Works Stormwater Operations Group. Any maintenance issues identified by the monitoring effort or other observers will be flagged to the Operations Group to address. The City intends to maintain the construction staging area to support future project maintenance needs. After completion of the monitoring program, the City will perform inspections every 2-5 years and make any repairs needed for the life of the project.

Evaluation

Indicators of Success

Indicators of success for this project have been identified during the development of the monitoring plan. Three (3) indicators of success were defined in relation to the primary objectives of the project (as defined elsewhere in this document), and include:

- The establishment of a sustainable coastal marsh island system.
- Stability of the marsh terrace structures.
- Establishment of a sustainable SAV community.

What data will be collected and how will it be used to measure success?

Data collection for the project has been detailed in the proposed monitoring plan and includes two sets of data: one set associated with as-built surveys to establish baseline reference conditions for subsequent monitoring efforts, and monitoring data to assess the success of the project in meeting the indicators defined above. Baseline and monitoring data will be compiled in an annual report and distributed to permitting agencies, and stakeholders as appropriate, to fulfill monitoring requirements and ensure success criteria are being met and maintenance needs are addressed.

Baseline data, which is proposed to be collected after the completion of each of two phases of terrace installation, will include the following data:

- Coordinates and diagrams of established transects, as well as site photographs from photo stations established along each sampling transect, as defined in the Methods section of the monitoring plan.
- Final location of all planted vegetation (upland plantings, high marsh plantings and low marsh plantings).
- Final location and extent of SAV plantings.
- Final grade topographic surveys (plan, profile, and cross sections).
- Discussion of the project design versus as-built conditions.

Monitoring data will be collected at the end of the full growing season during each monitoring year and include the following:

- Site photographs from photo stations defined in the Methods section of the monitoring report.
- Estimated percent cover and change in coverage from the as-built conditions to sampling year conditions for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- Estimated percent cover and change in coverage from planted conditions to sampling year conditions for SAV planting quadrants

- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

This monitoring data will be used to define success by tracking the establishment of the proposed vegetative communities on and between the proposed marsh terraces as well as the structural integrity of the marsh terrace structures themselves. Vegetation cover thresholds for each year will be defined to ensure planted communities are appropriately established on each marsh terrace. Acceptable measures of deviation will be defined for structural elements to ensure design requirements are met. Maintenance and mitigation measures defined in the monitoring plan will be implemented as required if success criteria are not met during any particular monitoring year.

How was cost effectiveness evaluated and measured against the expected outcomes?

Through a BCA approach using FEMA methods and ecosystem service valuations, a BCR of 1.17 was calculated for the project. This BCR is greater than 1, indicating the project can be considered cost-effective. The project also provides an additional $9.2M in value over the current estimated project costs.

A description of the BCA analysis and methods is provided in the following Benefit Cost Analysis Section.

What products, services, meetings, outreach efforts etc. will be conducted and how will success be measured?

The City is firmly dedicated to fostering meaningful engagement with project partners and external stakeholders throughout the project, with the goal of raising awareness about the project's approach and its benefits and enhancing the likelihood of its successful adoption in other areas within the region and the state.

Activity 4, titled "Stakeholder Engagement and Lessons-Learned Dissemination," provides a comprehensive outline of the City's outreach strategy, encompassing proposed deliverables and outreach endeavors. This strategic plan entails the development of project marketing materials, along with the facilitation of presentations and meetings with local and regional stakeholders, as well as participation in state and national-level conferences.

To gauge the effectiveness of our efforts, the City will employ metrics to track and document the number of individuals engaged throughout the project. This information will be regularly communicated to DCR to serve as a key performance indicator for project success.

For a more detailed breakdown of the tasks and deliverables associated with Activity 4, please refer to the Supporting Documentation section of this application.

Project Progress Monitoring Plan

The City's Project Progress Monitoring Plan is designed to guarantee the seamless and effective execution of the project. We have established a robust internal system to oversee the entire project lifecycle, ensuring that all key stakeholders are aligned with the project's objectives, activities, deliverables, and schedule.

The process commences with a kickoff meeting involving all project partners, where we collectively set the stage for the project. During this meeting, we thoroughly review the project's objectives and scope, ensuring that everyone is on the same page. This initial step is instrumental in fostering a shared understanding of the project's vision and goals among all involved parties.

In addition to the kickoff meeting, we place a strong emphasis on quality assurance and control. We meticulously assess each contractor's quality management system to ensure that well-defined procedures are in place to maintain the highest standards of quality throughout the project. This dedication to quality is paramount to delivering a successful project that meets the City's standards and the expectations of our stakeholders.

The City is committed to ongoing and transparent communication with our design and construction contractors, as well as our advisory stakeholders. Regular meetings will be held to monitor progress, address any potential challenges, and ensure the project adheres to the proposed milestone schedule and deliverables as outlined in this grant application. This proactive approach to project monitoring allows us to stay on track, identify and address issues promptly, and uphold our commitment to the successful completion of the project.

Supporting Documentation

Project Information

The following sections provide details regarding the project site and highlight the impacted population, residential and commercial structures, and critical facilities. This section also provides an overview of the historical, existing, and projected flood conditions in and around the project site.

Population

As shown in Figure 14, two census block groups (518100454.121 and 518100464.001) adjacent to Back Bay are within the extent of the anticipated project benefits. The total population of these two block groups is 3,531.[6] The residential population has grown approximately 1.8% in the past two decades. The median household income in 2021 dollars is $99,078. There are approximately 2,500 residential housing units, of which 43.1% are owner-occupied, 11.4% are renter-occupied, and 45.5% are vacant. The high percentage of vacant housing units can likely be attributed to seasonal rentals within the Sandbridge Resort Area. The race and ethnicity demographics of the community are 94.4% White, 1.4% Black, 3.4% Hispanic, and less than 1% Asian and American Indian.

[6] Population, household income, housing units, and demographic data obtained from Esri ArcGIS Community Analyst (2022). Esri forecasts for 2021 based on U.S. Census Bureau 2010 data.

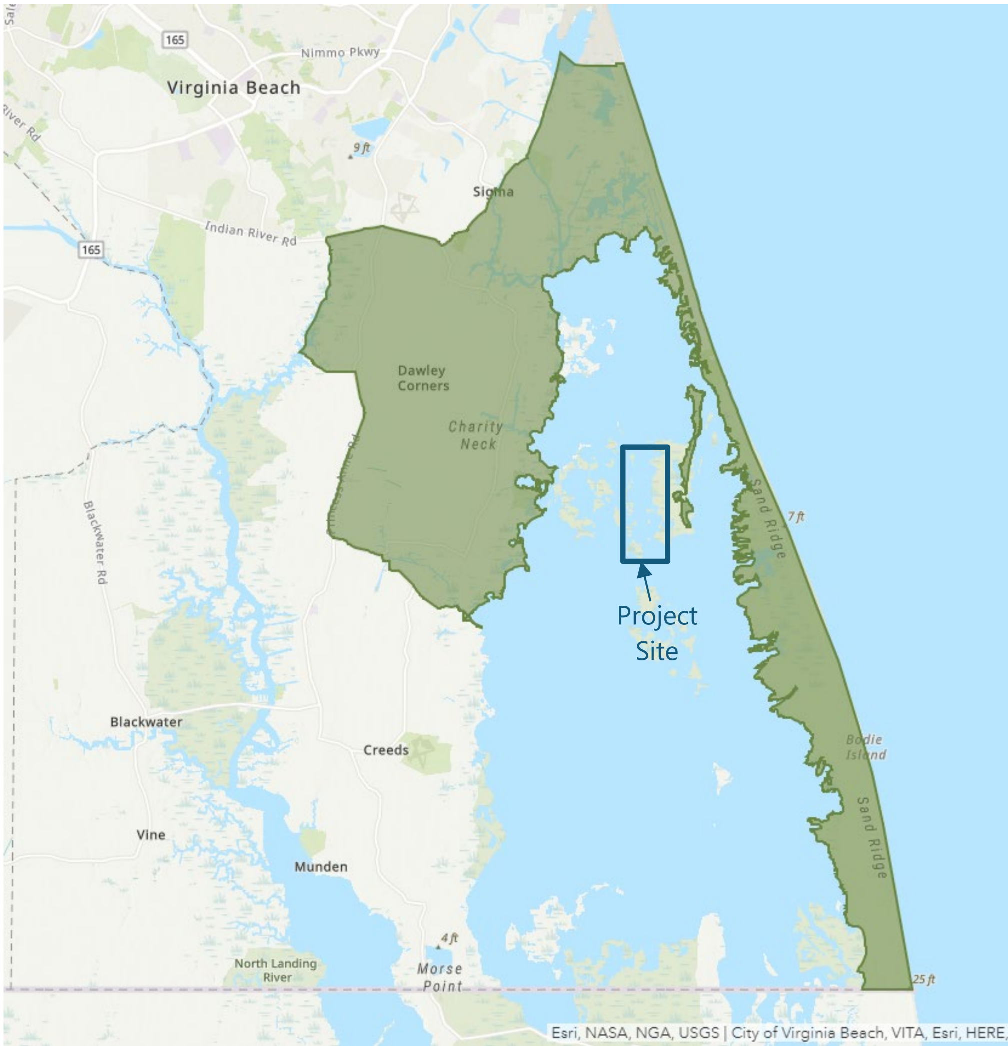

Figure 14: Census block groups selected for population estimates.

Historic Flooding Data and Hydrologic Studies Projecting Flood Frequency

Historical and Existing Flood Data

The project is located within a Federal Emergency Management Agency (FEMA) mapped Special Flood Hazard Area (SFHA), as shown in Figure 15 and Figure 16. Based on the City's current flood maps (effective January 16, 2015), the project site's flood zones are VE, AE, and Open Water. Portions of the site are within Otherwise Protected areas.

The following maps provide an overview of the existing flood hazards for the project area, including the northern boundary (Figure 15) and southern boundary (Figure 16). Based on the City's current flood maps (effective January 16, 2015), the project site contains VE and AE flood zones and Open Water.

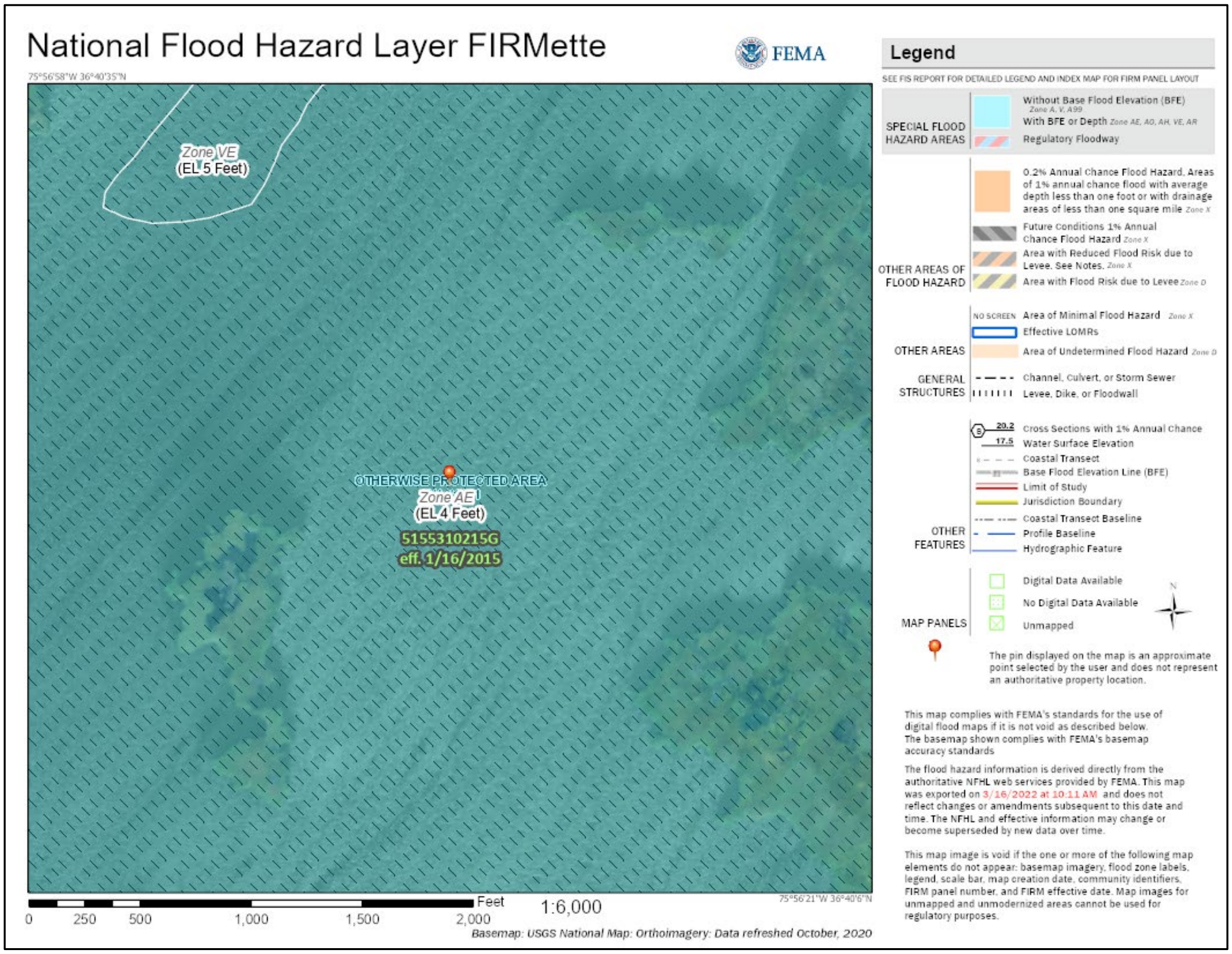

Figure 15: FIRMette for the project area (northern boundary).

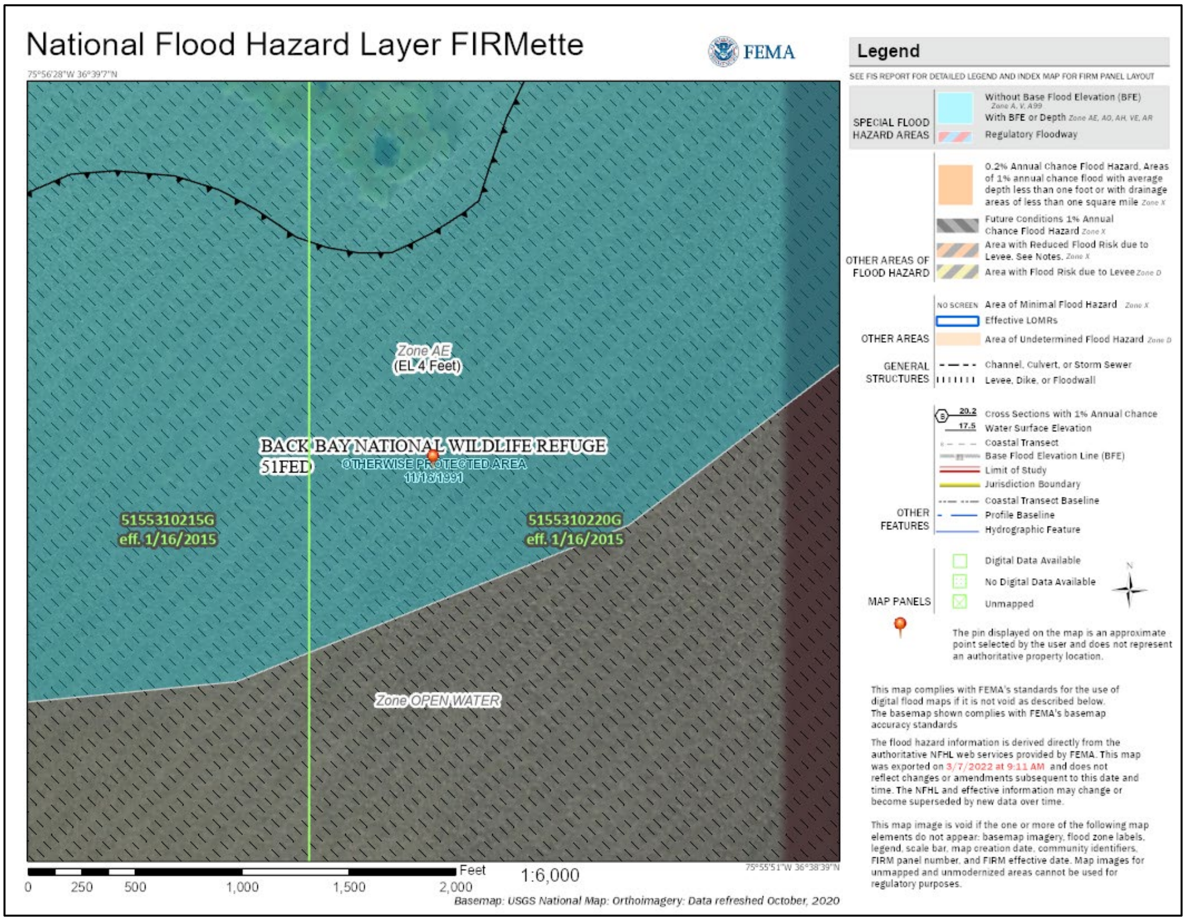

Figure 16: FIRMette for the project area (southern boundary).

The City maintains records of where residents report flood issues and what type of flooding is causing the issue. Residents regularly report flood issues through a hotline, which are then recorded in a flood event database. The census block groups adjacent to the project area reported 111 flood issues associated with heavy rain or high tide between 2001 and 2019. Critical facilities and flood incidences are relatively concentrated in the Sandbridge Resort Area.

Projected Flood Frequency

The USFWS, the City, and other stakeholders have made significant investments in detailed assessments, sophisticated computer models, and water level gauges to better understand historical and future wind tide flooding. Figure 17 displays the projected flood pathways under the 10-year and 100-year storm event under a 3 feet sea level rise scenario surrounding the project site.

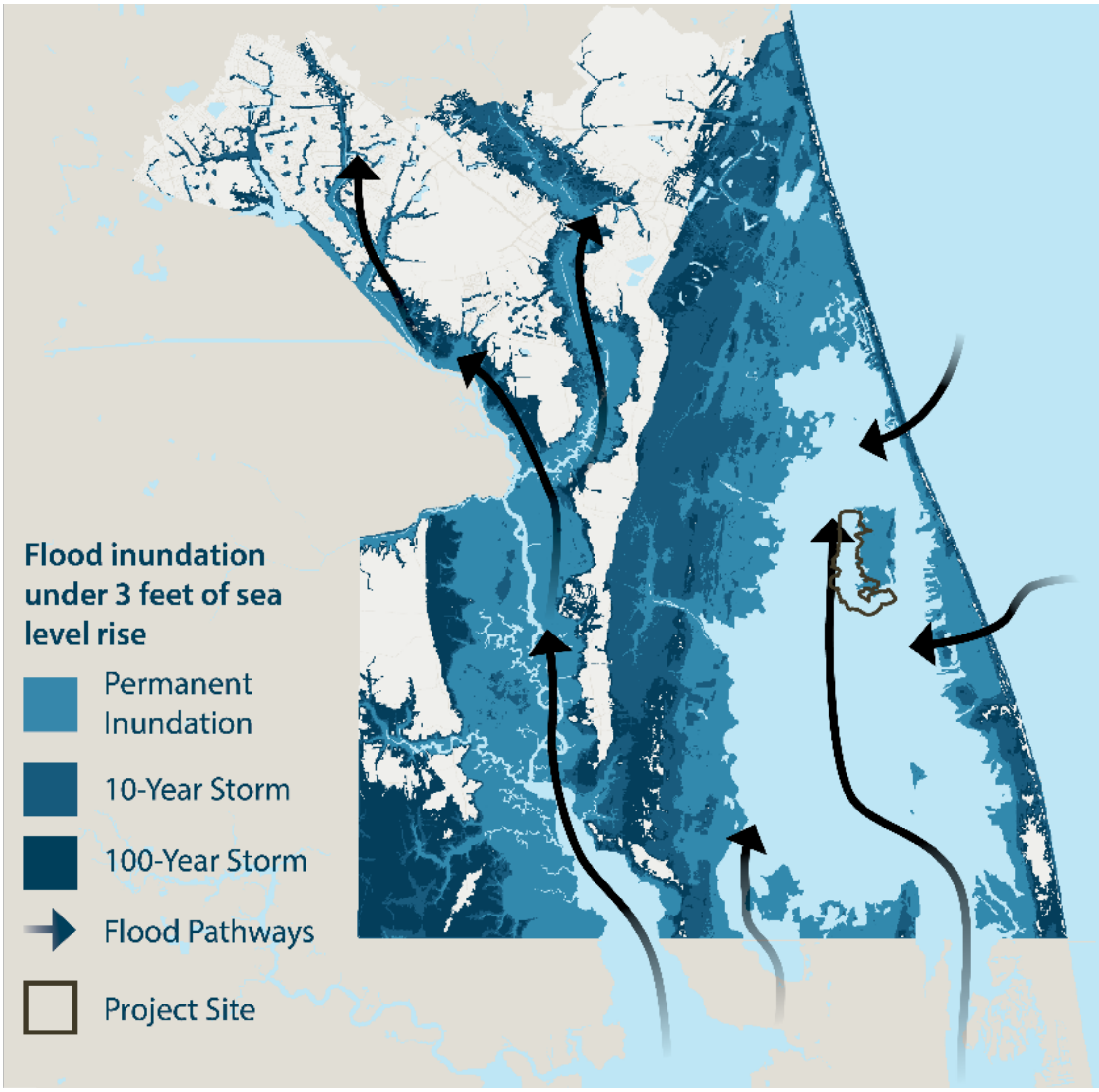

Figure 17: Flood pathways into the Southern Rivers Watershed with 3 feet of sea level rise.

Numerical modeling also shows that as sea levels continue to rise, a shorter duration wind event will produce more wind-induced flooding in less time. The three lines in Figure 18 represent the water level response to a sustained 15-mph wind for each sea level rise scenario. With the existing marsh system today (blue line), it takes approximately five days of sustained southerly wind to cause flooding. With 1.5 feet (yellow line) and 3 feet (red line) of sea level rise, the peak water level could be reached two to three days sooner, respectively. Model simulations showed that marsh island creation across Back Bay would help delay the onset of flooding by several days, which would allow the City and residents more preparation time[7].

[7] City of Virginia Beach. (2018). Analysis of Marsh Response to Sea Level Rise (PDF).

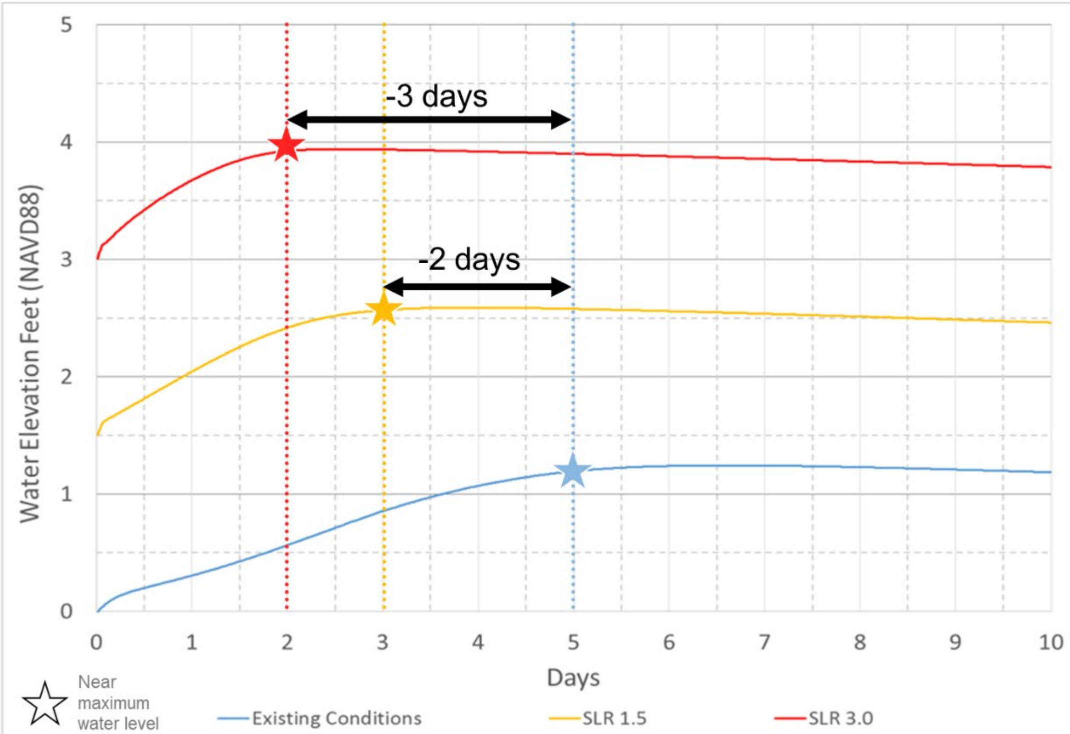

Figure 18: Water-level response under sustained 15-mph southerly wind.

The City analyzed future marsh conditions using the Sea Level Affecting Marshes Model (SLAMM).[7] Figure 19 illustrates areas likely to experience accelerated degradation of marsh in Back Bay due to rising water levels. If no action is taken, substantial marsh loss is projected in Bonney Cove under 3 feet of sea level rise. Within a 1-mile radius of Bonney Cove, the City's SLAMM model predicts that approximately 730 additional acres could be eroded into open water in response to sea level rise. This represents more than a 70% reduction as compared to the existing marsh system surrounding Bonney Cove today. It is also presumed that open water areas would continue to experience high levels of turbidity, which will continue to negatively affect SAV communities in Back Bay.

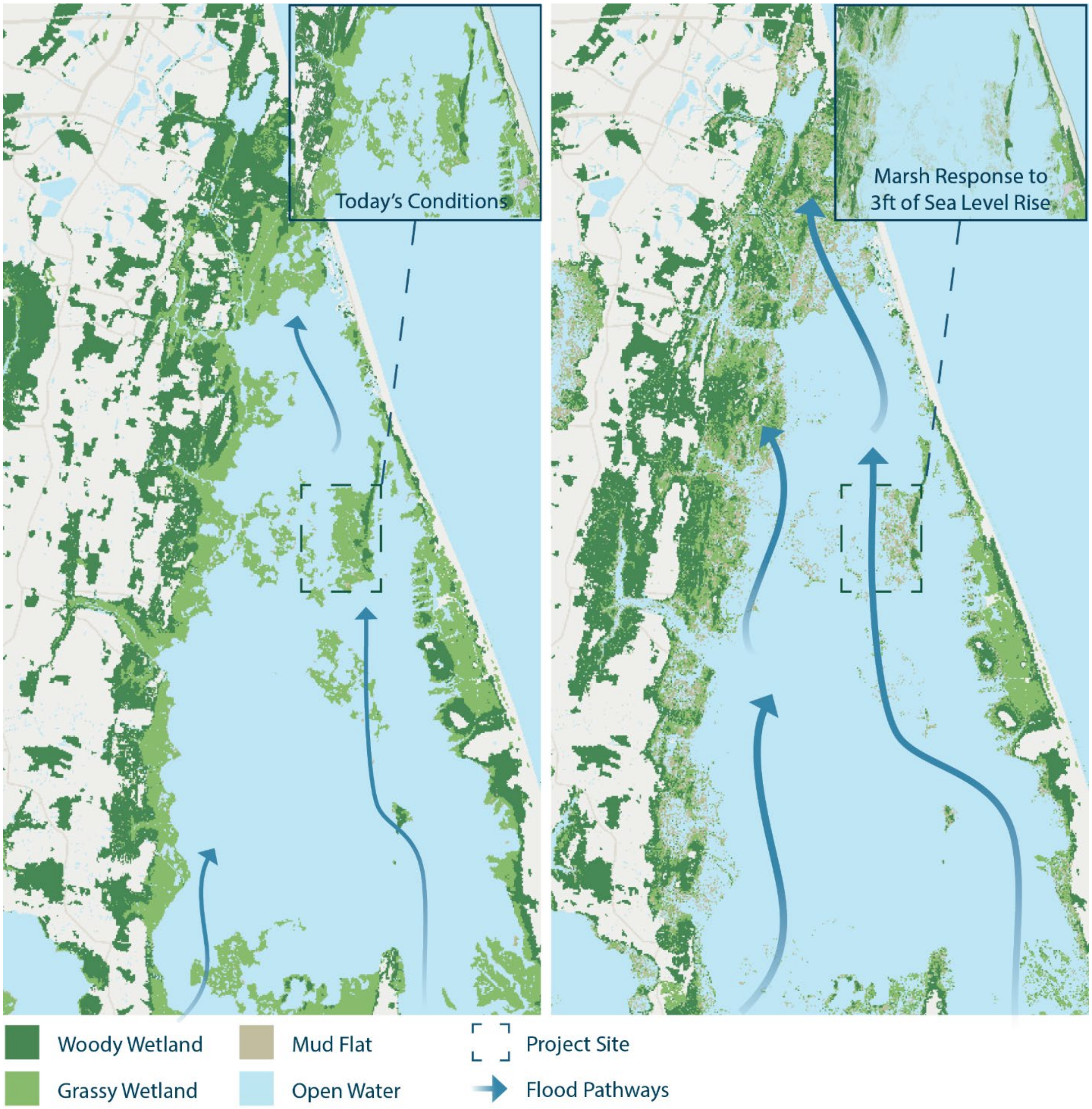

Figure 19: Comparison of current marsh conditions to future marsh conditions with 3 feet of sea level rise.

The proposed project site in Bonney Cove has a predominant south-southwest wind direction, which contributes to significant wave generation in the large unobstructed open-water areas and provides a continuous source of scouring and erosion in those areas. Marsh loss is likely to continue in the project area, creating a negative feedback cycle as continued fragmentation of the marsh would further deteriorate the remaining stands of healthy marsh and increase fetch. Today, the site faces low to medium fetch exposure, but in the future, the site could experience high to very high fetch exposure, as defined by the Virginia Institute of Marine Science (VIMS)

Shoreline Design Guidelines for Shore Protection in Virginia's Estuarine Environments.[8] Projections of increasing fetch at the site, along with the transects used for the wind fetch analysis, are summarized in Figure 20.

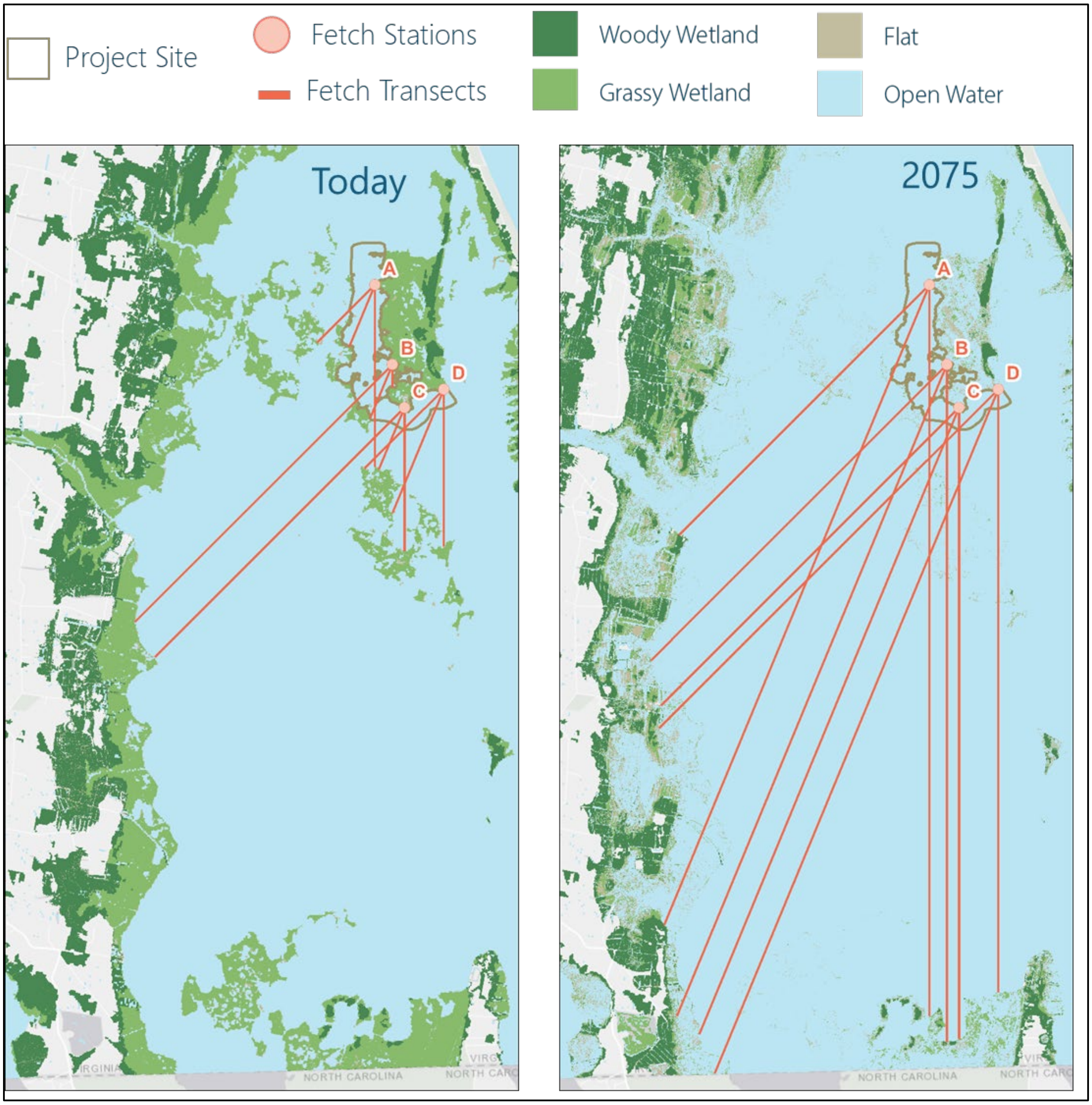

Figure 20: Wind fetch analysis of project area.

The following table displays specific values of fetch distances and classifications that correspond with the transects displayed in Figure 20 above.

[8] Virginia Institute of Marine Science. (2010). Living Shoreline Design Guidelines for Shore Protection in Virginia's Estuarine Environments; Version 1.2 (PDF).

Table 5: Measurements of fetch transects referenced in Figure 20.

Fetch Transect	Length, Miles (Today)	Classification	Length, Miles (3 feet SLR)	Classification
A-SW	0.9	Low	3.7	High
A-SSW	0.7	Low	7.3	Very High
A-S	1.9	Medium	7.7	Very High
B-SW	3.8	Medium	4.4	High
B-SSW	0.6	Low	7.4	Very High
B-S	0.2	Very Low	7.2	Very High
C-SW	3.7	Medium	4.4	High
C-SSW	0.7	Low	7.2	Very High
C-S	1.5	Medium	6.7	Very High
D-SW	1.2	Medium	5.1	Very High
D-SSW	1.4	Medium	7.8	Very High
D-S	1.7	Medium	6.4	Very High

No Adverse Impact

The City conducted additional hydraulic numerical modeling to identify any potential adverse impacts in response to concerns raised during a public meeting in July 2023. The City utilized a Danish Hydraulic Institute MIKE FLOOD model developed for stormwater master planning activities in Lower Southern Rivers Watershed of Virginia Beach. This model encompasses the entirety of Back Bay and extends into North Carolina's Currituck Sound. Model performance has been validated against observations from multiple flood events.

The effort looked at water level and velocities in response to a historical southerly wind tide flood in May 2017 and a northerly wind event associated with Tropical Storm Ophelia in September 2022. These events were ran with model grids depicting with- and without project conditions, considering the 100% project design specifications. The northerly wind event was

included to address concerns from residents of Knott's Island, at the southern end of Back Bay. Both the terrace field and the construction staging area were included in the with-project condition. The modeling found that there were no increases in water levels to areas within Back Bay or to Knotts Island. Negligible changes in water velocity (0.2 ft/s or less) were observed in the channel to the west of the terrace field. No increases in water levels were observed in the area of the construction staging area.

Local Government to Provide its Share of the Cost

The City of Virginia Beach is fully prepared to cover the cost share of the proposed project, as highlighted in the attached budget narrative, "Amount of Cash Funds Available." The funding for the grant match is contained within the City budget.

Benefit-Cost Analysis

FEMA recognizes the economic value of restoration projects and has provided ecosystem service economic valuations for benefit cost considerations. The approach and values used here are consistent with FEMA Benefit-Cost-Assessment (BCA) toolkit approaches and ecosystem service valuations published in "FEMA Ecosystem Service Value Updates, June 2022[9]." The 2022 FEMA guidance provides methods and values for various nature-based projects, including coastal wetlands. The valuations recognize ecosystem services for coastal wetlands including aesthetic value, climate regulation (carbon sequestration), flood and storm hazard reduction, habitat, recreation/tourism, water filtration and supply benefits of coastal wetland features.

Feasibility and Effectives Criteria

The project meets FEMA's Feasibility and Effectives Criteria for a Coastal Wetland as defined in the 2022 guidance, including:

- Land cover associated with the project is a "Estuarine and Marine Wetland" as classified for NWI for remaining marsh within and adjacent to the study area. The area of the project is also a historical marsh.
- The project demonstrates "ecosystem restoration" by using the terrace approach to recover degraded, damaged, and destroyed wetlands and submerged aquatic vegetation in the Back Bay ecosystem.
- The project meetings EPA concepts of restoration through direct creation of marshes (the terraces themselves) and enhancement of the ecosystem (reduction of water turbidity to enhance growth of submerged aquatic vegetation).
- The project will result in notable increased health and function of the local ecosystem in the "after mitigation" scenario through reduction of wave heights, water flow, and significantly decreased turbidity within the project area, as well as reduction of wave heights to adjacent areas.

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[9] FEMA Ecosystem Service Value Updates, June 2022 (PDF).

- The project approach was aligned with established principles and techniques on wetland restoration, as outlined in the Coastal Wetlands and Tidal Flats section of the International Guidelines on Natural and Nature-base Features for Flood Risk Management10.

Design Life

As mentioned, the project useful life is 30-years. The FEMA 2022 guidance allows 50-years a typical lifespan; however, as stated in the project description, the elevation of the terraces was set based on a 30-year design life and estimated settlement.

Ecosystem Services Valuation

- The 2022 guidance values ecosystem services for coastal wetlands at $8,955 in 2021 U.S. dollars (USD), per acre, per year.
- The project will restore 46.5 acres of intertidal and upland marsh through direct creation of the marsh terraces. The project will also promote the growth of SAV in between the terraces, an area estimated at 310 acres. This provide for a total project benefit area of (46.5 + 310) = 356.5 acres.
- Project benefits occur over a period of time into the future; while most of the project costs are incurred up front and in the present. FEMA conducts its BCAs on a net present value basis, meaning the present value of the benefits gained from the project over the life of the project are compared to the total project cost to establish the BCR. Because project benefits accumulate over time, project benefits are calculated on an average annual basis ("annualized") and then multiplied by a Present Value Coefficient (PVC) to determine the present value of the annualized benefits.
- The present value coefficient is calculate as follows:

$$PVC = \left[\frac{1-(1-r)^{-T}}{r}\right]$$

  where *r* is the discount rate and *T* is the useful life of the project. The CFPF 2023 Grant Manual does not specify a discount rate for the benefits calculation; therefore, the latest FEMA program grant guidance was reviewed. For the 2023 FEMA Building Resilient Infrastructure and Communities (BRIC) and Floodplain Mitigation Assistance Grant Program (FMA) cycles FEMA has established a set discount rate of 3%[11]. The 3% discount rate provides for a PVC of 19.60 for a 30-year lifecycle for the project.
- Project benefits were calculated by:

$$Benefits = PVC \times Project\ Area \times Coastal\ Wetland\ Benefits$$

- The benefit cost ratio (BCR) was calculated as:

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[10] International Guidelines on Natural and Nature-Based Features for Flood Risk Management - Engineering With Nature (dren.mil)

[11] FEMA Fact Sheet. Notice of Funding Opportunity for Fiscal Year 2023 Building Resilient Infrastructure and Communities Program (PDF).

$$BCR = \frac{Benefits}{Costs}.$$

A summary of the calculated values is provided in the below table:

Table 6. Summary of BCA parameters and results.

Project Area	Benefits (acre / year, 2021 USD)	Project Lifespan	Benefits, 3% discount rate	Project Cost	BCR, 3% discount rate
356.5	8,954	30	$62,566,588	$53,378,490	1.17

The calculated BCR for the project was 1.17, based on the FEMA ecosystem services valuation approach. This BCR is greater than 1, indicating the project can be considered cost-effective. The project also provides an additional $9.19M in value over the project cost.

Local Floodplain Management Regulations

The City recognizes the vital importance of floodplains in the natural movement of water through the community. Appendix K of the Virginia Beach Code of Ordinances regulates development in the community's floodplains. The City requires that a permit is obtained for any construction or development in the Special Flood Hazard Area. For more information and details regarding the City's floodplain management and ordinances, please refer to the following:

- Link to current floodplain ordinance: Virginia Beach Floodplain Ordinance.

In addition, a copy of the current floodplain ordinance has been included in *Part IV, Section E5*. For further information regarding the City's hazard mitigation and comprehensive planning, please refer to the following:

- Link to current hazard mitigation plan: Regional Hazard Mitigation Planning.
- Link to current comprehensive plan: Virginia Beach Comprehensive Planning.

Other Necessary Information to Establish Project Priority

Repetitive Loss and/or Severe Repetitive Loss Properties

The repetitive loss database shows 113 repetitive loss and severe repetitive loss properties within the two census block groups (518100454.121 and 518100464.001) associated with the project area.

Residential and/or Commercial Structures

A detailed economic flood loss assessment presented in the City's Resilience Plan showed that approximately 45% of the entire future risk exposure in the City is concentrated in the Southern Rivers watershed. Of that risk, 65% is concentrated in three communities north of Back Bay

(Figure 21).[12] Under a "no action" scenario, average annualized flood losses would increase from $974 thousand, representing present day conditions, to $6 million with 1.5 feet of sea level rise as anticipated by 2050. This figure equals an increase of six times present day conditions. With 3 feet of sea level rise as anticipated by 2080, annualized losses are expected to drastically increase to $80 million, more than 80 times today's conditions.

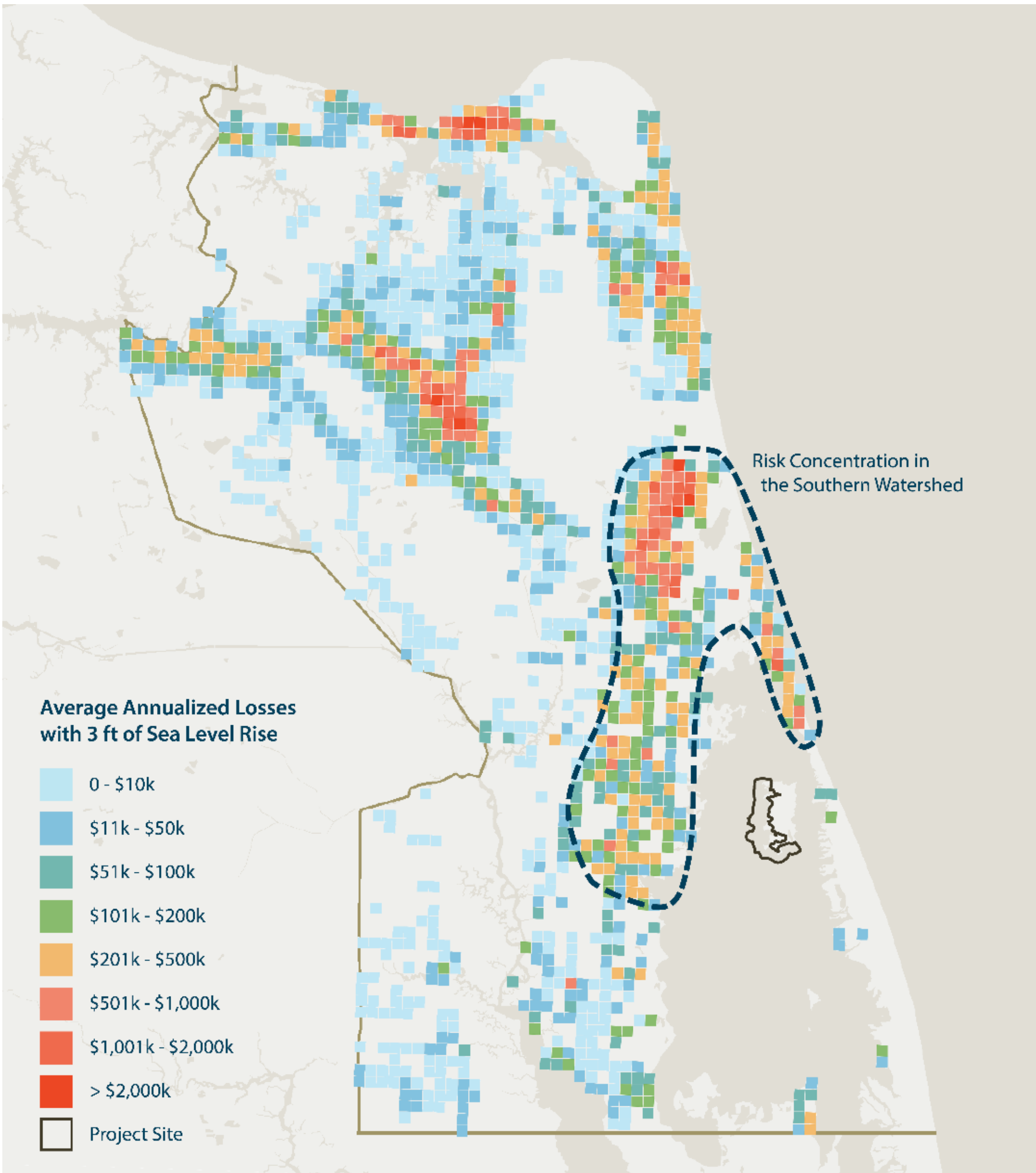

Figure 21: Concentration of average annualized losses estimated with 3 feet of sea level rise under a "no action" scenario presented in the City's Resilience Plan.

[12] City of Virginia Beach. (2020). Coastal Flooding and Economic Loss Analysis (PDF).

Within the two census block groups adjacent to Back Bay near the project area, there are approximately 70 commercial structures and 2,350 residential structures. Of those structures, approximately 635 structures are vulnerable to flooding during a 50-year event today. With 3 feet of sea level rise, approximately 2,060 structures are expected to be vulnerable during a 50-year event, representing approximately 85% of the residential structures within the project vicinity. These numbers underscore the importance of implementing the proposed project alongside complimentary flood risk reduction projects.

Critical Facilities

The two census block groups near the project site include 10 critical facilities. Table 7 summarizes critical facilities by type, total number, and the number of facilities exposed to the 50-year storm scenario under current and future "no action" scenarios. Under current 50-year storm conditions, 2 communication facilities and 1 electric power station would be exposed to flooding. With 3 feet of sea level rise, the number of critical facilities exposed to flooding increases to 9 total facilities.

Table 7: Summary of critical facilities located in the selected census block groups and flood hazard exposure to the 50-year storm event under current conditions and with 1.5 feet and 3 feet of sea level rise.

Type of Facility	Number of Facilities	Current 50-year storm	50-year storm with 1.5 feet sea level rise	50-year storm with 3 feet sea level rise
Communication	3	2 (66%)	2 (66%)	3 (100%)
Electric Power	1	1 (100%)	1 (100%)	1 (100%)
Fire Station	1	0	0	0
Potable Water	2	0	2 (100%)	2 (100%)
School	1	0	0	1 (100%)
Wastewater Treatment	2	0	0	2 (100%)

Need for Assistance

The City of Virginia Beach has invested significant time, money, and staff resources in understanding, communicating, and planning for the threats of sea level rise and recurrent flooding to the community. The City is ready to begin the implementation of adaptation measures, and the marsh terrace project is the first project to advance to construction from the City's Resilience Plan. The project represents the first step in restoring Back Bay and the larger Albemarle-Pamlico estuary, and serves as a pilot for additional restoration projects. Virginia Beach understands that flood mitigation costs are substantial and is seeking funds to support project implementation alongside dedicated resources procured by the City. The City's

Department of Public Works Stormwater Engineering Center has closely coordinated with the City's Department of Planning & Community Development throughout the design and permitting process. The Department of Public Works will oversee the construction of the marsh terrace project, including providing construction inspectors to monitor that the project is built to the City's design standards and technical specifications. Additionally, the City has access to necessary software, including AutoCAD and ArcGIS Desktop, and support from consultants to augment the City's technical capabilities.

Examples of City staff who will support the project include the following:

- Program Manager for the Technical Services Division of the Stormwater Engineering Center.
- Project Manager for Green Infrastructure Projects for the Technical Services Division of the Stormwater Engineering Center.
- Environmental Planner / Certified Floodplain Manager from the Wetlands & Shoreline Construction Team of the Planning Administration Division of the Department of Planning & Community Development.
- Planning Evaluation Coordinator from the Chesapeake Bay Preservation Area & Southern Rivers Watershed Team of the Planning Administration Division of the Department of Planning & Community Development.
- Full-time Construction Inspector assigned exclusively to this project from the City's Construction Bureau or under contract with the City Public Works Engineering Division.
- Grant Coordinator from the City's Public Works Engineering Division.

Additional staffing will be provided as needed to ensure project success.

This project benefits communities in northern Back Bay with a high concentration of flood losses (as shown in Figure 21). These communities contribute significantly to Virginia Beach's rural economy, including agriculture, forestry, fishing, hunting, and eco-tourism. In Hampton Roads, these industries contribute a combined $100 million in gross domestic product.[13] Protection of vulnerable natural infrastructure, such as the marshes in Back Bay, is critical to ensuring these industries can continue to thrive within the region.

Alternatives

Several other alternatives were considered but not advanced due to technical and environmental limitations. These alternatives are briefly summarized below.

[13] Office of Governor Ralph S. Northam Commonwealth of Virginia and Virginia Department of Conservation and Recreation. (2021). Virginia Coastal Resilience Master Plan Phase 1 (PDF); data referenced sourced from the US Bureau of Economic Analysis. (2019).

Alternative 1 - No Action Alternative

Under this alternative, no action would be taken to restore marsh habitat in the shallow open water channel of Bonney Cove. Erosion of the adjacent marsh would continue to occur, resulting in fragmented habitat lacking the capacity to reduce wave action and slow water velocities. It is anticipated that wind-driven flooding events will continue to increase in frequency, resulting in increasing flooding of the low-lying properties and roadways surrounding northern Back Bay.

Alternative 2 - Alternative Terrace Configuration Design(s)

Several configuration alternatives for the terraces were considered during the design process. These included four alternative layouts with different spacing and terrace top widths:

- **Alternative 2a** (Figure 22): Terraces would be spaced at approximately 300-foot intervals and have a top width of 15 feet. Between the base of the terraces, there would be approximately 220 feet for potential establishment of SAV habitat.
- **Alternative 2b** (Figure 23): Terraces would be spaced at approximately 300-foot intervals and have a top width of 30 feet. Between the base of the terraces, there would be approximately 200 feet for potential establishment of SAV habitat.
- **Alternative 2c** (Figure 24): Terraces would be spaced at approximately 600-foot intervals and have a top width of 15 feet. Between the base of the terraces, there would be approximately 520 feet for potential establishment of SAV habitat.
- **Alternative 2d** (Figure 25): Terraces would be spaced at approximately 600-foot intervals and have a top width of 30 feet. Between the base of the terraces, there would be approximately 500 feet for potential establishment of SAV habitat.

A common feature across all of these design alternatives was a breakwater that spanned the entire length of the southern extent of Long Island and a northern breakwater that spanned the northern exposed section of the project site.

Alternative 2a and 2b were eliminated due to constructability concerns regarding the quantity of sediment that would be required and due to the limited amount of room for SAV establishment in between the terraces (approximately 220- and 200- feet of potential SAV habitat between terraces for Alternative 2a and 2b, respectively).

Alternatives 2c and 2d were discussed extensively amongst the project team; however, it was ultimately determined that they did not maximize the opportunity for species diversity (by including both smaller and larger terraces). These alternatives were combined to form the preferred alternative presented in this document. Additional refinements that were made to these alternatives include the removal of the perimeter breakwater, as the proposed design elevation evaluated in the geotechnical analysis revealed stability issues with these large features.

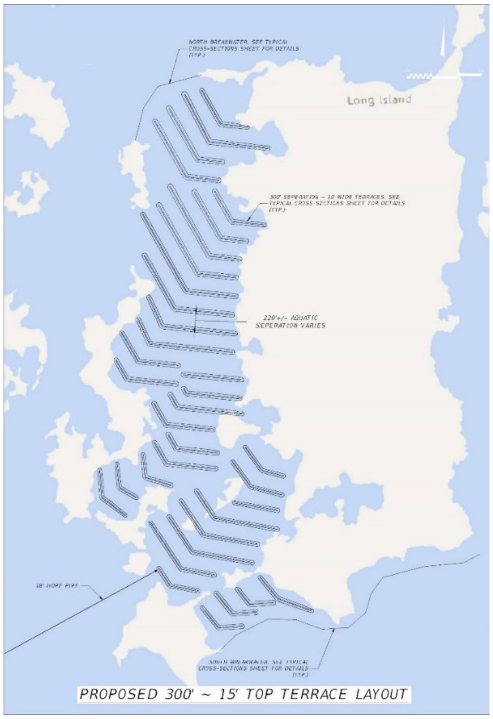

Figure 22: Alternative 2a.

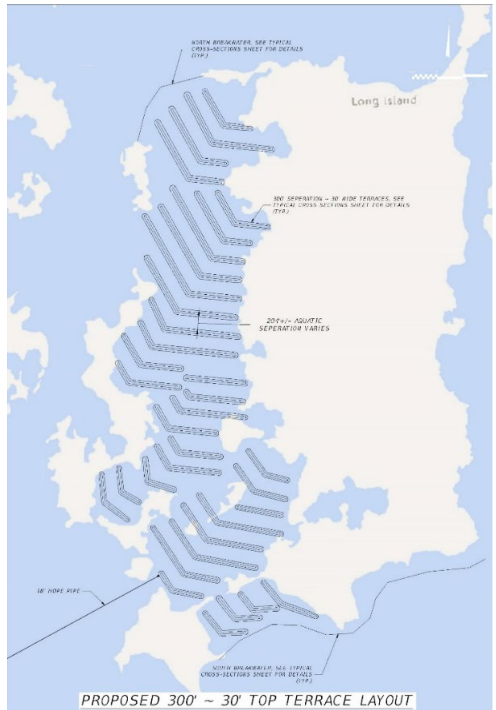

Figure 23: Alternative 2b.

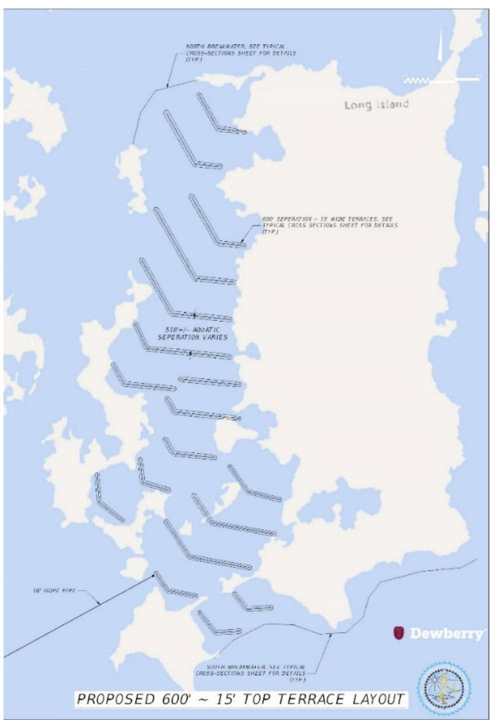

Figure 24: Alternative 2c.

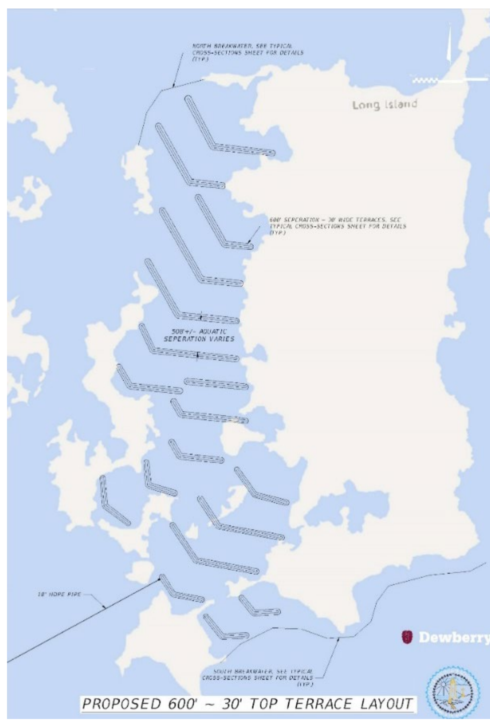

Figure 25: Alternative 2d.

Alternative Terrace Core Material Sources and Transportation – Alternative 3

In the proposed alternative with sand cores, a no-dredging alternative was considered. However, in order to successfully complete the project and establish the vegetation desired, material would need to be sourced, blended, transported, and placed. The City helped identify two potential borrow sources of material: Bow Creek Golf Course (Figure 26) and the Whitehurst Dredged Material Management Area (DMMA) (Figure 27).

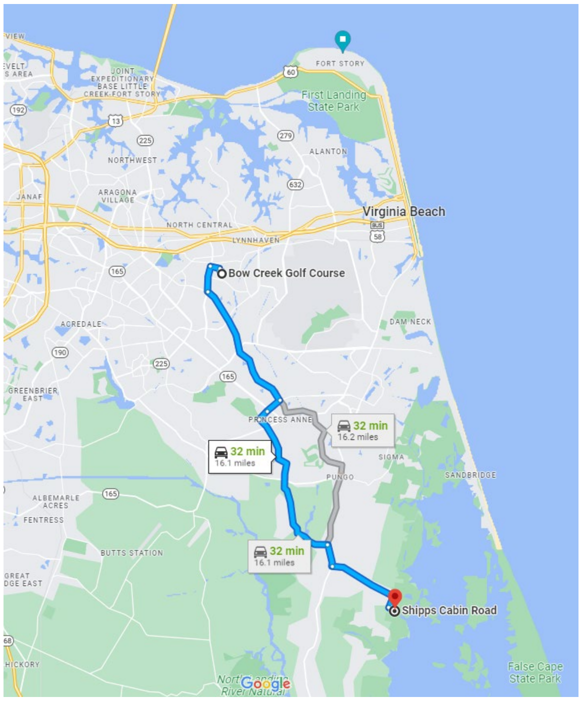

Figure 26: Distance from Bow Creek Golf Course to the proposed Shipps Cabin staging area.

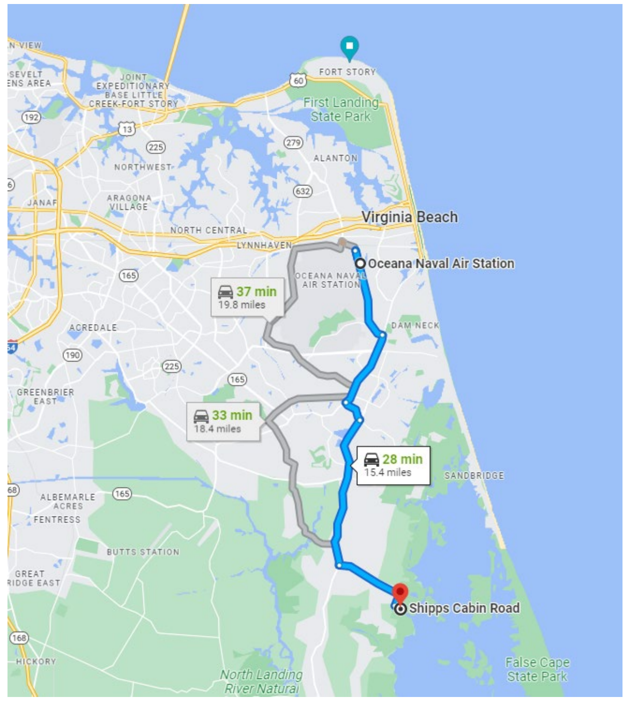

Figure 27: Distance from Whitehurst DMMA to the proposed Shipps Cabin staging area.

Bow Creek Golf Course: Bow Creek Golf Course is located approximately 16 miles from the proposed Shipps Cabin staging area. In the next few years, The Bow Creek Golf Course is scheduled to be converted into a Stormwater Park as one of 21 projects funded by the City's Stormwater Flood Protection Program. Large quantities of materials will be removed from the site for use within the City. The material from Bow Creek would need to be excavated, screened, and tested for foreign seeds and contaminants. Most likely, this material would have to be processed before it could be loaded again on dump trucks and hauled approximately 16 miles to a potential staging area where it would be loaded again on shallow draft barges.

Whitehurst DMMA: The Whitehurst DMMA is a similar distance to the proposed Shipps Cabin Road Construction Staging Area. The material at Whitehurst may not have to be processed as much; however, it would need to be tested for foreign seeds and contaminants. Because of the organic components in this soil and the need for the material to establish vegetation on the terraces, this material is not able to be hydraulically blended and pumped to the site. Therefore, this material would need to be loaded on shallow draft barges and then

placed by mechanical means. Further, the amount of material needed to cap the proposed terraces is approximately 110,000 cubic yards which equates to roughly 5,500 quad-axle dump trucks traveling city streets and damaging other infrastructure.

Barging of all materials was considered. Dewberry conducted meetings, site investigations, and talked with both industry leaders in maritime construction and locals who know the water in Back Bay. A typical 35-foot by 95-foot construction barge drafts approximately 7 feet. This type of barge is not able to be trucked to the landing site, nor is it able to be brought into Back Bay. There are truckable barges, but again the drafts of those barges can be in the 4 to 5 feet range when loaded and would require dredging a channel for access. Shallow draft barges can be used in Back Bay that only draft 1 to 3 feet, and they would need to be off-loaded from a staging site. To bring any materials such as stone, sandy fill, or terrace cap material by barge around Knotts Island is not feasible. The actual channel into the southern point of Back Bay has a height restriction due to the causeway serving Knotts Island.

Continuous Marsh Platform – Alternative 4

A continuous marsh platform to fill in the areas of historical marsh would help to restore this eroded habitat but would not provide conditions suitable for SAV establishment or optimize the wave/flow velocity attenuation through the project area. Furthermore, for a single marsh platform across Bonney Cove, the amount of material required would be more than 3 or 4 million cubic yards of material. To achieve that volume of material by dredging, significant areas of existing SAV present in Back Bay would need to be impacted. As the geotechnical report indicated, the existing material of the project site and surrounding areas is not capable of supporting itself in a constructed arrangement and would slough off back into the water. Further, providing this amount of material without dredging would require bringing external sediment sources into Back Bay, which could introduce invasive species. Finally, while the platform will reclaim marshland, it is not anticipated to establish extensive areas appropriate for SAV reestablishment and would eliminate deeper water areas preferred by some endemic wildlife species.

Goals and Objectives

The overarching goal of this project is to construct the City's first nature-based adaptation project in the Southern Rivers Watershed and one of the CRMP's exemplary nature-based projects. This project aims to stabilize two critically eroding marsh islands from further degradation, decrease turbidity to promote the growth of aquatic vegetation and provide flood risk reduction benefits through increased friction and wave attenuation. The following section summarizes the objectives through which this goal will be realized.

Objective 1 – Create a Construction Access and Staging Area

The project's first objective is to employ a construction approach that is compatible with the shallow nature of Back Bay and the large quantity of material required to build the marsh terraces. The engineering team performed a constructability review of suitable landing sites to

stage construction operations for the terraces. A property located at the end of Shipps Cabin Road (Figure 28) was identified as the preferred staging and construction access location for the following reasons:

- Shipps Cabin Road Construction Staging Area Proximity to site (2 miles).
- Shipps Cabin Road Construction Staging Area Proximity to sand borrow sources.
- Shipps Cabin Road between Muddy Creek Road and the Construction Staging Area is in disrepair and was identified as an opportunity to improve the condition of the road as part of the construction activities.

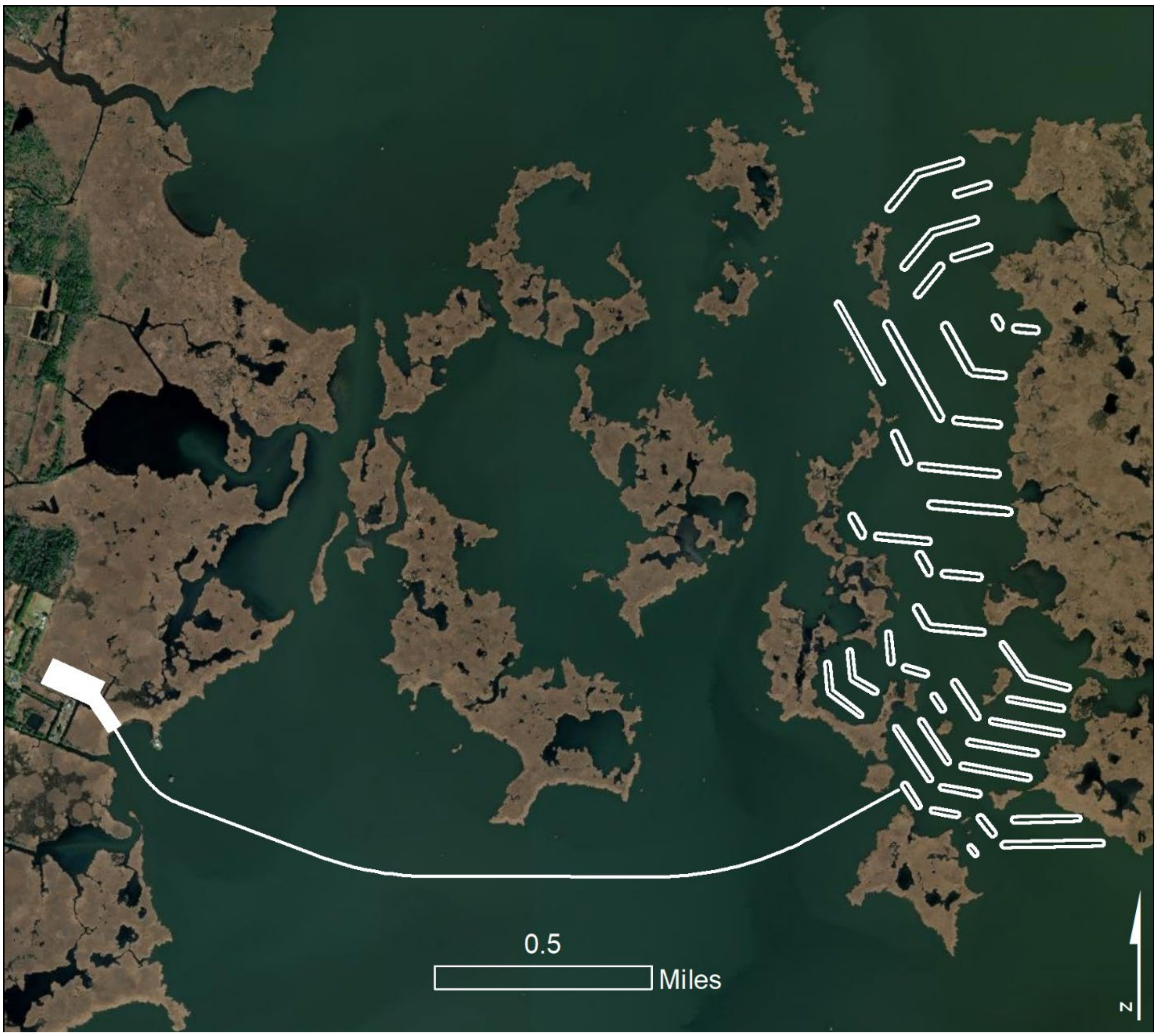

Figure 28: Proposed Construction Access.

On completion of the project, the City plans to retain the staging area for future monitoring and maintenance needs for the project. This future use is consistent with the sentiments of local stakeholders, as communicated during public engagement meetings for the study.

Expected Benefits:

- Enables constructability of the marsh terraces.
- Enable access to the project for post-construction monitoring and future marsh restoration projects.

Objective 2 – Restore Marsh and Aquatic Vegetation

The second objective of the project is to restore marsh and aquatic vegetation for habitat and flood resilience. Specifically, the City's construction of the marsh terraces will result in the restoration of approximately 46 acres of habitat within Back Bay, consisting of:

- 10 acres of low marsh habitat; low marsh plantings would include Big Cordgrass (*Spartina cynosuroides*) and Saltmarsh Cordgrass (*Spartina alterniflora*).
- 6 acres of high marsh habitat; high marsh plantings would include Black Needlerush (*Juncus roemerianus*) and Salt Meadow Hay (*Spartina patens*).
- 14 acres of upland vegetated habitat; upland vegetation would include Arrow-leaf Tearthumb (*Persicaria sagittate*), Groundsel Tree (*Baccharis halimifolia*), Wax Myrtle (*Myrica cerifera*), and Bald Cypress (*Taxodium distichum*).
- 16 acres of submerged terrace habitat anticipated to create suitable conditions for the emergence of SAV.

Additionally, approximately 310 acres of open water SAV habitat would remain between the proposed marsh terraces, and it is anticipated that construction of the terraces would create conditions within the project area favorable to the re-establishment of SAV populations.

Expected Benefits:

- Reduce wave heights, flow velocities, and wind sheer stress within the project area to protect marsh islands from continued erosion.
- Restore the natural buffer that helps protect low-lying neighborhoods and critical access roads from wind-driven flooding.
- Improved water quality by removing excess nutrients.
- Lowered transport of suspended sediment and prevention of resuspension of fine sediments in the water.
- Reduced flow velocity and absorbing wave/wind energy to reduce shoreline erosion.
- Creation of habitat (nursery and feeding areas) for fish (such as Largemouth Bass, Bluegill Yellow Perch, Striped, Blueback Herring, Alewife, and American Eel), migratory waterfowl (such as the Canvasback Duck [*Aythya vallisineria*]), and other aquatic animals.

Objective 3 – Engage Stakeholders and Disseminate Effective Practices

The City is committed to continued meaningful engagement with project partners and external stakeholders throughout the restoration and monitoring phases to ensure transferability to other sites in the region and state.

Expected Benefits:

- Ensure that the lessons from this project can be transferred and scaled to other sites in the state or region.

Approach, Milestones, and Deliverables

The following approach, milestones, and deliverables lay out a plan of action. The milestone schedule follows in *Section B: Milestone Schedule*.

Approach & Deliverables

Activity 1 – Construction Staging Area Preparation and Construction

Activity 1 involves preparing the Shipps Cabin Road property as a construction staging area. Construction activities will include stabilization of the road, laying geotextile to stabilize the ground under the construction staging area, filling with material for the construction staging area, adding fencing, creating bridge abutments and installing a temporary bridge and ramp for waterfront construction access, construction of slurry basins, and establishment of traffic flagging stations.

In the final step, the contractor will install pipe to pump the slurry material from the Shipps Cabin staging area to Bonney Cove. The pipe will be floated with subaqueous tie-downs at channels and certain points of access to maintain boat crossings. Those subaqueous locations will be marked by a buoy every 10 feet and temporary signage as reasonable. The contractor will install two booster stations along the alignment, one approximately half-way between the landing and Bonney Cove, and one at the edge of Bonney Cove. These booster stations will consist of a pontoon-mounted diesel engine pump capable of moving the sand slurry from the construction staging area to the site. It is estimated that 150 CY per hour of sand slurry would be pumped through the pipe in a 60:40 ratio. Additional booster stations may be required for manifolding and supplying slurry stations to individual terraces.

Relevant Objective(s): Objective 1

Deliverables:

- Conduct daily inspections to monitor construction progress of the Shipps Cabin Road Construction Staging Area preparation.

Assumptions:

- It is anticipated that the Shipps Cabin Road Construction Staging Area construction activities can occur simultaneously with material production in Year 1 (2024).

Activity 2 – Marsh Terrace Construction

Once the Shipps Cabin Construction Staging Area preparation is complete, marsh terrace construction activities can commence. The contractor will construct the terraces according to the 100% Final PS&E documents. The most recent engineering designs and design report are available upon request; they are not included as an attachment to this proposal due to file size. Figure 29 shows the overall layout of the terraces, and Figure 30 and Figure 31 show the project renderings. Terrace construction will begin in the northern extent of the project site at Terrace #100, noted in Figure 29, and the contractor will work south towards Terrace #140. The contractor will complete each terrace (including installation of plants) before moving onto the next.

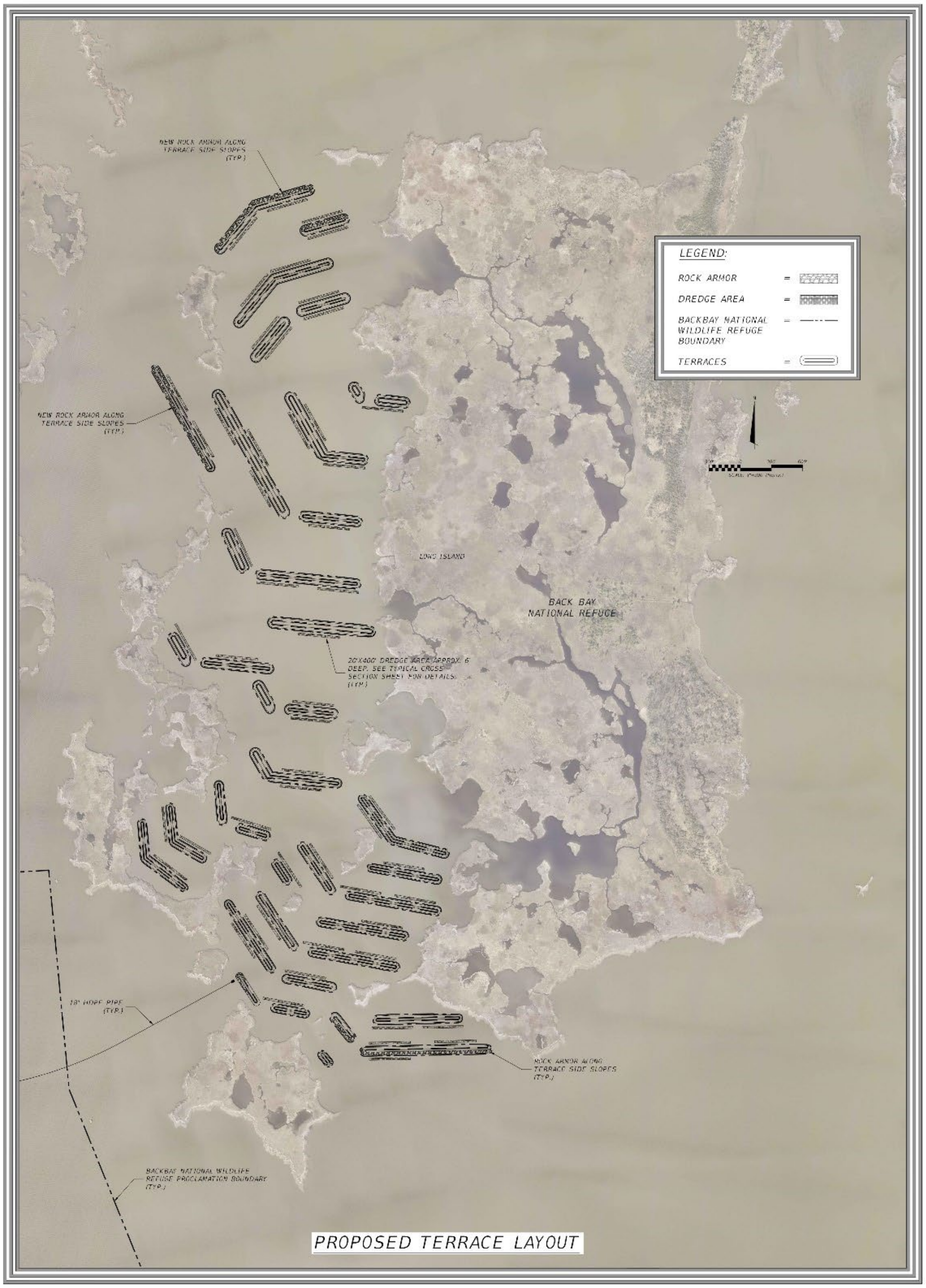

Figure 29: Marsh terrace layout across Bonney Cove.

Figure 30: Marsh terrace design rendering.

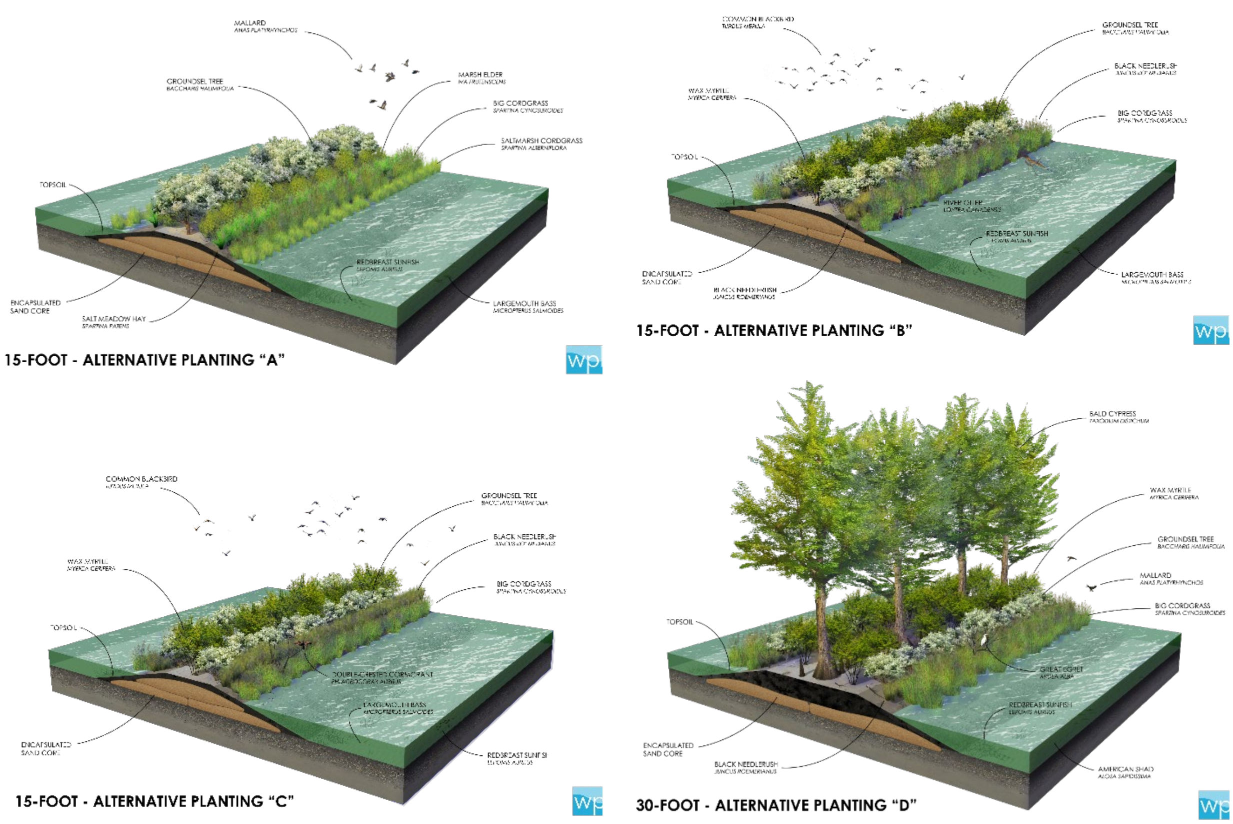

Figure 31: Marsh terrace cross-section design renderings.

The following section provides a high-level description of the proposed design and

construction approach.

Terrace Orientation:

The orientation of the terraces will be perpendicular to the predominant wind direction (south-southwest) to maximize wave energy reduction. The terraces in the northern extent of the project site will be angled perpendicular to a north-northwest wind direction. The terraces would be segmented in a chevron pattern (duck-wing pattern) to provide the most favorable fish and swimming crustacean (termed "nekton") habitat while also allowing adequate circulation to promote sedimentation and maintaining navigability throughout the project area. The terraces would not be connected to the adjacent marsh; this gap, or physical open water barrier, is intended to deter the invasion of Common Reed (*Phragmites australis*) stands from adjacent marshes.

Spacing:

The terraces would be spaced at approximately 300-foot intervals in the northern and southern quarters, and then 600-foot or greater intervals in the center. This arrangement aims to lessen the open water and subsequent wave action at the northern and southern ends of the site and allow adequate construction space for marine-based construction equipment.

Terrace Elevation and Width:

To achieve a sustainable marsh elevation throughout the project life, the marsh terraces would initially be built to a higher elevation during construction and allowed to settle to the desired target elevation over time. Taller terraces improve the functionality and resiliency of the system while also providing diversified habitat for fish and wildlife. The goal is that, by the end of the 30-year design life and with 1.5 feet of relative sea level rise, the terraces will be at or above the elevation of a moderate wind tide event (when Back Bay water levels are anticipated to reach +3.0 feet NAVD88 over the design water level). This threshold was determined to ensure the terraces would not be fully overtopped during a future wind tide event and maintain resiliency to anticipated sea level rise. The 1.5 feet sea level rise scenario is consistent with the near-term planning scenarios identified in the City's Resilience Plan to represent conditions from 2035 to 2050 and adopted by the Hampton Roads Planning District Commission (HRPDC) as part of resolution number 2018-01.

The terraces would have a top width of 15 or 30 feet and be built to an elevation of +4.5 to +5.0 feet NAVD88, depending on the width of the crest, underlying soils, and local bottom depth, with side slopes of 4 horizontal to 1 vertical (4H:1V). The +4.5- to +5.0-foot elevation is calculated based on a target elevation of +3.0 feet NAVD88 or higher at the end of the project's 30-year design life and an estimated settlement of approximately 1 to 2 feet, depending on where the terrace is located. The geotechnical investigation revealed that terraces in the site's southern portion are expected to experience greater settlement than those to the north.

Terrace Composition:

The terraces would consist of a sand-filled core that is encapsulated by a high-strength blend of woven and non-woven geotextile fabrics. The sand for this material will come from nearby offsite sources and be pumped through the 1-inch diameter pipe described in Activity 2. Once the cores are in place, long-reach excavators would travel along the tops of the terraces and begin to shape the cross slopes. Existing adjacent material devoid of SAV would be mechanically dredged and placed over the sand-filled cores. The marsh terraces would be covered with 1 to 3 feet of suitable fill, depending on crest widths, and then planted with native emergent and brackish plant species to stabilize the terraces and provide wind-driven flood reduction benefits.

Relevant Objective(s): Objective 2

Deliverables:

- Conduct daily inspections to monitor construction progress of the marsh terraces.

Assumptions:

- It is anticipated that construction of the terraces will occur in two phases over two years from 2025 through 2026, with the following assumptions:
    - Construction activities are not permitted within BBNWR from October 31 through February 28, annually, to limit disturbance to wintering waterfowl and migration during those months.

Activity 3 – Stakeholder Engagement and Lessons-Learned Dissemination

As the first large scale terracing project on the Atlantic coast, the City recognizes the importance of documenting lessons learned and effective practices during each of the proposed activities: contractor procurement, construction, and post-construction monitoring. The City plans to develop a set of project marketing materials (PowerPoint presentations, StoryMap, information flyers, etc.) to cover key topics, such as:

- Lessons learned during contractor procurement, construction, and post-construction monitoring.
- Effective practices for contractor procurement, bid development, and evaluation. This project is expected to require a highly specialized contractor given the complexity of the project, very shallow water depths, and distance of the site from available construction access and staging areas.
- Guidance for identifying the best sources for local and regional materials for building the terraces and developing a project construction schedule with enough lead time for producing the quantity of material needed for large-scale marsh creation projects.
- Effective practices for developing a post-construction monitoring plan for marsh terraces that a) aligns with permitting, grant, and other requirements and b) enables quantification of project benefits and areas for improvement.

- Effective practices for communicating project benefits based on a combination of field data collection, numerical modeling, and post-construction monitoring.

The City plans to leverage the materials to facilitate dissemination to key stakeholders to increase likelihood of transferability of the approach to other areas in the region and state. The City's plan for engagement is summarized in the following table. In addition to these efforts, the City is committed to collaborating with DCR to identify any additional opportunities to help socialize the project's innovative design and lessons learned.

Table 8: Summary of opportunities for City, regional, state, and national stakeholder engagement; expected benefits.

	Description of Proposed Outreach Activities
CITY	• Facilitate internal municipal awareness, coordination, and approval to gain budgetary approval for funding to expand the approach to other sites in Back Bay (such as "The Great Narrows", Mackay Island and Princess Anne Wildlife Management Areas, and Ragged Island) through presentations to the: o Virginia Beach City Council o City Manager Working Group for SLR and Recurrent Flooding, comprised of representatives from all City departments, to facilitate awareness, coordination, and action to advance the project to the restoration phase. • City of Virginia Beach Management Leadership Team (MLT), which includes the City Manager, Deputy City Managers, and Department heads from across the City.
REGION	• Collaborate with the National Audubon Society and Albemarle-Pamlico National Estuarine Partnership (APNEP) to: o Highlight the marsh terrace project as a success story in the next iteration of the Currituck Sound Coalition Marsh Conservation Plan. o Explore opportunities for marsh terrace projects in the Knotts Island Channel, a key flood pathway into Back Bay, as well as other locations in the Currituck and Albemarle-Pamlico Sound. • Share lessons learned to regional and state stakeholders, improving knowledge-based, awareness, and capacity for future efforts through presentations to: o Hampton Roads Adaptation Forum – a regional dialogue for academics, non-profits, consultants, and municipalities committed to resilience measures. o The Hampton Roads Planning District Commission (HRPDC) Coastal Resiliency Committee . o Regional conferences on green infrastructure, coastal resilience, and SLR adaptation. • Collaborate with Wetlands Watch, a regional non-profit organization committed to the protection of wetlands using nature-based solutions, to socialize the project and disseminate lessons learned.

	Description of Proposed Outreach Activities
STATE	• Continue to coordinate with the Virginia Department of Conservation and Recreation (DCR) to: o Promote the project as a success story for the State Coastal Master Plan (CRMP), which highlighted the project as an "exemplary" resilience project that aligns with the Commonwealth's objective to protect and enhance the state's natural infrastructure. o Incorporate project updates and lessons learned on the CRMP website is an excellent mechanism for dissemination to all coastal Planning District Commissions (PDCs)/Regional Commissions (RCs) across the state. • Continue to collaborate with The Nature Conservancy (TNC), a national player in guiding the implementation of nature-based strategies, to help disseminate lessons learned on project implementation. The City has engaged in early discussions with TNC about partnering to host a state-level workshop that would draw from the network of TNC's local and regional chapters • Presentations at state-level conferences on water resources, floodplain management, and resilience, such as hosted by Resilient Virginia and Virginia Lakes and Watersheds Association.
NATION	• Disseminate lessons learned/effective practices through presentations at 1-2 relevant national conferences such as Restore America's Estuaries, Association of State Floodplain Managers, or the American Shore and Beach Preservation Association, etc. • Leverage working relationships and existing contract work with the U.S. Army Corps of Engineers and partners to integrate lessons learned into the International Natural and Nature-Based Feature Design Guidelines to promote consideration of marsh terraces within similar Back Bay environments (for example, in North Carolina, Maryland, New Jersey, and New York).

Relevant Objective(s): Objective 3

Deliverables:

- Project marketing materials.
- Records documenting number of stakeholders engaged during outreach activities.

Activities Not Included Under this Grant

Submerged Aquatic Vegetation Transplant Plan: The City will evaluate opportunities for restoring native submerged aquatic vegetation populations in Back Bay, such as Wild Celery (*Vallisneria americana*), through consultations with subject matter experts. After terrace construction, the City will formulate a plan for planting submerged aquatic vegetation in between the terraces in coordination with identified partners and the construction contractor.

Post-Construction Monitoring: Post-construction monitoring and inspections will occur for a minimum of five (5) years following construction. Given the period of performance for the CFPF grant, post-construction monitoring activities have not been included in this application.

Milestone Schedule

The scope of work proposed in this grant application are scheduled to occur between June 2024 and June 2027. Work activities are anticipated to complete in December 2026; however, the proposed schedule extends through June 2027 for contingency. The project's expected progression is shown in the following milestone schedule, noting deliverables for each milestone:

2024 Activities

- *1st Quarter* ***(pre-grant period activities):***
    - 100% Final PS&E
    - Submit Bid Documents
- *2nd Quarter (pre-grant period activities):*
    - Final Bid Coordination/Acceptance
    - Construction NTP
- ***Begin Year 1 Grant Activities – 2nd Quarter 2024:***
    - Mobilization for Shipps Cabin Road Construction Staging Area
    - Initiation of Marsh Terrace Material Production
- *3rd Quarter:*
    - Construction NTP and Mobilization for Slurry Basin Installation
- *4th Quarter:*
    - Completion of Shipps Cabin Road Construction Staging Area and Slurry Basin Construction

2025

- *1st Quarter*
    - Completion of Marsh Terrace Material Production
    - Construction Mobilization for Marsh Terraces (beginning on March 1, 2025)
    - Oversight, Management, and Inspection Services of Slurry Basin Installation
- ***Begin Year 2 Grant Activities - 2nd Quarter 2025***
    - Construction of Marsh Terraces #100 – 105
- *3rd Quarter*
    - Construction of Marsh Terraces #106 – 114
- *4th Quarter*
    - Construction of Marsh Terraces #115 – 119
    - Marsh Terrace Construction Demobilization (to accommodate break in construction period from October 31, 2025 – February 28, 2026)

2026

- *1st Quarter*
    - Construction Re-Mobilization for Marsh Terraces (beginning on March 1, 2026)
- ***Begin Year 3 Grant Activities - 2nd Quarter 2026***

  - Construction of Marsh Terraces #120 – 134
- *3rd Quarter*
  - Construction of Marsh Terraces #135 – 140
- *4th Quarter*
  - Shipps Cabin Road Construction Staging Area Final Improvements & Demobilization

2027

- *1st and 2nd Quarter*
  - *Contingency for any delays experienced through end of 2026*

End Year 3 Grant Activities

Project Partners

The following table highlights the specific project partners, their roles, and their capabilities concerning the proposed project.

Table 9: Potential Project Partners.

Entity	Role	Description
U.S. Fish and Wildlife Service, Back Bay National Wildlife Refuge	Project Partner / Advisor / Adjacent Land Owner	BBNWR owns the land adjacent to the project footprint and monitors migratory bird hunting within Presidential Proclamation boundaries. BBNWR has coordinated with the City on project design and will continue to be involved during project construction as a stakeholder and advisor.
Virginia Department of Wildlife Resources	Project Advisory / Stakeholder	The City has coordinated closely with VDWR on project design. Furthermore, VDWR has been monitoring SAV distribution in Back Bay for decades and will be a critical partner for identifying native seagrass species and techniques for restoration based on extensive experience from previous SAV restoration projects in Back Bay.
Virginia Beach Department of Planning & Community Development	Permit Compliance	The City's Department of Public Works has been in close coordination with the City's Department of Planning & Community Development throughout the design and permitting process. Continued involvement and coordination during construction and post-construction monitoring is anticipated.
Dewberry	Engineering Contractor	Engineering consultant to support the City with contractor procurement and construction administration.
To be Determined	Construction Contractors	Construction contractor for the Shipps Cabin Road Construction Staging Area and marsh terrace construction activities.

Entity	Role	Description
Friends of Back Bay	Project Advisory / Stakeholder	Friends of Back Bay was formed in the 1980s to lead efforts to expand and conserve BBNWR, including securing millions in funding to support the Refuge's expansion. The City has coordinated with the BBNWR Society throughout the design and permitting process and will continue this coordination through construction and post-construction monitoring.
Back Bay National Wildlife Refuge Society	Project Advisory / Stakeholder	The Back Bay National Wildlife Refuge Society (BBNWR Society) is an independent, 501(c)(3) non-profit group dedicated to supporting the mission of the USFWS National Wildlife Refuge System and specifically promoting awareness of the BBNWR through education and participation. The City has coordinated with BBNWR Society throughout the design and permitting process and will continue this coordination through construction and post-construction monitoring.
Back Bay Restoration Foundation	Project Advisory / Stakeholder	Back Bay Restoration Foundation (BBRF) is an independent, 501(c)(3) non-profit group focusing on growing concerns about issues such as recurrent flooding, sea level rise, and development in the Southern Rivers Watershed. The group aims to serve as an advocate for the Bay and surrounding residents. The City has coordinated with BBRF throughout the design and permitting process and will continue this coordination through construction and post-construction monitoring.

Relationship to Other Projects

This project represents the first nature-based project in the Southern Rivers Watershed to advance to design and construction to implement the City's Wise Resilience Plan. The project is also an aspect of the Stormwater Green Infrastructure aspect of the City's Flood Protection Plan. The City has received a $3M award from the CFPF to support another project in the Stormwater Green Infrastructure element of the Flood Protection Program – the Elizabeth River Wetland and Floodplain Restoration Project (Round 1 CFPF Grant Awards).

The City has also received two NFWF NRCF grants from the Marsh Restoration in Back Bay project. Approximately $135,000 in NFWF NRCF funding was awarded in 2020 for the previous phase (design and permitting) for the project. The City continues to meet the obligations and period of performance of this NFWF grant. In 2022, the NFWF NRCF awarded $9,886,400 to support construction activities.

In its Resilience Plan, Virginia Beach identifies an adaptation approach for the Southern Rivers Watershed that emphasizes natural mitigation methods and integrated systems of defenses. As a natural mitigation strategy, the marsh terrace project aims to serve as a first line of defense during flood events, reducing wind-driven fetch, wave energy, and flow velocities to protect the important marsh buffer surrounding the shorelines of Back Bay. Other projects are also needed to provide multi-layered flood protection to northern Back Bay communities (Figure 32). Several

of these projects are highlighted below. It should be noted that the projects described below are either not yet funded or will be funded in the future through the City's Capital Improvement Program.

Figure 32: Southern Rivers Watershed Adaptation Vision.

Marsh island restoration serves as a critical first line of defense of the multi-layered protection system in the Southern Rivers Watershed. The following map (Figure 33) shows the structural adaptation projects proposed for the Southern Rivers Watershed, including the Muddy Creek Road and Sandbridge flood defense systems. The City's numerical modeling shows that, if implemented, there is potential for small increases in flooding outside of these structural protection systems.[14] This emphasizes the need for complimentary measures, including the marsh terrace project, land acquisition, and conservation efforts, to mitigate this residual risk.

[14] City of Virginia Beach (2020). City-wide Structural Alternatives for Coastal Flood Protection (PDF).

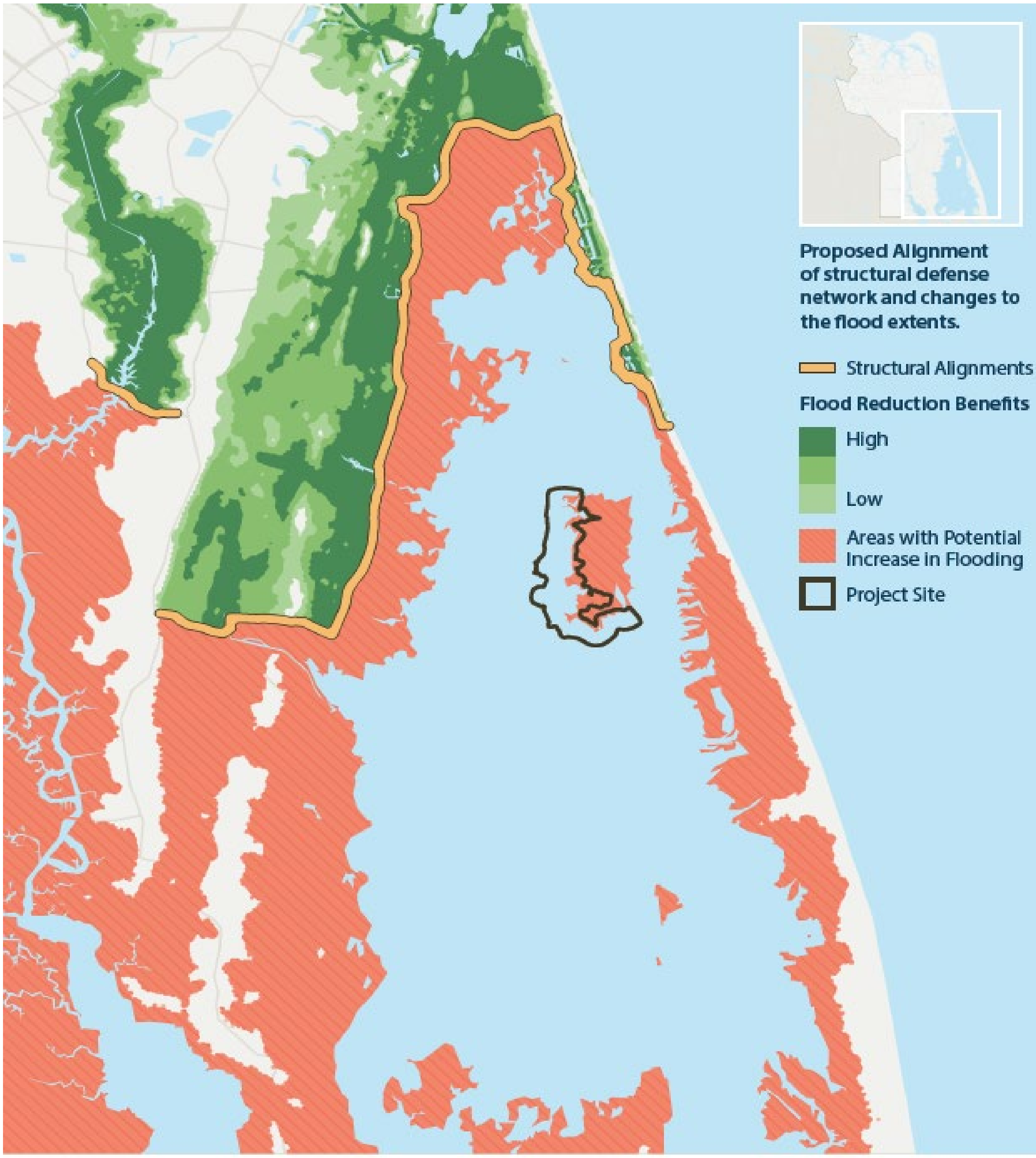

Figure 33: Structural adaptation projects proposed for the Southern Rivers Watershed, including the Muddy Creek Road and Sandridge flood defense systems.

Backside of Sandbridge Flood Defense System

Protection of the Sandbridge resort community from increasing coastal flood hazards would require a complex and expensive structural protection system because of the manufactured land configuration on the backside of Sandbridge. The proposed protection system includes elevating Sandbridge Road and constructing a network of seawalls, levees, and gates along the Back Bay shoreline of Sandbridge. This project does not have designated funding at this time.

Hell Point Creek Flood Defense System

As part of the integrated Sandbridge City-Wide flood defense network, a storm surge barrier across Hell Point Creek could block flood waters originating from Back Bay. Sandbridge Road would also need to be raised to ensure floodwaters could not flank the system. This project does not have designated funding at this time.

Sandbridge/New Bridge Intersection Improvements

Road and shoulder improvements are planned to increase safety at the New Bridge Road/Sandbridge Road intersection and reduce the need for road closures due to flooding from the adjacent Ashville Creek.

Muddy Creek Road Flood Defense System

Muddy Creek Road provides access to important rural and agricultural communities and Back Bay and the Wildlife Refuge. Muddy Creek Road is one of the lowest-lying roadways in all of Virginia Beach and frequently floods. This City-Wide Structural Alternative Flood Protection analysis identified this roadway as a critical location to provide flood protection. The proposed system, known as the Muddy Creek Road Alignment, would transform much of Muddy Creek Road into a levee, with the road on the top. The City's numerical modeling effort shows that the Muddy Creek Road Flood Defense System could potentially increase flood risk to the east of Muddy Creek Road, as shown in Figure 33. Therefore, the implementation of nature-based strategies suitable to the low-lying shorelines of Back Bay is essential to mitigate these impacts. This project does not have designated funding at this time.

Voluntary Acquisition Program

Virginia Beach City Council has recently funded a $2.0 million City-wide voluntary acquisition program to encourage flood-prone property owners to apply for a buyout. Parcels acquired by the City, in the Southern Rivers Watershed, would then be converted to open space to serve as flood storage and a marsh migration buffer.

Stormwater Master Plan

The City Council initiated an update of the City's Stormwater Master Plan in 2014. This effort is interchanging information with aspects of the City's Resilience Plan to account for the impact of sea level rise on the stormwater system's performance. Specific stormwater drainage improvement projects are included within the Lower Southern Rivers Watershed Drainage Basin.

Virginia Coastal Resilience Master Plan

The CRMP highlighted the marsh terrace project as an exemplary nature-based resilience project. The CRMP emphasizes Virginia Beach's strategic use of multiple funding streams to implement a large-scale nature-based project. DCR’s contribution to the project’s construction could be highlighted as a success story for implementation of the CRMP.

Audubon North Carolina Currituck Sound Coalition Marsh Conservation Plan

In coordination with Audubon North Carolina, the Currituck Sounds Coalition identified marsh restoration priorities based on criteria for siting restoration projects, including vulnerability to sea level rise, historic increase in surface water, and distance to hardened shorelines. This assessment identified Virginia Beach's marsh terrace project site as a high-priority area for restoration. There is an opportunity to highlight this project as a success story in the next iteration of the Audubon's Marsh Conservation Plan, which is slated to be updated every three years.

Maintenance Plan

Standard maintenance measures have been defined as part of the draft Annual Monitoring Plan and Post-Construction Monitoring Report developed for this project. See Attachment 5 for a copy of the draft report.

Subsequent to the monitoring period, project maintenance will be addressed by the City's Public Works Stormwater Operations Group, who will also respond to any maintenance issues identified by the monitoring effort or other observers. The City intends to maintain the construction staging area to support future project maintenance needs. The City will perform inspections every 2-5 years and make any repairs needed for the life of the project after completion of the initial monitoring program.

As described by the draft Annual Monitoring Plan and Post-Construction Monitoring Report, maintenance measures include the replacement of plantings (including upland, marsh and SAV plantings), the removal of debris from the terraces, the removal of invasive vegetation identified in the planting areas, the addition of sediment to eroding areas of the terraces, and the replacement of waterfowl barriers as necessary. In addition, structural maintenance measures that might be identified and prescribed during monitoring efforts include replacement of dislodged stones, addition of stone to address structure settlement, and general repair of sand cores or other structural elements. As proposed, these measures would become conditions of the wetland permits required for this project, in addition to standard commitments and requirements defined by the permitting agencies.

In addition to the commitments made in the monitoring plan, and those anticipated to be defined during the permitting process, it is the assumption that the placement of the proposed marsh terrace structures in state waters (subaqueous bottoms) will require the City to maintain the marsh terraces in perpetuity. As previously defined through coordination with VMRC, the City would obtain a compensable interest in the property that has been filled on top of state-owned subaqueous bottomlands (i.e. the terraces). As such, the City would be responsible for maintaining the proposed marsh terraces structures to ensure they fulfill their intended functions, as defined in the objectives and indicators of success previously defined in this proposal.

Criteria

The project receives a total score of **65 Points**. An explanation of how the project meets each

of the applicable scoring criteria contained in Appendix D is provided below.

Eligible Project (Type)

Category/Points: Wetland/floodplain restoration, Living shorelines and vegetated buffers (25 Points)

Explanation: Marsh terraces are considered a type of wetland restoration or a component of a living shoreline project:

- Wetland Restoration: Wetland restoration aims to reestablish or enhance natural wetland ecosystems. Marsh terraces can be constructed in areas where wetlands have been degraded or lost, and they help to recreation or support wetland functions. They provide habitat for various species, improve water quality, and can contribute to the overall health and resilience of a wetland ecosystem.
- Living Shoreline Project: Living shorelines are designed to protect shorelines from erosion while also promoting ecological and environmental benefits. Marsh terraces are often used as a component of living shoreline projects. They can serve as a buffer against wave action, stabilize shorelines, and create suitable habitat for marsh and aquatic species.

Social Vulnerability Index Score

Category/Points: Low Social Vulnerability (0 Points)

Explanation: Based on the Virginia Flood Risk Information System (VFRIS) Social Vulnerability Index Layer, the Social Vulnerability Index scores of the communities located in the two census block groups adjacent to Back Bay near the project site are -1.07 and -0.43 (an average of -0.75), which falls into the Low Social Vulnerability category.

Community Scale Benefits

Category/Points: More than one census block group (30 Points)

Explanation: As documented in the *Supporting Documentation - Project Information – Population* section of this document, the project is anticipated to benefit two census block groups (518100454.121 and 518100464.001).

Expected Lifespan of Project

Category/Points: Over 20 Years (10 Points)

Explanation: As documented in the *Supporting Documentation – Approach, Milestones, and Deliverables – Activity 3 (Marsh Terrace Construction)* section, the marsh terraces have a 30-year design life.

Budget Narrative

The following budget narrative details the proposed project expenditures. See Appendix B for completed budget spreadsheet.

Estimated Total Project Cost

The current estimated total project cost is **$53,378,490.** This estimate includes design, site acquisition for the construction staging area, construction, inspections and support, implementation, and contingencies, as shown in the below table. The design engineer's opinion of probable cost for construction is provided

Project Activity	Capital Improvement Program Estimate
Design	$276,800
Site Acquisition	$50,000
Construction	$41,839,900
Inspections and Support	$5,609,200
Implementation	$750,000
Contingencies	$4,852,590
Total:	$53,378,490

Funds Requested from the Fund

The City is requesting a total of **$5,000,000.00** in funding from the CFPF Round 4. These funds will support contractual services of the engineering consultant and construction contractor to execute Activity 2 (Construction Staging Area Preparation and Construction) and Activity 3 (Marsh Terrace Construction). No support is requested for City personnel.

These funds will be used to support ongoing construction activities through 2024-2026. Example activities include contractor construction services, mobilization/demobilization, construction staging area construction, slurry pipe installation, portions of the terrace materials, and waterfowl barriers. Construction costs are based on a detailed estimate from the design engineer that includes detailed breakdown of estimated quantities and costs from the 95% design package using industry standards for the anticipated aspects of the project construction. The City has withheld the detailed estimate as it provides information that would affect bidding on the construction.

Amount of Funds Available

The City as prime recipient is providing a cash match of $38,356,966 from funds fully programmed and available from the City's Flood Protection Program Capital Improvement Program to support the project. The Flood Protection Program is supported by a related bond referendum that provided $567.5M to fund more than 40 projects identified for Phase 1 of the Program. The program is tightly managed by the City, an independent contractor, and has a resident oversight board. The City is fully confident these funds will be available for constructing this project.

The City's dedicated funds will provide cash match to cover contractual services to support Activity 1 (Construction Staging Area Preparation and Construction), Activity 2 (Marsh Terrace Construction), Activity 3 (Stakeholder Engagement and Dissemination), and all related City support and direct overhead costs related for the project.

The National Fish and Wildlife Foundation is also supporting the project through two grant awards from the National Coastal Resilience Fund. This includes an initial award of $135,124 in 2020 for design and a second award of $9,886,400 in 2022 to support construction. The 2022 grant funds are dedicated to purchasing the native vegetation and a portion of the materials needed to build the marsh terraces.

A summary of project costs, funds available, and funds requested is provided below:

Item	Amount
Project Cost:	$53,378,490.00
Funding Sources Available	
NFWF Grant:	$10,021,524.00
CFPF Grant Request:	$5,000,000
City Funds Available:	$38,356,96600
Total Project Funding:	**$53,378,490.00**

Authorization to Request for Funding

Please refer to *attachment* for the documentation authorizing the funding request.

Attachment 1: Virginia Beach Resilience Plan DCR Approval

Matthew J. Strickler
Secretary of Natural Resources

Clyde E. Cristman
Director

COMMONWEALTH of VIRGINIA
DEPARTMENT OF CONSERVATION AND RECREATION

Rochelle Altholz
Deputy Director of Administration and Finance

Russell W. Baxter
Deputy Director of Dam Safety & Floodplain Management and Soil & Water Conservation

Nathan Burrell
Deputy Director of Government and Community Relations

Thomas L. Smith
Deputy Director of Operations

July 20, 2021

Toni Utterback, P.E.
Department of Public Works
2875 Sabre Street, Suite 250
Virginia Beach, VA 23452

RE: Virginia Beach Resilience Plan Second Submission - CFPF

Dear Ms. Utterback:

Thank you for the resubmission of the Sea Level Wise Adaptation Plan for City of Virginia Beach. After careful review and consideration, the Virginia Department of Conservation and Recreation has deemed the Plan complete and meets all the criteria outlined in the June 2021 Community Flood Preparedness Grant Manual. This approval will remain in effect for a period of three years, ending on July 31, 2024.

The following elements were evaluated as part of this review:

1. **Element 1: It is project-based with projects focused on flood control and resilience. DCR RESPONSE**

    a. Project-based: Four watersheds—each with a defined geographic area, analysis of community social and environmental characteristics, types of flooding, and a tailored flood resilience strategy with <u>discrete projects identified</u>.

Projects focused on flood control and resilience include:

Neighborhood	Flood Control Project
Elizabeth River	City-wide alignment, living shoreline, marsh restoration, land conservation
Lynnhaven	Chesapeake Bay alignment, Lesner Bridge Neighborhood alignment (East & West), beach & dune nourishment, ecological revetments, shellfish reef restoration, seagrass restoration
Oceanfront	Atlantic Oceanfront alignment, Rudee Heights alignment
Southern Rivers	West Neck Creek city-wide alignment, Muddy Creek Road city-wide alignment, Sandbridge city-wide alignment

**additional projects listed within the Sea Level Wise Adaptation Strategy.*

2. **Element 2: It incorporates nature-based infrastructure to the maximum extent possible. DCR RESPONSE**

   a. Nature-based infrastructure: Flood mitigation projects throughout the city incorporate nature-based solutions and were identified for maximum use within specific watersheds.

3. **Element 3: It includes considerations of all parts of a locality regardless of socioeconomics or race. DCR RESPONSE**
   a. All parts of a locality: Locality divided into four watersheds, covering the entirety of the jurisdictional boundary.
   b. Social vulnerability: Social implications of flood hazards and analysis of populations at-risk documented.
   c. Demographic Analysis: Demographic and Population Vulnerability Analysis conducted by Dewberry and incorporated into the Plan.

4. **Element 4: It includes coordination with other local and inter-jurisdictional projects, plans, and activities and has a clearly articulated timeline or phasing for plan implementation. DCR RESPONSE**
   a. Coordination with other projects, plans, and activities: Contains the planning processes and frameworks which outline local and regional plans used by the City and address resilience; and how they have been integrated for flood adaptation planning.
   b. Clearly articulated timeline or phasing for plan implementation: Program phases clearly articulated and described in detail—Impact assessment, Adaptation research, Strategy development, and Long-term implementation.

5. **Element 5: Is based on the best available science, and incorporates climate change, sea level rise, storm surge (where appropriate), and current flood maps.**
   a. Technically backed water-resources analysis, sea level rise projections, storm surge, and climate change incorporated into strategic approach.

VA DCR looks forward to working with you as you work to make Virginia Beach a more resilient community. If you have questions or need additional assistance, please contact us at cfpf@dcr.virginia.gov. Again, thank you for your interest in the Community Flood Preparedness Fund.

Sincerely,

Wendy Howard Cooper

Wendy Howard Cooper, Director
Dam Safety and Floodplain Management

cc: Darryl Glover, DCR

Attachment 2: Authorization to request funding from the Fund from governing body or chief executive of the local government

City of Virginia Beach

DEPARTMENT OF BUDGET AND MANAGEMENT SERVICES
(757) 385-8234
(757) 385-1857 FAX

VBgov.com
MUNICIPAL CENTER
BUILDING 1, 3RD FLOOR
2401 COURTHOUSE DRIVE
VIRGINIA BEACH, VA 23456-9001

INTER-OFFICE MEMORANDUM

DATE: November 1, 2023

TO: Patrick A. Duhaney, City Manager

FROM: Stuart McCrery, Budget and Policy Analyst KJ for SM

SUBJECT: Application for Virginia Community Flood Preparedness Fund Grant

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The Department of Public Works is requesting permission to apply for the Virginia Community Flood Preparedness Fund Grant from the Virginia Department of Conservation and Recreation. The Virginia Community Flood Preparedness Fund was established in the 2020 session of the General Assembly. Money in this fund comes from the auction of carbon allowances through the Regional Greenhouse Gas Initiative. It was established to provide support to localities across Virginia to reduce the impacts of flooding, including flooding driven by climate change.

Public Works is requesting a total of $5,000,000 to construct marsh terraces in Back Bay to promote wetland restoration and mitigate frequent flooding. The City has already made significant investments into this project through CIP project 100551 "Stormwater Green Infrastructure."

This grant also requires a local match of 30% for projects that implement nature-based solutions; however, the City has more than met this requirement through its current appropriations to CIP project 1000551 "Stormwater Green Infrastructure" which currently total over $49 million from the Referendum and other grant awards.

Budget & Management Services recommends this grant application for approval. Please indicate approval or disapproval below. Applications are due by November 12, 2023.

Approve	(Date) 11/1/2023	Disapprove	(Date)

Attachment 3: Virginia Beach Floodplain Administrator Support Letter

City of Virginia Beach

VBgov.com

DEPARTMENT OF PLANNING & COMMUNITY DEVELOPMENT
PHONE (757) 385-4621
FAX (757) 385-5667
VA Relay Number TTY: 711

2875 SABRE STREET, SUITE 500
VIRGINIA BEACH, VA 23452-7385

November 7, 2023

Division of Dam Safety and Floodplain Management
600 East Main Street, 24th Floor
Richmond, Virginia 23219

RE: Community Flood Preparedness Fund – Marsh Terrace Creation, Back Bay

The proposed project is located in both open water and a Federal Emergency Management Agency (FEMA) mapped Special Flood Hazard Area (SFHA). Hydraulic modeling analysis identified Bonney Cove as a location where marsh restoration has the potential to reduce the propagation of floodwater through key pathways within Back Bay. This project aims to stabilize two critically eroding marsh islands that serve as a key flood pathway into northern Back Bay, promote the growth of aquatic vegetation, and provide flood risk reduction benefits to communities in the surrounding area. Within the two census block groups that would benefit from this project, there are 113 repetitive loss and severe repetitive loss properties.

If I can provide any further information or assistance, please call me at 757-385-4621, or e-mail me at wmcnamar@vbgov.com.

Sincerely,

Whitney McNamara

Whitney McNamara, CFM
Floodplain Administrator and CRS Coordinator

Attachment 4: Letters of Support

Back Bay Restoration Foundation

PO Box 57041 • Virginia Beach, Virginia • 23457• 757-818-4829

November 6, 2023

Department of Conservation and Recreation
Dam Safety and Floodplain Management
600 E. Main St., 24th Floor
Richmond, VA 23219

Re: Virginia Community Flood Preparedness Fund Grant

Grantors:

The Back Bay Restoration Foundation (BBRF), is a 35 year-old non-profit watershed organization, founded in 1986 by a group of local citizens concerned about deterioration of the Back Bay watershed visible then through decreases in Submerged Aquatic Vegetation (SAV), fish, and waterfowl. BBRF is the only voice solely dedicated to conserving and improving Virginia Beach's two Southern Watersheds; namely, the Back Bay and North Landing River watersheds. Our efforts focus on education, stewardship and outreach to conserve the largest watersheds in Virginia Beach. We team with other non-profits, and city, state and federal agencies to work toward best solutions for the future of the Back Bay and North Landing River watersheds. BBRF strives to raise awareness, addressing issues that negatively affect these watersheds such as sea level rise, land subsidence and land use changes.

Back Bay is a historical, nationally significant, watershed. With the Back Bay National Wildlife Refuge (NWR) and significant State conservation lands at its core, the watershed was recognized as an Aquatic Resource of National Importance (ARNI) in 2008 by both the US Fish and Wildlife Service and the US Army Corps of Engineers. Back Bay is a wind-tidal oligohaline estuary and is located at the northern tip of the Albemarle/Pamlico estuarine system, the second largest estuarine complex in the United States. The Albemarle/Pamlico estuarine system was designated as an Estuary of National Significance in 1987 and selected to be studied as part of the Environmental Protection Agency's National Estuary Program. Back Bay is a shallow-water aquatic ecosystem with an average depth of four feet. Winds can influence the water depth by as much as three feet.

BBRF supports the City of Virginia Beach's application for Round 4 of VADCR's Community Flood Preparedness Fund. We were strong advocates of the City's successful applications to the National Fish and Wildlife Foundation (NFWF), and have seen what they accomplished with the initial NFWF funding they received. With the combined funding of NFWF, the City of Virginia Beach, and this application for DCR funding, their project of creating a Marsh Terrace Network to Achieve Restoration and Flood Resilience has overachieved by any measure. From community engagement and the NEPA process to conceptual and preliminary designs as described in the recent Army Corps Public Notice, the City has been productive and completely transparent.

As noted above, the City's community engagement and partnerships with organizations like ours has been transparent and resulted in broad support. Although the current project is localized in its first application, we expect the results will significantly mitigate SLR, land subsidence and wind tides in Back Bay. Similarly, this restoration will provide the biotic building blocks to maintain the watershed's national importance for wildlife. The innovative designs proposed will inform future projects at the landscape level. Although innovative, we believe the project is technically sound based on BBRF's 35 years of experience in habitat restoration.

Please feel free to contact us for further information.

Jared Brandwein

Jared Brandwein

Executive Director
Back Bay Restoration Foundation

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Back Bay National Wildlife Refuge
1324 Sandpiper Road
Virginia Beach, VA 23456

October 30, 2023

Wendy Howard Cooper
Division of Dam Safety and Floodplain Management
600 East Main Street, 24th Floor
Richmond, Virginia 23219

Dear Ms. Cooper,

The City of Virginia Beach is proposing to install marsh terraces in the waters of Back Bay adjacent to Back Bay National Wildlife Refuge. This project is expected to reduce wave energy and thus decrease the speed of erosion of remaining islands in the project area, many of which are managed by the U.S. Fish and Wildlife Service and provide habitat for migratory birds and other species. Additionally, the addition of multiple vegetative structures added to the bay will supplement habitat and provide nesting grounds for multiple species.

The mission of the U.S. Fish and Wildlife Service is *working with others to conserve, protect, and enhance fish, wildlife, plants, and their habitats for the continuing benefit of the American people*. Although much work is conducted on federal property to achieve this mission, the Service equally coordinates with external partners to further mutual goals. The proposed marsh terrace project is an excellent example of local and federal government coordination, and we support the City of Virginia Beach's proposed project.

Megan Reed

Megan Reed
Refuge Manager

Albemarle-Pamlico
National Estuary Partnership

*Our mission is to identify, protect, and restore
the significant resources of the Albemarle-Pamlico estuarine system.*

October 26, 2023

Wendy Howard Cooper
Virginia Dept. of Conservation and Recreation
Division of Dam Safety and Floodplain Management
600 E. Main St., 24th Floor
Richmond, VA 23219

Dear Wendy,

The Albemarle-Pamlico National Estuary Partnership (APNEP) strongly endorses the City of Virginia Beach and partners' application to Round 4 of The Virginia Community Flood Preparedness Fund (CFPF). The proposal is to support construction of the Back Bay Marsh Terrace Restoration Project.

APNEP relies on regional partnerships and collaboration to implement our 2012-2022 Comprehensive Conservation & Management Plan (CCMP) within the waterways of our congressionally designated "estuary of national significance." The proposed partnership between the City of Virginia Beach and the U.S. Fish and Wildlife Service will also advance our 2020 Memorandum of Understanding between Virginia and North Carolina to protect the ecosystem resources in the shared waterways between our two states. The project also addresses a "high priority" area for restoring and enhancing vulnerable marshes with high flood risk reduction benefits and habitat value, as identified by Audubon's Currituck Sound Coalition Marsh Conservation Plan released in 2021.

The marsh terrace project employs the use of natural features to build resilience to flooding in the Back Bay watershed. The project offers coastal resilience and habitat protection and conservation co-benefits including preserving marsh islands, restoring Submerged Aquatic Vegetation, migratory bird and fish habitat, reducing flow that could exacerbate wind tide flooding in local communities, and filling a gap in prior applied research on predominantly fresh water coastal lagoons. These features support the following CCMP actions:

- A2.3: Support research on adapting to impacts associated with climate change and sea level rise.
- C3.2: Develop and implement a coordinated wetland restoration strategy.
- C3.3: Develop and implement a submerged aquatic vegetation (SAV) restoration strategy.
- D3.3: Provide assistance to state, regional, and local governments to incorporate climate change and sea level rise considerations into their planning processes.

In closing, we strongly support the full funding of the City of Virginia Beach's proposal to Round 4 of The Virginia Community Flood Preparedness Fund (CFPF). Please contact Steve Anderson, Partnership Coordinator, at (919) 707-8743 with questions.

Sincerely,

W. Crowell

William L. Crowell, Jr., Ph.D., AICP, CEE
Director

Attachment 5: Copy of the Current Floodplain Ordinance

ORD-3685

AN ORDINANCE TO AMEND SECTIONS 1.1, 1.2, 1.3, 1.8, 2.1, 2.2, 2.3, 2.4, 2.8, 2.11, 3.1, 4.1, 4.2, 4.3, 4.4, 4.6, 4.8, 4.9, 4.10, 5.1, 6.1, AND 6.3 OF APPENDIX K, FLOODPLAIN ORDINANCE OF THE CITY CODE PERTAINING TO HOUSEKEEPING THE DELETION OF PUBLIC WORKS REQUIREMENTS AND THE ADDITION OF A COASTAL A ZONE AND A COASTAL HIGH HAZARD ZONE

Sections Amended: 1.1, 1.2, 1.3, 1.8, 2.1, 2.2, 2.3, 2.4, 2.8, 2.11, 3.1, 4.1, 4.2, 4.3, 4.4, 4.6, 4.8, 4.9, 4.10, 5.1, 6.1, and 6.3 of Appendix K, Floodplain Ordinance

WHEREAS, the public necessity, convenience, general welfare and good zoning practice so require;

BE IT ORDAINED BY THE CITY COUNCIL OF THE CITY OF VIRGINIA BEACH, VIRGINIA:

That Sections 1.1, 1.2, 1.3, 1.8, 2.1, 2.2, 2.3, 2.4, 2.8, 2.11, 3.1, 4.1, 4.2, 4.3, 4.4, 4.6, 4.8, 4.9, 4.10, 5.1, 6.1, and 6.3 of Appendix K, Floodplain Ordinance is hereby amended and reordained to read as follows:

APPENDIX K FLOODPLAIN ORDINANCE

ARTICLE I. GENERAL PROVISIONS

Sec. 1.1. Statutory authorization and purpose.

A. This ordinance is adopted pursuant to the authority granted to localities by Code of Virginia § ~~10.1-600 et seq~~ 15.2-984.

B. The city council finds the purpose of these provisions is to prevent the loss of life and property, the creation of health and safety hazards, the disruption of commerce and governmental services, the extraordinary and unnecessary expenditure of public funds for flood protection and relief, and the impairment of the tax base by:

1. Regulating uses, activities, and development that, alone or in combination with other existing or future uses, activities, and development, will cause unacceptable increases in flood heights, velocities, and frequencies;

2. Restricting or prohibiting certain uses, activities, and development from locating within districts subject to flooding;
3. Requiring all uses, activities, and developments that do occur in flood-prone districts be protected or flood-proofed against flooding and flood damage;

4. Protecting individuals from buying land and structures that are unsuited for intended purposes because of flood hazards; and

5. Acknowledging that the tide data over the last one hundred (100) years shows that Virginia Beach is facing an increased danger of flooding caused by both sea level rise and subsidence and has adopted the Sea Level Wise Adaptation Report as part of the Comprehensive Plan.

Sec. 1.2. Applicability.

These provisions shall apply to all privately and publicly owned lands within the jurisdiction of the City of Virginia Beach and identified as areas ~~of special flood hazard~~ at risk of flooding by the City of Virginia Beach or shown ~~according to~~ on the Flood Insurance Rate Map (FIRM) or included on the flood insurance study (FIS) that ~~is~~ are provided to the City of Virginia Beach by the Federal Emergency Management Agency (FEMA) and dated January 16, 2015 ~~or identified as floodplains subject to special restrictions in section 4.10 of this ordinance~~.

Sec. 1.3. Definitions.

. . . .

City manager. The City Manager of the City of Virginia Beach, or his designees.

Design Flood Elevation (regulatory flood protection elevation). The base flood elevation plus the freeboard required by this ordinance.

. . . .

Recreational vehicle. A vehicle that is:

1. Built on a single chassis;
2. Four hundred (400) square feet or less when measured at the largest horizontal projection;
3. Designed to be self-propelled or permanently towable by a light duty truck; and
4. Designed primarily not for use as a permanent dwelling but as temporary living quarters for recreational camping, travel, or seasonal use.

~~*Regulatory flood protection elevation (design flood elevation)*. The base flood elevation plus the freeboard required by this ordinance.~~

. . . .

Sec. 1.8. Penalty for violations.

Any person who fails to comply with any of the requirements or provisions of this ordinance or directions of the ~~d~~Directors of ~~p~~Planning ~~or public works~~ or any authorized employee of the City of Virginia Beach shall be guilty of the appropriate violation and subject to the penalties therefore. Any violation of the provision of this ordinance shall be punishable by a fine of not more than one hundred dollars ($100.00). Each person shall be deemed guilty of a separate offense for each and every day or portion thereof during which any violation of any of the provisions of this ordinance is committed.

The Virginia Uniform Statewide Building Code (VA USBC) addresses building code violations and the associated penalties in ~~section 104 and section 115~~ VA USBC § 104 and § 115. Violations and associated penalties of the Zoning Ordinance for the City of Virginia Beach are addressed in § 104 of the Zoning Ordinance.

In addition to the above penalties, all other actions are hereby reserved, including an action in equity for the proper enforcement of this ordinance. The imposition of a fine or penalty for any violation of, or noncompliance with, this ordinance shall not excuse the violation or noncompliance or permit it to continue, and all such persons shall be required to correct or remedy such violations within a reasonable time. Any structure constructed, reconstructed, enlarged, altered, or relocated in noncompliance with this ordinance may be declared by the City of Virginia Beach to be a public nuisance and abatable as such. Flood insurance may be withheld from structures constructed in violation of this ordinance.

ARTICLE II. ADMINISTRATION

Sec. 2.1. Designation of the floodplain administrator.

The City Manager of the City of Virginia Beach is hereby appointed the floodplain administrator to administer and implement this ordinance. The floodplain administrator has delegated the duties and responsibilities set forth in this ordinance to the ~~departments of public works and planning, as specified below~~ Department of Planning and Community Development.

Sec. 2.2. Duties and responsibilities of the ~~department of public works~~ floodplain administrator or his designee.

The duties and responsibilities of the ~~department of public works~~ floodplain administrator of his designee shall include but are not limited to:

A. Interpreting floodplain boundaries and providing available base flood elevation and flood hazard information;

B. Verifying that applicants proposing an alteration of a watercourse have notified adjacent communities, the department of conservation and recreation (division of dam safety and floodplain management), and other appropriate agencies (Virginia Department of Environmental Quality (VADEQ), United States Army Corps of Engineers (USACE), etc.) and have submitted copies of such notifications to FEMA;

C. Advising applicants for new construction or substantial improvement of structures that are located within an area of the coastal barrier resources system established by the Coastal Barrier Resources Act that Federal flood insurance is not available on such structures; areas subject to this limitation are shown on FIRMs as coastal barrier resource system areas or otherwise protected areas;

D. Submitting to FEMA, or requiring applicants to submit to FEMA, data and information necessary to maintain FIRMs, including hydrologic and hydraulic engineering analyses prepared by or for the city, within six (6) months after such data and information becomes available if the analyses indicate changes in base flood elevations;

E. Maintaining and permanently keeping records that are necessary for the administration of these regulations, including:

1. ~~flood~~ Flood insurance studies, FIRMs (including historic studies and maps and current effective studies and maps) and letters of map change; and

2. Documentation supporting issuance and denial of permits, Elevation Certificates, documentation of the elevation (in relation to the datum on the FIRM) to which structures have been floodproofed, inspection records, other required design certifications, variances, and records of enforcement actions taken to correct violations of these regulations.

F. Notifying FEMA when the corporate boundaries of the City of Virginia Beach have been modified and:

1. Providing a map that clearly delineates the new corporate boundaries or the new area for which the authority to regulate pursuant to this ordinance has either been assumed or relinquished through annexation; and

2. If the FIRM for any annexed area includes SFHAs that have flood zones with regulatory requirements that are not set forth in this

ordinance, prepare amendments to this ordinance to adopt the FIRM and appropriate requirements, and submit the amendments to the city council for adoption; such adoption shall take place at the same time as or prior to the date of annexation and a copy of the amended ordinance shall be provided to the department of conservation and recreation (division of dam safety and floodplain management) and FEMA.

G. Upon the request of FEMA, completing and submitting a report concerning participation in the NFIP, which may request information regarding the number of buildings in the SFHA, the number of permits issued for development in the SFHA, and the number of variances issued for development in the SFHA.

<u>H. Reviewing applications for permits to determine whether proposed activities will be located in the SFHA;</u>

<u>I. Reviewing applications to determine whether proposed activities will be reasonably safe from flooding and requiring new construction and substantial improvements to meet the requirements of this ordinance;</u>

<u>J. Reviewing applications to determine whether all necessary permits have been obtained from the federal, state, or local agencies from which prior or concurrent approval is required; in particular, permits from state agencies for any construction, reconstruction, repair, or alteration of a dam, reservoir, or waterway obstruction (including bridges, culverts, structures), any alteration of a watercourse, or any change of the course, current, or cross section of a stream or body of water, including any change to the SFHAs of free-flowing non-tidal waters of the state;</u>

<u>K. Approving applications and issuing permits to develop in flood hazard areas if the provisions of this ordinance have been met, or disapproving applications if the provisions of this ordinance have not been met;</u>

<u>L. Granting administrative variances pursuant to section 6.1 of this ordinance;</u>

<u>M. Inspecting, or causing to be inspected, buildings, structures, and other development for which permits have been issued to determine compliance with this ordinance or to determine if non-compliance has occurred or violations have been committed;</u>

<u>N. Reviewing elevation certificates and requiring incomplete or deficient certificates to be corrected;</u>

O. Maintaining and permanently keeping documentation supporting the issuance and denial of permits, elevation certificates, documentation of the elevation (in relation to the datum on the FIRM) to which structures have been flood proofed, and other required design certifications, variances, and records of enforcement actions taken to correct violations of this ordinance;

P. Enforcing the provisions of this ordinance, investigating violations, issuing notices of violations or stop work orders, and requiring permit holders to take corrective action;

Q. Advising the city council regarding the intent of this ordinance and, for each application for a variance, preparing a staff report and recommendation; and

R. Administering the requirements related to proposed work on existing buildings:

1. Making determinations as to whether buildings and structures that are located in flood hazard areas and that are damaged by any cause have been substantially damaged; and

2. Making reasonable efforts to notify owners of substantially damaged structures of the need to obtain a permit to repair, rehabilitate, or reconstruct, and prohibit the non-compliant repair of substantially damaged buildings except for temporary emergency protective measures necessary to secure a property or stabilize a building or structure to prevent additional damage.

S. Undertaking, as determined appropriate by the floodplain administrator due to the circumstances, other actions that may include but are not limited to: issuing press releases, public service announcements, and other public information materials related to permit requests and repair of damaged structures; coordinating with other federal, state, and local agencies to assist with substantial damage determinations; providing owners of damaged structures information related to the proper repair of damaged structures in SFHAs; and assisting property owners with documentation necessary to file claims for increased cost of compliance coverage under National Flood Insurance Program (NFIP) flood insurance policies; and

T. It is the duty of the city floodplain administrator to take into account flood, mudslide, and flood-related erosion hazards, to the extent that they are known, in all official actions relating to land management and use throughout the entire jurisdictional area of the city, whether or not those

hazards have been specifically delineated geographically (e.g., via mapping or surveying).

~~Sec. 2.3. Duties and responsibilities of the department of planning.~~ Reserved.

~~The duties and responsibilities of the department of planning shall include but are not limited to:~~

~~A.~~ ~~Reviewing applications for permits to determine whether proposed activities will be located in the SFHA;~~

~~B.~~ ~~Reviewing applications to determine whether proposed activities will be reasonably safe from flooding and requiring new construction and substantial improvements to meet the requirements of this ordinance;~~

~~C.~~ ~~Reviewing applications to determine whether all necessary permits have been obtained from the federal, state, or local agencies from which prior or concurrent approval is required; in particular, permits from state agencies for any construction, reconstruction, repair, or alteration of a dam, reservoir, or waterway obstruction (including bridges, culverts, structures), any alteration of a watercourse, or any change of the course, current, or cross section of a stream or body of water, including any change to the SFHAs of free-flowing non-tidal waters of the state;~~

~~D.~~ ~~Approving applications and issuing permits to develop in flood hazard areas if the provisions of this ordinance have been met, or disapproving applications if the provisions of this ordinance have not been met;~~

~~E.~~ ~~Granting administrative variances pursuant to section 6.1 of this ordinance;~~

~~F.~~ ~~Inspecting, or causing to be inspected, buildings, structures, and other development for which permits have been issued to determine compliance with this ordinance or to determine if non-compliance has occurred or violations have been committed;~~

~~G.~~ ~~Reviewing elevation certificates and requiring incomplete or deficient certificates to be corrected;~~

~~H.~~ ~~Maintaining and permanently keeping documentation supporting the issuance and denial of permits, elevation certificates, documentation of the elevation (in relation to the datum on the FIRM) to which structures have been flood proofed, and other required design certifications, variances, and records of enforcement actions taken to correct violations of this ordinance;~~

~~I.~~ ~~Enforcing the provisions of this ordinance, investigating violations, issuing notices of violations or stop work orders, and requiring permit holders to take corrective action;~~

~~J.~~ ~~Advising the city council regarding the intent of this ordinance and, for each application for a variance, preparing a staff report and recommendation; and~~

~~K.~~ ~~Administering the requirements related to proposed work on existing buildings:~~

~~1.~~ ~~Making determinations as to whether buildings and structures that are located in flood hazard areas and that are damaged by any cause have been substantially damaged; and~~

~~2.~~ ~~Making reasonable efforts to notify owners of substantially damaged structures of the need to obtain a permit to repair, rehabilitate, or reconstruct, and prohibit the non-compliant repair of substantially damaged buildings except for temporary emergency protective measures necessary to secure a property or stabilize a building or structure to prevent additional damage.~~

~~Sec. 2.4. Shared duties and responsibilities.~~ Reserved.

~~The duties and responsibilities shared by the departments of public works and Planning shall include but are not limited to:~~

~~A.~~ ~~Undertaking, as determined appropriate by the floodplain administrator due to the circumstances, other actions that may include but are not limited to: issuing press releases, public service announcements, and other public information materials related to permit requests and repair of damaged structures; coordinating with other federal, state, and local agencies to assist with substantial damage determinations; providing owners of damaged structures information related to the proper repair of damaged structures in SFHAs; and assisting property owners with documentation necessary to file claims for increased cost of compliance coverage under National Flood Insurance Program (NFIP) flood insurance policies; and~~

~~B.~~ ~~It is the duty of the city floodplain administrator to take into account flood, mudslide, and flood-related erosion hazards, to the extent that they are known, in all official actions relating to land management and use throughout the entire jurisdictional area of the city, whether or not those hazards have been specifically delineated geographically (e.g., via mapping or surveying).~~

. . . .

Sec. 2.8. Interpretation of district boundaries.

Initial interpretations of the boundaries of the floodplain districts shall be made by the floodplain administrator. Should a dispute arise concerning the boundaries of any of the districts~~, the city council shall make the necessary determination. The person questioning or contesting the location of the district boundary shall be given a reasonable opportunity to present his case to the city council and to submit his own technical evidence if he so desires~~ <u>a surveyor shall provide either an elevation certificate or recent survey showing topographic elevations and delineating the Special Flood Hazard Area</u>.

. . . .

Sec. 2.11. Appeals to decisions made by the floodplain administrator.

It is further provided that any decision of the floodplain administrator or his designee may be modified, reversed, or affirmed by the city council upon appeal by any aggrieved party to such decision, if such appeal is filed with the floodplain administrator within thirty (30) days of such decision <u>through the application for a Floodplain Variance outlined in Section VI of this ordinance</u>.

ARTICLE III. ESTABLISHMENT OF FLOODPLAIN DISTRICTS

Sec. 3.1. Description of floodplain districts.

A. Special flood hazard areas (SFHA). The SFHAs shall include land in the floodplain subject to a one (1) percent or greater chance of being flooded in any given year. The basis for the delineation of these districts shall be the FIS and the FIRM for the City of Virginia Beach prepared by FEMA, Federal Insurance Administration, dated January 16, 2015, and any subsequent revisions or amendments thereto.

The boundaries of the SFHAs are established as shown on the FIRM, which is declared to be a part of this ordinance and shall be kept on file at the City of Virginia Beach Department of ~~Public Works~~ <u>Planning and Community Development</u>, and include the following districts:

1. The Floodway District is in an AE Zone and is delineated, for the purposes of this ordinance, using the criterion that certain areas within the floodplain must be capable of carrying the waters of the one (1) percent annual chance flood without increasing the water surface elevation of that flood more than one (1) foot at any point. The areas included in this district are specifically defined in Table 7 of the above-referenced FIS and shown on the accompanying FIRM.

2. The AE or AH Zones on the FIRM accompanying the FIS shall be those areas for which one (1) percent annual chance flood elevations have been provided and the floodway has not been delineated.

3. The A Zone on the FIRM accompanying the FIS shall be those areas for which no detailed flood profiles or elevations are provided, but the one (1) percent annual chance floodplain boundary has been approximated.

4. The AO Zone on the FIRM accompanying the FIS shall be those areas of shallow flooding identified as AO on the FIRM.

5. ~~Reserved.~~ The Coastal A Zone on the FIRM accompanying the FIS shall be those areas labeled as AE and are located seaward of the limit of moderate wave action (LiMWA) line.

6. The VE or V Zones on FIRMs accompanying the FIS shall be those areas that are known as coastal high hazard areas, extending from offshore to the inland limit of a primary frontal dune along an open coast and any other area subject to high velocity wave action from storm or seismic sources.

B. ~~Floodplain subject to special restrictions~~ *Local Flood Hazard Areas*. The City of Virginia Beach may identify and regulate local flood hazard or ponding areas that are not delineated on the FIRM. These areas are ~~identified in section 4.10 and may be delineated on a map using best available topographic data and locally derived information such as flood of record, historic high water marks, or approximate study methodologies~~ identified as follows:~~.~~

a. *Other areas of flood risk*. The X and the X(Shaded) Zone on the FIRM where the City of Virginia Beach Stormwater Master Plan has identified areas, outside SFHAs delineated on the FIRM, that area susceptible to flooding. The most recent updated version of the modeling shall be used to identify areas that are likely to experience flooding.

b. *Floodplain Subject to Special Restrictions*. The Floodplain Subject to Special Restrictions is identified in section 4.10 and includes areas in the southern part of the city which are characterized by wind tides, low topography, and poorly draining soils.

ARTICLE IV. FLOODPLAIN DISTRICT PROVISIONS

Sec. 4.1. Permit and application requirements.

. . . .

B. Site plans and permit applications. All applications for development within any floodplain district and all building permits issued within ~~the~~ any floodplain district shall incorporate the following information:

1. For any addition, conversion of any non-habitable space to habitable space, or the construction or installation of a new accessory structure that requires a building permit.

   a. A physical survey, performed after the effective date of the FIRM that:

      i. accurately depicts current improvements on the property;
      ii. provides a flood zone determination and BFE or flood depth at the stie; and
      iii. delineates the location of the flood zones on the property.

   b. For structures located in the SFHA delineated on the FIRM, a current elevation certificate sealed by a licensed design professional.

2. For new construction and any substantial improvement of the principal structure:

   a. a proposed site plan sealed by a registered design professional that provides:

      ~~1~~i. The elevation of the base flood at the site;

      ~~2~~ii. The elevation of the lowest floor (including basement) or, in V Zones, the lowest horizontal structural member;

      ~~3~~iii. For structures to be flood-proofed (non-residential only), the elevation to which the structure will be flood-proofed; and

      4iv. Topographic information showing existing and proposed ground elevations.

Sec. 4.2. General standards.

. . . .

5. Electrical, heating, ventilation, plumbing, air conditioning equipment, and other service facilities, including duct work, shall be designed and/or ~~located so as to prevent water from entering or accumulating within the components during conditions of flooding~~ or above the design flood elevation.

6. New and replacement water supply systems shall be designed to minimize or eliminate infiltration of flood waters into the system.

7. New and replacement sanitary sewage systems shall be designed to minimize or eliminate infiltration of flood waters into the systems and discharges from the systems into flood waters.

8. On-site waste disposal systems shall be located and constructed to avoid impairment to them or contamination from them during flooding.

9. No use shall be permitted if such use will increase the amounts of potentially damaging materials, including those likely to be injurious to health, that might be transported in floods.

10. For properties located in SFHAs delineated on the FIRM, an elevation certificate and, if applicable, a flood-proofing certificate shall be provided to the Floodplain Administrator prior to any foundation inspection, final inspections, and the issuance of any certificates of occupancy, in order to assure compliance with these floodplain regulations.

11. Prior to any proposed alteration or relocation of any channels or of any watercourse or stream within the city, a permit shall be obtained from the USACE, VADEQ, the Virginia Marine Resources Commission, and the Wetlands Board through the joint permit application process. Furthermore, notification of the proposal shall be given by the applicant to all affected adjacent jurisdictions, the department of conservation and recreation (division of dam safety and floodplain management), other required agencies, and FEMA.

12. The flood carrying capacity within an altered or relocated portion of any watercourse shall be maintained.

~~B. In all SFHAs, the following additional provisions shall apply:~~

~~1. Prior to any proposed alteration or relocation of any channels or of any watercourse or stream, within the city a permit shall be obtained from the USACE, VADEQ, the Virginia Marine Resources Commission, and the Wetlands Board through the joint permit application process. Furthermore, notification of the proposal shall be given by the applicant to all affected adjacent jurisdictions, the department of conservation and recreation (division of dam safety and floodplain management), other required agencies, and FEMA.~~

~~2. The flood carrying capacity within an altered or relocated portion of any watercourse shall be maintained.~~

~~3. Sand dunes, barrier beaches, and other natural protective barriers shall remain intact to provide protection against wind, waves, and erosion drainage. Any person who desires to use or alter any coastal primary sand dune, other than for the purpose of conducting the activities specified in section 1602 of the Zoning Ordinance of the City of Virginia Beach, shall first obtain a permit from the USACE, VADEQ, the Virginia Marine Resources Commission, and the Wetlands Board through the joint permit application process.~~

Sec. 4.3. Elevation and construction requirements.

In all ~~SFHAs where base flood elevations have been provided in the FIS or generated by a licensed professional in accordance with section 4.6 of this ordinance~~ floodplain districts, with the exception of Coastal A and Coastal High Hazard (VE) zones, the following provisions shall apply:

A. Residential construction requirements. ~~New construction or substantial improvement of any residential structure or manufactured home in Zones AE, AH, and A with detailed base flood elevations shall have the lowest floor, including basement, elevated to a minimum of two (2) feet above the base flood level.~~ The lowest flood, including basement, shall be set to the higher of the following:

i. A minimum of two (2) feet above the base flood elevation established on the most recent FIRM or by the most recent FIS or,

ii. A minimum of one (1) foot above the 100-year HGL elevation measured at the nearest existing or proposed public drainage structure or BMP, in the City Stormwater Master Plan.

B. Non-residential construction requirements. New construction or substantial improvement of any commercial, industrial, or non-residential building or manufactured home shall have the lowest floor, including basement, elevated as ~~minimum of two (2) feet above the base flood level~~ established in Section 4.3 A of this ordinance. Buildings ~~located in AE or AH Zones~~ may be flood-proofed in lieu of being elevated provided that all areas of the building components below the ~~elevation corresponding to the base flood elevation plus a minimum of two (2) feet freeboard~~ design flood elevation are watertight with walls substantially impermeable to the passage of water, and use structural components having the capability of resisting hydrostatic and hydrodynamic loads and the effect of buoyancy. A professional engineer or architect licensed by the Commonwealth of Virginia shall certify that the standards of this subsection are satisfied. Such certification, including the specific elevation (in relation to NAVD88) to which such structures are flood proofed, shall be maintained by the building official.

C. ~~Space below the lowest floor requirements. In Zones A, AE, AH, and AO, f~~Fully enclosed areas of new construction or substantially improved existing structures that are below the ~~regulatory~~ design flood protection elevation shall:

1. Not be designed or used for human habitation, but shall only be used for parking of vehicles, building access, or limited storage of maintenance equipment used in connection with the premises. Access to the enclosed area shall be the minimum necessary to allow for parking of vehicles (garage door), limited storage of maintenance equipment (standard exterior door), or entry to the living area (stairway or elevator).

2. Be constructed entirely of flood resistant materials below the ~~regulatory~~ design flood ~~protection~~ elevation.

3. Space below the lowest floor of SFHAs delineated on the FIRM shall ~~I~~include measures to automatically equalize hydrostatic flood forces on walls by allowing for the entry and exit of floodwaters. To meet this requirement, the openings shall either be certified by a professional engineer or architect licensed by the Commonwealth of Virginia or meet or exceed the following minimum design criteria:

. . . .

Sec. 4.4. Floodway requirements.

. . . .

B. The placement of new or replacement manufactured homes (mobile homes) is prohibited.

~~C. The following uses and structures may be permitted in the floodway district, subject to the requirements of articles III, IV, V, and VI of this ordinance:~~

~~1. Public and private outdoor recreational facilities;~~

~~2. Agricultural uses, including farming, grazing, and the raising of poultry or livestock; provided, that poultry or livestock shall not be housed within five hundred (500) feet of any residential, apartment, or hotel district;~~

~~3. Open uses, such as public and private roadways, off street parking, or loading and unloading areas related to uses in adjoining districts;~~

4. ~~Commercial mining, soil removal, and sand pits subject to regulations applicable to extractive industries as set forth in the conditional use provisions of the Zoning Ordinance of the City of Virginia Beach;~~

5. ~~Public improvements, such as dams, levees and channel improvements, and utilities installations and substations, including temporary storage of materials, except flammable, toxic or noxious materials, and temporary location of maintenance installations; and~~

6. ~~Uses and structures customarily accessory and clearly incidental and subordinate to uses listed above, including in connection with agricultural uses; roadside stands for the sale of agricultural products produced on the premises; provided that:~~

    a. ~~Only one (1) such stand shall be permitted per lot;~~

    b. ~~No such stand shall exceed five hundred (500) square feet in floor area; and~~

    c. ~~No such stand on the street frontage shall be erected within twenty (20) feet of the property line.~~

. . . .

Sec. 4.6. A Zone requirements.

. . . .

B. The floodplain administrator reserves the right to require a hydrologic and hydraulic analysis for any development and to determine the base flood elevation. When such base flood elevation data is utilized, the lowest floor shall be elevated to minimum of two (2) feet above the base flood level. During the permitting process, the floodplain administrator shall obtain:

1. The elevation of the lowest floor (including the basement) of all new and substantially improved structures; and

2. If the structure has been flood-proofed in accordance with the requirements of this ordinance, the elevation (in relation to NAVD88) to which the structure has been flood-proofed.

~~C. When the data is not available from any source, the lowest floor of the structure shall be elevated to not less than two (2) feet above the highest adjacent grade.~~

Sec. 4.8. ~~Reserved~~ X and X(Shaded) Zone requirements. (Other Areas of Flood Risk).

A. *Residential construction requirements*. The lowest floor, including basements, shall be set to a minimum of one (1) foot above the 100-year HGL elevation measured at the nearest existing or proposed public drainage structure or BMP, in the City Stormwater Master Plan.

B. *Non-residential construction requirements*. New construction or substantial improvement of any commercial, industrial, or non-residential building or manufactured home shall have the lowest floor, including basement, elevated as established in Section 4.8 A of this ordinance above. Buildings may be flood-proofed in lieu of being elevated provided that all areas of the building components below the design flood elevation are watertight with walls substantially impermeable to the passage of water, and use structural components having the capability of resisting hydrostatic and hydrodynamic loads and the effect of buoyancy. A professional engineer or architect licensed by the Commonwealth of Virginia shall certify that the standards of this subsection area satisfied. Such certification, including the specific elevation (in relation to NAVD88) to which such structures are flood proofed, shall be maintained by the building official.

Sec. 4.9. – Coastal High Hazard (~~V and~~ VE Zone) requirements.

The following provisions shall apply within ~~V and VE Zones~~ Coastal A Zones and Coastal High Hazard Areas:

A. All new construction and substantial improvements, including to manufactured homes, shall be elevated on pilings or columns so that:

1. The bottom of the lowest horizontal structural member of the lowest floor (excluding the pilings or columns) is elevated to a minimum of ~~two~~ three (~~2~~3) feet above the base flood ~~level~~ elevation; and

2. The pile or column foundation and structure attached thereto is anchored to resist flotation, collapse, and lateral movement due to the effects of wind and water loads acting simultaneously on all building components. Wind and water loading values shall each have a one (1) percent chance of being equaled or exceeded in any given year.

B. A professional engineer or architect licensed by the Commonwealth of Virginia shall develop or review the structural design, specifications, and plans for the construction and shall certify that the design and methods of construction to be used are in accordance with accepted standards of practice for meeting the provisions of article IV, section 4.6 A. A V Zone

Design Certificate shall be submitted to Permits and Inspections with plans for a building permit.

. . . .

I. ~~The man-made alteration of sand dunes, which would increase potential flood damage, is prohibited.~~ Sand dunes, barrier beaches, and other natural protective barriers shall remain intact to provide protection against wind, waves, and erosion drainage. Any person who desires to use or alter any coastal primary sand dune or beaches, other than for the purpose of conducting the activities specified in Article 1600, Section 1602 of the Zoning Ordinance of the City of Virginia Beach, shall first obtain a permit, or authorization, from the USACE, VADEQ, the Virginia Marine Resources Commission, and the Wetlands Board through the joint permit application process.

J. Manufactured homes are prohibited.

Sec. 4.10. Floodplain subject to special restrictions.

A. All ~~FIRM delineated~~ SFHAs that ultimately drain to Back Bay or the Currituck Sound ~~located in the following areas~~ shall be identified as a floodplain subject to special restrictions~~:~~.

~~1. North Landing River and its tributaries south of Lynnhaven Parkway;~~

~~2. West Neck Creek and its tributaries south of Shipps Corner Road, London Bridge Road, and the portion of Dam Neck Road east of its intersection with London Bridge Road; and~~

~~3. Bays, creeks, lakes, guts, coves, wetlands, marshes and swamps and their tributaries comprising the Back Bay and Small Coastal South watersheds south of South Birdneck Road and east of Princess Anne Road and General Booth Boulevard.~~

B. The following provisions shall apply within the floodplain subject to special restrictions:

1. Notwithstanding any provision of this ordinance to the contrary, no filling shall be permitted, including filling with material excavated from the same floodplain except for:

a. The purpose of public roadway or other similar public works construction undertaken by the Department of Public Works or Virginia Department of Transportation, or their agent for

construction. This construction includes flood protection and flood mitigation projects;

b. The maintenance, alteration, or relocation of bona fide agricultural ditches, swales, or agricultural pathways or those ditches required for proper lot drainage;

c. For shoreline stabilization or maintenance projects, such as riprap revetment, bulkheads, or other treatment used to stabilize and protect the banks of waterways, the city manager or his designee may approve the placement of fill provided the following criteria are met:

i. A joint permit application is submitted;

ii. The alignment of the stabilization structure is along the escarpment or in line with adjacent stabilization structures; ~~and~~

iii. If there is an existing shoreline stabilization structure, any proposed replacement structure shall be no more than six (6) inches higher than the existing structure; and

~~iii~~iv. Fill must be the minimum necessary to support the stabilization project.

2. The city manager, or his designee, may approve the placement of fill provided that the following criteria are met:

a. Proposed fill within the floodplain:

i. Shall be mitigated to result in no decrease in flood storage volume on the site;

ii. Shall be mitigated entirely on the same site that will incur the fill;

iii. Shall be contiguous to the existing floodplain that is being filled; and

iv. Shall be limited to the smallest amount of area and volume possible to correct irregularities within the boundary of the project.

b. The combined areas of fill and mitigation shall not exceed five (5) percent of the total area within the floodplain located on the site that will incur the fill.

3. Residential dwelling structures shall not be located within the floodplains subject to special restrictions on lots created after October 23, 2001. Residential dwelling structures located in ~~local flood hazard areas as of~~ a SFHA and constructed prior to October 23, 2001 may be expanded with attached additions to a total footprint of less than one thousand (1,000) square feet; such additions shall also comply with the requirements set forth in article V of this ordinance.

. . . .

ARTICLE V. EXISTING STRUCTURES IN FLOODPLAIN AREAS

Sec. 5.1. Existing structures.

A structure or use of a structure or premises that lawfully existed prior to the adoption of this ordinance, but which is not in conformity with this ordinance, may be continued subject to the following conditions:

A. Any existing structures in the floodway area shall not be expanded or enlarged unless it has been demonstrated through hydrologic and hydraulic analyses performed in accordance with standard engineering practices that the proposed expansion or enlargement would not result in any increase in the base flood elevation.

B. Any modification, alteration, repair, reconstruction, or improvement of any kind to a structure and/or use located in any floodplain ~~areas~~ district to an extent or amount of less than fifty (50) percent of its market value shall conform to the VA USBC and meet the freeboard height in effect at the start of construction for the original structure.

C. Any modification, alteration, repair, reconstruction, or improvement of any kind to a structure and/or use, in any floodplain ~~area~~ district to an extent or amount of fifty (50) percent or more of its market value shall be undertaken only in full compliance with this ordinance and shall require the entire structure to conform to the VA USBC.

ARTICLE VI. VARIANCES AND APPEALS

Sec. 6.1. Administrative variances.

The floodplain administrator shall approve or deny an application requesting an administrative variance after receipt of a complete application. Administrative variances may only be granted for the following uses, development, or redevelopment:

A. As defined in section 4.10, floodplains subject to special restrictions, for filling only.

B. Any structure or use sustaining damage not caused by flood to an extent or amount of fifty (50) percent or more of its market value to allow the structure to be rebuilt to the freeboard height in effect at the start of construction for the original structure. If the structure is a pre-FIRM structure, full compliance with the current VAUSBC freeboard above the base flood elevation is required. Structures that are utilizing an approved land management plan for their on-site waste disposal may be allowed to continue the use of the land management plan as long as it is approved by the city and the health department, even for damage or destruction resulting from flood.

C. As defined in section 4.8 B, X and X(Shaded) Zone requirements. (Other Areas of Flood Risk), and 4.3 A(ii) when the required finished floor is higher than the BFE plus two feet of freeboard, where the floodplain administrator, in consultation with the Development Services Center, has determined that the proposed stormwater engineering design will approximately mitigate any impacts to the finished floor of the nonresidential development.

Sec. 6.3. Application process.

A. Applications for variances from the requirements of this ordinance shall be made to the city council and filed with the director of planning. The fee for such applications shall be ~~six hundred fifty dollars~~ seven hundred eighty ($~~650~~780.00). Such fee shall include all costs of notifications and advertising. Except in cases in which such fee is waived, the director shall not accept any application not accompanied by payment of the required fee. The procedure for the advertising, hearing and determination of applications for floodplain variances shall be in accordance with the requirements pertaining to applications for subdivision variances, as set forth in section 9.4 of the subdivision ordinance. In cases in which a variance application is filed by reason of a natural disaster that is the subject of a federal declaration of emergency, application and associated advertising fees shall be waived and such application shall be given expedited processing to the maximum practical extent.

B. All applications shall be accompanied by the following:

1. A separate map, on a 1″ = 100′ or greater scale, identifying all proposed land disturbance, including fill and mitigation areas, and the limits of the existing and proposed SFHAs, tidal and non-tidal wetlands, Southern Rivers Watershed Management Area Buffer, and CBPA Resource Protection Area Buffer; and

2. A preliminary floodplain study addressing the physical and environmental characteristics of the floodplain located on adjoining properties and in the general area. Such study shall be sufficient to show that the variance, if granted, will meet the standards defined in section 6.~~3~~4 and in addition thereto, shall:

   a. Contain supporting data and calculations required for a Preliminary Stormwater Engineering Analysis as appropriate~~, given the preliminary nature of the floodplain study~~;

   b. Comply with the Public Works Design Standards Manual; and

   c. Be certified by a professional engineer, architect, surveyor, landscape architect or practitioner of a related field having a valid license issued by the Commonwealth of Virginia or who is exempt from licensure pursuant to applicable provisions of the Virginia Code.

Adopted by the Council of the City of Virginia Beach, Virginia, on the 1st day of February, 2022.

Attachment 6: Copy of Monitoring/Maintenance Plan

[DRAFT] Annual Monitoring Plan and Post-Construction Monitoring Report

Marsh Restoration in Back Bay, Virginia Beach, VA

Prepared by: Dewberry Engineers, Inc.

[July 6, 2023]

[REPORT VERSION [DRAFT]]

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INTRODUCTION

This project is intended to implement one of the nature-based projects proposed in Virginia Beach's "Sea Level Wise" (SLW) Adaptation Strategy[1] adopted by the Virginia Beach City Council in June 2020. The SLW Adaptation Strategy presents a holistic framework for addressing flood risks across the City, consisting of four general strategies – natural mitigations, engineered defenses, adapted structures, and prepared communities. These strategies were applied to each major watershed in the City and tailored to their unique characteristics and risk profiles. The adaptation vision for the Lower Southern Rivers Drainage Basin, where the proposed project is located, focuses on employing natural mitigation methodologies to strategically reduce flow into and within Back Bay, along with an integrated system of defense structures and complementary adaptation measures, such as land-use strategies, to improve flood storage and overall coastal resiliency. The Bonney Cove area of Back Bay, where the project site is proposed, is particularly suitable for the use of nature-based strategies given the low elevations of marshlands and documented historic degradation of habitat. Participants at the 'near-neighbor' public engagement meetings held during the SLW Adaptation Strategy development were supportive of these types of strategies.

The City has several dedicated Capital Improvement Program (CIP) initiatives for the Lower Southern Rivers Drainage Basin for implementation of these strategies. The City's Stormwater Green Infrastructure CIP has obligated approximately $421,700 in contracts to support field investigations, environmental assessments, and engineering designs of the project – a true indication of the City's commitment to nature-based approaches and the critical first step in a broader effort. During the General Election on November 2, 2021, Virginia Beach residents voted to authorize $567.5 million dollars in debt to fund the design and construction of 21 Phase 1 projects in the citywide Flood Protection Program. [2] The Back Bay Marsh Terrace project is included under the Stormwater Green Infrastructure Master Project.[3] Other Southern Watershed projects that received funding under the Flood Protection Program include the West Neck Creek Bridge City-Wide Sea Level Rise Strategy, the Pungo Ferry Road Improvements, and the Sandbridge/New Bridge Intersection Improvements projects.

Outside of this project, the Virginia Beach City Council has recently funded a $5.2 million dollar voluntary acquisition program to encourage flood-prone properties to apply for a buyout to enable the City to convert parcels to open space to serve as flood storage and a marsh migration buffer. The City's

[1] City of Virginia Beach Sea Level Wise Adaptation Strategy webpage: https://www.vbgov.com/government/departments/public-works/comp-sea-level-rise/Pages/default.aspx

[2] City of Virginia Beach Flood Protection Program webpage: https://www.vbgov.com/government/departments/public-works/flood-protection-program/Pages/Flood-Protection-Program.aspx.

[3] Stormwater Green Infrastructure Page: https://www.vbgov.com/government/departments/public-works/flood-protection-program/Pages/Stormwater-Green-Infrastructure-.aspx

Stormwater Green Infrastructure CIP is also supporting the implementation of other natural and nature-based projects across the City, including a wetland and floodplain restoration project along the Eastern Branch of the Elizabeth River.

An assessment of restoration opportunities in the City's Lower Southern Rivers Drainage Basin with dual flood reduction and habitat restoration benefits identified the Bonney Cove area as a potential project site for several reasons. The Bonney Cove site has experienced significant historical ecological degradation. Historical shoreline data from 1869 indicates approximately 50% of present-day open water in Bonney Cove (260 acres) was previously marsh (Figure 1). Loss of the marsh island habitat within Bonney Cove has resulted in the opening of a secondary channel allowing increased flow exchange between the upper and lower bays. In comparison to shore-adjacent restoration, off-shore marsh restoration leveraging hydraulic modeling identified Bonney Cove as a location where marsh restoration has the potential to reduce the propagation of floodwaters through key pathways within Back Bay. The United States Fish and Wildlife Service (USFWS) and the Virginia Department of Wildlife Resources (VDWR) also identified Bonney Cove as a restoration priority as this area serves as an ideal location for Submerged Aquatic Vegetation (SAV) reestablishment and vital habitat for migratory birds and fish.

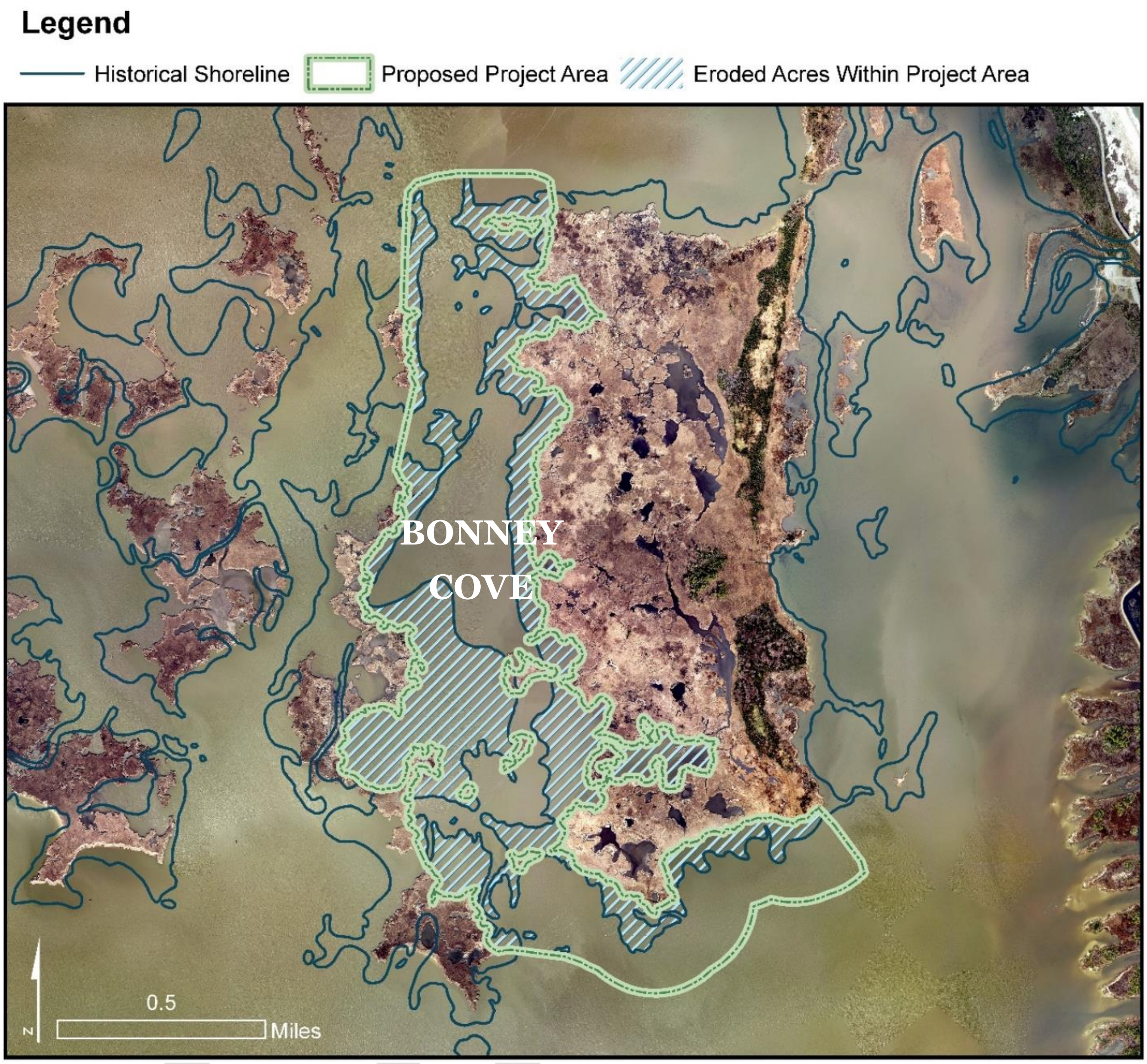

Figure 1: Historical marsh erosion within the project area.

The project is situated within the Bonney Cove area of Back Bay, spanning the western and southern lengths of Long Island, as shown in Figure 1.

Project Background

Marsh island restoration through terracing was identified as a particularly viable solution given Back Bay's shallow bottom and the historical loss of habitat. The marsh terraces are narrow man-made islands that will be arranged across areas that were historically marsh but are now shallow open water. A series of these islands, or terraces, are typically arranged in a chevron pattern. The overall field of terraces dissipates waves and slows down water moving through the area. In turn, the calmer water allows more sunlight to penetrate to the shallow bottom, promoting establishment and growth of marsh

and SAV habitats. Further, as opposed to one continuous marsh platform, marsh terraces maximize habitat for a variety of fish and wildlife species.

The Preferred Alternative includes the creation of 41 individual marsh terraces totaling approximately 25,000 linear feet (or an approximately 47-acre footprint) across Bonney Cove. These 47 acres of terraces are comprised of approximately 13 acres of emergent (low and high marsh) vegetated habitat, 14 acres of upland vegetated habitat, and 16 acres of submerged terrace habitat. Approximately 310 acres of suitable SAV habitat will remain in between the terraces.

Terrace Construction and Orientation

Terrace construction will begin in the northern extent of the project site, and the contractor will work towards the southern extent of the site. The contractor will complete each terrace, including installing plants, before moving to the next. Marsh terrace construction will occur over two years (2025 to 2026) and will pause annually between October 31st and March 1st to limit disturbance to wintering waterfowl and migration, in accommodation of BBNWR's requirement. Approximately 20 terraces will be constructed in 2025 ("Phase 1"), and 21 terraces will be constructed in 2026 ("Phase 2"). The following sections summarize the proposed design and construction approach.

Terraces will be generally oriented perpendicular to the predominant wind direction (south-southwest) to maximize wave energy reduction. The terraces will be segmented in a chevron (duck-wing) pattern to create the most favorable fish and swimming crustacean (termed "nekton") habitat, facilitate adequate circulation, and maintain navigability throughout the project area. The terraces will not be connected to the adjacent marsh to maintain a physical open water barrier to deter the invasion of Common Reed (*Phragmites australis*) stands.

The terraces will be spaced at approximately 300-foot intervals in the northern and southern quarters and span 15 feet in width, and at least 600-foot intervals in the center and span 30 feet in width. This arrangement will lessen the amount of open water and subsequent wave action at the northern and southern ends of the site and provide space for marine-based construction equipment. The design team reviewed the final spacing layout of the terraces to ensure navigability of a watercraft through the project site which will be required for post-construction monitoring, any needed maintenance, as well as community recreational access.

The terraces would consist of a sand filled core encapsulated by a high-strength blend of woven and non-woven geotextile fabrics ("geobags"). The sand for this material would need to come from offsite sources. Back Bay is too shallow to accommodate conventional barges for material placement. To avoid extensive impacts to the bottom of the bay, the slurry basin will pump sand for the project from the proposed Shipps Cabin Road staging area to Bonney Cove. The slurry pipeline will consist of approximately 10,424 linear feet of 12" diameter HDPE fused/welded pipeline that will be assembled on land and floated into its proposed alignment within Back Bay. The pipe would be marked by floats

every 5 feet and temporary signage as reasonable. It is anticipated the pipeline will be submerged to the bottom of the bay at channel crossings and adjacent to a duck hunting cabin adjacent to the alignment. By establishing a floating pipeline, it will limit disturbances to the subaqueous bottomlands along the alignment and allow for the retraction of the pipeline during the winter inactive periods and inclement weather events. Booster stations would be placed approximately every mile. These booster stations would consist of a pontoon mounted diesel engine pump capable of moving the sand slurry from the laydown area to the site. Given the distance to the site, four or five of these booster stations are anticipated to be necessary to create the sand cores of the terrace. It is estimated that 450 Gallons Per Minute (GPM) of sand slurry would be pumped through the pipe.

Once the cores are in place, long reach excavators would travel along the tops of the terraces and begin to shape the cross slopes. Appropriate materials for establishing vegetation atop the terraces will be primarily sourced from materials dredged during the Sandbridge Road Nimmo Parkway Phase VII-A project located immediately north of Back Bay (VMRC 15-1564, USACE IP NAO-2015-00151). Materials will be tested and screened to remove organics prior to application to the terraces. As needed, dredging sites adjacent to the proposed terrace locations that are confirmed to be devoid of SAV will be utilized to provide supplemental soil materials to top the proposed terraces[4]. It was determined that the in-situ bay sediment would be suitable for vegetation growth. The marsh terraces would be covered with 1 to 3 feet of suitable fill, depending on crest widths. Jute netting will cover the topsoil to control erosion and promote vegetation establishment. Coir logs will be places along the terrace slope controls to further promote vegetation establishment along the slope.

SAV Plantings

The City has partnered with Virginia Polytechnic Institute and State University ("Virginia Tech") to evaluate opportunities for restoring populations of native Wild Celery (*Vallisneria americana*) in Back Bay. The Virginia Tech research team has developed an innovative technique to grow Wild Celery in an aquaculture center that results in larger, mature plants that can better withstand Back Bay's turbidity. Once transplanted, plants are surrounded by cages to prevent predation. These founder colonies can be used for propagation throughout Back Bay. After terrace construction, the City will transplant Wild Celery in an area adjacent to the site. This founder colony will be used to strategically transplant Wild Celery in between the terraces for 5 years after construction (2026 – 2029) with the ultimate goal of establishing 10 acres of SAV vegetation in between the marsh terraces.

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[4] The 60% preliminary design showed preliminary siting of these dredge areas based on avoidance of existing SAV habitat; however, pre-construction surveys of SAV would be required to re-delineate these dredging areas.

Terrace Plantings – Upland and Marsh Vegetation

The terraces' intertidal perimeter will be planted with appropriate emergent estuarine plant species (e.g., Saltmarsh Cordgrass [*Spartina alterniflora*] and Salt Meadow Hay [*Spartina patens*]) and brackish plant species (e.g., Big Cordgrass [*Spartina cynosuroides*]). These plants will be installed as soon as possible after construction to stabilize planting areas and protect the terrace from erosion. In addition to emergent grass, woody growth (i.e., shrubs and trees) within the terrace crest will be incorporated to protect the terraces' surfaces from rain and wind erosion and hold the landform together through substantial root systems.

Appropriate native species were identified based on the review of the reference marshes surrounding the project site and a review of water levels in Back Bay. Since the Bay's water levels are not affected by lunar tides and instead by wind-driven fluctuations, the project team evaluated average water elevations at the U.S. Geological Survey (USGS) Beggars Bridge Creek Gauge (Gauge ID 0204300267) from 2016 – 2021 to determine ranges of inundation to achieve functional marsh elevations throughout the project life, defined as:

- *Mean Low Water (MLW)*: the average low water at the site (10th Percentile: -0.62 ft NAVD88)
- *Mean High Water (MHW)*: the average high water at the site (95th Percentile: 1.22 ft NAVD88)
- *Mean Tide Level (MTL)*: halfway between MLW and MHW (0.3 ft NAVD88)
- *Upper Limit of Wetlands (ULW)*: approximately 1.5 times the mean tide range at the site (2.76 ft NAVD88)

These elevations were correlated to suitability for low marsh, high marsh, and upland species, as shown in Table 1.

Table 1: Proposed planting elevation zones.

Planting Zone	Definition	Elevation Range	Elevation (feet NAVD88)	Percentage of record where water reaches these elevations
Low Marsh	Marsh that is flooded frequently but exposed sometimes	MTL - MHW	0.3 – 1.2 ft	48%
High Marsh	Marsh that is generally only flooded during higher-than average water conditions	MHW – ULW	1.2 to 2.8 ft	7%
Upland Habitat	Habitat that is rarely flooded, only during extreme conditions	> ULW	> 2.8 ft	0%

Five planting schemas were identified to provide the highest possible environmental benefit in terms of erosion control, habitat diversity, and fetch reduction. The wider (30-foot) terraces will be planted with Bald Cypress (*Taxodium districhum*) trees capable of withstanding rising water levels. The full list of species and quantities is provided in the 95% design plan set.

The final engineered design component is the strategic placement of rock on the exposed perimeter terraces on the project site's north, west, and southern extents. The need for the rock armor was determined through analysis of wind data both from NOAA and ASCE-7-10 50-year return period anticipated 3-second gust values. These values were used to calculate fetch-generated waves at the project site. The calculations performed confirmed that armored protection would be required to protect the proposed terraces from the forces created by wave action. The stone sizes required for these features (Class II rip rap) were calculated following the procedures laid out in the USACE Coastal Engineering Manual (CEM) and Virginia Institute of Marine Science (VIMS) Living Shoreline Design Guidelines for Shore Protection in Virginia's Estuarine Environments. Two calculation methods, Hudson (1974) and Van Der Meer (1988), from the CEM were utilized to evaluate the range of acceptable rock armor for the exposed perimeter. These two methods calculate the armor stone size based on several design inputs including initial wave height, allowable damage level, revetment slope, and breaking versus non-breaking waves. The two methods often result in corresponding values that are used by the engineer to make an experienced determination on the final rock armor sizing. The rock armor will serve as a nature-based design element by acting as a substrate for the Wild Celery grass that has proven to be successful for SAV establishment in Back Bay (see Figure 2).

Figure 2: Example Back Bay SAV experiment; photo courtesy of Virginia Tech.

Monitoring Goals and Objectives

Annual post-construction monitoring of the site is required by the Virginia Marine Resource Commission (VMRC) (TBD) Permit (VMRC #XXXX-XXXX) and the U.S. Army Corps of Engineers (USACE) Individual Permit (NOA-20XX-XXXXX). [Insert details of the relevant permits and permit conditions]. The following goals, objectives, and metrics were established to enable consistent tracking of the primary living shoreline project components across each monitoring year.

1. **Monitoring Goal 1**: Establishment of a Sustainable Coastal Marsh Island System
   a. Objective 1a: Establish Emergent Marsh Habitat
      - Metric: For each monitoring year, the project area should maintain or increase the overall coverage of emergent marsh vegetation. There should be no significant signs of herbivory or invasive species establishment.

   b. Objective 1b: Establish Upland Habitat
      - Metric: For each monitoring year, the project area should maintain or increase the overall coverage of upland vegetation. There should be no significant signs of herbivory or invasive species establishment.
2. **Monitoring Goal 2**: Stability of Marsh Terraces
   a. Objective 2: Marsh Terrace Structures
      - Metric: For each monitoring year, the terrace structures should show no significant signs of damage, deterioration or extreme settlement.
3. **Monitoring Goal 3**: Establishment of a Sustainable SAV Community
   a. Objective 3: Establish SAV Communities

- Metric: For each monitoring year, the SAV planting areas should maintain or increase the overall coverage of SAV vegetation. There should be no significant signs of herbivory or invasive species establishment.

MONITORING PLAN

The monitoring plan includes stakeholders, a schedule for the annual monitoring inspections, the monitoring strategy/sampling plan, and approach for addressing any needs for maintenance.

Monitoring Stakeholders

An Environmental Scientist from Dewberry Engineers Inc. will perform the annual monitoring inspections and provide a copy of the monitoring report to the City of Virginia Beach, USACE, VDEQ, VMRC, and the City of Virginia Beach Wetlands Board as necessary. As owners of the project, the City of Virginia Beach will review monitoring recommendations and perform corrective actions as necessary.

Annual Inspection Schedule

Monitoring inspections should be conducted annually, during the peak growing season, which is defined by VMRC as between June and August. To enable consistent tracking of project performance from year to year, annual monitoring inspections will be conducted prior to the end of the growing season in September of each year, with annual reports to be submitted to regulatory stakeholders prior to November 30th [or an annual date defined in the permit conditions] of each year. The following outlines the monitoring inspection schedule and deliverables.

Phase 1 Post-Construction As-Built Report (Date: Prior to December 31st, 2025)

To serve as a baseline for the post-construction annual monitoring, an as-built report for the Phase 1 terraces will be completed following the construction of each phase of terraces and submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following.

- Coordinates and diagrams of established transects, as well as site photographs from photo stations 1-40 as defined in the Methods section.
- Final location of all planted vegetation (upland plantings, high marsh plantings and low marsh plantings).
- Final grade topographic surveys (plan, profile, and cross sections).
- Discussion of the project design versus as-built conditions.

Phase 2 Post-Construction As-Built Report (Date: Prior to December 31st, 2026)

To serve as a baseline for the post-construction annual monitoring, an as-built report for the Phase 2 terraces will be completed following the construction of each phase of terraces and submitted to the

City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following.

- Coordinates and diagrams of established transects, as well as site photographs from photo stations 41-80 as defined in the Methods section.
- Final location of all planted vegetation (upland plantings, high marsh plantings and low marsh plantings).
- Final location and extent of SAV plantings.
- Final grade topographic surveys (plan, profile, and cross sections).
- Discussion of the project design versus as-built conditions.

Year 1a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2026)

At the end of the first full growing season following planting of the Phase 1 terraces, a Year 1a monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 40 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 1 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion; it is anticipated that the wetland planting contractor will provide a one-year post construction maintenance and guarantee period for the wetland plantings.

Year 1b/2a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2027)

At the end of the first full growing season following planting of the Phase 2 terraces following planting, and the second full growing season of the Phase 1 terraces, a Year 1b/2a monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 1 conditions (for Phase 2 terraces) and to Year 2 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).

- Estimated percent cover and change in coverage from planted conditions to Year 1 conditions for SAV planting quadrants
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion; it is anticipated that the wetland planting contractor will provide a one-year post construction maintenance and guarantee period for the wetland plantings.

Year 2b/3a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2028)

At the end of the second full growing season of the Phase 2 terraces following planting, and the third full growing season of the Phase 1 terraces, a Year 2b/3a monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 2 conditions (for Phase 2 terraces) and to Year 3 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- Estimated percent cover and change in coverage from planted conditions to Year 2 conditions for SAV planting quadrants
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

Year 3b/4a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2029)

At the end of the third full growing season of the Phase 2 terraces following planting, and the fourth full growing season of the Phase 1 terraces, a Year 3b/4a monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 3 conditions (for Phase 2 terraces) and to Year 4 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).

- Estimated percent cover and change in coverage from planted conditions to Year 3 conditions for SAV planting quadrants
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

Year 4b/5a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2030)

At the end of the fourth full growing season of the Phase 2 terraces following planting, and the fifth full growing season of the Phase 1 terraces, a Year 4b/Final (Year 5a) monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 4 conditions (for Phase 2 terraces) and to Year 5 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- Estimated percent cover and change in coverage from planted conditions to Year 4 conditions for SAV planting quadrants
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

Year 5b Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2031)

At the end of the fifth full growing season of the Phase 2 terraces following planting, a Final (Year 5b) monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 41 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 5 conditions (for Phase 2 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- Estimated percent cover and change in coverage from planted conditions to Year 5 conditions for SAV planting quadrants

- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

Monitoring Strategy

The monitoring strategy consists of established transects with photo stations and quadrants that cover the area between transects. This approach enables monitoring of the four primary features of the living shoreline: uplands, low-marsh plantings, high-marsh plantings, and SAV*.

*Note: The planting scheme for SAV has not yet been established but it is anticipated that some SAV will be planted along the submerged portions of the marsh terraces. If more suitable planting locations are determined to be between terraces, separate transects will be established and sampled to track SAV survival apart from the proposed terrace transects.

Transects/Photo Points

A total of eighty (80) transects will be established across the project site, with 10 transects located along each of 8 terraces. Transects will span perpendicular to the length of each terrace from the ridge to the edge of the planted/vegetated area. See Figures 3 and 4 for graphic depictions of the proposed transect locations and layouts. Terraces were selected using a random stratified method to ensure representative terraces in each location within the project area (North Interior, North Exterior, South Interior, South Exterior), and of each planting scheme, were represented in the proposed monitoring plan. The selected terraces are as follows:

- North Interior: T-110, T-113
- North Exterior: T-100, T-106
- South Interior: T-124, T-131
- South Exterior: T-123, T-140

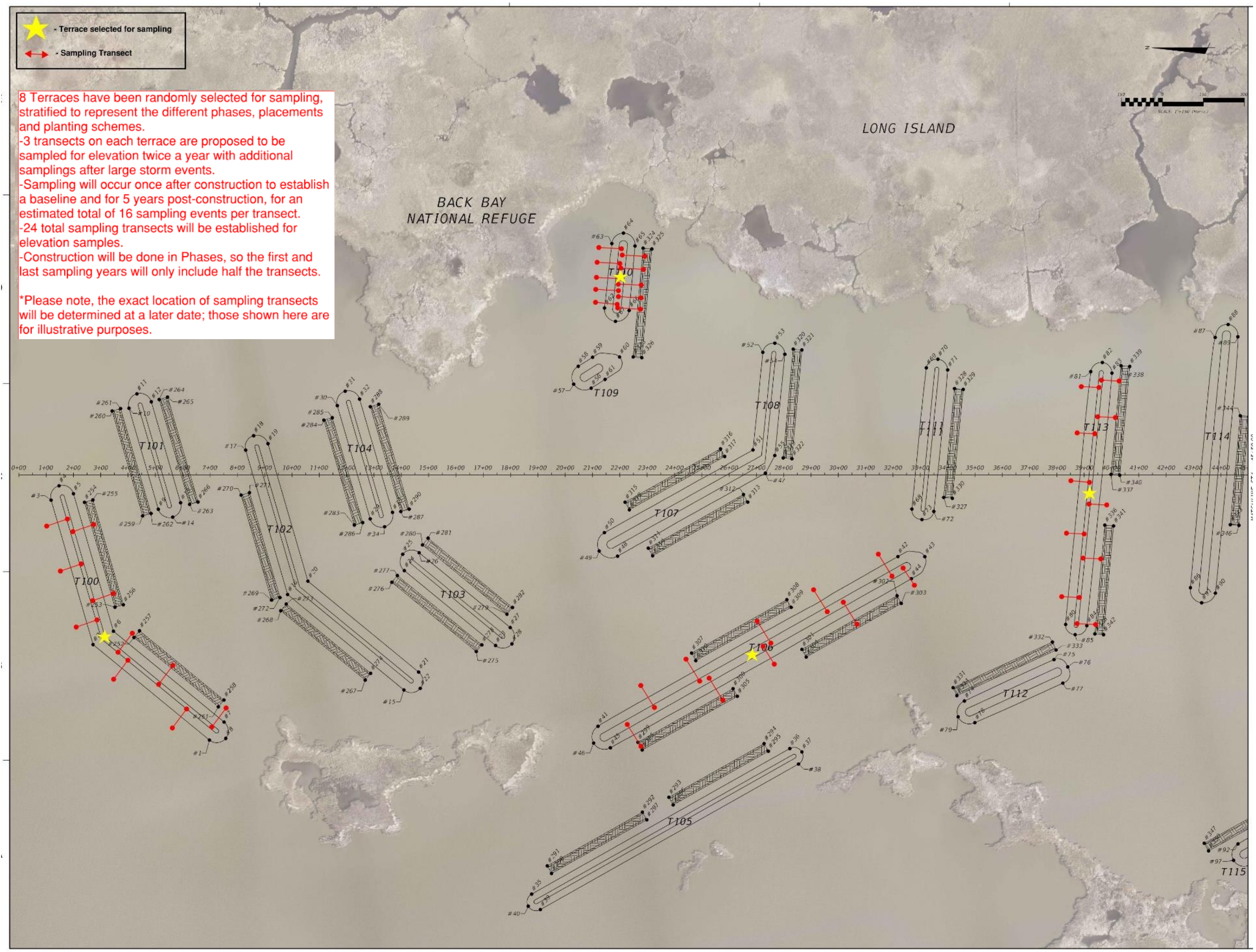

Figure 3: Monitoring design site plan – North Terraces

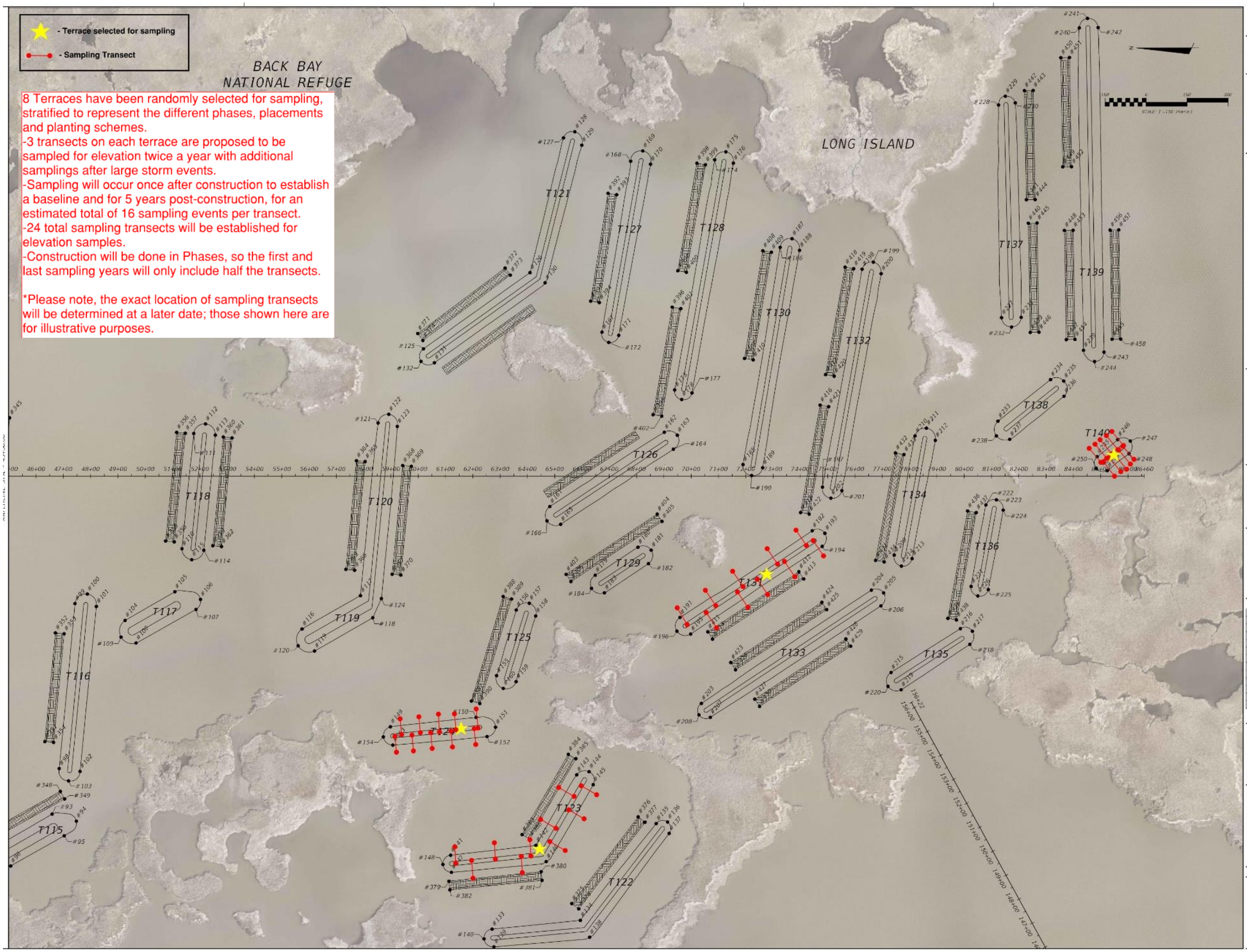

Figure 4: Monitoring design site plan – South Terraces

Permanent photo stations will be established at each quadrant along each transect to capture the design features/established habitats and vegetation. Figure 5 shows the general proposed locations (indicated by the red arrows/labels) for each quadrant and photograph station along each transect. Photos were shot from each photo location on [DATE]. These photos will be collected annually and compiled in Appendix B.

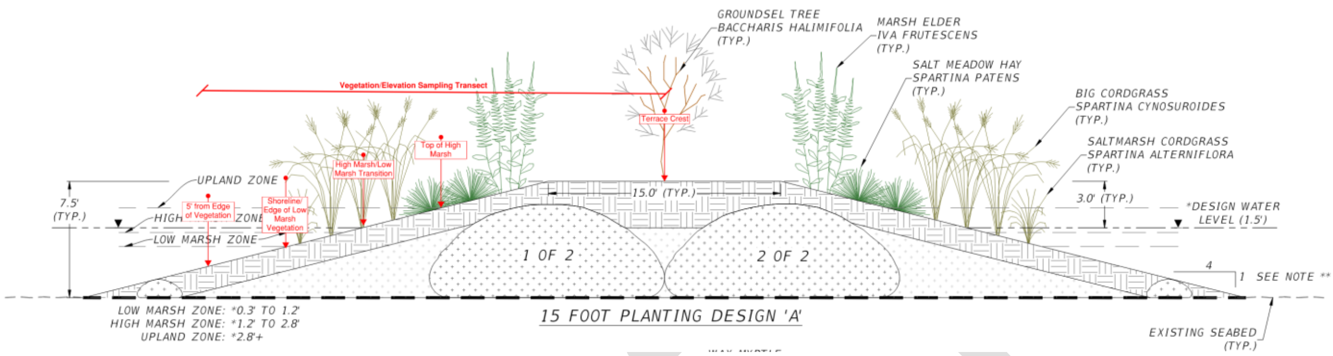

Figure 5: Photo station layout example

Quadrants

To estimate percent cover of vegetation, four (4) quadrants along each of ten (10) transects will be established on the eight selected terraces to allow for estimates of habitat coverage and planting survival. Estimates of coverage and survival were compared to post-construction conditions to evaluate changes.

Further, the following guiding questions were established to monitor overall project performance, presence of invasive species, and identify any needs for maintenance:

1. Are there specific problem areas where plants are dying or appear unhealthy?
2. Were any signs of herbivory observed?
3. Are there any undesirable plant species present?
4. Condition of the terrace structures: Is there any observed settlement, dislodged stone, significant debris etc.?
5. If an updated survey was conducted, are there any significant changes in the profile of the marsh terraces?
6. Does the upland portion of each terrace show any significant signs of erosion or loss of vegetation?

MONITORING RESULTS

Table 2: Low Marsh Vegetation Percent Cover Monitoring Results (Example Table – Terrace 1).

		Estimated Percent Coverage						Percent Change in Coverage (from Baseline)				
Terrace/ Transect	Photo Station Reference	Baseline (2024)	Year 1 (2025)	Year 2 (2026)	Year 3 (2027)	Year 4 (2028)	Year 5 (2029)	Baseline to Year 1	Baseline to Year 2	Baseline to Year 3	Baseline to Year 4	Baseline to Year 5
1 - 1	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 2	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 3	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 4	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 5	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 6	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 7	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 8	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 9	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 10	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
Overall		**Choose an item.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**

Table 3: High Marsh Vegetation Percent Cover Monitoring Results (Example Table – Terrace 1).

		Estimated Percent Coverage						Percent Change in Coverage (from Baseline)				
Terrace/ Transect	Photo Station Reference	Baseline (2024)	Year 1 (2025)	Year 2 (2026)	Year 3 (2027)	Year 4 (2028)	Year 5 (2029)	Baseline to Year 1	Baseline to Year 2	Baseline to Year 3	Baseline to Year 4	Baseline to Year 5
1 - 1	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 2	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 3	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 4	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 5	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 6	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 7	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 8	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 9	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 10	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
Overall		**Choose an item.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**

Table 4: General Observations for Wetland Planting Areas on the Marsh Terraces (Example Table – Terrace 1)

Monitoring Questions	Terrace/Transect									
	1 - 1	1 - 2	1 - 3	1 - 4	1 - 5	1 - 6	1 - 7	1 - 8	1 - 9	1 - 10
Are there specific problem areas where plants are dying or appear unhealthy?	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.
Were any herbivory issues observed?	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.
Are there any undesirable plant species present?	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.
If updated survey was conducted, are there any significant changes in the profile of the living shoreline system?	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.

Table 5: General Observations for the Unplanted Structural Components of the Marsh Terraces (Example Table – Terrace 1)

	Terrace/Transect									
Monitoring Questions	1 - 1	1 - 2	1 - 3	1 - 4	1 - 5	1 - 6	1 - 7	1 - 8	1 - 9	1 - 10
Are there any structural issues with the planted terrace structures (e.g. observed settlement, loss of topsoil, etc.)?	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.
Is there any observed growth in SAV on or adjacent to the marsh terraces?	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.

Are there any structural issues with the rock armoring on the terraces (e.g. observed settlement, dislodged stone, significant debris, etc.)?	YES ☐ NO ☒ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☒ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.

MAINTENANCE RECOMMENDATIONS

The following table outlines the recommendations for maintenance, including estimated quantities and specific guidance, based on the results of the [YEAR] monitoring results.

Table 6: Maintenance Recommendations Checklist

Design Feature/ Monitoring Objective	Maintenance Elements	Location & Estimated Quantity	Specific Guidance
Terrace Upland and Wetland Habitats and Wetland Soils – Monitoring Objectives 1a/1b	☐ Replace plants	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Add new plants	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Remove debris	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Remove invasive vegetation	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Add sand to eroding areas	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Replace waterfowl barrier	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.

Design Feature/ Monitoring Objective	Maintenance Elements	Location & Estimated Quantity	Specific Guidance
Terrace Structures & Stone Armoring, Monitoring Objective 2a/2b	☐ Re-place dislodged stones	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Add additional stone to address settlement	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Remove debris	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Repair sand cores or other structural elements	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
SAV Establishment, Monitoring Objective 3	☐ Replace plants	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Add new plants	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.

APPENDIX A: AS-BUILT PLANS

[Page left intentionally blank; as-built plans will be included in the Year 1 monitoring report]

APPENDIX B: MONITORING PHOTOGRAPHS

Table 7: Terrace 1 Transect 1 Photographs

Photograph from Photo Location 1A	Photograph from Photo Location 1B
Photograph from Photo Location 1C	Additional photos of any problem areas.

Table 8: Terrace 1 Transect 2 Photographs

Photograph from Photo Location 2A	Photograph from Photo Location 2B
Photograph from Photo Location 2C	Additional photos of any problem areas.

Table 9: Terrace 1 Transect 3 Photographs

Photograph from Photo Location 3A	Photograph from Photo Location 3B
Photograph from Photo Location 3C	Additional photos of any problem areas.

Table 10: Terrace 1 Transect 4 Photographs

Photograph from Photo Location 4A	Photograph from Photo Location 4B
Photograph from Photo Location 4C	Additional photos of any problem areas.

Table 11: Terrace 1 Transect 5 Photographs

Photograph from Photo Location 5A	Photograph from Photo Location 5B
Photograph from Photo Location 5C	Additional photos of any problem areas.

Table 12: Terrace 1 Transect 6 Photographs

Photograph from Photo Location 6A	Photograph from Photo Location 6B
Photograph from Photo Location 6C	Additional photos of any problem areas.

Table 13: Terrace 1 Transect 7 Photographs

Photograph from Photo Location 7A	Photograph from Photo Location 7B
Photograph from Photo Location 7C	Additional photos of any problem areas.

Table 14: Terrace 1 Transect 7 Photographs

Photograph from Photo Location 7A	Photograph from Photo Location 7B
Photograph from Photo Location 7C	Additional photos of any problem areas.

Table 15: Terrace 1 Transect 8 Photographs

Photograph from Photo Location 8A	Photograph from Photo Location 8B
Photograph from Photo Location 8C	Additional photos of any problem areas.

Table 16: Terrace 1 Transect 9 Photographs

Photograph from Photo Location 9A	Photograph from Photo Location 9B
Photograph from Photo Location 9C	Additional photos of any problem areas.

Table 17: Terrace 1 Transect 10 Photographs

Photograph from Photo Location 9A	Photograph from Photo Location 9B
Photograph from Photo Location 9C	Additional photos of any problem areas.

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City of Virginia Beach

DEPARTMENT OF BUDGET AND MANAGEMENT SERVICES
(757) 385-8234
(757) 385-1857 FAX

VBgov.com

MUNICIPAL CENTER
BUILDING 1, 3RD FLOOR
2401 COURTHOUSE DRIVE
VIRGINIA BEACH, VA 23456-9001

INTER-OFFICE MEMORANDUM

DATE: November 1, 2023

TO: Patrick A. Duhaney, City Manager

FROM: Stuart McCrery, Budget and Policy Analyst KJ for SM

SUBJECT: Application for Virginia Community Flood Preparedness Fund Grant

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The Department of Public Works is requesting permission to apply for the Virginia Community Flood Preparedness Fund Grant from the Virginia Department of Conservation and Recreation. The Virginia Community Flood Preparedness Fund was established in the 2020 session of the General Assembly. Money in this fund comes from the auction of carbon allowances through the Regional Greenhouse Gas Initiative. It was established to provide support to localities across Virginia to reduce the impacts of flooding, including flooding driven by climate change.

Public Works is requesting a total of $5,000,000 to construct marsh terraces in Back Bay to promote wetland restoration and mitigate frequent flooding. The City has already made significant investments into this project through CIP project 100551 "Stormwater Green Infrastructure."

This grant also requires a local match of 30% for projects that implement nature-based solutions; however, the City has more than met this requirement through its current appropriations to CIP project 1000551 "Stormwater Green Infrastructure" which currently total over $49 million from the Referendum and other grant awards.

Budget & Management Services recommends this grant application for approval. Please indicate approval or disapproval below. Applications are due by November 12, 2023.

11/1/2023

Approve (Date) Disapprove (Date)

2023 Virginia Community Flood Preparedness Fund

Marsh Restoration in Back Bay, Virginia Beach

CITY OF VIRGINIA BEACH

Table of Contents

Appendix A – Application Form

Applicants must have prior approval from the Department to submit <u>applications, forms, and supporting documents by mail in lieu of the WebGrants portal.</u>

Appendix A: Application Form for Grant and Loan Requests for All Categories

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Virginia Department of Conservation and Recreation
Virginia Community Flood Preparedness Fund Grant Program

Name of Local Government:

Category Being Applied for (check one):

☐ **Capacity Building/Planning**

☑ **Project**

☐ **Study**

NFIP/DCR Community Identification Number (CID) 515531

Name of Authorized Official and Title: Toni Utterback, Stormwater Engineering Center Administrator

Signature of Authorized Official: Katie E Shannon for Toni Utterback

Mailing Address (1): 2875 Sabre Street, Suite 250

Mailing Address (2): ______

City: Virginia Beach **State:** Virginia **Zip:** 23452

Telephone Number: (757) 385-8746 **Cell Phone Number:** (____) ______

Email Address: TPUtterback@vbgov.com

Contact and Title (If different from authorized official): C.J. Bodnar, Technical Services Program Manager

Type text here

Mailing Address (1): 2875 Sabre Street, Suite 250

Mailing Address (2): ____________________

City: Virginia Beach **State:** Virginia **Zip:** 23452

Telephone Number: (757) 385-8430 **Cell Phone Number:** (____) ____________

Email Address: CBodnar@vbgov.com

Is the proposal in this application intended to benefit a low-income geographic area as defined in the Part 1 Definitions? Yes ____ No ✓

Categories (select applicable activities that will be included in the project and used for scoring criterion):

Capacity Building and Planning Grants

- ☐ Floodplain Staff Capacity.
- ☐ Resilience Plan Development
  - ☐ Revisions to existing resilience plans and modifications to existing comprehensive and hazard mitigation plans.
  - ☐ Resource assessments, planning, strategies, and development.
    - Policy management and/or development.
    - Stakeholder engagement and strategies.
- ☐ Other: ____________________

Study Grants (Check All that Apply)

- ☐ Studies to aid in updating floodplain ordinances to maintain compliance with the NFIP, or to incorporate higher standards that may reduce the risk of flood damage. This must include establishing processes for implementing the ordinance, including but not limited to, permitting, record retention, violations, and variances. This may include revising a floodplain ordinance when the community is getting new Flood Insurance Rate Maps (FIRMs), updating a floodplain ordinance to include floodplain setbacks, freeboard, or other

higher standards, RiskMAP public noticing requirements, or correcting issues identified in a Corrective Action Plan.

- ☐ Revising other land use ordinances to incorporate flood protection and mitigation goals, standards, and practices.
- ☐ Conducting hydrologic and hydraulic (H&H) studies of floodplains. *Changes to the base flood, as demonstrated by the H&H must be submitted to FEMA within 6 months of the data becoming available.*
- ☐ Studies and Data Collection of Statewide and Regional Significance.
- ☐ Revisions to existing resilience plans and modifications to existing comprehensive and hazard.
- ☐ Other relevant flood prevention and protection project or study.

Project Grants and Loans (Check All that Apply – Hybrid Solutions will include items from both the "Nature-Based" and "Other" categories)

Nature-based solutions

- ☐ Acquisition of property (or interests therein) and/or structures for purposes of allowing floodwater inundation, strategic retreat of existing land uses from areas vulnerable to flooding; the conservation or enhancement of natural flood resilience resources; or acquisition of structures, provided the acquired property will be protected in perpetuity from further development, <u>and where the flood mitigation benefits will be achieved as a part of the same project as the property acquisition.</u>
- ☑ Wetland restoration.
- ☐ Floodplain restoration.
- ☐ Construction of swales and settling ponds.
- ☑ Living shorelines and vegetated buffers.
- ☐ Permanent conservation of undeveloped lands identified as having flood resilience value by *ConserveVirginia* Floodplain and Flooding Resilience layer or a similar data driven analytic tool, or the acquisition of developed land for future conservation.
- ☐ Dam removal.
- ☐ Stream bank restoration or stabilization.
- ☐ Restoration of floodplains to natural and beneficial function.

Other Projects

- ☐ Structural floodwalls, levees, berms, flood gates, structural conveyances.
- ☐ Storm water system upgrades.
- ☐ Medium and large-scale Low Impact Development (LID) in urban areas.

- ☐ Developing flood warning and response systems, which may include gauge installation, to notify residents of potential emergency flooding events.
- ☐ Dam restoration.
- ☐ Beneficial reuse of dredge materials for flood mitigation purposes
- ☐ Removal or relocation of structures from flood-prone areas where the land will not be returned to open space.
- ☐ Acquisition of property (or interests therein) and/or structures for purposes of allowing floodwater inundation, strategic retreat of existing land uses from areas vulnerable to flooding; the conservation or enhancement of natural flood resilience resources; or acquisition of structures, provided the acquired property will be protected in perpetuity from further development, <u>and where the flood mitigation benefits will **not be** achieved as a part of the same project as the property acquisition.</u>
- ☐ Other project identified in a DCR-approved Resilience Plan.

Location of Project or Activity (Include Maps): Bonney Cove in Back Bay, Virginia Beach

NFIP Community Identification Number (CID#) : 515531

Is Project Located in an NFIP Participating Community? ☑ Yes ☐ No

Is Project Located in a Special Flood Hazard Area? ☑ Yes ☐ No

Flood Zone(s) (If Applicable): Zone VE (EL 5 Feet), Zone AE (EL 4 Feet), Zone Open Water

Flood Insurance Rate Map Number(s) (If Applicable): 5155310215G and 5155310220G

Total Cost of Project: $53,378,490

Total Amount Requested $5,000,000

Amount Requested as Grant $5,000,000

Amount Requested as Project Loan (not including short-term loans for up-front costs) ___________________

Amount Requested as Short-Term loan for Up-Front Costs (not to exceed 20% of amount requested as Grant) __________________________

For projects, planning, capacity building, and studies in low-income geographic areas: Are you requesting that match be waived? □ Yes □ No

Additional Information for Loan Requests

Requested Loan Security: ______________________________

(General Obligation, Lease, Revenue, Special Fund Revenue, and/or Moral obligation from other government entity)

Desired loan term: __________________________________

Since the date of your latest financial statements, did the applicant issue any new debt? ______ (If yes, provide details)

Is there any pending or potential litigation by or against the applicant? ______________

Attach five years of current audited financial statements (FY18-22) or refer to website if posted (Not necessary for existing VRA borrowers)

Attach FY2024 adopted budget or refer to website

Attach current Capital Improvement Plan

Attach adopted Financial Policies

Attach a list of the ten largest employers in the Applicant's jurisdiction.

Attach a list of the ten largest taxpayers in the Applicant's jurisdiction

Appendix B: Budget Form

Appendix B: Budget Narrative Template

Applicant Name: Community Flood Preparedness Fund & Resilient Virginia Revolving Loan Fund Detailed Budget Narrative Period of Performance: June 2024 through June 2027 Submission Date: November 12, 2023									
								Grand Total State Funding Request	$ 5,000,000
								Grand Total Local Share of Project	$ 38,356,966
		National Fish and Wildlife Foundation Grants						Federal Funding (if applicable)	$ 10,021,524
								Project Grand Total	$ 53,378,490
								Locality Cost Match	% 71.85
Breakout By Cost Type	Personnel	Fringe	Travel	Equipment	Supplies	Contracts	Indirect Costs	Other Costs	Total
Federal Share (if applicable)								10,021,524	10,021,524
Local Share								37,330,166	37,330,166
State Share								5,000,000	5,000,000
Pre-Award/Startup								276,800	276,800
Maintenance								750,000	750,000
Total	$	$	$	$	$	$	$	$53,378,490	$ 53,378,490

1. Federal Share represents National Fish and Wildlife Foundation (NFWF) Grants. NFWF is not a federal agency.
2. Local Share represents the total project cost less design and implementation (monitoring and initial maintenance) costs.
3. State Share represents the CFPF grant request.
4. Pre-Award costs represent project design costs.
5. Maintenance costs represent implementation (monitoring and initial maintenance costs).

Scope of Work Narrative

Introduction

The City of Virginia Beach ("City") is pleased to submit the Marsh Restoration in Back Bay project for consideration under the Flood Prevention and Protection Projects category in the 2023 Virginia Community Flood Preparedness Fund. The City has made significant investments in the study of historical flooding data, current and future hydrology, and the projected increase in flood frequency due to changing rainfall patterns and sea level rise. These studies culminated in Virginia Beach's Resilience Plan, socialized as "Sea Level Wise,"[1] which includes a conceptual suite of projects focused on flood control and resilience. The Virginia Beach Resilience Plan leverages four overarching adaptation strategies to identify actionable projects for each of the City's four unique major watersheds. This project represents the first adaptation project to advance to construction to implement the City's Resilience Plan.

The adaptation strategy for the Southern Rivers Watershed, which includes Back Bay, is presented in Figure 1. The strategy focuses on employing natural mitigation methods, an integrated system of defense structures, and complementary measures, such as land-use strategies. Collectively these approaches are designed to strategically reduce flow into and within Back Bay and improve flood storage and overall coastal resiliency. Marsh restoration was identified as a key resilience-building strategy as part of an extensive evaluation of structural and non-structural alternatives. Marsh restoration provides multiple benefits of flood risk reduction, enhanced habitat, and improved water quality.

As part of the Virginia Coastal Resilience Master Planning Framework, a precursor to the first phase of the Virginia Coastal Resilience Master Plan (CRMP), the Commonwealth of Virginia identified guiding principles for a statewide resilience strategy. One of these guiding principles is recognizing the importance of protecting and enhancing natural infrastructure and prioritizing nature-based infrastructure.[2] The City's marsh restoration project aligns with this principle and was highlighted as an exemplary nature-based project in the CRMP (refer to pages 178-179).[3]

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[1] City of Virginia Beach (2020). Virginia Beach Sea Level Wise Adaptation Strategy (Website).

[2] Office of Governor Ralph S. Northam Commonwealth of Virginia. (2020). Virginia Coastal Resilience Master Planning Framework (PDF).

[3] Office of Governor Ralph S. Northam Commonwealth of Virginia. (2021). Virginia Coastal Resilience Master Plan Phase 1 (PDF).

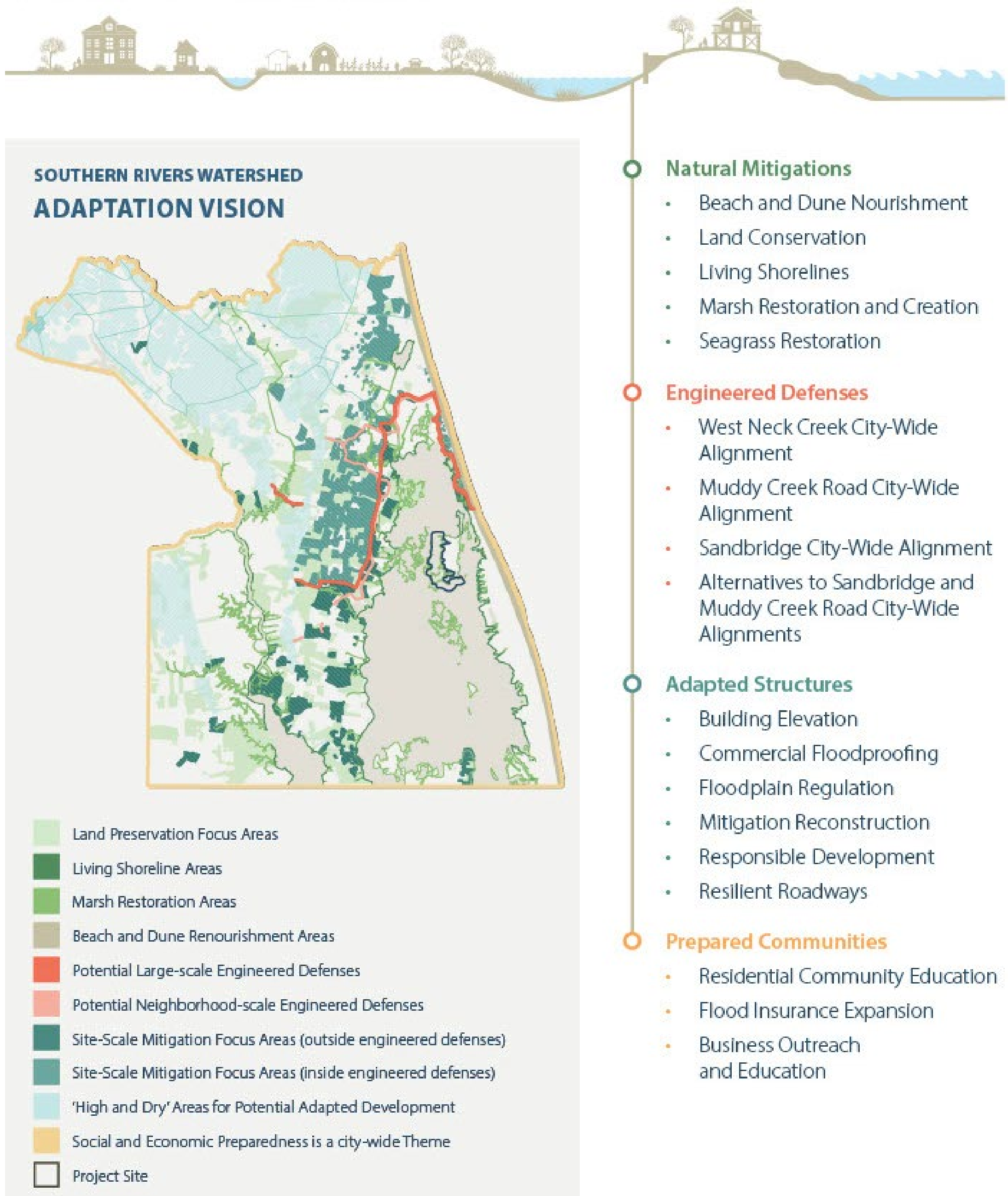

Figure 1: Adaptation Vision for the Southern Rivers Watershed.

Hydraulic modeling analysis identified Bonney Cove as a location where marsh restoration has the potential to reduce the propagation of floodwater through key pathways within Back Bay (Figure 2). The City prioritized this project as the first to advance to construction due to its significant benefits to community and habitat resilience.

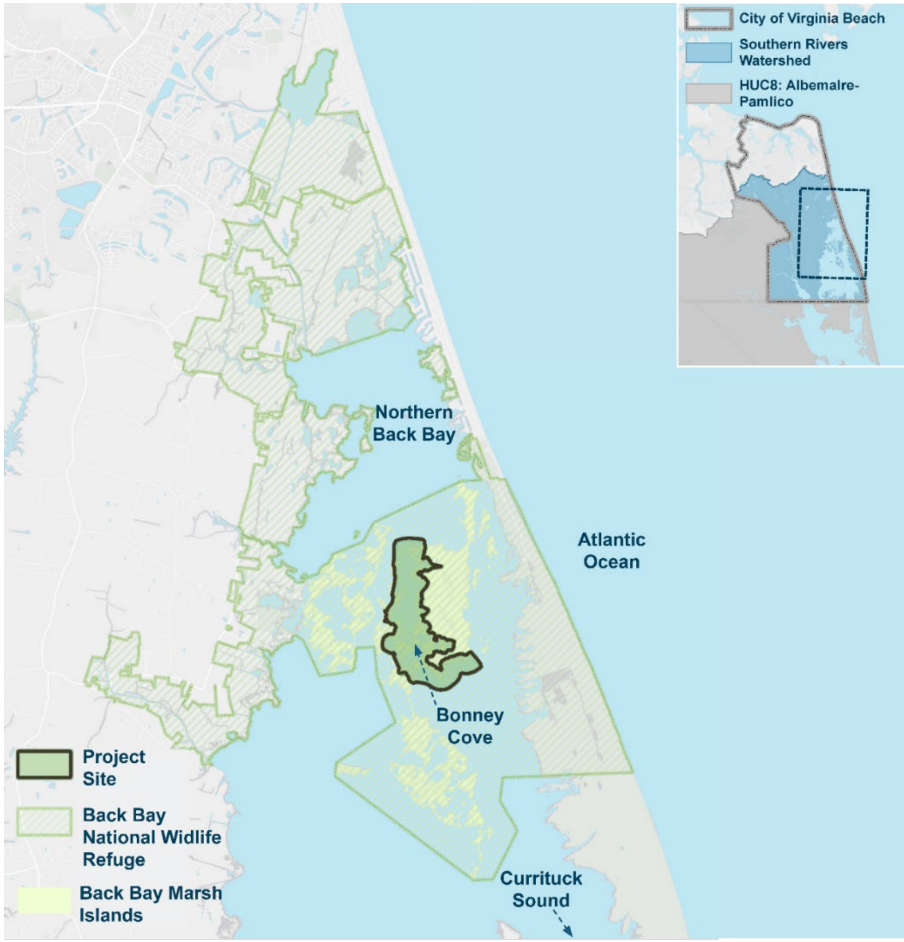

Figure 2: Project site location map.

This project represents a collaborative effort between the City's Department of Public Works alongside other City departments, public constituents, local nonprofits, and state and federal agencies. In selecting the project location and developing the design approach, the City has coordinated closely with the Back Bay National Wildlife Refuge (BBNWR), part of the U.S. Fish and Wildlife Service (USFWS), and the Virginia Department of Wildlife Resources (VDWR). Environmental organizations committed to stewardship of Back Bay have also contributed input throughout the design process, including the Back Bay Restoration Foundation (BBRF), Friends of Back Bay, the Back Bay National Wildlife Refuge Society, and the Albemarle-Pamlico National Estuary Partnership (APNEP). Project field investigations involved local support from Old Dominion University (ODU) and others, and outside expertise from Louisiana. The National Fish and Wildlife Foundation (NFWF) provided grant funding under the National Coastal Resilience Fund (NCRF) to support design, permitting, and environmental assessments. Broad support of the project is demonstrated by contributions from the organizations noted above along with other stakeholders engaged in the restoration effort.

Needs and Problems

Specific Problem Being Solved – Habitat Degradation and "Wind Tide" Flooding

Marshes are vital to the Southern Rivers Watershed for the ecological and flood reduction benefits they provide. The Southern Rivers Watershed contains 90% of the City's land area under an elevation of three feet, making this area particularly susceptible to flood impacts. As illustrated in Figure 3, sustained southerly winds push water up from the Albemarle-Pamlico Sound through the Currituck Sound and into Back Bay, creating a phenomenon referred to locally as "wind tide flooding". Marsh habitat loss has contributed to the opening of a secondary channel in Bonney Cove that has increased water flow during wind tide and other flood events to areas with high community exposure.

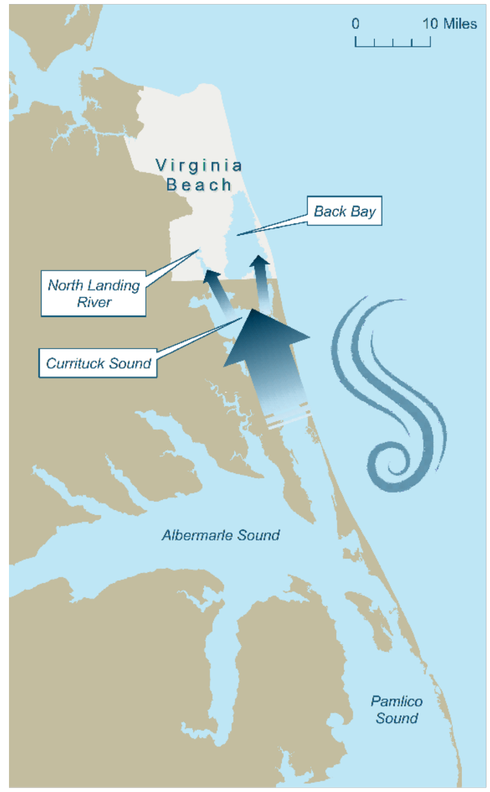

Figure 3: Flood pathways in the Southern Rivers Watershed.

Within today's marsh system, it takes between two to five days of sustained southerly winds to cause flooding, depending on the wind speed and direction. Over the last four years, more than five wind tide flooding events have occurred in this area. The increasing frequency of flooding events is primarily attributed to a foot of relative sea level rise in the last 50 years and degradation of marsh and seagrass habitat.

This marsh restoration project aims to address the challenges of habitat degradation and "wind tide" flooding by stabilizing two critically eroding marsh islands, decreasing turbidity to promote the growth of aquatic vegetation, and providing flood risk reduction benefits through increased friction and wave attenuation.

Factors Contributing to the Identified Problem

This growing flood risk in the Southern Rivers Watershed can be attributed mainly to the reduced friction in the water column from the increased water depth and eroded vegetation, which allows water to move more quickly through key hydraulic pathways. Another term for this is "fetch", which is defined as the open water distance over which a given wind can blow and generate higher waves without obstruction. Unmitigated, the continued loss of these marsh island systems and aquatic vegetation is expected to result in more frequent and intense wind tide flooding events.

Emergent Marsh Degradation

Approximately 50% of former marshland at the site (260 acres) has eroded into open water leading to the opening of a wide secondary channel ("Bonney Cove") that is about two miles

long and half a mile wide (Figure 4). The southern exposed edge of the adjacent marsh islands is exposed to approximately 1.5 miles of fetch in the predominant wind direction.

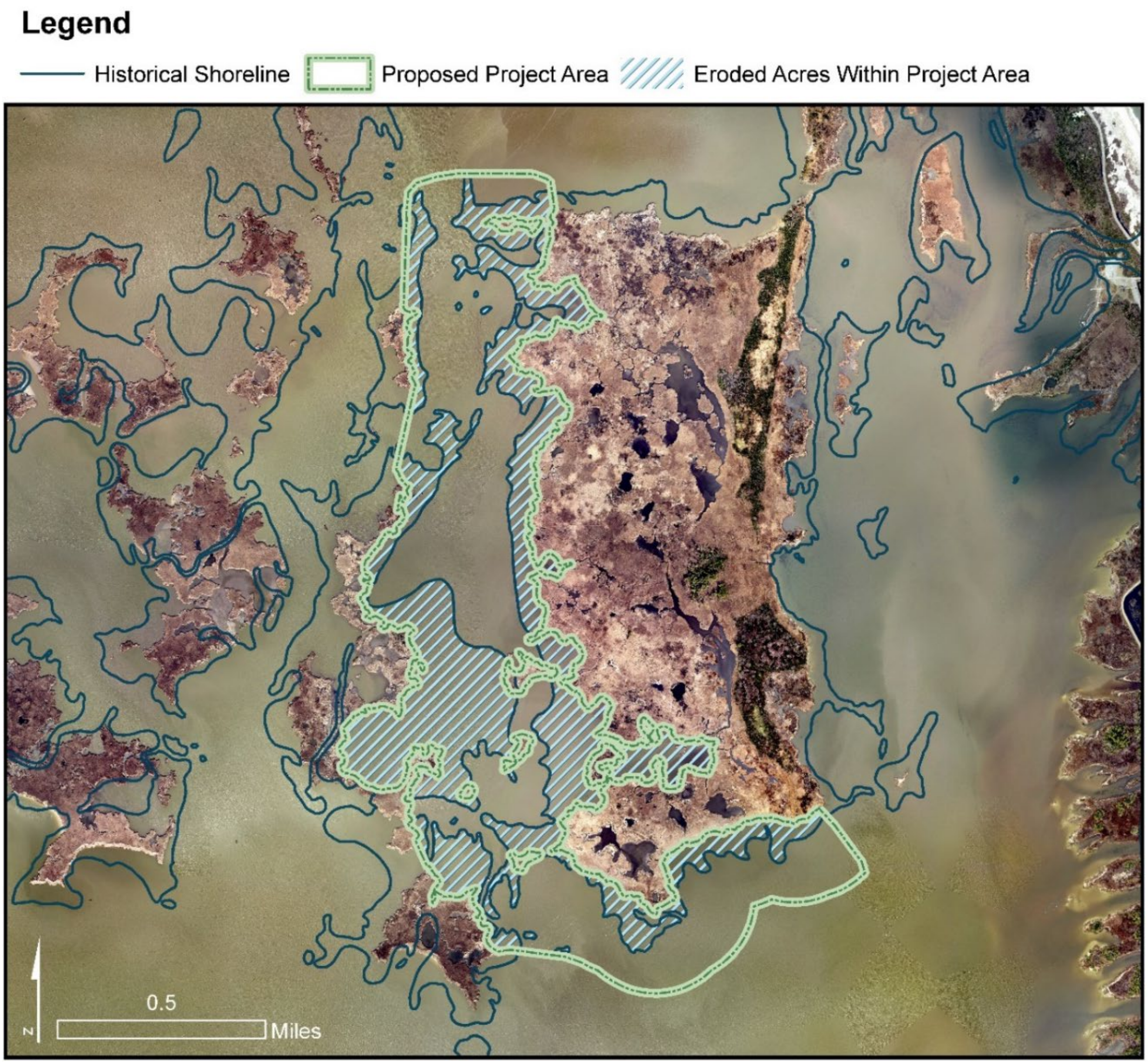

Figure 4: Historical marsh erosion within the project area.

Submerged Aquatic Vegetation (SAV) Loss

SAV used to be abundant at the site (around 45% coverage, overall) but is now extremely sparse, ranging from 0% to 10% coverage across the site, on average. Field studies conducted by the VDWR show that wind-driven waves and high flow velocities are the primary drivers of this loss, particularly in the last 5 years as shown in Figure 5.

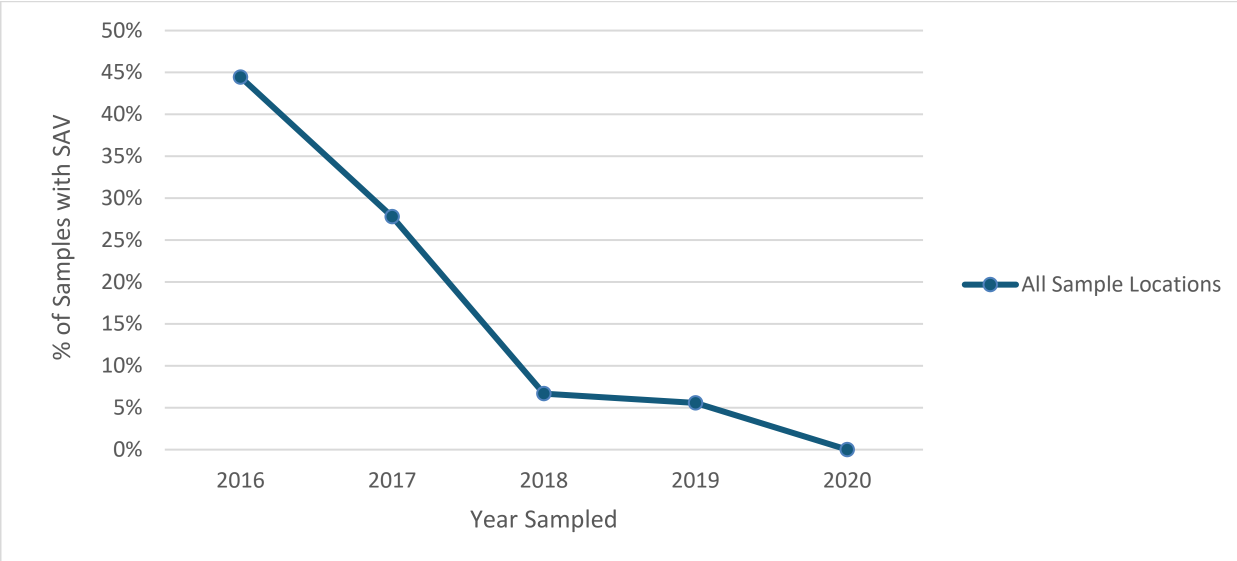

Figure 5: SAV sampling data from VDWR within the project vicinity.

Why is the Project Needed Locally/Regionally?

Pilot Project

The City's design concept for the marsh restoration project leverages "marsh terracing," an innovative coastal engineering technique widely used in Texas and Louisiana to convert shallow subtidal bottom to marsh. This technique has not yet been implemented along the U.S. East Coast and has not yet been implemented in the Mid-Atlantic region. Through the export of proven expertise from successful marsh terraces, this project would lay the foundation for future projects in the region, Virginia, and other states along the East Coast. The project would document detailed cost estimates, demonstrate effective construction practices for large-scale marsh creation projects, identify best sources for local/regional materials, and establish partnerships with permitting officials at various levels of government. The City has outlined a preliminary sequencing plan for marsh island restoration projects in Back Bay to strategically close hydraulic pathways and address priority restoration areas as shown in Figure 6. Some of these projects would require coordination with the State of North Carolina to realize its broader resilience efforts.

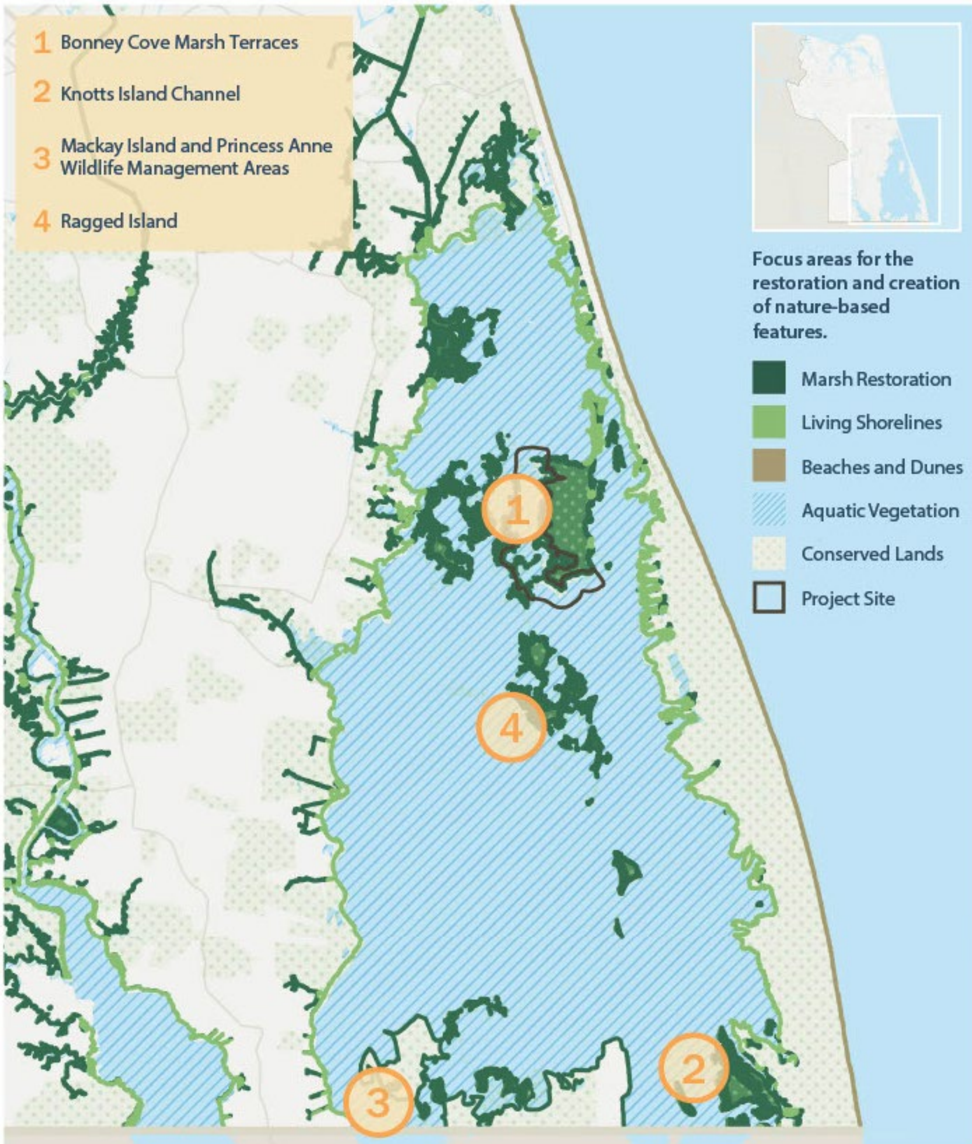

Figure 6: Preliminary Sequencing Restoration Plan.

Virginia Coastal Resilience Master Plan Exemplary Project

The CRMP impact assessment shows a high vulnerability of nature-based features to coastal flood hazards that is consistent with the City's analysis. In the Hampton Roads region, the CRMP impact assessment estimates a decrease from 40,600 acres to 2,940 acres of tidal wetlands by 2080, representing a 93% decline in tidal wetlands.[4] Back Bay was identified as a hotspot for tidal wetland loss, emphasizing the critical location of the City's marsh restoration effort. Specifically, the Virginia CRMP impact assessment shows that portions of tidal wetlands within the project area have "High" and "Very High" impact levels, which indicates areas of tidal marsh

[4] Office of Governor Ralph S. Northam Commonwealth of Virginia and Virginia Department of Conservation and Recreation (2021). Virginia Coastal Resilience Master Plan Phase 1 (PDF).

that are anticipated to be lost through inundation causing conversion to open water (Figure 7).

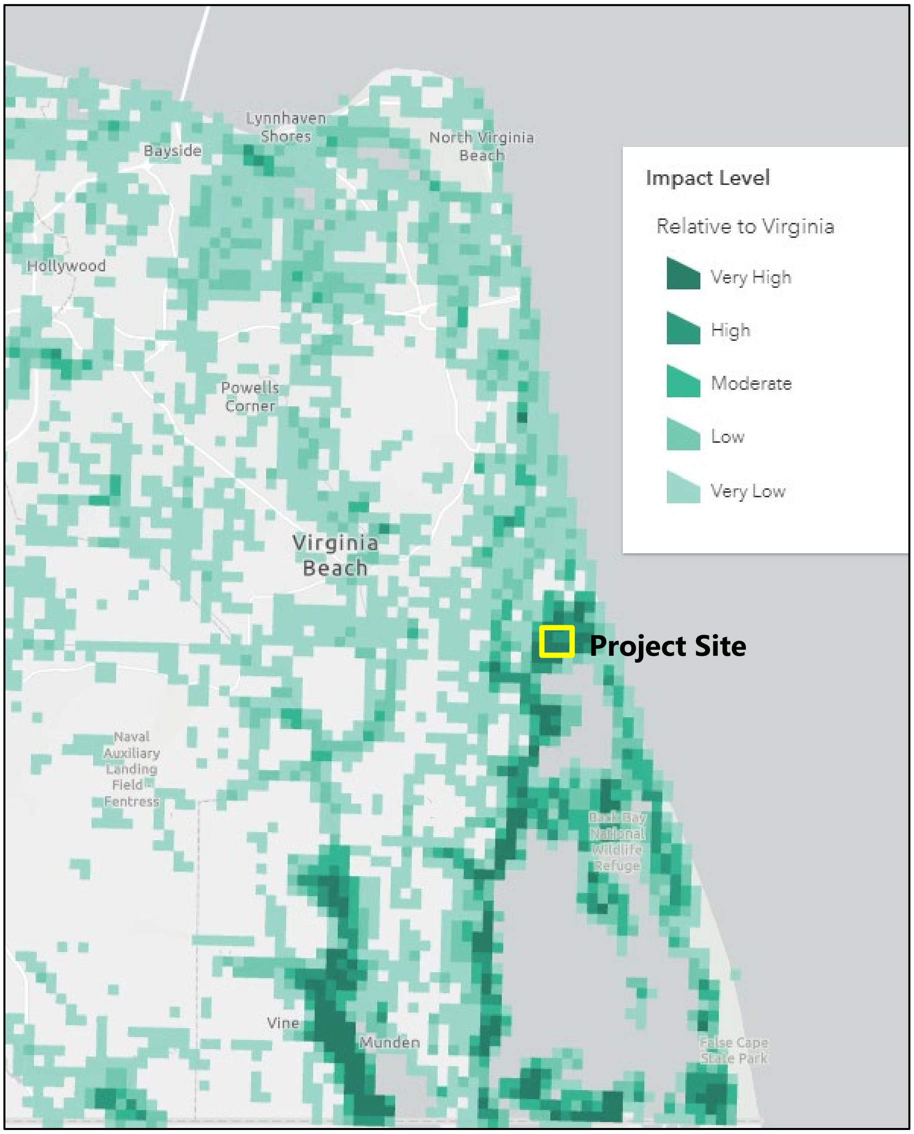

Figure 7: Virginia CRMP Impact Assessment for Tidal Wetlands.

Currituck Sound Coalition High Priority Area

In coordination with Audubon North Carolina, the Currituck Sounds Coalition designated the project site as a High Priority Area for restoring and enhancing vulnerable and degraded marshes with "high flood risk reduction benefits and habitat value" as shown in Figure 8[5].

[5] Audubon North Carolina. (2021). Currituck Sound Coalition Marsh Conservation Plan. (PDF)

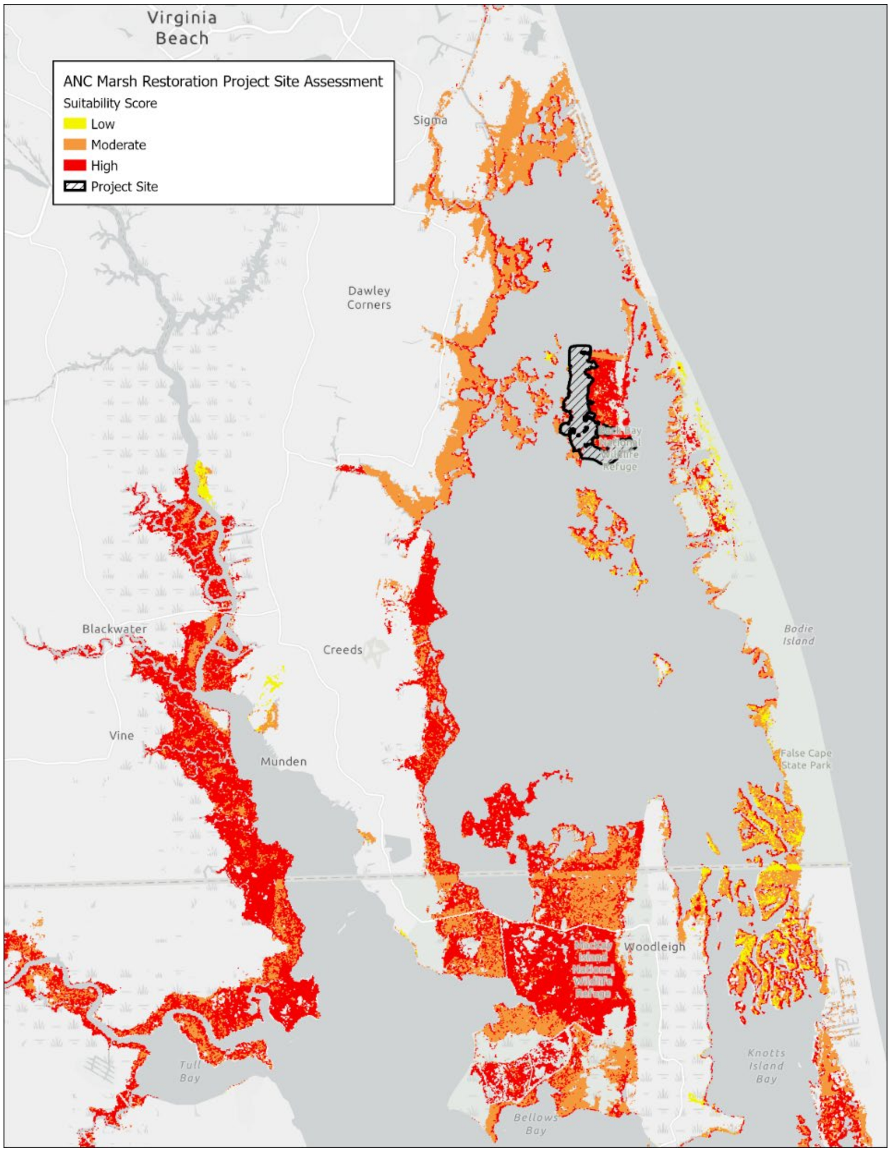

Figure 8: Audubon North Carolina Marsh Restoration Project Site Assessment

Ecological Core for Flood Resilience

The Virginia Department of Conservation and Recreation Natural Heritage Data Explorer provides data from ConserveVirginia v3.0 and other data to support conservation planning. The following map in Figure 9 displays Ecological Cores and the Floodplains and Flooding Resilience Category layer (blue polygon) from ConserveVirginia. The project area contains "High" (C3) and "General" (C5) Ecological Cores and is within the boundaries of the Floodplain and Flooding Resilience area.

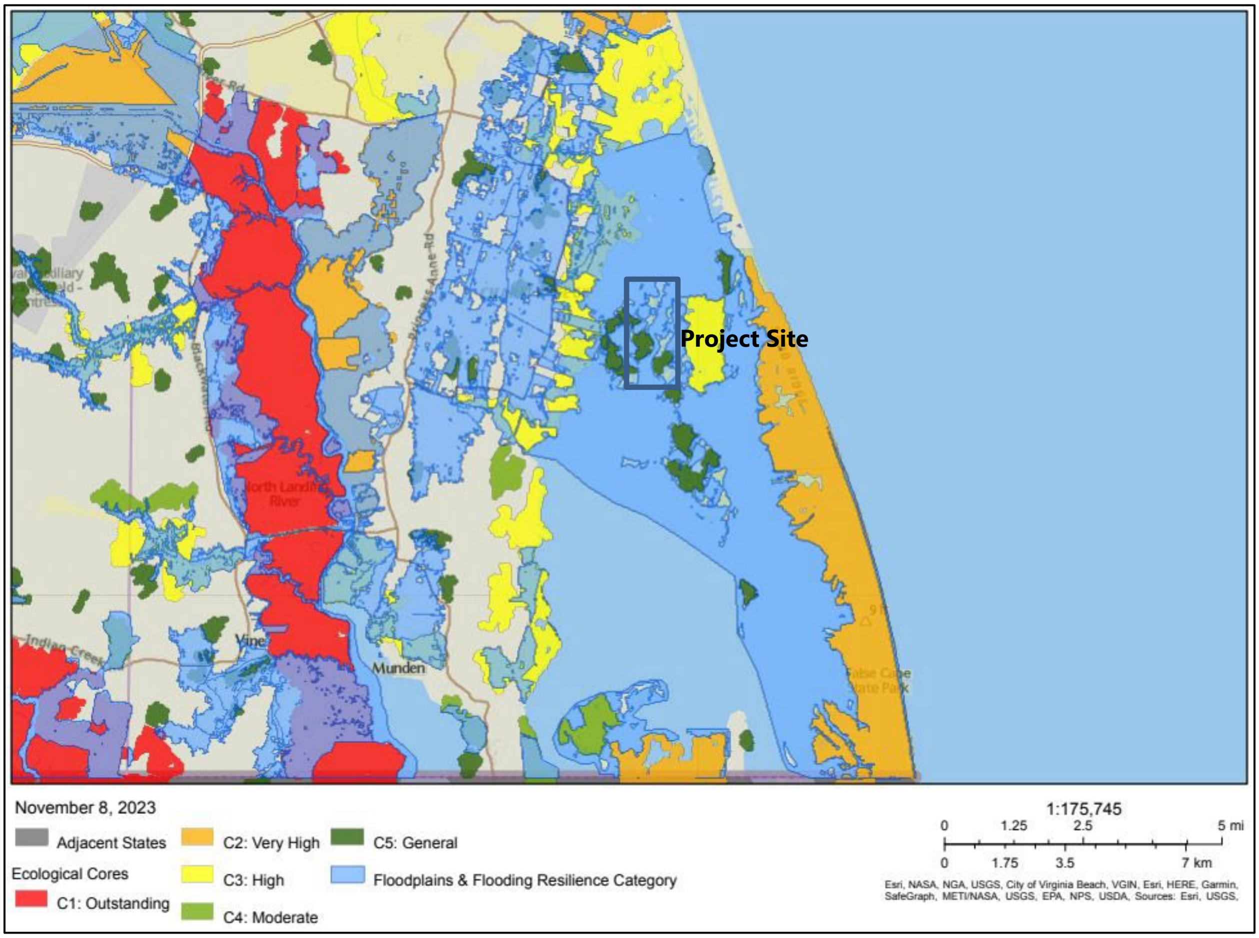

Figure 9: Virginia Natural Heritage Data Explorer Ecological Cores and ConserveVirginia Data.

The safety threats, or environmental concerns related to flood risk.

The City's risk assessment forecasts that approximately 70% of the remaining marsh (730 acres) surrounding the project site will convert to open water with three feet of sea level rise if unmitigated. Fragmentation of this adjacent marsh would result in about eight miles of fetch acting on the southern extent of the site in the predominant wind direction. Without these central marsh islands, the northern shorelines of Back Bay would be exposed to 12 miles of fetch from the Knotts Island Channel at the Virginia-North Carolina boundary. This condition would leave the fringing marshes highly vulnerable to accelerated erosion.

How does the project decrease the risk to public safety through flood risk reduction?

Construction of the forty-one individual marsh terraces, totaling 27,000 linear feet (a 51-acre footprint), across Bonney Cove offers a nature-based technique that will stabilize and protect the marsh island in the center of the bay and reduce erosion of the fringing marsh systems to the north. Numerical modeling was leveraged to quantify specific erosion reduction benefits of the project for wave heights and flow velocities:

- **Wave Height Reduction**: The marsh terraces are expected to reduce wave heights within the project site by approximately 45%. This reduction is consistent with other field studies, which have found that average wave heights within two terraced sites were 37% to 48% lower than those observed at the reference site (Brasher 2015). Wave energy reduction is anticipated to increase the potential for sediment deposition on the terraces' leeward side, leading to the growth of new emergent marsh and reducing erosion of adjacent marsh. Approximately five miles of marsh island shoreline around Bonney Cove will benefit directly from the erosion reduction associated with the computed wave attenuation.
- **Flow Velocity Reduction**: The marsh terraces reduce flow velocity within the project area. This reduction in velocity will reduce bottom shear stress, decrease turbidity, increase light penetration into the water column and promote the growth of SAV. Reducing bottom shear stress will make conditions more suitable for SAV growth between the terraces. Field studies of marsh terraces in Texas and Louisiana document an approximately 45% to 56% reduction in turbidity and the emergence of SAV in the years following terrace construction (Brasher 2015).
- **Wind Shear Stress Reduction**: Although not included as a parameter within the numerical modeling effort, the bald cypress trees planted on the terraces within the middle of the site are expected to reduce wind speed within the project site. This will further reduce wind-generated waves within the project site on the terraces' leeward and windward sides. Research shows that trees that grow to at least 30 feet at maturity result in lower wind speeds of up to 60 to 150 ft on the windward side and up to 900 ft on the leeward side (USDA).

How does the project protect or conserve natural resources?

The proposed project aims to restore marsh island communities in Bonney Cove that have historically provided environmental and flood reduction benefits to the communities in northern Back Bay. As illustrated in Figure 10, when an intact marsh begins to fragment and convert to open water, fetch increases and enables greater wave energy, increasing marsh erosion rates, and ultimately accelerating conversion to an ever-expanding body of open water. Strategic marsh restoration and creation in Bonney Cove would help mitigate the cycle of marsh island erosion and loss of SAV currently occurring in Back Bay, thereby protecting the remaining marsh islands and reducing fetch and wave energy.

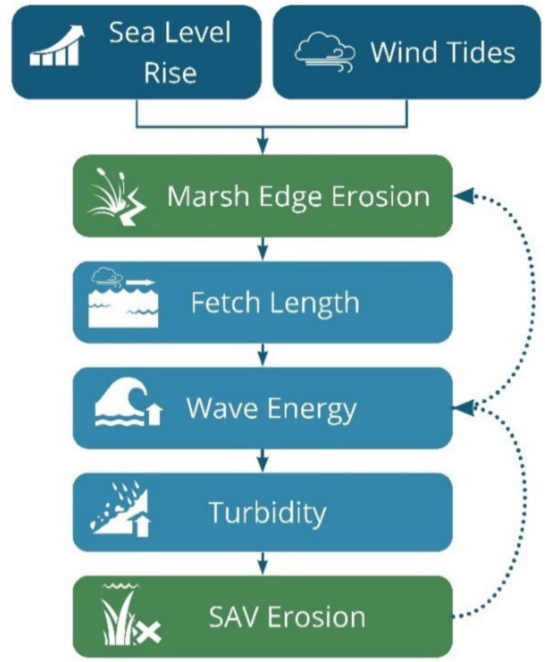

Figure 10: Cycle of marsh erosion, SAV loss, and increased wind-driven flooding.

The primary objective of this project is to create a sustainable coastal marsh island system in Back Bay through reclamation of historically lost marsh habitat and protection of existing marsh complexes from erosion. This restoration effort aims to provide multiple benefits of reduced flood impacts, enhanced fish and wildlife habitat, and improved water quality. The project is designed to achieve the following outcomes:

- Decrease turbidity to create conditions that promote the growth of emergent vegetation and aquatic grasses;
- Maximize habitat value for ecologically important fish and wildlife populations (e.g. Largemouth Bass, Bluegill, Yellow Perch, Striped Bass, Blueback Herring, Alewife, American Eel, etc.); and,
- Reduce fetch, wave heights, and flow velocities to mitigate erosion of fringing marsh systems that provide a buffer for the low-lying neighborhoods and roads that experience frequent flooding in northern Back Bay.

The City selected marsh terracing as the preferred restoration approach because the design is compatible with Back Bay's shallow bottom and the historical loss of habitat. Marsh terraces are narrow, man-made islands placed in shallow open water to restore previous marsh environments. Typically arranged in a chevron pattern, the overall field of marsh terraces dissipates waves, decreases turbidity, and slows down the moving water. The resulting calmer water conditions allow more sunlight to penetrate to the shallow bottom, promoting the establishment and growth of marsh seagrass and ultimately improving habitat quality for fish and wildlife. Further, as opposed to one continuous marsh platform, marsh terraces maximize habitat for a variety of fish and wildlife species, as illustrated in Figure 11.

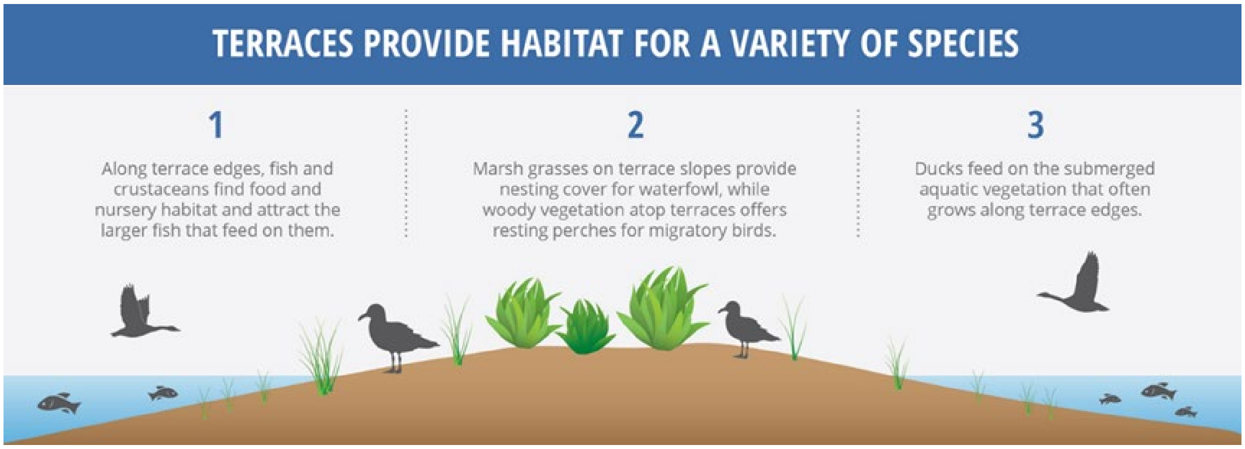

Figure 11: Conceptual diagram of marsh terraces.

Groups to be targeted who might directly benefit from this flood risk reduction effort.

The northern Back Bay communities adjacent to the project area and interested stakeholders have been engaged in the planning effort through public meetings. These meetings provided an opportunity for the community to provide feedback on the 30% and 95% designs and artistic renderings. We anticipate the project to benefit properties and infrastructure assets in northern Back Bay, including the following:

- **Reduce erosion rates along approximately 8 miles of shoreline by reducing wind and wave energy north of the project site.** Most of the properties along this reach of shoreline are not protected by traditional erosion risk reduction measures, such as bulkheads. Maintaining a naturalized shoreline while protecting fringe marsh is a priority of the City and its project partners. This approach will ensure that these marsh systems can migrate landward in response to sea level rise.
- **Reduce flood risk to commercial and residential properties north of the project site.** There are approximately 70 commercial and 2,350 residential structures within the two census block groups surrounding the project site. Around 635 of those structures are vulnerable to flooding during a 50-year event today. With three feet of sea level rise, approximately 2,060 structures are expected to be vulnerable to flooding during a 50-year return period event, representing about 85% of the residential structures within the project vicinity. These numbers underscore the importance of implementing the proposed project alongside complimentary flood risk reduction projects.
- **Reduce the magnitude and duration of flooding along critical access roads and critical facilities.** In addition to Muddy Creek Road, two other critical access roads are anticipated to benefit from delayed flooding. This includes Shipps Cabin Road (intersecting with Muddy Creek Road) and Sandpiper Road, which runs parallel to the eastern bank of Back Bay and provides ingress/egress out of the Sandbridge community (Figure 12).

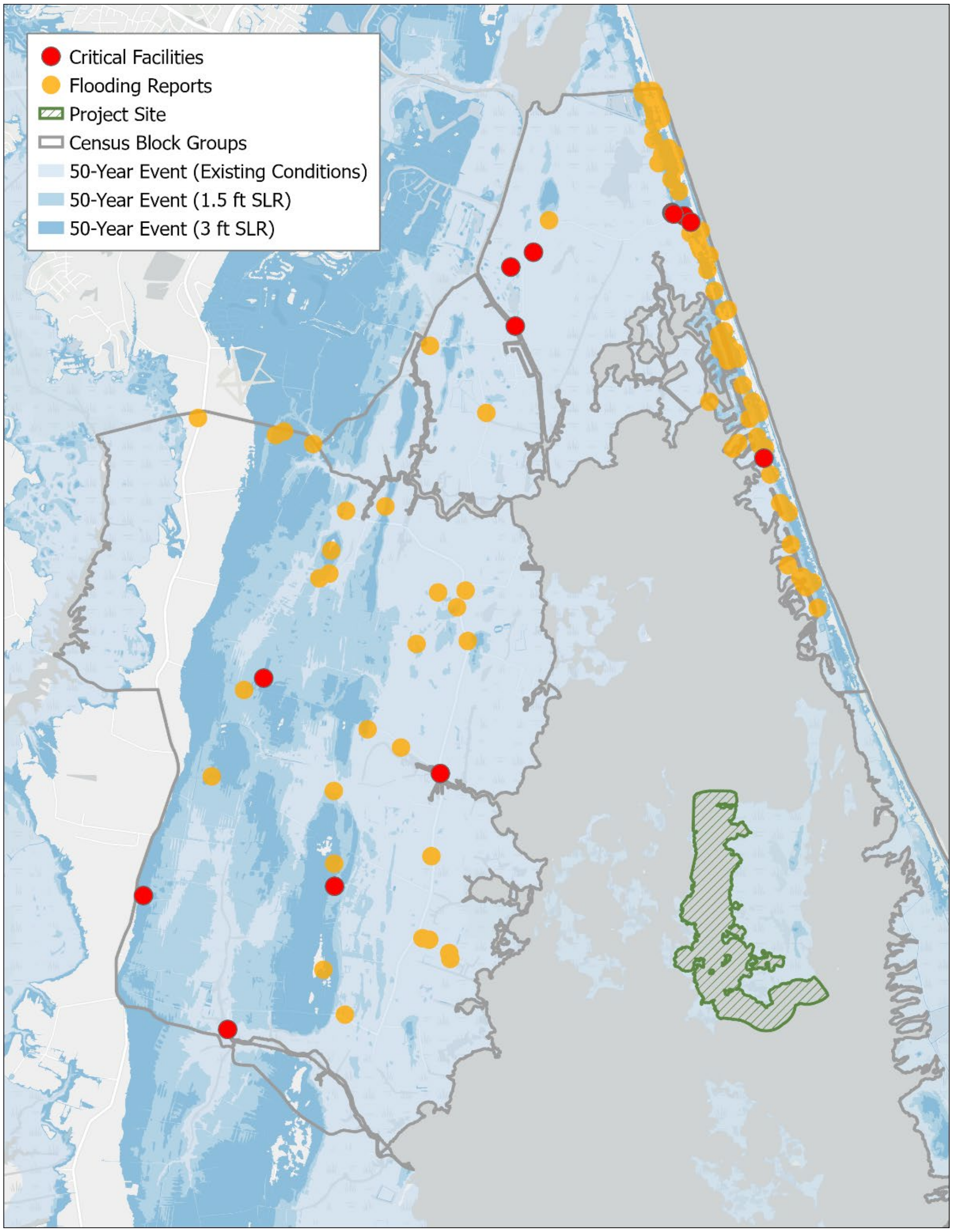

Figure 12: Critical facilities and flooding reports within project vicinity.

What would happen (or not happen) if the applicant does not receive funding?

If this project does not advance from design to construction, erosion of the adjacent marsh would continue to occur, resulting in fragmented habitat lacking the capacity to reduce wave action and slow water velocities. It is anticipated that wind-driven flooding events will continue to increase in frequency, resulting in increasing flooding of the low-lying properties and roadways surrounding northern Back Bay.

Alternatives Analysis

The proposed project offers the best approach for addressing the needs and problem statement outlined in this Scope of Work narrative. The project would result in the creation of 46.5 acres of marsh terraces, which would produce a net gain of approximately 16 acres of low/high marsh habitat by the end of the project construction compared to the No Action Alternative. The integrated system of marsh terrace ridges and perimeter rock armoring would stabilize the two critically eroding marsh islands (Long Island to the east, and a series of smaller unnamed islands to the west) from continued degradation. The tall terrace design improves the functionality and resiliency of the marsh system while also providing diversified habitat for fish and wildlife in the form of increased marsh edge as sea level rises. Numerical modeling of the preferred alternative demonstrated that the project would decrease wave heights and decrease the overall flow velocity of water moving through the project site, reducing water exchange in Back Bay during flooding events, encouraging sediment deposition, mitigating wave effects and consequent erosion, and result in localized water quality benefits. The proposed terraces would not only create a platform for vegetation growth within the marsh, but also reduce wave fetch in these large open water areas. The reduction in wave energy would lead to improved water clarity to promote the growth of SAV in the area between the terraces (approximately 310 acres).

Dredging in between the terraces to obtain sediment for the terrace cap would ensure no invasive vegetation is introduced into Back Bay, which is a high priority of the USFWS and VRMC. The dredging areas would also create valuable fish habitat to attract signature Back Bay fish and wildlife populations such as Largemouth Bass. The proposed dredging areas in between the terraces was evaluated and not anticipated to increase erosion of the adjacent marsh system. Furthermore, dredging in-situ material for building terraces is a widely accepted approach in Gulf Coast region marsh creation/terracing projects, as determined through conversations with project owners in Louisiana. Some terrace cap material will also be obtained from the Nimmo VII-A project. Through export of proven expertise from successful marsh terracing projects, this project would lay the foundation for future similar projects in the region through the development of detailed cost estimates, identification of best sources for local/regional materials, and establishment of partnerships with permitting officials at various levels of government.

Goals and Objectives

The overarching goal of this project is to construct the City's first nature-based adaptation project in the Southern Rivers Watershed and one of the CRMP's exemplary nature-based projects. This project aims to stabilize two critically eroding marsh islands from further degradation, decrease turbidity to promote the growth of aquatic vegetation, and provide flood risk reduction benefits through increased friction and wave attenuation. Table 1 below provides a high-level overview of the specific objectives established to solve the problem/need identified – specifically habitat degradation and wind tide flooding along with measure(s) of success. A more detailed description of these objectives is provided in the Supporting Documentation section.

Table 1: Overview of Project Objectives.

Objectives	Description	Measure(s) of Success	Timing of Measures
Objective 1	Create a Construction Access and Staging Area	a. Secured permits for construction. b. Contractor Selection. c. Construction of Staging Area.	a. December 2023 b. April-May 2023 c. June 2023 -February 2024
Objective 2	Restore Marsh and Aquatic Vegetation	a. Secured permits for construction. b. Restoration of 46.5 acres of habitat.	a. December 2023 b. March - October 2025 and March – October 2026
Objective 3	Engage Stakeholders and Disseminate Effective Practices	Number of people meaningfully engaged in the process of the project within the agreement period.	Continuous through period of performance.

Work Plan

Current Status and Ongoing Activities

The marsh terrace project design is progressing and will be ready for construction in the CFPF grant timeline. Table 2 summarizes ongoing tasks related to the project and an anticipated schedule for completion.

Table 2: Completed, ongoing, and anticipated activities leading up to construction.

Activity	Description	Schedule
Stakeholder Scoping Workshop	In November 2020, the City hosted a virtual workshop to receive initial input from project stakeholders.	Completed (Fall 2020)
Site Characterization and Vegetation Survey	In fall 2020, a site characterization and vegetation survey within Bonney Cove was conducted under a USFWS Special Use Permit (SUP). The purpose of the survey was to document existing emergent marsh and submerged aquatic vegetation (SAV) species composition and percent coverage within the proposed project area. MAP Environmental, Inc. conducted a literature review of marsh terracing projects in the Gulf Coast region to identify effective practices for project planning and design.	Completed (Fall 2020)
Bathymetric Survey	An updated bathymetric survey of Bonney Cove, also covered under a USFWS SUP, was completed in March 2021. This data serves as an input to identify appropriate design elevations to determine quantities of materials necessary to build the proposed marsh terraces and for numerical modeling of project alternatives.	Completed (Spring 2021)
Geotechnical Investigation	A geotechnical investigation of Bonney Cove was conducted in the spring of 2021. The permitted survey, (Virginia Marine Resources Commission (VMRC) Permit No. 2020-2286, U.S. Army Corps of Engineers (USACE) Permit No. 2020-02439, and USFWS SUP) included the collection of 10 soil borings in locations that avoided aquatic vegetation habitat. The soil samples were retrieved by drilling with a specialized airboat-mounted drill rig which was essential for drilling in shallow areas as it avoids disruption to bottom habitat. The soil samples were analyzed to determine the suitability and physical characteristics of the soils within the project area. Additional soil analysis was conducted to determine the suitability of Back Bay sediments for building components of the marsh terraces.	Completed (Spring 2021)

Activity	Description	Schedule
Water Quality and Hydrodynamic Survey	ODU conducted a water quality and hydrodynamic survey of Bonney Cove in the spring of 2021. The USFWS permitted survey collected water samples and deployment/retrieval of hydrodynamic sensors (pressure sensors, acoustic Doppler current profilers, and optical backscatter sensors) at three sampling points in Bonney Cove. Sensor equipment was deployed for two one-month periods (3/10/2021 – 4/12/2021 and 5/19/2021 – 6/8/2021). The water level, wave, and current data served as an input to the numerical model calibration. The water quality parameters (including pH, salinity, temperature, dissolved oxygen, chlorophyll, and turbidity) will serve as a reference to compare pre-and post-construction water quality conditions.	Completed (Summer 2021)
30% Design	Dewberry leveraged the field-collected data to establish design criteria for the project to ensure that it will be resilient in the face of changing future conditions during wind-tide events. Artistic design renderings were developed to enable stakeholders to visualize the implemented project.	Completed (Fall 2021)
Public Engagement – 30% Design	The City held a public information meeting on October 14, 2021, at Creeds Elementary School. The project team delivered a 10-minute presentation of the proposed project followed by an open-format discussion where participants reviewed the preliminary (30%) designs and artistic renderings and submitted comments regarding environmental and community impacts.	Completed (Fall 2021)
Numerical Modeling	Numerical modeling has been completed to evaluate the proposed project's impact on water levels, wave heights, and flow velocities within and surrounding the project area. Potential water quality impacts were also evaluated. The numerical modeling effort involved the development of an XBeach model, which is a nearshore model that accounts for wave-vegetation interactions based on field-derived drag coefficients.	Completed (Winter 2021)
Environmental Assessment and Scoping	In coordination with the USFWS and with technical assistance from Dewberry, the City evaluated the potential environmental impacts of the project. The draft environmental assessment document was distributed to key stakeholders with jurisdictional authority or a vested interest in the project for review and comment.	Completed (Summer 2023)

Activity	Description	Schedule
60% Design	After numerical modeling and stakeholder review of the 30% design, the engineering design plans were advanced from 30% to 60%.	Completed (Spring 2023)
95% Design and Public Engagement	The engineering design team prepared 95% engineering design plans to address comments on the 60% plan set. The City held a second public information meeting from 6:00 – 7:30 p.m. on July 13, 2023, at the Senior Resource Center in Virginia Beach where the project team delivered a 10-minute presentation of the proposed project followed by an open-format discussion where participants reviewed the 95% designs, updated artistic renderings, and submitted comments.	Completed (Fall 2023)
Construction Permit Applications Submitted	The City submitted the Joint Permit Applications for the proposed project, including the initial post-construction monitoring plan, to VMRC and the USACE in August 2023.	Completed (Summer 2023)
Modeling of Potential Adverse Impacts	In response to public concerns, the City performed additional numerical modeling of both northerly and southerly wind events and reviewed water level responses at locations in Back Bay for any potential adverse impacts. No adverse impacts were found for either type of event.	Completed (Fall 2023)
Publication of Frequently Asked Questions	The City will be publishing findings for the potential adverse impacts modeling, along with other responses to public concerns raised at the question in a Frequently Asked Questions webpage in November 2023.	In Progress (Fall 2023)
100% Design	The engineering design team prepared and submitted the 100% engineering design plans to the City for review. The plans will be finalized on receipt of any comments from the permitting process, anticipated to occur by end of 2023.	In Progress (Fall 2023)
Contractor Procurement	The engineering team will provide final plans, specifications, and construction estimates (PS&E). The City will prepare the bid Request for Proposal (RFP), provide Bid Packages, and review bids obtained, and select a construction contractor.	Planned (Winter 2023 - Spring 2024

What are the major activities and tasks?

The key activities and tasks to be competed under the agreement period are summarized in Table 3. Please refer to the Supporting Documentation section for a more detailed description of these activities and tasks.

Table 3: Overview of Activities and Tasks.

Activities	Description	Tasks
Activity 1	Construction Staging Area Preparation and Construction	1. Mobilize equipment 2. Stabilize road, establish construction staging area, abutments, install pre-engineered bridge, construct ramp to water and slurry basins. 3. Establish traffic flagging stations. 4. Install pipe and booster stations.
Activity 2	Marsh Terrace Construction	1. Construct 41 terraces (2-phased approach). 2. Demobilize equipment.
Activity 3	Stakeholder Engagement	1. Develop project marketing materials. 2. Attend and document engagement activities.

Who is responsible for completing the activities and tasks?

Responsibility for completing the project's activities and tasks lies with a collaborative effort led by the City's Department of Public Works. To ensure the successful execution of the project, the City has assembled a diverse team of consultants, advisors and subject matter experts. For a comprehensive understanding of the specific roles and responsibilities of each entity involved in carrying out the proposed scope of work, please refer to the *Supporting Documentation – Approach, Milestones, and Deliverables – Project Partner*s section of this report, which provides a detailed description of how each team member contributes to the project's overall success.

What is the timeframe for accomplishing activities and tasks?

An overview of the planned project timeline is shown in Figure 13. Grant activities will initiated in Summer 2024 with construction of the staging area and material acquisition. Please refer to the S*upporting Documentation – Approach, Milestones, and Deliverables –Milestone Schedule* section of this report for a detailed outline for each activity and associated deliverables.

Figure 13. Timeline overview for project implementation.

Identify the required partners to ensure success and where they are represented in the workplan.

A diverse team of consultants, advisors, and subject matter experts, led by the City's Department of Public Works, has been assembled to complete the project's activities and tasks. Please refer to the *Supporting Documentation – Approach, Milestones, and Deliverables – Project Partner*s section of this report for a detailed description of each team member's role, responsibilities, and contribution to the project's overall success.

Deliverables

An overview of the project deliverables is provided in Table 4. Please refer to the *Supporting Documentation – Approach, Milestones, and Deliverables* section of this report for more detail.

Table 4: Summary of Deliverables.

Activities	Deliverables
Activity 1: Construction Staging Area Preparation and Construction	1. Material acquisition. 2. Progression and completion of the construction staging area, with daily inspections to monitor progress. 3. Documented progress and completion through quarterly reports to DCR.
Activity 2: Marsh Terrace Construction	1. Progression and completion of the 2025 and 2026 construction phases, including plantings, with daily inspections to monitor progress. 2. Demobilization and removal of equipment from construction staging area. 3. Documented progress and completion through quarterly reports to DCR.
Activity 3: Stakeholder Engagement and Lessons-Learned Dissemination	1. Project marketing materials. 2. Records documenting number of stakeholders engaged during the outreach activities.

Maintenance plan tied to the identified viability of the project. Plan for sustaining the project after the agreement period (if applicable)

The City has developed a draft Annual Monitoring Plan and Post-Construction Monitoring Report that was submitted along with the Joint Permit Application for the project. See Attachment 5 for a copy of the draft report.

Project maintenance will be addressed by the City of Virginia Beach's Public Works Stormwater Operations Group. Any maintenance issues identified by the monitoring effort or other observers will be flagged to the Operations Group to address. The City intends to maintain the construction staging area to support future project maintenance needs. After completion of the monitoring program, the City will perform inspections every 2-5 years and make any repairs needed for the life of the project.

Evaluation

Indicators of Success

Indicators of success for this project have been identified during the development of the monitoring plan. Three (3) indicators of success were defined in relation to the primary objectives of the project (as defined elsewhere in this document), and include:

- The establishment of a sustainable coastal marsh island system.
- Stability of the marsh terrace structures.
- Establishment of a sustainable SAV community.

What data will be collected and how will it be used to measure success?

Data collection for the project has been detailed in the proposed monitoring plan and includes two sets of data: one set associated with as-built surveys to establish baseline reference conditions for subsequent monitoring efforts, and monitoring data to assess the success of the project in meeting the indicators defined above. Baseline and monitoring data will be compiled in an annual report and distributed to permitting agencies, and stakeholders as appropriate, to fulfill monitoring requirements and ensure success criteria are being met and maintenance needs are addressed.

Baseline data, which is proposed to be collected after the completion of each of two phases of terrace installation, will include the following data:

- Coordinates and diagrams of established transects, as well as site photographs from photo stations established along each sampling transect, as defined in the Methods section of the monitoring plan.
- Final location of all planted vegetation (upland plantings, high marsh plantings and low marsh plantings).
- Final location and extent of SAV plantings.
- Final grade topographic surveys (plan, profile, and cross sections).
- Discussion of the project design versus as-built conditions.

Monitoring data will be collected at the end of the full growing season during each monitoring year and include the following:

- Site photographs from photo stations defined in the Methods section of the monitoring report.
- Estimated percent cover and change in coverage from the as-built conditions to sampling year conditions for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- Estimated percent cover and change in coverage from planted conditions to sampling year conditions for SAV planting quadrants

- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

This monitoring data will be used to define success by tracking the establishment of the proposed vegetative communities on and between the proposed marsh terraces as well as the structural integrity of the marsh terrace structures themselves. Vegetation cover thresholds for each year will be defined to ensure planted communities are appropriately established on each marsh terrace. Acceptable measures of deviation will be defined for structural elements to ensure design requirements are met. Maintenance and mitigation measures defined in the monitoring plan will be implemented as required if success criteria are not met during any particular monitoring year.

How was cost effectiveness evaluated and measured against the expected outcomes?

Through a BCA approach using FEMA methods and ecosystem service valuations, a BCR of 1.17 was calculated for the project. This BCR is greater than 1, indicating the project can be considered cost-effective. The project also provides an additional $9.2M in value over the current estimated project costs.

A description of the BCA analysis and methods is provided in the following Benefit Cost Analysis Section.

What products, services, meetings, outreach efforts etc. will be conducted and how will success be measured?

The City is firmly dedicated to fostering meaningful engagement with project partners and external stakeholders throughout the project, with the goal of raising awareness about the project's approach and its benefits and enhancing the likelihood of its successful adoption in other areas within the region and the state.

Activity 4, titled "Stakeholder Engagement and Lessons-Learned Dissemination," provides a comprehensive outline of the City's outreach strategy, encompassing proposed deliverables and outreach endeavors. This strategic plan entails the development of project marketing materials, along with the facilitation of presentations and meetings with local and regional stakeholders, as well as participation in state and national-level conferences.

To gauge the effectiveness of our efforts, the City will employ metrics to track and document the number of individuals engaged throughout the project. This information will be regularly communicated to DCR to serve as a key performance indicator for project success.

For a more detailed breakdown of the tasks and deliverables associated with Activity 4, please refer to the Supporting Documentation section of this application.

Project Progress Monitoring Plan

The City's Project Progress Monitoring Plan is designed to guarantee the seamless and effective execution of the project. We have established a robust internal system to oversee the entire project lifecycle, ensuring that all key stakeholders are aligned with the project's objectives, activities, deliverables, and schedule.

The process commences with a kickoff meeting involving all project partners, where we collectively set the stage for the project. During this meeting, we thoroughly review the project's objectives and scope, ensuring that everyone is on the same page. This initial step is instrumental in fostering a shared understanding of the project's vision and goals among all involved parties.

In addition to the kickoff meeting, we place a strong emphasis on quality assurance and control. We meticulously assess each contractor's quality management system to ensure that well-defined procedures are in place to maintain the highest standards of quality throughout the project. This dedication to quality is paramount to delivering a successful project that meets the City's standards and the expectations of our stakeholders.

The City is committed to ongoing and transparent communication with our design and construction contractors, as well as our advisory stakeholders. Regular meetings will be held to monitor progress, address any potential challenges, and ensure the project adheres to the proposed milestone schedule and deliverables as outlined in this grant application. This proactive approach to project monitoring allows us to stay on track, identify and address issues promptly, and uphold our commitment to the successful completion of the project.

Supporting Documentation

Project Information

The following sections provide details regarding the project site and highlight the impacted population, residential and commercial structures, and critical facilities. This section also provides an overview of the historical, existing, and projected flood conditions in and around the project site.

Population

As shown in Figure 14, two census block groups (518100454.121 and 518100464.001) adjacent to Back Bay are within the extent of the anticipated project benefits. The total population of these two block groups is 3,531.[6] The residential population has grown approximately 1.8% in the past two decades. The median household income in 2021 dollars is $99,078. There are approximately 2,500 residential housing units, of which 43.1% are owner-occupied, 11.4% are renter-occupied, and 45.5% are vacant. The high percentage of vacant housing units can likely be attributed to seasonal rentals within the Sandbridge Resort Area. The race and ethnicity demographics of the community are 94.4% White, 1.4% Black, 3.4% Hispanic, and less than 1% Asian and American Indian.

[6] Population, household income, housing units, and demographic data obtained from Esri ArcGIS Community Analyst (2022). Esri forecasts for 2021 based on U.S. Census Bureau 2010 data.

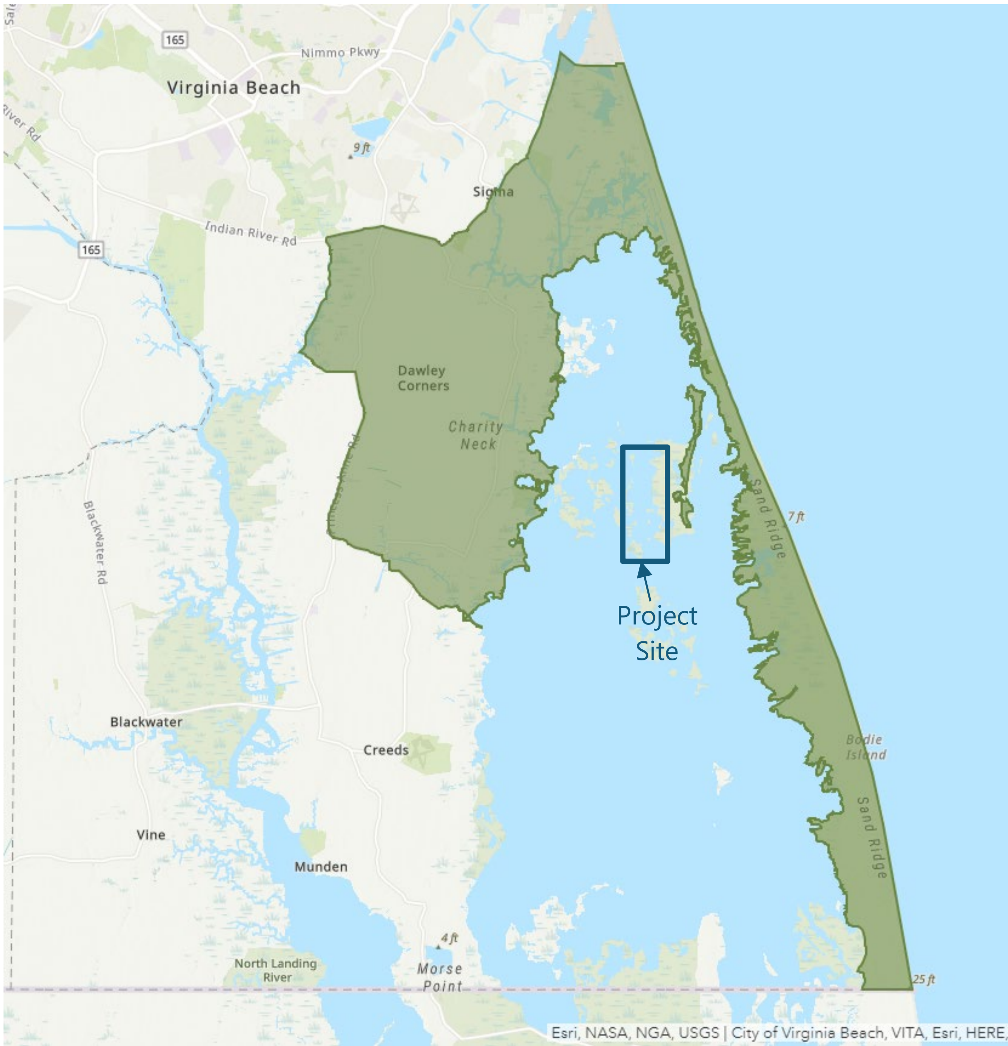

Figure 14: Census block groups selected for population estimates.

Historic Flooding Data and Hydrologic Studies Projecting Flood Frequency

Historical and Existing Flood Data

The project is located within a Federal Emergency Management Agency (FEMA) mapped Special Flood Hazard Area (SFHA), as shown in Figure 15 and Figure 16. Based on the City's current flood maps (effective January 16, 2015), the project site's flood zones are VE, AE, and Open Water. Portions of the site are within Otherwise Protected areas.

The following maps provide an overview of the existing flood hazards for the project area, including the northern boundary (Figure 15) and southern boundary (Figure 16). Based on the City's current flood maps (effective January 16, 2015), the project site contains VE and AE flood zones and Open Water.

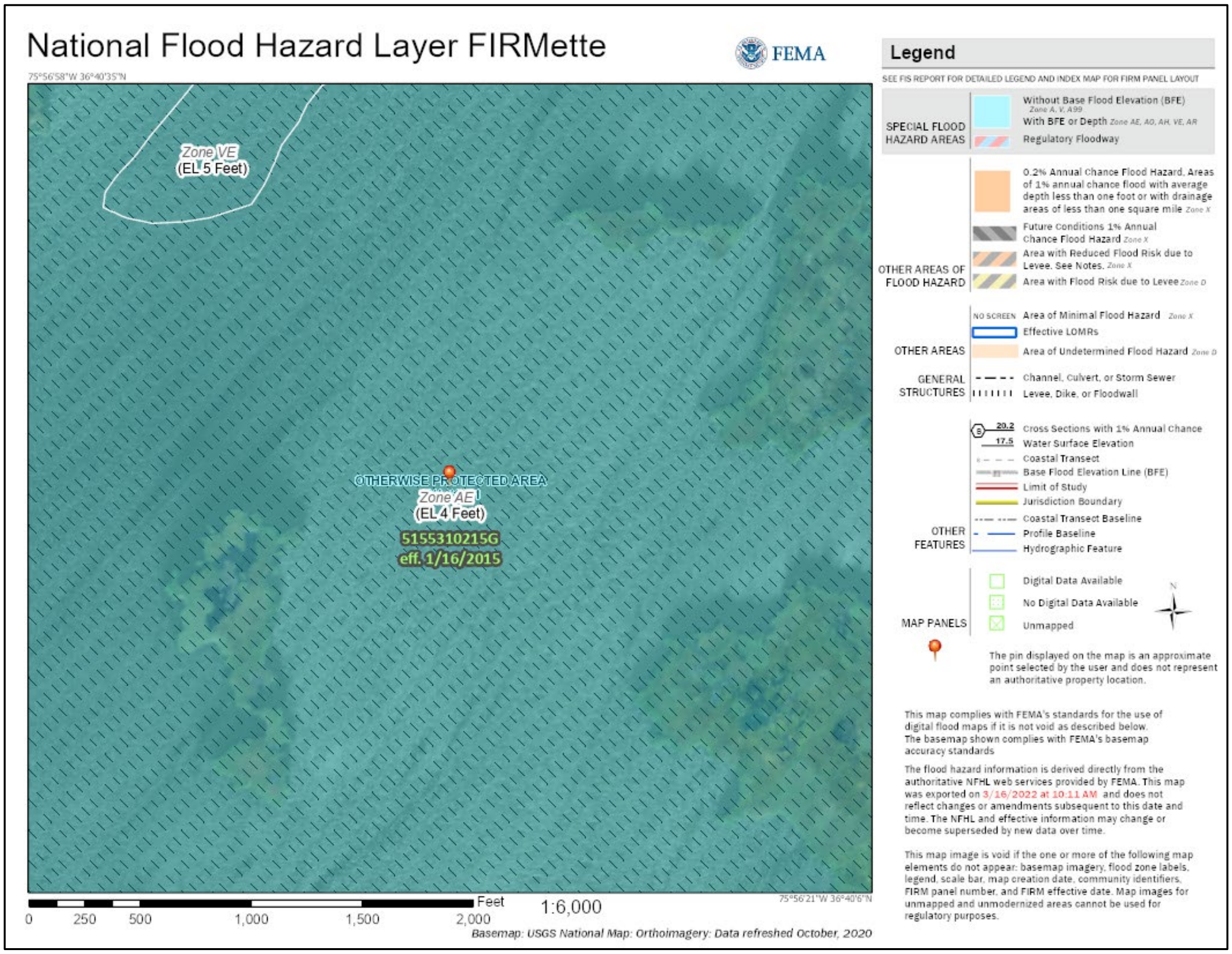

Figure 15: FIRMette for the project area (northern boundary).

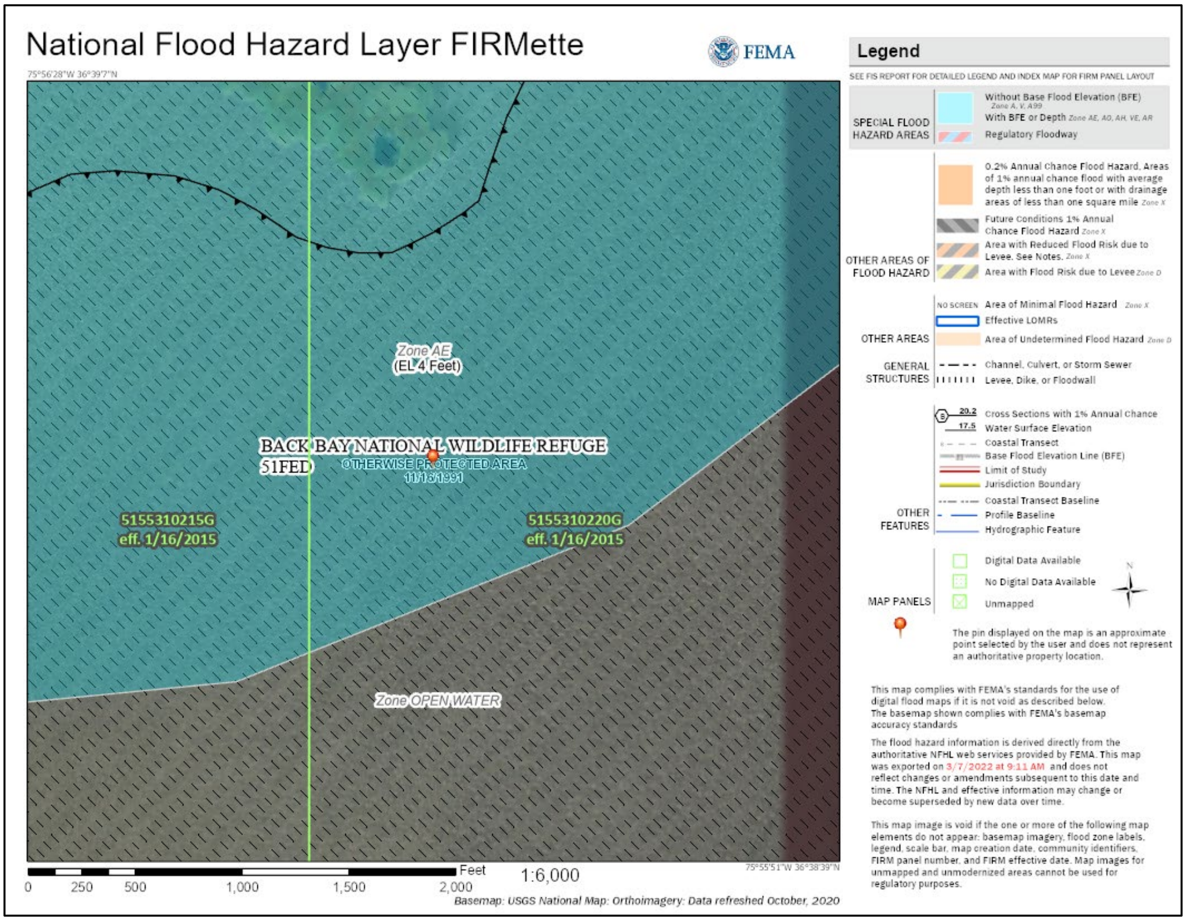

Figure 16: FIRMette for the project area (southern boundary).

The City maintains records of where residents report flood issues and what type of flooding is causing the issue. Residents regularly report flood issues through a hotline, which are then recorded in a flood event database. The census block groups adjacent to the project area reported 111 flood issues associated with heavy rain or high tide between 2001 and 2019. Critical facilities and flood incidences are relatively concentrated in the Sandbridge Resort Area.

Projected Flood Frequency

The USFWS, the City, and other stakeholders have made significant investments in detailed assessments, sophisticated computer models, and water level gauges to better understand historical and future wind tide flooding. Figure 17 displays the projected flood pathways under the 10-year and 100-year storm event under a 3 feet sea level rise scenario surrounding the project site.

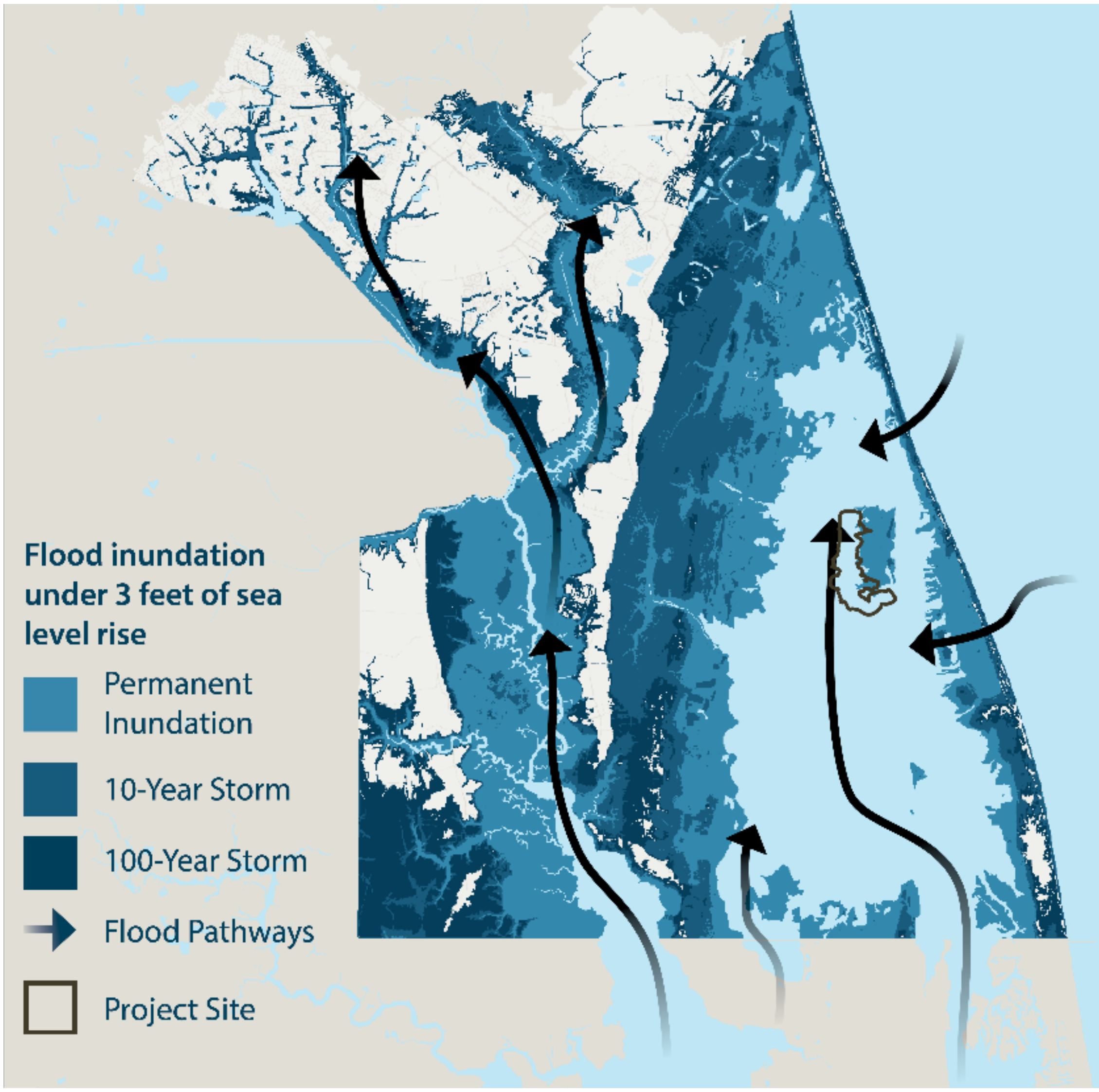

Figure 17: Flood pathways into the Southern Rivers Watershed with 3 feet of sea level rise.

Numerical modeling also shows that as sea levels continue to rise, a shorter duration wind event will produce more wind-induced flooding in less time. The three lines in Figure 18 represent the water level response to a sustained 15-mph wind for each sea level rise scenario. With the existing marsh system today (blue line), it takes approximately five days of sustained southerly wind to cause flooding. With 1.5 feet (yellow line) and 3 feet (red line) of sea level rise, the peak water level could be reached two to three days sooner, respectively. Model simulations showed that marsh island creation across Back Bay would help delay the onset of flooding by several days, which would allow the City and residents more preparation time[7].

[7] City of Virginia Beach. (2018). Analysis of Marsh Response to Sea Level Rise (PDF).

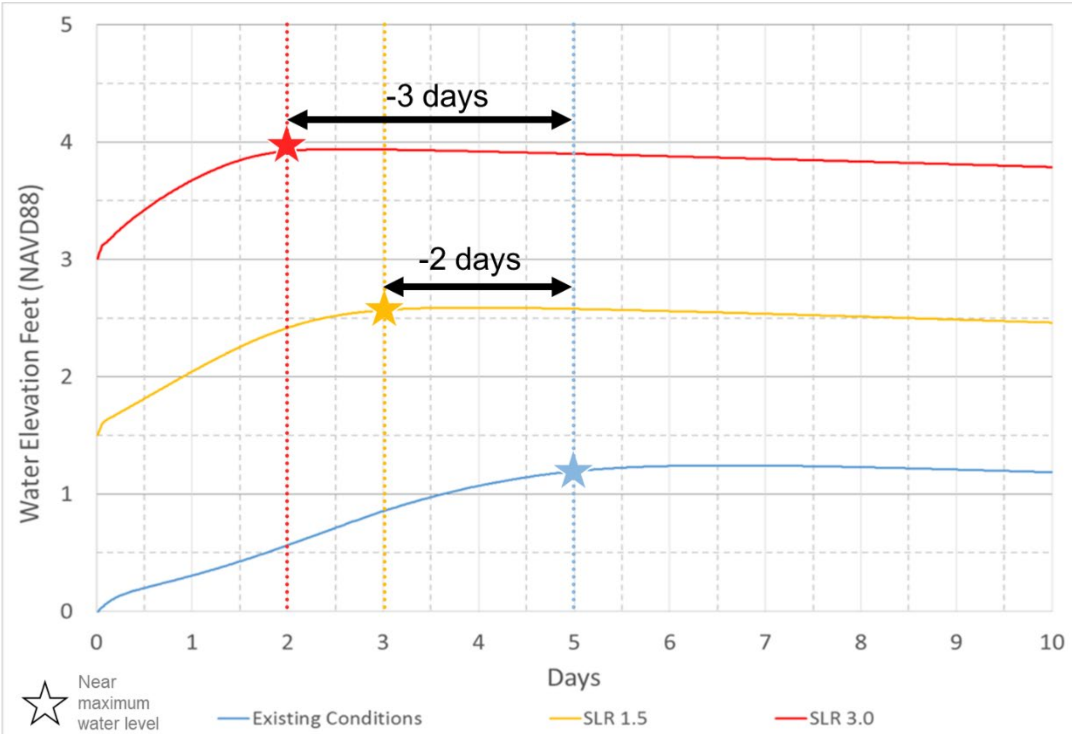

Figure 18: Water-level response under sustained 15-mph southerly wind.

The City analyzed future marsh conditions using the Sea Level Affecting Marshes Model (SLAMM).[7] Figure 19 illustrates areas likely to experience accelerated degradation of marsh in Back Bay due to rising water levels. If no action is taken, substantial marsh loss is projected in Bonney Cove under 3 feet of sea level rise. Within a 1-mile radius of Bonney Cove, the City's SLAMM model predicts that approximately 730 additional acres could be eroded into open water in response to sea level rise. This represents more than a 70% reduction as compared to the existing marsh system surrounding Bonney Cove today. It is also presumed that open water areas would continue to experience high levels of turbidity, which will continue to negatively affect SAV communities in Back Bay.

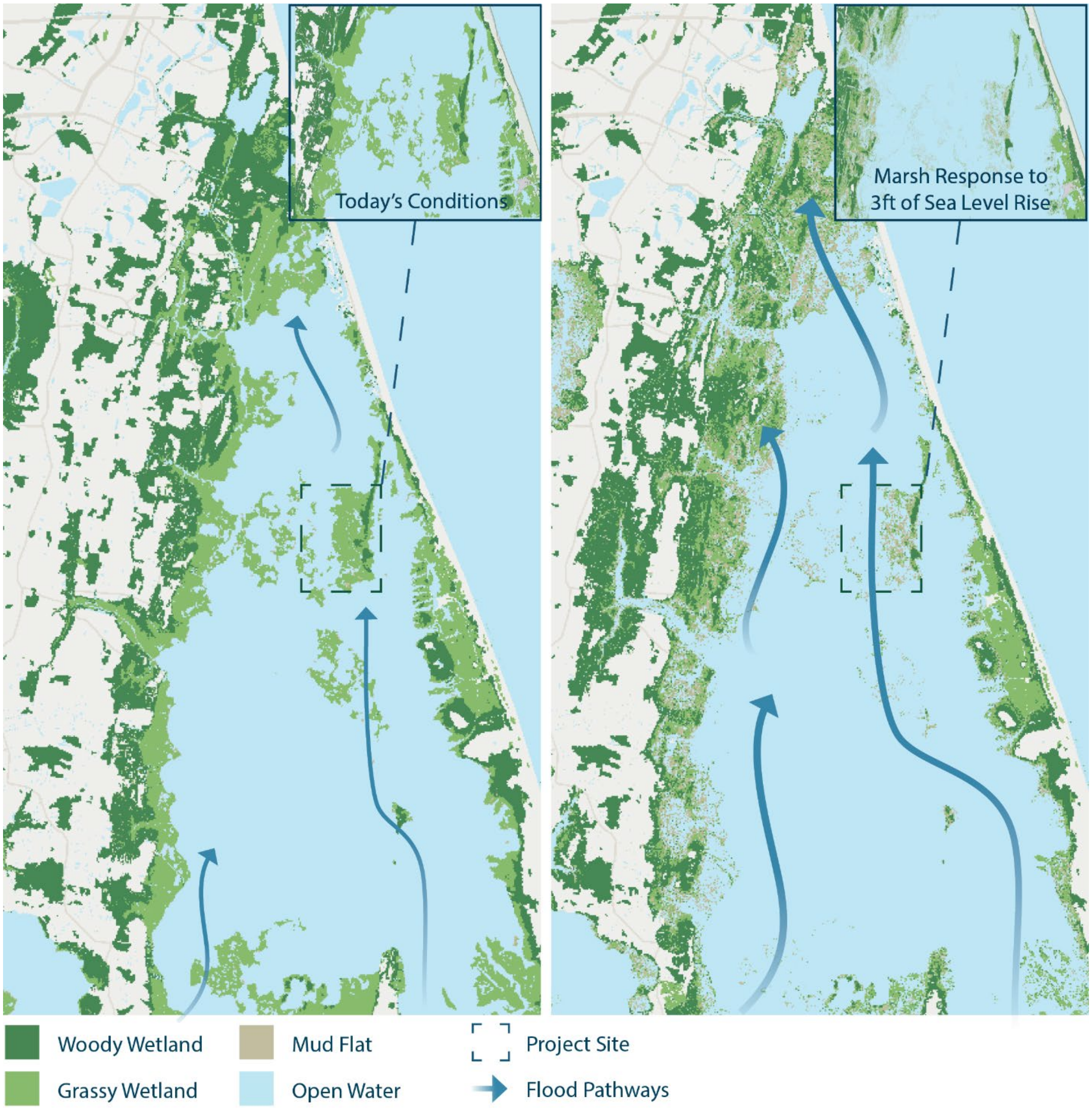

Figure 19: Comparison of current marsh conditions to future marsh conditions with 3 feet of sea level rise.

The proposed project site in Bonney Cove has a predominant south-southwest wind direction, which contributes to significant wave generation in the large unobstructed open-water areas and provides a continuous source of scouring and erosion in those areas. Marsh loss is likely to continue in the project area, creating a negative feedback cycle as continued fragmentation of the marsh would further deteriorate the remaining stands of healthy marsh and increase fetch. Today, the site faces low to medium fetch exposure, but in the future, the site could experience high to very high fetch exposure, as defined by the Virginia Institute of Marine Science (VIMS)

Shoreline Design Guidelines for Shore Protection in Virginia's Estuarine Environments.[8] Projections of increasing fetch at the site, along with the transects used for the wind fetch analysis, are summarized in Figure 20.

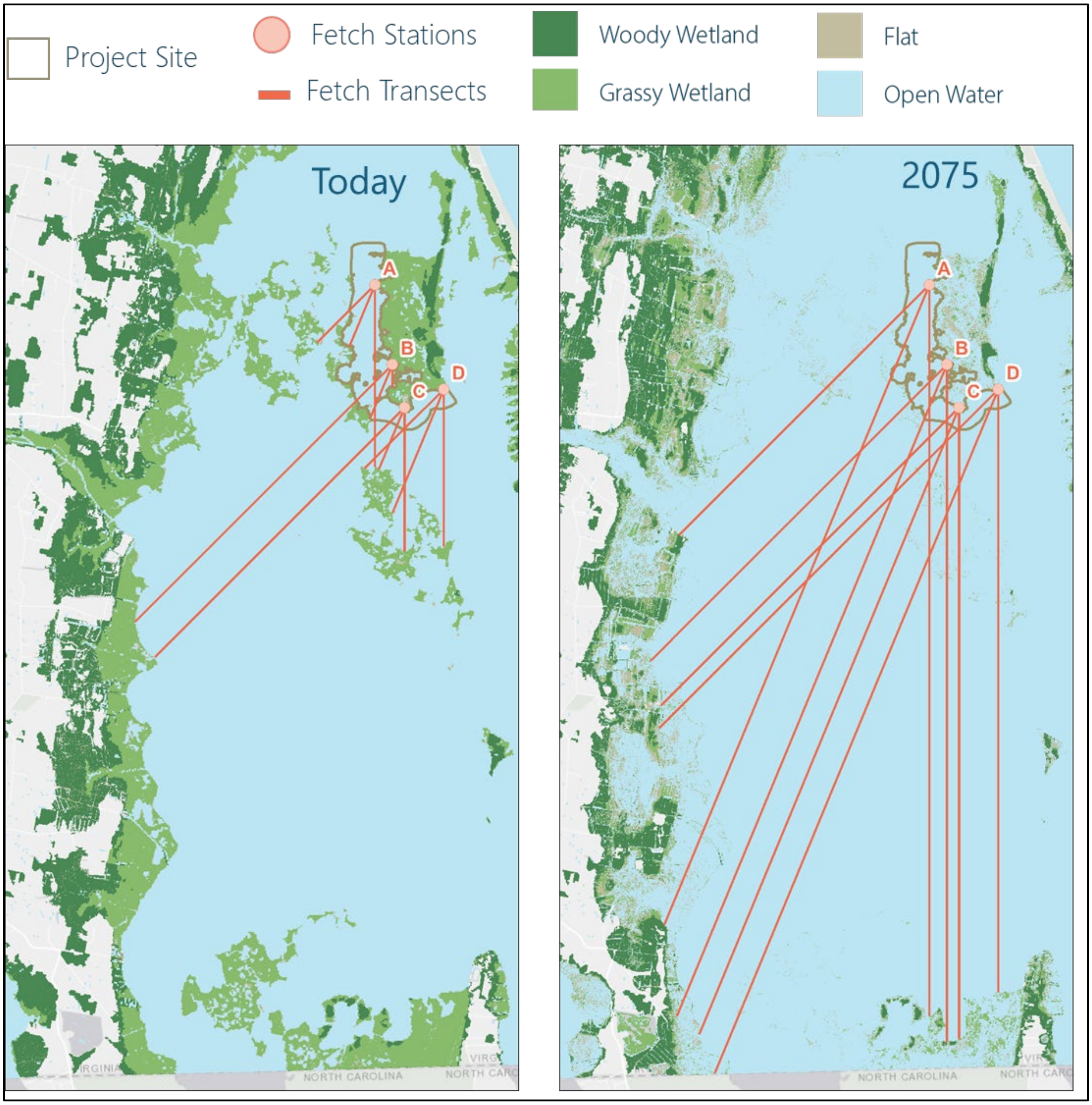

Figure 20: Wind fetch analysis of project area.

The following table displays specific values of fetch distances and classifications that correspond with the transects displayed in Figure 20 above.

[8] Virginia Institute of Marine Science. (2010). Living Shoreline Design Guidelines for Shore Protection in Virginia's Estuarine Environments; Version 1.2 (PDF).

Table 5: Measurements of fetch transects referenced in Figure 20.

Fetch Transect	Length, Miles (Today)	Classification	Length, Miles (3 feet SLR)	Classification
A-SW	0.9	Low	3.7	High
A-SSW	0.7	Low	7.3	Very High
A-S	1.9	Medium	7.7	Very High
B-SW	3.8	Medium	4.4	High
B-SSW	0.6	Low	7.4	Very High
B-S	0.2	Very Low	7.2	Very High
C-SW	3.7	Medium	4.4	High
C-SSW	0.7	Low	7.2	Very High
C-S	1.5	Medium	6.7	Very High
D-SW	1.2	Medium	5.1	Very High
D-SSW	1.4	Medium	7.8	Very High
D-S	1.7	Medium	6.4	Very High

No Adverse Impact

The City conducted additional hydraulic numerical modeling to identify any potential adverse impacts in response to concerns raised during a public meeting in July 2023. The City utilized a Danish Hydraulic Institute MIKE FLOOD model developed for stormwater master planning activities in Lower Southern Rivers Watershed of Virginia Beach. This model encompasses the entirety of Back Bay and extends into North Carolina's Currituck Sound. Model performance has been validated against observations from multiple flood events.

The effort looked at water level and velocities in response to a historical southerly wind tide flood in May 2017 and a northerly wind event associated with Tropical Storm Ophelia in September 2022. These events were ran with model grids depicting with- and without project conditions, considering the 100% project design specifications. The northerly wind event was

included to address concerns from residents of Knott's Island, at the southern end of Back Bay. Both the terrace field and the construction staging area were included in the with-project condition. The modeling found that there were no increases in water levels to areas within Back Bay or to Knotts Island. Negligible changes in water velocity (0.2 ft/s or less) were observed in the channel to the west of the terrace field. No increases in water levels were observed in the area of the construction staging area.

Local Government to Provide its Share of the Cost

The City of Virginia Beach is fully prepared to cover the cost share of the proposed project, as highlighted in the attached budget narrative, "Amount of Cash Funds Available." The funding for the grant match is contained within the City budget.

Benefit-Cost Analysis

FEMA recognizes the economic value of restoration projects and has provided ecosystem service economic valuations for benefit cost considerations. The approach and values used here are consistent with FEMA Benefit-Cost-Assessment (BCA) toolkit approaches and ecosystem service valuations published in "FEMA Ecosystem Service Value Updates, June 2022[9]." The 2022 FEMA guidance provides methods and values for various nature-based projects, including coastal wetlands. The valuations recognize ecosystem services for coastal wetlands including aesthetic value, climate regulation (carbon sequestration), flood and storm hazard reduction, habitat, recreation/tourism, water filtration and supply benefits of coastal wetland features.

Feasibility and Effectives Criteria

The project meets FEMA's Feasibility and Effectives Criteria for a Coastal Wetland as defined in the 2022 guidance, including:

- Land cover associated with the project is a "Estuarine and Marine Wetland" as classified for NWI for remaining marsh within and adjacent to the study area. The area of the project is also a historical marsh.
- The project demonstrates "ecosystem restoration" by using the terrace approach to recover degraded, damaged, and destroyed wetlands and submerged aquatic vegetation in the Back Bay ecosystem.
- The project meetings EPA concepts of restoration through direct creation of marshes (the terraces themselves) and enhancement of the ecosystem (reduction of water turbidity to enhance growth of submerged aquatic vegetation).
- The project will result in notable increased health and function of the local ecosystem in the "after mitigation" scenario through reduction of wave heights, water flow, and significantly decreased turbidity within the project area, as well as reduction of wave heights to adjacent areas.

[9] FEMA Ecosystem Service Value Updates, June 2022 (PDF).

- The project approach was aligned with established principles and techniques on wetland restoration, as outlined in the Coastal Wetlands and Tidal Flats section of the International Guidelines on Natural and Nature-base Features for Flood Risk Management10.

Design Life

As mentioned, the project useful life is 30-years. The FEMA 2022 guidance allows 50-years a typical lifespan; however, as stated in the project description, the elevation of the terraces was set based on a 30-year design life and estimated settlement.

Ecosystem Services Valuation

- The 2022 guidance values ecosystem services for coastal wetlands at $8,955 in 2021 U.S. dollars (USD), per acre, per year.
- The project will restore 46.5 acres of intertidal and upland marsh through direct creation of the marsh terraces. The project will also promote the growth of SAV in between the terraces, an area estimated at 310 acres. This provide for a total project benefit area of (46.5 + 310) = 356.5 acres.
- Project benefits occur over a period of time into the future; while most of the project costs are incurred up front and in the present. FEMA conducts its BCAs on a net present value basis, meaning the present value of the benefits gained from the project over the life of the project are compared to the total project cost to establish the BCR. Because project benefits accumulate over time, project benefits are calculated on an average annual basis ("annualized") and then multiplied by a Present Value Coefficient (PVC) to determine the present value of the annualized benefits.
- The present value coefficient is calculate as follows:

$$PVC = \left[\frac{1-(1-r)^{-T}}{r}\right]$$

  where *r* is the discount rate and *T* is the useful life of the project. The CFPF 2023 Grant Manual does not specify a discount rate for the benefits calculation; therefore, the latest FEMA program grant guidance was reviewed. For the 2023 FEMA Building Resilient Infrastructure and Communities (BRIC) and Floodplain Mitigation Assistance Grant Program (FMA) cycles FEMA has established a set discount rate of 3%[11]. The 3% discount rate provides for a PVC of 19.60 for a 30-year lifecycle for the project.
- Project benefits were calculated by:

$$Benefits = PVC \times Project\ Area \times Coastal\ Wetland\ Benefits$$

- The benefit cost ratio (BCR) was calculated as:

[10] International Guidelines on Natural and Nature-Based Features for Flood Risk Management - Engineering With Nature (dren.mil)

[11] FEMA Fact Sheet. Notice of Funding Opportunity for Fiscal Year 2023 Building Resilient Infrastructure and Communities Program (PDF).

$$BCR = \frac{Benefits}{Costs}.$$

A summary of the calculated values is provided in the below table:

Table 6. Summary of BCA parameters and results.

Project Area	Benefits (acre / year, 2021 USD)	Project Lifespan	Benefits, 3% discount rate	Project Cost	BCR, 3% discount rate
356.5	8,954	30	$62,566,588	$53,378,490	1.17

The calculated BCR for the project was 1.17, based on the FEMA ecosystem services valuation approach. This BCR is greater than 1, indicating the project can be considered cost-effective. The project also provides an additional $9.19M in value over the project cost.

Local Floodplain Management Regulations

The City recognizes the vital importance of floodplains in the natural movement of water through the community. Appendix K of the Virginia Beach Code of Ordinances regulates development in the community's floodplains. The City requires that a permit is obtained for any construction or development in the Special Flood Hazard Area. For more information and details regarding the City's floodplain management and ordinances, please refer to the following:

- Link to current floodplain ordinance: Virginia Beach Floodplain Ordinance.

In addition, a copy of the current floodplain ordinance has been included in *Part IV, Section E5*. For further information regarding the City's hazard mitigation and comprehensive planning, please refer to the following:

- Link to current hazard mitigation plan: Regional Hazard Mitigation Planning.
- Link to current comprehensive plan: Virginia Beach Comprehensive Planning.

Other Necessary Information to Establish Project Priority

Repetitive Loss and/or Severe Repetitive Loss Properties

The repetitive loss database shows 113 repetitive loss and severe repetitive loss properties within the two census block groups (518100454.121 and 518100464.001) associated with the project area.

Residential and/or Commercial Structures

A detailed economic flood loss assessment presented in the City's Resilience Plan showed that approximately 45% of the entire future risk exposure in the City is concentrated in the Southern Rivers watershed. Of that risk, 65% is concentrated in three communities north of Back Bay

(Figure 21).[12] Under a "no action" scenario, average annualized flood losses would increase from $974 thousand, representing present day conditions, to $6 million with 1.5 feet of sea level rise as anticipated by 2050. This figure equals an increase of six times present day conditions. With 3 feet of sea level rise as anticipated by 2080, annualized losses are expected to drastically increase to $80 million, more than 80 times today's conditions.

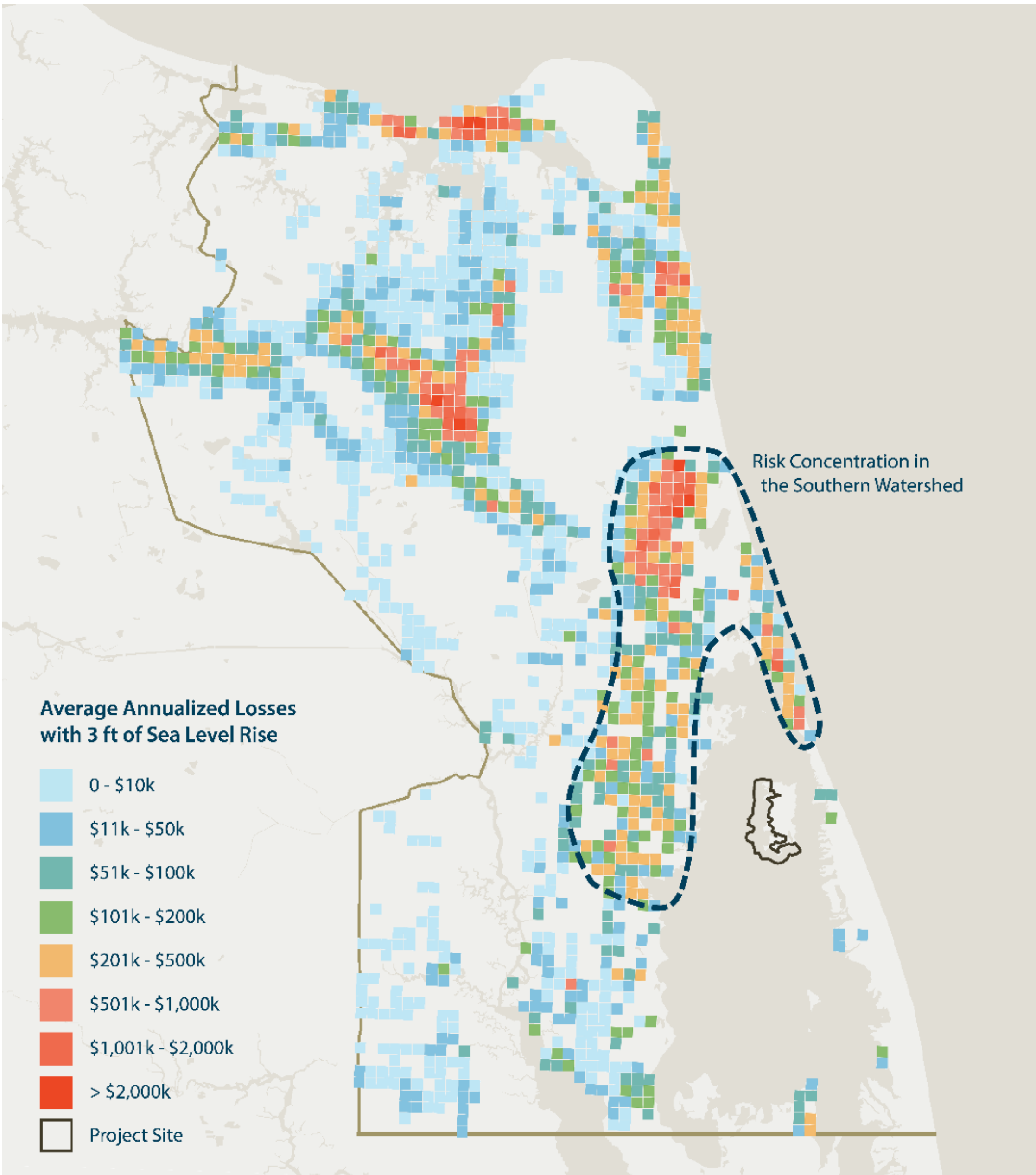

Figure 21: Concentration of average annualized losses estimated with 3 feet of sea level rise under a "no action" scenario presented in the City's Resilience Plan.

[12] City of Virginia Beach. (2020). Coastal Flooding and Economic Loss Analysis (PDF).

Within the two census block groups adjacent to Back Bay near the project area, there are approximately 70 commercial structures and 2,350 residential structures. Of those structures, approximately 635 structures are vulnerable to flooding during a 50-year event today. With 3 feet of sea level rise, approximately 2,060 structures are expected to be vulnerable during a 50-year event, representing approximately 85% of the residential structures within the project vicinity. These numbers underscore the importance of implementing the proposed project alongside complimentary flood risk reduction projects.

Critical Facilities

The two census block groups near the project site include 10 critical facilities. Table 7 summarizes critical facilities by type, total number, and the number of facilities exposed to the 50-year storm scenario under current and future "no action" scenarios. Under current 50-year storm conditions, 2 communication facilities and 1 electric power station would be exposed to flooding. With 3 feet of sea level rise, the number of critical facilities exposed to flooding increases to 9 total facilities.

Table 7: Summary of critical facilities located in the selected census block groups and flood hazard exposure to the 50-year storm event under current conditions and with 1.5 feet and 3 feet of sea level rise.

Type of Facility	Number of Facilities	Current 50-year storm	50-year storm with 1.5 feet sea level rise	50-year storm with 3 feet sea level rise
Communication	3	2 (66%)	2 (66%)	3 (100%)
Electric Power	1	1 (100%)	1 (100%)	1 (100%)
Fire Station	1	0	0	0
Potable Water	2	0	2 (100%)	2 (100%)
School	1	0	0	1 (100%)
Wastewater Treatment	2	0	0	2 (100%)

Need for Assistance

The City of Virginia Beach has invested significant time, money, and staff resources in understanding, communicating, and planning for the threats of sea level rise and recurrent flooding to the community. The City is ready to begin the implementation of adaptation measures, and the marsh terrace project is the first project to advance to construction from the City's Resilience Plan. The project represents the first step in restoring Back Bay and the larger Albemarle-Pamlico estuary, and serves as a pilot for additional restoration projects. Virginia Beach understands that flood mitigation costs are substantial and is seeking funds to support project implementation alongside dedicated resources procured by the City. The City's

Department of Public Works Stormwater Engineering Center has closely coordinated with the City's Department of Planning & Community Development throughout the design and permitting process. The Department of Public Works will oversee the construction of the marsh terrace project, including providing construction inspectors to monitor that the project is built to the City's design standards and technical specifications. Additionally, the City has access to necessary software, including AutoCAD and ArcGIS Desktop, and support from consultants to augment the City's technical capabilities.

Examples of City staff who will support the project include the following:

- Program Manager for the Technical Services Division of the Stormwater Engineering Center.
- Project Manager for Green Infrastructure Projects for the Technical Services Division of the Stormwater Engineering Center.
- Environmental Planner / Certified Floodplain Manager from the Wetlands & Shoreline Construction Team of the Planning Administration Division of the Department of Planning & Community Development.
- Planning Evaluation Coordinator from the Chesapeake Bay Preservation Area & Southern Rivers Watershed Team of the Planning Administration Division of the Department of Planning & Community Development.
- Full-time Construction Inspector assigned exclusively to this project from the City's Construction Bureau or under contract with the City Public Works Engineering Division.
- Grant Coordinator from the City's Public Works Engineering Division.

Additional staffing will be provided as needed to ensure project success.

This project benefits communities in northern Back Bay with a high concentration of flood losses (as shown in Figure 21). These communities contribute significantly to Virginia Beach's rural economy, including agriculture, forestry, fishing, hunting, and eco-tourism. In Hampton Roads, these industries contribute a combined $100 million in gross domestic product.[13] Protection of vulnerable natural infrastructure, such as the marshes in Back Bay, is critical to ensuring these industries can continue to thrive within the region.

Alternatives

Several other alternatives were considered but not advanced due to technical and environmental limitations. These alternatives are briefly summarized below.

[13] Office of Governor Ralph S. Northam Commonwealth of Virginia and Virginia Department of Conservation and Recreation. (2021). Virginia Coastal Resilience Master Plan Phase 1 (PDF); data referenced sourced from the US Bureau of Economic Analysis. (2019).

Alternative 1 - No Action Alternative

Under this alternative, no action would be taken to restore marsh habitat in the shallow open water channel of Bonney Cove. Erosion of the adjacent marsh would continue to occur, resulting in fragmented habitat lacking the capacity to reduce wave action and slow water velocities. It is anticipated that wind-driven flooding events will continue to increase in frequency, resulting in increasing flooding of the low-lying properties and roadways surrounding northern Back Bay.

Alternative 2 - Alternative Terrace Configuration Design(s)

Several configuration alternatives for the terraces were considered during the design process. These included four alternative layouts with different spacing and terrace top widths:

- **Alternative 2a** (Figure 22): Terraces would be spaced at approximately 300-foot intervals and have a top width of 15 feet. Between the base of the terraces, there would be approximately 220 feet for potential establishment of SAV habitat.
- **Alternative 2b** (Figure 23): Terraces would be spaced at approximately 300-foot intervals and have a top width of 30 feet. Between the base of the terraces, there would be approximately 200 feet for potential establishment of SAV habitat.
- **Alternative 2c** (Figure 24): Terraces would be spaced at approximately 600-foot intervals and have a top width of 15 feet. Between the base of the terraces, there would be approximately 520 feet for potential establishment of SAV habitat.
- **Alternative 2d** (Figure 25): Terraces would be spaced at approximately 600-foot intervals and have a top width of 30 feet. Between the base of the terraces, there would be approximately 500 feet for potential establishment of SAV habitat.

A common feature across all of these design alternatives was a breakwater that spanned the entire length of the southern extent of Long Island and a northern breakwater that spanned the northern exposed section of the project site.
Alternative 2a and 2b were eliminated due to constructability concerns regarding the quantity of sediment that would be required and due to the limited amount of room for SAV establishment in between the terraces (approximately 220- and 200- feet of potential SAV habitat between terraces for Alternative 2a and 2b, respectively).

Alternatives 2c and 2d were discussed extensively amongst the project team; however, it was ultimately determined that they did not maximize the opportunity for species diversity (by including both smaller and larger terraces). These alternatives were combined to form the preferred alternative presented in this document. Additional refinements that were made to these alternatives include the removal of the perimeter breakwater, as the proposed design elevation evaluated in the geotechnical analysis revealed stability issues with these large features.

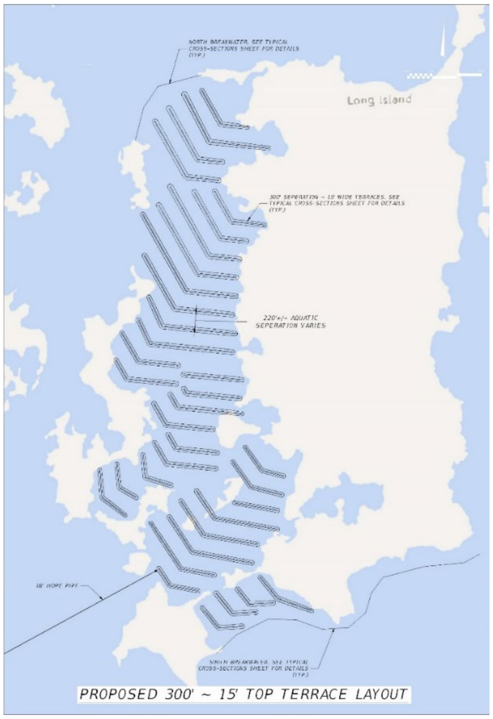

Figure 22: Alternative 2a.

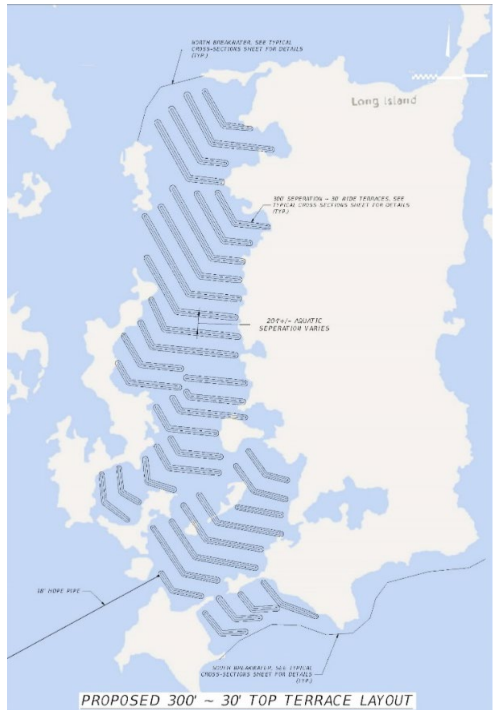

Figure 23: Alternative 2b.

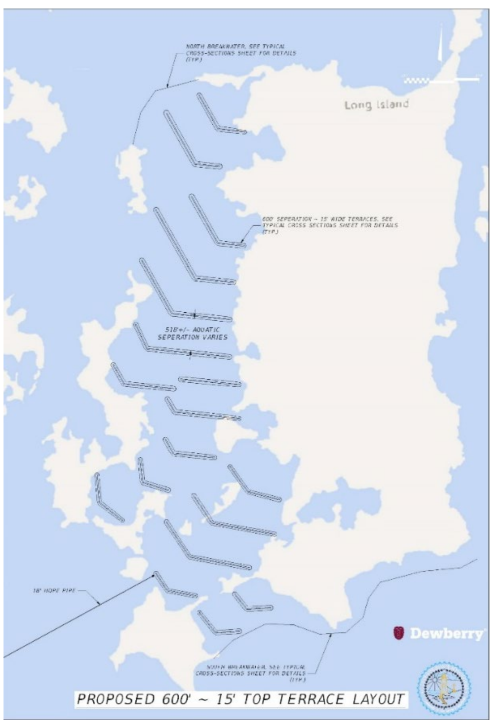

Figure 24: Alternative 2c.

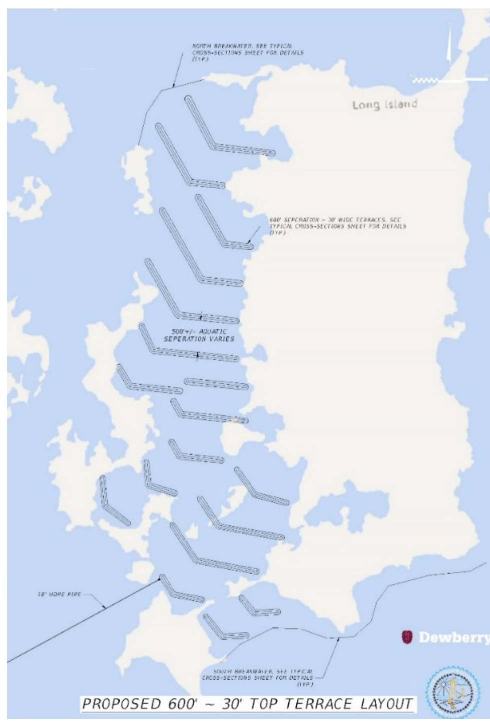

Figure 25: Alternative 2d.

Alternative Terrace Core Material Sources and Transportation – Alternative 3

In the proposed alternative with sand cores, a no-dredging alternative was considered. However, in order to successfully complete the project and establish the vegetation desired, material would need to be sourced, blended, transported, and placed. The City helped identify two potential borrow sources of material: Bow Creek Golf Course (Figure 26) and the Whitehurst Dredged Material Management Area (DMMA) (Figure 27).

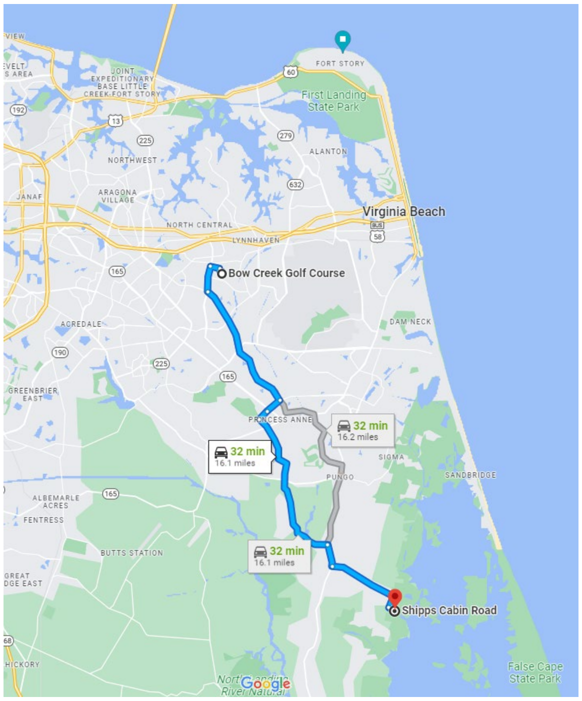

Figure 26: Distance from Bow Creek Golf Course to the proposed Shipps Cabin staging area.

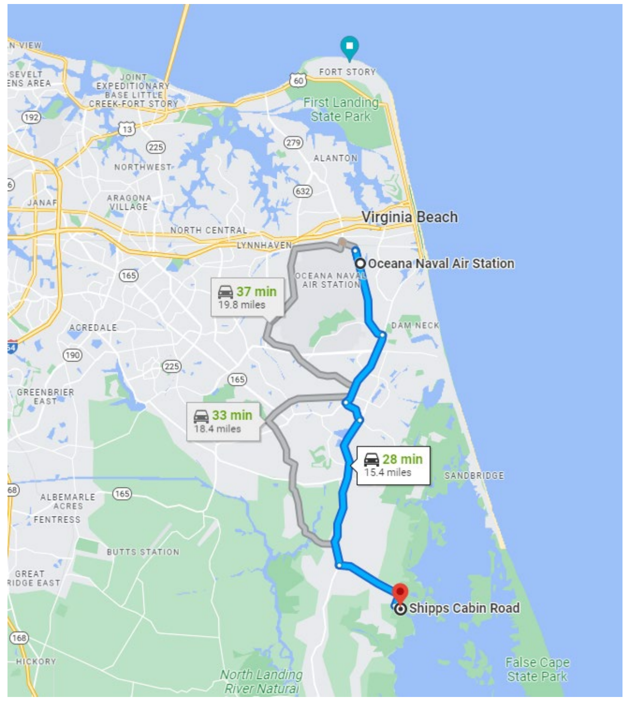

Figure 27: Distance from Whitehurst DMMA to the proposed Shipps Cabin staging area.

Bow Creek Golf Course: Bow Creek Golf Course is located approximately 16 miles from the proposed Shipps Cabin staging area. In the next few years, The Bow Creek Golf Course is scheduled to be converted into a Stormwater Park as one of 21 projects funded by the City's Stormwater Flood Protection Program. Large quantities of materials will be removed from the site for use within the City. The material from Bow Creek would need to be excavated, screened, and tested for foreign seeds and contaminants. Most likely, this material would have to be processed before it could be loaded again on dump trucks and hauled approximately 16 miles to a potential staging area where it would be loaded again on shallow draft barges.

Whitehurst DMMA: The Whitehurst DMMA is a similar distance to the proposed Shipps Cabin Road Construction Staging Area. The material at Whitehurst may not have to be processed as much; however, it would need to be tested for foreign seeds and contaminants. Because of the organic components in this soil and the need for the material to establish vegetation on the terraces, this material is not able to be hydraulically blended and pumped to the site. Therefore, this material would need to be loaded on shallow draft barges and then

placed by mechanical means. Further, the amount of material needed to cap the proposed terraces is approximately 110,000 cubic yards which equates to roughly 5,500 quad-axle dump trucks traveling city streets and damaging other infrastructure.

Barging of all materials was considered. Dewberry conducted meetings, site investigations, and talked with both industry leaders in maritime construction and locals who know the water in Back Bay. A typical 35-foot by 95-foot construction barge drafts approximately 7 feet. This type of barge is not able to be trucked to the landing site, nor is it able to be brought into Back Bay. There are truckable barges, but again the drafts of those barges can be in the 4 to 5 feet range when loaded and would require dredging a channel for access. Shallow draft barges can be used in Back Bay that only draft 1 to 3 feet, and they would need to be off-loaded from a staging site. To bring any materials such as stone, sandy fill, or terrace cap material by barge around Knotts Island is not feasible. The actual channel into the southern point of Back Bay has a height restriction due to the causeway serving Knotts Island.

Continuous Marsh Platform – Alternative 4

A continuous marsh platform to fill in the areas of historical marsh would help to restore this eroded habitat but would not provide conditions suitable for SAV establishment or optimize the wave/flow velocity attenuation through the project area. Furthermore, for a single marsh platform across Bonney Cove, the amount of material required would be more than 3 or 4 million cubic yards of material. To achieve that volume of material by dredging, significant areas of existing SAV present in Back Bay would need to be impacted. As the geotechnical report indicated, the existing material of the project site and surrounding areas is not capable of supporting itself in a constructed arrangement and would slough off back into the water. Further, providing this amount of material without dredging would require bringing external sediment sources into Back Bay, which could introduce invasive species. Finally, while the platform will reclaim marshland, it is not anticipated to establish extensive areas appropriate for SAV reestablishment and would eliminate deeper water areas preferred by some endemic wildlife species.

Goals and Objectives

The overarching goal of this project is to construct the City's first nature-based adaptation project in the Southern Rivers Watershed and one of the CRMP's exemplary nature-based projects. This project aims to stabilize two critically eroding marsh islands from further degradation, decrease turbidity to promote the growth of aquatic vegetation and provide flood risk reduction benefits through increased friction and wave attenuation. The following section summarizes the objectives through which this goal will be realized.

Objective 1 – Create a Construction Access and Staging Area

The project's first objective is to employ a construction approach that is compatible with the shallow nature of Back Bay and the large quantity of material required to build the marsh terraces. The engineering team performed a constructability review of suitable landing sites to

stage construction operations for the terraces. A property located at the end of Shipps Cabin Road (Figure 28) was identified as the preferred staging and construction access location for the following reasons:

- Shipps Cabin Road Construction Staging Area Proximity to site (2 miles).
- Shipps Cabin Road Construction Staging Area Proximity to sand borrow sources.
- Shipps Cabin Road between Muddy Creek Road and the Construction Staging Area is in disrepair and was identified as an opportunity to improve the condition of the road as part of the construction activities.

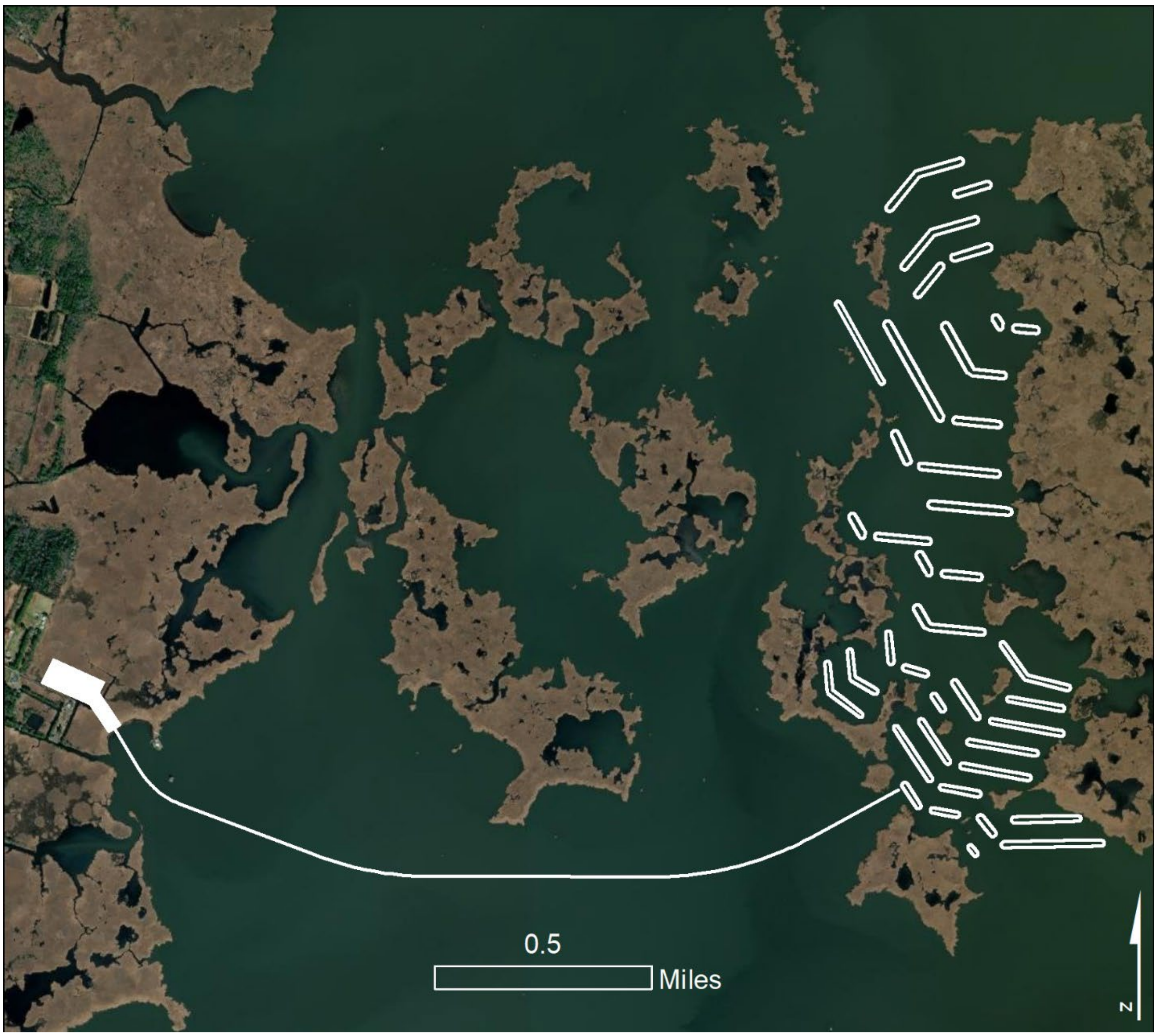

Figure 28: Proposed Construction Access.

On completion of the project, the City plans to retain the staging area for future monitoring and maintenance needs for the project. This future use is consistent with the sentiments of local stakeholders, as communicated during public engagement meetings for the study.

Expected Benefits:

- Enables constructability of the marsh terraces.
- Enable access to the project for post-construction monitoring and future marsh restoration projects.

Objective 2 – Restore Marsh and Aquatic Vegetation

The second objective of the project is to restore marsh and aquatic vegetation for habitat and flood resilience. Specifically, the City's construction of the marsh terraces will result in the restoration of approximately 46 acres of habitat within Back Bay, consisting of:

- 10 acres of low marsh habitat; low marsh plantings would include Big Cordgrass (*Spartina cynosuroides*) and Saltmarsh Cordgrass (*Spartina alterniflora*).
- 6 acres of high marsh habitat; high marsh plantings would include Black Needlerush (*Juncus roemerianus*) and Salt Meadow Hay (*Spartina patens*).
- 14 acres of upland vegetated habitat; upland vegetation would include Arrow-leaf Tearthumb (*Persicaria sagittate*), Groundsel Tree (*Baccharis halimifolia*), Wax Myrtle (*Myrica cerifera*), and Bald Cypress (*Taxodium distichum*).
- 16 acres of submerged terrace habitat anticipated to create suitable conditions for the emergence of SAV.

Additionally, approximately 310 acres of open water SAV habitat would remain between the proposed marsh terraces, and it is anticipated that construction of the terraces would create conditions within the project area favorable to the re-establishment of SAV populations.

Expected Benefits:

- Reduce wave heights, flow velocities, and wind sheer stress within the project area to protect marsh islands from continued erosion.
- Restore the natural buffer that helps protect low-lying neighborhoods and critical access roads from wind-driven flooding.
- Improved water quality by removing excess nutrients.
- Lowered transport of suspended sediment and prevention of resuspension of fine sediments in the water.
- Reduced flow velocity and absorbing wave/wind energy to reduce shoreline erosion.
- Creation of habitat (nursery and feeding areas) for fish (such as Largemouth Bass, Bluegill Yellow Perch, Striped, Blueback Herring, Alewife, and American Eel), migratory waterfowl (such as the Canvasback Duck [*Aythya vallisineria*]), and other aquatic animals.

Objective 3 – Engage Stakeholders and Disseminate Effective Practices

The City is committed to continued meaningful engagement with project partners and external stakeholders throughout the restoration and monitoring phases to ensure transferability to other sites in the region and state.

Expected Benefits:

- Ensure that the lessons from this project can be transferred and scaled to other sites in the state or region.

Approach, Milestones, and Deliverables

The following approach, milestones, and deliverables lay out a plan of action. The milestone schedule follows in *Section B: Milestone Schedule*.

Approach & Deliverables

Activity 1 – Construction Staging Area Preparation and Construction

Activity 1 involves preparing the Shipps Cabin Road property as a construction staging area. Construction activities will include stabilization of the road, laying geotextile to stabilize the ground under the construction staging area, filling with material for the construction staging area, adding fencing, creating bridge abutments and installing a temporary bridge and ramp for waterfront construction access, construction of slurry basins, and establishment of traffic flagging stations.

In the final step, the contractor will install pipe to pump the slurry material from the Shipps Cabin staging area to Bonney Cove. The pipe will be floated with subaqueous tie-downs at channels and certain points of access to maintain boat crossings. Those subaqueous locations will be marked by a buoy every 10 feet and temporary signage as reasonable. The contractor will install two booster stations along the alignment, one approximately half-way between the landing and Bonney Cove, and one at the edge of Bonney Cove. These booster stations will consist of a pontoon-mounted diesel engine pump capable of moving the sand slurry from the construction staging area to the site. It is estimated that 150 CY per hour of sand slurry would be pumped through the pipe in a 60:40 ratio. Additional booster stations may be required for manifolding and supplying slurry stations to individual terraces.

Relevant Objective(s): Objective 1

Deliverables:

- Conduct daily inspections to monitor construction progress of the Shipps Cabin Road Construction Staging Area preparation.

Assumptions:

- It is anticipated that the Shipps Cabin Road Construction Staging Area construction activities can occur simultaneously with material production in Year 1 (2024).

Activity 2 – Marsh Terrace Construction

Once the Shipps Cabin Construction Staging Area preparation is complete, marsh terrace construction activities can commence. The contractor will construct the terraces according to the 100% Final PS&E documents. The most recent engineering designs and design report are available upon request; they are not included as an attachment to this proposal due to file size. Figure 29 shows the overall layout of the terraces, and Figure 30 and Figure 31 show the project renderings. Terrace construction will begin in the northern extent of the project site at Terrace #100, noted in Figure 29, and the contractor will work south towards Terrace #140. The contractor will complete each terrace (including installation of plants) before moving onto the next.

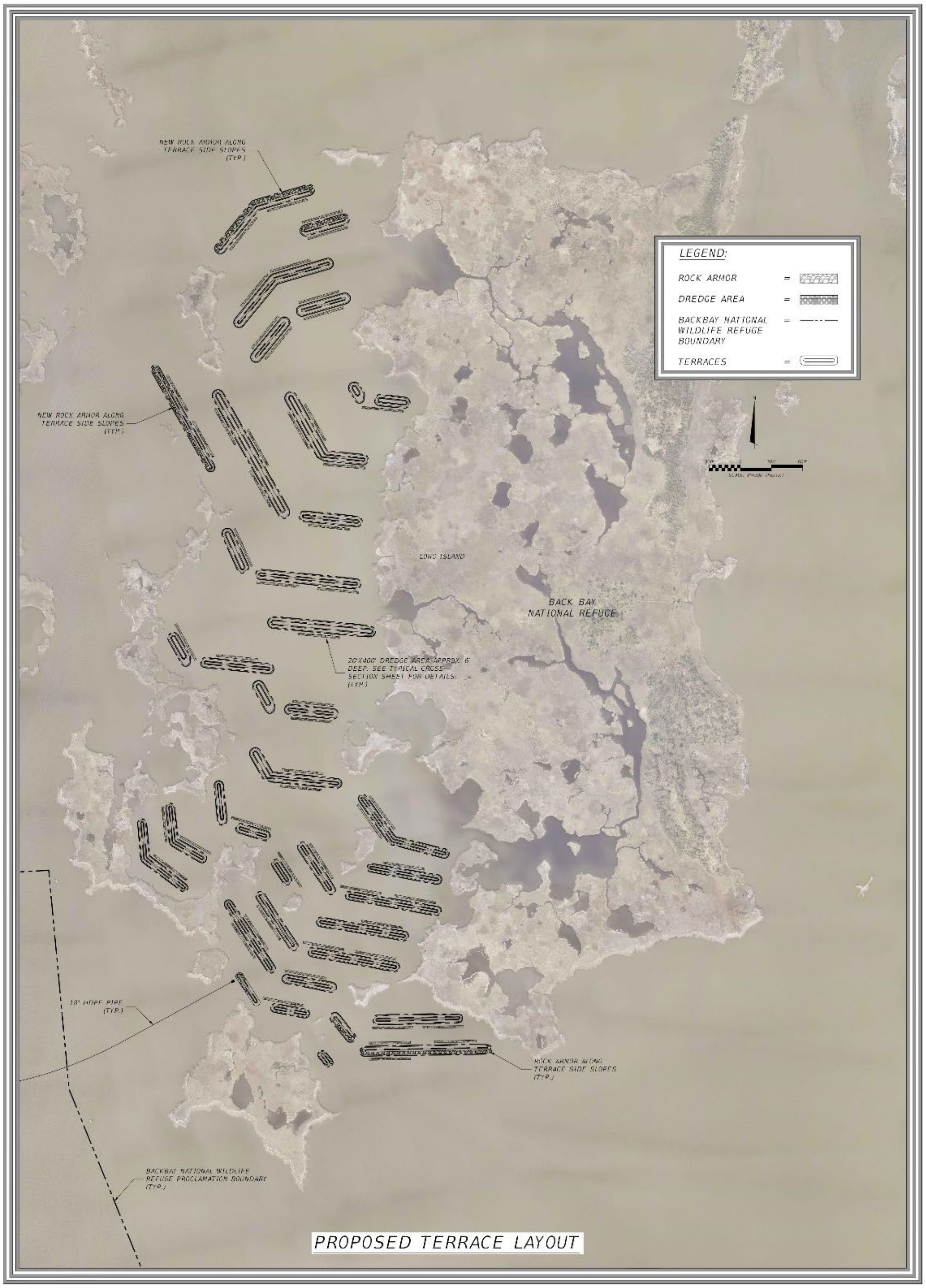

Figure 29: Marsh terrace layout across Bonney Cove.

Figure 30: Marsh terrace design rendering.

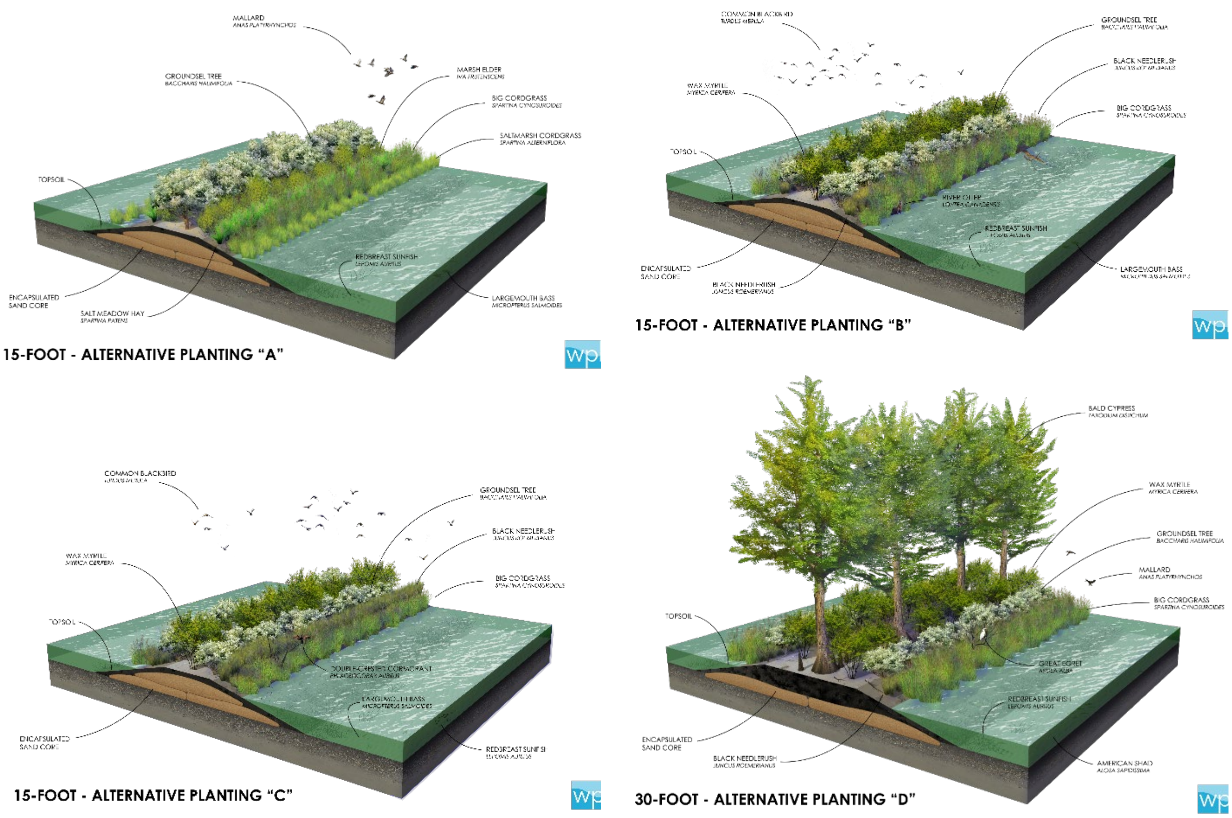

Figure 31: Marsh terrace cross-section design renderings.

The following section provides a high-level description of the proposed design and

construction approach.

Terrace Orientation:

The orientation of the terraces will be perpendicular to the predominant wind direction (south-southwest) to maximize wave energy reduction. The terraces in the northern extent of the project site will be angled perpendicular to a north-northwest wind direction. The terraces would be segmented in a chevron pattern (duck-wing pattern) to provide the most favorable fish and swimming crustacean (termed "nekton") habitat while also allowing adequate circulation to promote sedimentation and maintaining navigability throughout the project area. The terraces would not be connected to the adjacent marsh; this gap, or physical open water barrier, is intended to deter the invasion of Common Reed (*Phragmites australis*) stands from adjacent marshes.

Spacing:

The terraces would be spaced at approximately 300-foot intervals in the northern and southern quarters, and then 600-foot or greater intervals in the center. This arrangement aims to lessen the open water and subsequent wave action at the northern and southern ends of the site and allow adequate construction space for marine-based construction equipment.

Terrace Elevation and Width:

To achieve a sustainable marsh elevation throughout the project life, the marsh terraces would initially be built to a higher elevation during construction and allowed to settle to the desired target elevation over time. Taller terraces improve the functionality and resiliency of the system while also providing diversified habitat for fish and wildlife. The goal is that, by the end of the 30-year design life and with 1.5 feet of relative sea level rise, the terraces will be at or above the elevation of a moderate wind tide event (when Back Bay water levels are anticipated to reach +3.0 feet NAVD88 over the design water level). This threshold was determined to ensure the terraces would not be fully overtopped during a future wind tide event and maintain resiliency to anticipated sea level rise. The 1.5 feet sea level rise scenario is consistent with the near-term planning scenarios identified in the City's Resilience Plan to represent conditions from 2035 to 2050 and adopted by the Hampton Roads Planning District Commission (HRPDC) as part of resolution number 2018-01.

The terraces would have a top width of 15 or 30 feet and be built to an elevation of +4.5 to +5.0 feet NAVD88, depending on the width of the crest, underlying soils, and local bottom depth, with side slopes of 4 horizontal to 1 vertical (4H:1V). The +4.5- to +5.0-foot elevation is calculated based on a target elevation of +3.0 feet NAVD88 or higher at the end of the project's 30-year design life and an estimated settlement of approximately 1 to 2 feet, depending on where the terrace is located. The geotechnical investigation revealed that terraces in the site's southern portion are expected to experience greater settlement than those to the north.

Terrace Composition:

The terraces would consist of a sand-filled core that is encapsulated by a high-strength blend of woven and non-woven geotextile fabrics. The sand for this material will come from nearby offsite sources and be pumped through the 1-inch diameter pipe described in Activity 2. Once the cores are in place, long-reach excavators would travel along the tops of the terraces and begin to shape the cross slopes. Existing adjacent material devoid of SAV would be mechanically dredged and placed over the sand-filled cores. The marsh terraces would be covered with 1 to 3 feet of suitable fill, depending on crest widths, and then planted with native emergent and brackish plant species to stabilize the terraces and provide wind-driven flood reduction benefits.

Relevant Objective(s): Objective 2

Deliverables:

- Conduct daily inspections to monitor construction progress of the marsh terraces.

Assumptions:

- It is anticipated that construction of the terraces will occur in two phases over two years from 2025 through 2026, with the following assumptions:
    - Construction activities are not permitted within BBNWR from October 31 through February 28, annually, to limit disturbance to wintering waterfowl and migration during those months.

Activity 3 – Stakeholder Engagement and Lessons-Learned Dissemination

As the first large scale terracing project on the Atlantic coast, the City recognizes the importance of documenting lessons learned and effective practices during each of the proposed activities: contractor procurement, construction, and post-construction monitoring. The City plans to develop a set of project marketing materials (PowerPoint presentations, StoryMap, information flyers, etc.) to cover key topics, such as:

- Lessons learned during contractor procurement, construction, and post-construction monitoring.
- Effective practices for contractor procurement, bid development, and evaluation. This project is expected to require a highly specialized contractor given the complexity of the project, very shallow water depths, and distance of the site from available construction access and staging areas.
- Guidance for identifying the best sources for local and regional materials for building the terraces and developing a project construction schedule with enough lead time for producing the quantity of material needed for large-scale marsh creation projects.
- Effective practices for developing a post-construction monitoring plan for marsh terraces that a) aligns with permitting, grant, and other requirements and b) enables quantification of project benefits and areas for improvement.

- Effective practices for communicating project benefits based on a combination of field data collection, numerical modeling, and post-construction monitoring.

The City plans to leverage the materials to facilitate dissemination to key stakeholders to increase likelihood of transferability of the approach to other areas in the region and state. The City's plan for engagement is summarized in the following table. In addition to these efforts, the City is committed to collaborating with DCR to identify any additional opportunities to help socialize the project's innovative design and lessons learned.

Table 8: Summary of opportunities for City, regional, state, and national stakeholder engagement; expected benefits.

	Description of Proposed Outreach Activities

CITY	• Facilitate internal municipal awareness, coordination, and approval to gain budgetary approval for funding to expand the approach to other sites in Back Bay (such as "The Great Narrows", Mackay Island and Princess Anne Wildlife Management Areas, and Ragged Island) through presentations to the:
	  o Virginia Beach City Council
	  o City Manager Working Group for SLR and Recurrent Flooding, comprised of representatives from all City departments, to facilitate awareness, coordination, and action to advance the project to the restoration phase.
	• City of Virginia Beach Management Leadership Team (MLT), which includes the City Manager, Deputy City Managers, and Department heads from across the City.

REGION	• Collaborate with the National Audubon Society and Albemarle-Pamlico National Estuarine Partnership (APNEP) to:
	  o Highlight the marsh terrace project as a success story in the next iteration of the Currituck Sound Coalition Marsh Conservation Plan.
	  o Explore opportunities for marsh terrace projects in the Knotts Island Channel, a key flood pathway into Back Bay, as well as other locations in the Currituck and Albemarle-Pamlico Sound.
	• Share lessons learned to regional and state stakeholders, improving knowledge-based, awareness, and capacity for future efforts through presentations to:
	  o Hampton Roads Adaptation Forum – a regional dialogue for academics, non-profits, consultants, and municipalities committed to resilience measures.
	  o The Hampton Roads Planning District Commission (HRPDC) Coastal Resiliency Committee .
	  o Regional conferences on green infrastructure, coastal resilience, and SLR adaptation.
	• Collaborate with Wetlands Watch, a regional non-profit organization committed to the protection of wetlands using nature-based solutions, to socialize the project and disseminate lessons learned.

	Description of Proposed Outreach Activities
STATE	• Continue to coordinate with the Virginia Department of Conservation and Recreation (DCR) to: o Promote the project as a success story for the State Coastal Master Plan (CRMP), which highlighted the project as an "exemplary" resilience project that aligns with the Commonwealth's objective to protect and enhance the state's natural infrastructure. o Incorporate project updates and lessons learned on the CRMP website is an excellent mechanism for dissemination to all coastal Planning District Commissions (PDCs)/Regional Commissions (RCs) across the state. • Continue to collaborate with The Nature Conservancy (TNC), a national player in guiding the implementation of nature-based strategies, to help disseminate lessons learned on project implementation. The City has engaged in early discussions with TNC about partnering to host a state-level workshop that would draw from the network of TNC's local and regional chapters • Presentations at state-level conferences on water resources, floodplain management, and resilience, such as hosted by Resilient Virginia and Virginia Lakes and Watersheds Association.
NATION	• Disseminate lessons learned/effective practices through presentations at 1-2 relevant national conferences such as Restore America's Estuaries, Association of State Floodplain Managers, or the American Shore and Beach Preservation Association, etc. • Leverage working relationships and existing contract work with the U.S. Army Corps of Engineers and partners to integrate lessons learned into the International Natural and Nature-Based Feature Design Guidelines to promote consideration of marsh terraces within similar Back Bay environments (for example, in North Carolina, Maryland, New Jersey, and New York).

Relevant Objective(s): Objective 3

Deliverables:

- Project marketing materials.
- Records documenting number of stakeholders engaged during outreach activities.

Activities Not Included Under this Grant

Submerged Aquatic Vegetation Transplant Plan: The City will evaluate opportunities for restoring native submerged aquatic vegetation populations in Back Bay, such as Wild Celery (*Vallisneria americana*), through consultations with subject matter experts. After terrace construction, the City will formulate a plan for planting submerged aquatic vegetation in between the terraces in coordination with identified partners and the construction contractor.

Post-Construction Monitoring: Post-construction monitoring and inspections will occur for a minimum of five (5) years following construction. Given the period of performance for the CFPF grant, post-construction monitoring activities have not been included in this application.

Milestone Schedule

The scope of work proposed in this grant application are scheduled to occur between June 2024 and June 2027. Work activities are anticipated to complete in December 2026; however, the proposed schedule extends through June 2027 for contingency. The project's expected progression is shown in the following milestone schedule, noting deliverables for each milestone:

2024 Activities

- *1st Quarter* ***(pre-grant period activities):***
  - 100% Final PS&E
  - Submit Bid Documents
- *2nd Quarter (pre-grant period activities):*
  - Final Bid Coordination/Acceptance
  - Construction NTP
- ***Begin Year 1 Grant Activities – 2nd Quarter 2024:***
  - Mobilization for Shipps Cabin Road Construction Staging Area
  - Initiation of Marsh Terrace Material Production
- *3rd Quarter:*
  - Construction NTP and Mobilization for Slurry Basin Installation
- *4th Quarter:*
  - Completion of Shipps Cabin Road Construction Staging Area and Slurry Basin Construction

2025

- *1st Quarter*
  - Completion of Marsh Terrace Material Production
  - Construction Mobilization for Marsh Terraces (beginning on March 1, 2025)
  - Oversight, Management, and Inspection Services of Slurry Basin Installation
- ***Begin Year 2 Grant Activities - 2nd Quarter 2025***
  - Construction of Marsh Terraces #100 – 105
- *3rd Quarter*
  - Construction of Marsh Terraces #106 – 114
- *4th Quarter*
  - Construction of Marsh Terraces #115 – 119
  - Marsh Terrace Construction Demobilization (to accommodate break in construction period from October 31, 2025 – February 28, 2026)

2026

- *1st Quarter*
  - Construction Re-Mobilization for Marsh Terraces (beginning on March 1, 2026)
- ***Begin Year 3 Grant Activities - 2nd Quarter 2026***

  - Construction of Marsh Terraces #120 – 134
- *3rd Quarter*
  - Construction of Marsh Terraces #135 – 140
- *4th Quarter*
  - Shipps Cabin Road Construction Staging Area Final Improvements & Demobilization

2027

- *1st and 2nd Quarter*
  - *Contingency for any delays experienced through end of 2026*

End Year 3 Grant Activities

Project Partners

The following table highlights the specific project partners, their roles, and their capabilities concerning the proposed project.

Table 9: Potential Project Partners.

Entity	Role	Description
U.S. Fish and Wildlife Service, Back Bay National Wildlife Refuge	Project Partner / Advisor / Adjacent Land Owner	BBNWR owns the land adjacent to the project footprint and monitors migratory bird hunting within Presidential Proclamation boundaries. BBNWR has coordinated with the City on project design and will continue to be involved during project construction as a stakeholder and advisor.
Virginia Department of Wildlife Resources	Project Advisory / Stakeholder	The City has coordinated closely with VDWR on project design. Furthermore, VDWR has been monitoring SAV distribution in Back Bay for decades and will be a critical partner for identifying native seagrass species and techniques for restoration based on extensive experience from previous SAV restoration projects in Back Bay.
Virginia Beach Department of Planning & Community Development	Permit Compliance	The City's Department of Public Works has been in close coordination with the City's Department of Planning & Community Development throughout the design and permitting process. Continued involvement and coordination during construction and post-construction monitoring is anticipated.
Dewberry	Engineering Contractor	Engineering consultant to support the City with contractor procurement and construction administration.
To be Determined	Construction Contractors	Construction contractor for the Shipps Cabin Road Construction Staging Area and marsh terrace construction activities.

Entity	Role	Description
Friends of Back Bay	Project Advisory / Stakeholder	Friends of Back Bay was formed in the 1980s to lead efforts to expand and conserve BBNWR, including securing millions in funding to support the Refuge's expansion. The City has coordinated with the BBNWR Society throughout the design and permitting process and will continue this coordination through construction and post-construction monitoring.
Back Bay National Wildlife Refuge Society	Project Advisory / Stakeholder	The Back Bay National Wildlife Refuge Society (BBNWR Society) is an independent, 501(c)(3) non-profit group dedicated to supporting the mission of the USFWS National Wildlife Refuge System and specifically promoting awareness of the BBNWR through education and participation. The City has coordinated with BBNWR Society throughout the design and permitting process and will continue this coordination through construction and post-construction monitoring.
Back Bay Restoration Foundation	Project Advisory / Stakeholder	Back Bay Restoration Foundation (BBRF) is an independent, 501(c)(3) non-profit group focusing on growing concerns about issues such as recurrent flooding, sea level rise, and development in the Southern Rivers Watershed. The group aims to serve as an advocate for the Bay and surrounding residents. The City has coordinated with BBRF throughout the design and permitting process and will continue this coordination through construction and post-construction monitoring.

Relationship to Other Projects

This project represents the first nature-based project in the Southern Rivers Watershed to advance to design and construction to implement the City's Wise Resilience Plan. The project is also an aspect of the Stormwater Green Infrastructure aspect of the City's Flood Protection Plan. The City has received a $3M award from the CFPF to support another project in the Stormwater Green Infrastructure element of the Flood Protection Program – the Elizabeth River Wetland and Floodplain Restoration Project (Round 1 CFPF Grant Awards).

The City has also received two NFWF NRCF grants from the Marsh Restoration in Back Bay project. Approximately $135,000 in NFWF NRCF funding was awarded in 2020 for the previous phase (design and permitting) for the project. The City continues to meet the obligations and period of performance of this NFWF grant. In 2022, the NFWF NRCF awarded $9,886,400 to support construction activities.

In its Resilience Plan, Virginia Beach identifies an adaptation approach for the Southern Rivers Watershed that emphasizes natural mitigation methods and integrated systems of defenses. As a natural mitigation strategy, the marsh terrace project aims to serve as a first line of defense during flood events, reducing wind-driven fetch, wave energy, and flow velocities to protect the important marsh buffer surrounding the shorelines of Back Bay. Other projects are also needed to provide multi-layered flood protection to northern Back Bay communities (Figure 32). Several

of these projects are highlighted below. It should be noted that the projects described below are either not yet funded or will be funded in the future through the City's Capital Improvement Program.

Figure 32: Southern Rivers Watershed Adaptation Vision.

Marsh island restoration serves as a critical first line of defense of the multi-layered protection system in the Southern Rivers Watershed. The following map (Figure 33) shows the structural adaptation projects proposed for the Southern Rivers Watershed, including the Muddy Creek Road and Sandbridge flood defense systems. The City's numerical modeling shows that, if implemented, there is potential for small increases in flooding outside of these structural protection systems.[14] This emphasizes the need for complimentary measures, including the marsh terrace project, land acquisition, and conservation efforts, to mitigate this residual risk.

[14] City of Virginia Beach (2020). City-wide Structural Alternatives for Coastal Flood Protection (PDF).

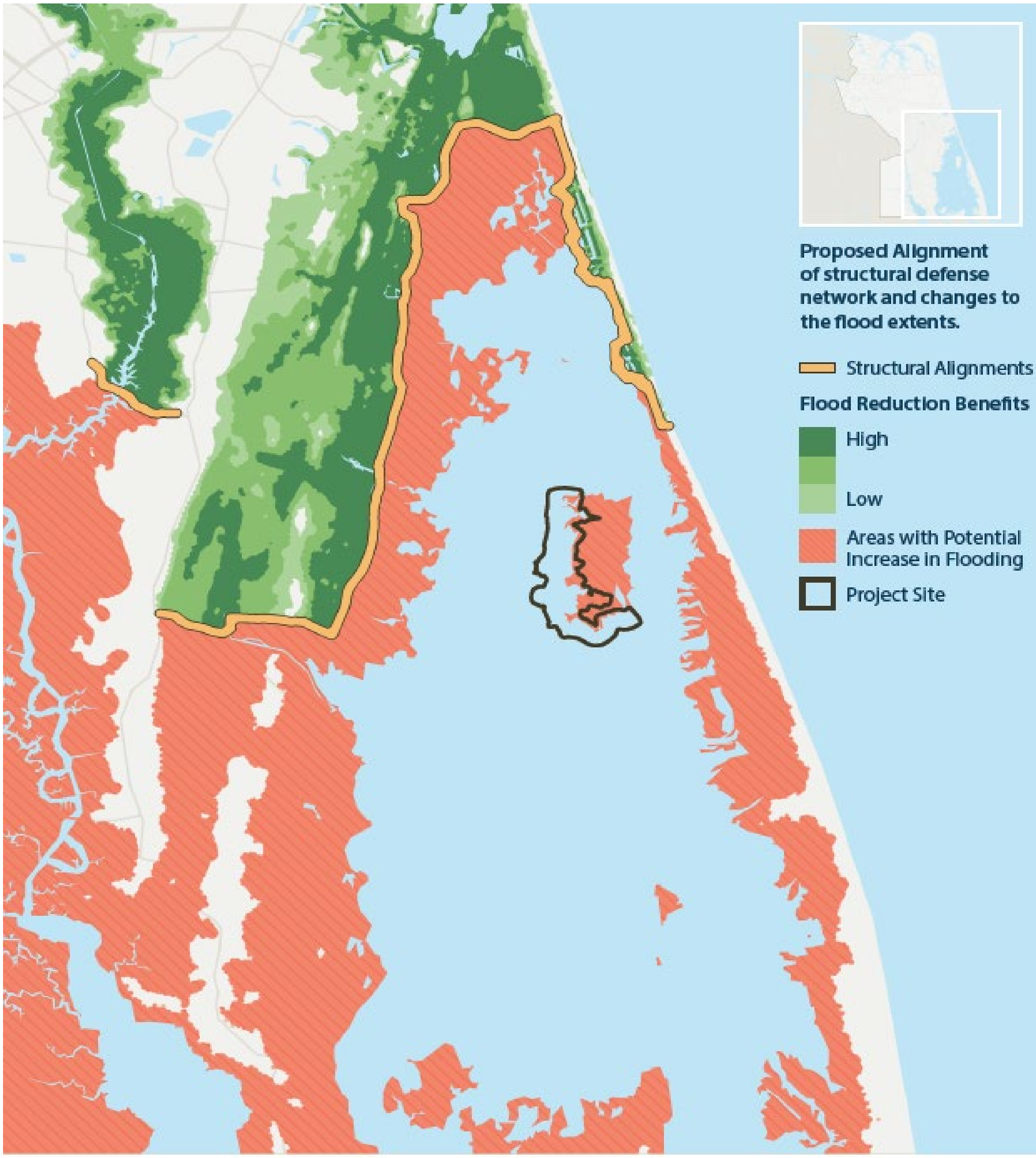

Figure 33: Structural adaptation projects proposed for the Southern Rivers Watershed, including the Muddy Creek Road and Sandridge flood defense systems.

Backside of Sandbridge Flood Defense System

Protection of the Sandbridge resort community from increasing coastal flood hazards would require a complex and expensive structural protection system because of the manufactured land configuration on the backside of Sandbridge. The proposed protection system includes elevating Sandbridge Road and constructing a network of seawalls, levees, and gates along the Back Bay shoreline of Sandbridge. This project does not have designated funding at this time.

Hell Point Creek Flood Defense System

As part of the integrated Sandbridge City-Wide flood defense network, a storm surge barrier across Hell Point Creek could block flood waters originating from Back Bay. Sandbridge Road would also need to be raised to ensure floodwaters could not flank the system. This project does not have designated funding at this time.

Sandbridge/New Bridge Intersection Improvements

Road and shoulder improvements are planned to increase safety at the New Bridge Road/Sandbridge Road intersection and reduce the need for road closures due to flooding from the adjacent Ashville Creek.

Muddy Creek Road Flood Defense System

Muddy Creek Road provides access to important rural and agricultural communities and Back Bay and the Wildlife Refuge. Muddy Creek Road is one of the lowest-lying roadways in all of Virginia Beach and frequently floods. This City-Wide Structural Alternative Flood Protection analysis identified this roadway as a critical location to provide flood protection. The proposed system, known as the Muddy Creek Road Alignment, would transform much of Muddy Creek Road into a levee, with the road on the top. The City's numerical modeling effort shows that the Muddy Creek Road Flood Defense System could potentially increase flood risk to the east of Muddy Creek Road, as shown in Figure 33. Therefore, the implementation of nature-based strategies suitable to the low-lying shorelines of Back Bay is essential to mitigate these impacts. This project does not have designated funding at this time.

Voluntary Acquisition Program

Virginia Beach City Council has recently funded a $2.0 million City-wide voluntary acquisition program to encourage flood-prone property owners to apply for a buyout. Parcels acquired by the City, in the Southern Rivers Watershed, would then be converted to open space to serve as flood storage and a marsh migration buffer.

Stormwater Master Plan

The City Council initiated an update of the City's Stormwater Master Plan in 2014. This effort is interchanging information with aspects of the City's Resilience Plan to account for the impact of sea level rise on the stormwater system's performance. Specific stormwater drainage improvement projects are included within the Lower Southern Rivers Watershed Drainage Basin.

Virginia Coastal Resilience Master Plan

The CRMP highlighted the marsh terrace project as an exemplary nature-based resilience project. The CRMP emphasizes Virginia Beach's strategic use of multiple funding streams to implement a large-scale nature-based project. DCR’s contribution to the project’s construction could be highlighted as a success story for implementation of the CRMP.

Audubon North Carolina Currituck Sound Coalition Marsh Conservation Plan

In coordination with Audubon North Carolina, the Currituck Sounds Coalition identified marsh restoration priorities based on criteria for siting restoration projects, including vulnerability to sea level rise, historic increase in surface water, and distance to hardened shorelines. This assessment identified Virginia Beach's marsh terrace project site as a high-priority area for restoration. There is an opportunity to highlight this project as a success story in the next iteration of the Audubon's Marsh Conservation Plan, which is slated to be updated every three years.

Maintenance Plan

Standard maintenance measures have been defined as part of the draft Annual Monitoring Plan and Post-Construction Monitoring Report developed for this project. See Attachment 5 for a copy of the draft report.

Subsequent to the monitoring period, project maintenance will be addressed by the City's Public Works Stormwater Operations Group, who will also respond to any maintenance issues identified by the monitoring effort or other observers. The City intends to maintain the construction staging area to support future project maintenance needs. The City will perform inspections every 2-5 years and make any repairs needed for the life of the project after completion of the initial monitoring program.

As described by the draft Annual Monitoring Plan and Post-Construction Monitoring Report, maintenance measures include the replacement of plantings (including upland, marsh and SAV plantings), the removal of debris from the terraces, the removal of invasive vegetation identified in the planting areas, the addition of sediment to eroding areas of the terraces, and the replacement of waterfowl barriers as necessary. In addition, structural maintenance measures that might be identified and prescribed during monitoring efforts include replacement of dislodged stones, addition of stone to address structure settlement, and general repair of sand cores or other structural elements. As proposed, these measures would become conditions of the wetland permits required for this project, in addition to standard commitments and requirements defined by the permitting agencies.

In addition to the commitments made in the monitoring plan, and those anticipated to be defined during the permitting process, it is the assumption that the placement of the proposed marsh terrace structures in state waters (subaqueous bottoms) will require the City to maintain the marsh terraces in perpetuity. As previously defined through coordination with VMRC, the City would obtain a compensable interest in the property that has been filled on top of state-owned subaqueous bottomlands (i.e. the terraces). As such, the City would be responsible for maintaining the proposed marsh terraces structures to ensure they fulfill their intended functions, as defined in the objectives and indicators of success previously defined in this proposal.

Criteria

The project receives a total score of **65 Points**. An explanation of how the project meets each

of the applicable scoring criteria contained in Appendix D is provided below.

Eligible Project (Type)

Category/Points: Wetland/floodplain restoration, Living shorelines and vegetated buffers (25 Points)

Explanation: Marsh terraces are considered a type of wetland restoration or a component of a living shoreline project:

- Wetland Restoration: Wetland restoration aims to reestablish or enhance natural wetland ecosystems. Marsh terraces can be constructed in areas where wetlands have been degraded or lost, and they help to recreation or support wetland functions. They provide habitat for various species, improve water quality, and can contribute to the overall health and resilience of a wetland ecosystem.
- Living Shoreline Project: Living shorelines are designed to protect shorelines from erosion while also promoting ecological and environmental benefits. Marsh terraces are often used as a component of living shoreline projects. They can serve as a buffer against wave action, stabilize shorelines, and create suitable habitat for marsh and aquatic species.

Social Vulnerability Index Score

Category/Points: Low Social Vulnerability (0 Points)

Explanation: Based on the Virginia Flood Risk Information System (VFRIS) Social Vulnerability Index Layer, the Social Vulnerability Index scores of the communities located in the two census block groups adjacent to Back Bay near the project site are -1.07 and -0.43 (an average of -0.75), which falls into the Low Social Vulnerability category.

Community Scale Benefits

Category/Points: More than one census block group (30 Points)

Explanation: As documented in the *Supporting Documentation - Project Information – Population* section of this document, the project is anticipated to benefit two census block groups (518100454.121 and 518100464.001).

Expected Lifespan of Project

Category/Points: Over 20 Years (10 Points)

Explanation: As documented in the *Supporting Documentation – Approach, Milestones, and Deliverables – Activity 3 (Marsh Terrace Construction)* section, the marsh terraces have a 30-year design life.

Budget Narrative

The following budget narrative details the proposed project expenditures. See Appendix B for completed budget spreadsheet.

Estimated Total Project Cost

The current estimated total project cost is **$53,378,490.** This estimate includes design, site acquisition for the construction staging area, construction, inspections and support, implementation, and contingencies, as shown in the below table. The design engineer's opinion of probable cost for construction is provided

Project Activity	Capital Improvement Program Estimate
Design	$276,800
Site Acquisition	$50,000
Construction	$41,839,900
Inspections and Support	$5,609,200
Implementation	$750,000
Contingencies	$4,852,590
Total:	$53,378,490

Funds Requested from the Fund

The City is requesting a total of **$5,000,000.00** in funding from the CFPF Round 4. These funds will support contractual services of the engineering consultant and construction contractor to execute Activity 2 (Construction Staging Area Preparation and Construction) and Activity 3 (Marsh Terrace Construction). No support is requested for City personnel.

These funds will be used to support ongoing construction activities through 2024-2026. Example activities include contractor construction services, mobilization/demobilization, construction staging area construction, slurry pipe installation, portions of the terrace materials, and waterfowl barriers. Construction costs are based on a detailed estimate from the design engineer that includes detailed breakdown of estimated quantities and costs from the 95% design package using industry standards for the anticipated aspects of the project construction. The City has withheld the detailed estimate as it provides information that would affect bidding on the construction.

Amount of Funds Available

The City as prime recipient is providing a cash match of $38,356,966 from funds fully programmed and available from the City's Flood Protection Program Capital Improvement Program to support the project. The Flood Protection Program is supported by a related bond referendum that provided $567.5M to fund more than 40 projects identified for Phase 1 of the Program. The program is tightly managed by the City, an independent contractor, and has a resident oversight board. The City is fully confident these funds will be available for constructing this project.

The City's dedicated funds will provide cash match to cover contractual services to support Activity 1 (Construction Staging Area Preparation and Construction), Activity 2 (Marsh Terrace Construction), Activity 3 (Stakeholder Engagement and Dissemination), and all related City support and direct overhead costs related for the project.

The National Fish and Wildlife Foundation is also supporting the project through two grant awards from the National Coastal Resilience Fund. This includes an initial award of $135,124 in 2020 for design and a second award of $9,886,400 in 2022 to support construction. The 2022 grant funds are dedicated to purchasing the native vegetation and a portion of the materials needed to build the marsh terraces.

A summary of project costs, funds available, and funds requested is provided below:

Item	Amount
Project Cost:	$53,378,490.00
Funding Sources Available	
NFWF Grant:	$10,021,524.00
CFPF Grant Request:	$5,000,000
City Funds Available:	$38,356,96600
Total Project Funding:	**$53,378,490.00**

Authorization to Request for Funding

Please refer to *attachment* for the documentation authorizing the funding request.

Attachment 1: Virginia Beach Resilience Plan DCR Approval

Matthew J. Strickler
Secretary of Natural Resources

Clyde E. Cristman
Director

COMMONWEALTH of VIRGINIA
DEPARTMENT OF CONSERVATION AND RECREATION

Rochelle Altholz
Deputy Director of Administration and Finance

Russell W. Baxter
Deputy Director of Dam Safety & Floodplain Management and Soil & Water Conservation

Nathan Burrell
Deputy Director of Government and Community Relations

Thomas L. Smith
Deputy Director of Operations

July 20, 2021

Toni Utterback, P.E.
Department of Public Works
2875 Sabre Street, Suite 250
Virginia Beach, VA 23452

RE: Virginia Beach Resilience Plan Second Submission - CFPF

Dear Ms. Utterback:

Thank you for the resubmission of the Sea Level Wise Adaptation Plan for City of Virginia Beach. After careful review and consideration, the Virginia Department of Conservation and Recreation has deemed the Plan complete and meets all the criteria outlined in the June 2021 Community Flood Preparedness Grant Manual. This approval will remain in effect for a period of three years, ending on July 31, 2024.

The following elements were evaluated as part of this review:

1. **Element 1: It is project-based with projects focused on flood control and resilience. DCR RESPONSE**

    a. Project-based: Four watersheds—each with a defined geographic area, analysis of community social and environmental characteristics, types of flooding, and a tailored flood resilience strategy with <u>discrete projects identified</u>.

Projects focused on flood control and resilience include:

Neighborhood	Flood Control Project
Elizabeth River	City-wide alignment, living shoreline, marsh restoration, land conservation
Lynnhaven	Chesapeake Bay alignment, Lesner Bridge Neighborhood alignment (East & West), beach & dune nourishment, ecological revetments, shellfish reef restoration, seagrass restoration
Oceanfront	Atlantic Oceanfront alignment, Rudee Heights alignment
Southern Rivers	West Neck Creek city-wide alignment, Muddy Creek Road city-wide alignment, Sandbridge city-wide alignment

**additional projects listed within the Sea Level Wise Adaptation Strategy.*

2. **Element 2: It incorporates nature-based infrastructure to the maximum extent possible. DCR RESPONSE**

   a. Nature-based infrastructure: Flood mitigation projects throughout the city incorporate nature-based solutions and were identified for maximum use within specific watersheds.

3. **Element 3: It includes considerations of all parts of a locality regardless of socioeconomics or race. DCR RESPONSE**
   a. All parts of a locality: Locality divided into four watersheds, covering the entirety of the jurisdictional boundary.
   b. Social vulnerability: Social implications of flood hazards and analysis of populations at-risk documented.
   c. Demographic Analysis: Demographic and Population Vulnerability Analysis conducted by Dewberry and incorporated into the Plan.

4. **Element 4: It includes coordination with other local and inter-jurisdictional projects, plans, and activities and has a clearly articulated timeline or phasing for plan implementation. DCR RESPONSE**
   a. Coordination with other projects, plans, and activities: Contains the planning processes and frameworks which outline local and regional plans used by the City and address resilience; and how they have been integrated for flood adaptation planning.
   b. Clearly articulated timeline or phasing for plan implementation: Program phases clearly articulated and described in detail—Impact assessment, Adaptation research, Strategy development, and Long-term implementation.

5. **Element 5: Is based on the best available science, and incorporates climate change, sea level rise, storm surge (where appropriate), and current flood maps.**
   a. Technically backed water-resources analysis, sea level rise projections, storm surge, and climate change incorporated into strategic approach.

VA DCR looks forward to working with you as you work to make Virginia Beach a more resilient community. If you have questions or need additional assistance, please contact us at cfpf@dcr.virginia.gov. Again, thank you for your interest in the Community Flood Preparedness Fund.

Sincerely,

Wendy Howard Cooper, Director
Dam Safety and Floodplain Management

cc: Darryl Glover, DCR

Attachment 2: Authorization to request funding from the Fund from governing body or chief executive of the local government

City of Virginia Beach

DEPARTMENT OF BUDGET AND MANAGEMENT SERVICES
(757) 385-8234
(757) 385-1857 FAX

VBgov.com

MUNICIPAL CENTER
BUILDING 1, 3RD FLOOR
2401 COURTHOUSE DRIVE
VIRGINIA BEACH, VA 23456-9001

INTER-OFFICE MEMORANDUM

DATE: November 1, 2023

TO: Patrick A. Duhaney, City Manager

FROM: Stuart McCrery, Budget and Policy Analyst KJ for SM

SUBJECT: Application for Virginia Community Flood Preparedness Fund Grant

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The Department of Public Works is requesting permission to apply for the Virginia Community Flood Preparedness Fund Grant from the Virginia Department of Conservation and Recreation. The Virginia Community Flood Preparedness Fund was established in the 2020 session of the General Assembly. Money in this fund comes from the auction of carbon allowances through the Regional Greenhouse Gas Initiative. It was established to provide support to localities across Virginia to reduce the impacts of flooding, including flooding driven by climate change.

Public Works is requesting a total of $5,000,000 to construct marsh terraces in Back Bay to promote wetland restoration and mitigate frequent flooding. The City has already made significant investments into this project through CIP project 100551 "Stormwater Green Infrastructure."

This grant also requires a local match of 30% for projects that implement nature-based solutions; however, the City has more than met this requirement through its current appropriations to CIP project 1000551 "Stormwater Green Infrastructure" which currently total over $49 million from the Referendum and other grant awards.

Budget & Management Services recommends this grant application for approval. Please indicate approval or disapproval below. Applications are due by November 12, 2023.

Approve (Date) 11/1/2023

Disapprove (Date)

Attachment 3: Virginia Beach Floodplain Administrator Support Letter

City of Virginia Beach

VBgov.com

DEPARTMENT OF PLANNING & COMMUNITY DEVELOPMENT
PHONE (757) 385-4621
FAX (757) 385-5667
VA Relay Number TTY: 711

2875 SABRE STREET, SUITE 500
VIRGINIA BEACH, VA 23452-7385

November 7, 2023

Division of Dam Safety and Floodplain Management
600 East Main Street, 24th Floor
Richmond, Virginia 23219

RE: Community Flood Preparedness Fund – Marsh Terrace Creation, Back Bay

The proposed project is located in both open water and a Federal Emergency Management Agency (FEMA) mapped Special Flood Hazard Area (SFHA). Hydraulic modeling analysis identified Bonney Cove as a location where marsh restoration has the potential to reduce the propagation of floodwater through key pathways within Back Bay. This project aims to stabilize two critically eroding marsh islands that serve as a key flood pathway into northern Back Bay, promote the growth of aquatic vegetation, and provide flood risk reduction benefits to communities in the surrounding area. Within the two census block groups that would benefit from this project, there are 113 repetitive loss and severe repetitive loss properties.

If I can provide any further information or assistance, please call me at 757-385-4621, or e-mail me at wmcnamar@vbgov.com.

Sincerely,

Whitney McNamara

Whitney McNamara, CFM
Floodplain Administrator and CRS Coordinator

Attachment 4: Letters of Support

Back Bay
Restoration
Foundation

PO Box 57041 • Virginia Beach, Virginia • 23457• 757-818-4829

November 6, 2023

Department of Conservation and Recreation
Dam Safety and Floodplain Management
600 E. Main St., 24th Floor
Richmond, VA 23219

Re: Virginia Community Flood Preparedness Fund Grant

Grantors:

The Back Bay Restoration Foundation (BBRF), is a 35 year-old non-profit watershed organization, founded in 1986 by a group of local citizens concerned about deterioration of the Back Bay watershed visible then through decreases in Submerged Aquatic Vegetation (SAV), fish, and waterfowl. BBRF is the only voice solely dedicated to conserving and improving Virginia Beach's two Southern Watersheds; namely, the Back Bay and North Landing River watersheds. Our efforts focus on education, stewardship and outreach to conserve the largest watersheds in Virginia Beach. We team with other non-profits, and city, state and federal agencies to work toward best solutions for the future of the Back Bay and North Landing River watersheds. BBRF strives to raise awareness, addressing issues that negatively affect these watersheds such as sea level rise, land subsidence and land use changes.

Back Bay is a historical, nationally significant, watershed. With the Back Bay National Wildlife Refuge (NWR) and significant State conservation lands at its core, the watershed was recognized as an Aquatic Resource of National Importance (ARNI) in 2008 by both the US Fish and Wildlife Service and the US Army Corps of Engineers. Back Bay is a wind-tidal oligohaline estuary and is located at the northern tip of the Albemarle/Pamlico estuarine system, the second largest estuarine complex in the United States. The Albemarle/Pamlico estuarine system was designated as an Estuary of National Significance in 1987 and selected to be studied as part of the Environmental Protection Agency's National Estuary Program. Back Bay is a shallow-water aquatic ecosystem with an average depth of four feet. Winds can influence the water depth by as much as three feet.

BBRF supports the City of Virginia Beach's application for Round 4 of VADCR's Community Flood Preparedness Fund. We were strong advocates of the City's successful applications to the National Fish and Wildlife Foundation (NFWF), and have seen what they accomplished with the initial NFWF funding they received. With the combined funding of NFWF, the City of Virginia Beach, and this application for DCR funding, their project of creating a Marsh Terrace Network to Achieve Restoration and Flood Resilience has overachieved by any measure. From community engagement and the NEPA process to conceptual and preliminary designs as described in the recent Army Corps Public Notice, the City has been productive and completely transparent.

As noted above, the City's community engagement and partnerships with organizations like ours has been transparent and resulted in broad support. Although the current project is localized in its first application, we expect the results will significantly mitigate SLR, land subsidence and wind tides in Back Bay. Similarly, this restoration will provide the biotic building blocks to maintain the watershed's national importance for wildlife. The innovative designs proposed will inform future projects at the landscape level. Although innovative, we believe the project is technically sound based on BBRF's 35 years of experience in habitat restoration.

Please feel free to contact us for further information.

Jared Brandwein

Jared Brandwein

Executive Director
Back Bay Restoration Foundation

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Back Bay National Wildlife Refuge
1324 Sandpiper Road
Virginia Beach, VA 23456

October 30, 2023

Wendy Howard Cooper
Division of Dam Safety and Floodplain Management
600 East Main Street, 24th Floor
Richmond, Virginia 23219

Dear Ms. Cooper,

The City of Virginia Beach is proposing to install marsh terraces in the waters of Back Bay adjacent to Back Bay National Wildlife Refuge. This project is expected to reduce wave energy and thus decrease the speed of erosion of remaining islands in the project area, many of which are managed by the U.S. Fish and Wildlife Service and provide habitat for migratory birds and other species. Additionally, the addition of multiple vegetative structures added to the bay will supplement habitat and provide nesting grounds for multiple species.

The mission of the U.S. Fish and Wildlife Service is *working with others to conserve, protect, and enhance fish, wildlife, plants, and their habitats for the continuing benefit of the American people*. Although much work is conducted on federal property to achieve this mission, the Service equally coordinates with external partners to further mutual goals. The proposed marsh terrace project is an excellent example of local and federal government coordination, and we support the City of Virginia Beach's proposed project.

Megan Reed

Megan Reed
Refuge Manager

Albemarle-Pamlico
National Estuary Partnership

Our mission is to identify, protect, and restore
the significant resources of the Albemarle-Pamlico estuarine system.

October 26, 2023

Wendy Howard Cooper
Virginia Dept. of Conservation and Recreation
Division of Dam Safety and Floodplain Management
600 E. Main St., 24th Floor
Richmond, VA 23219

Dear Wendy,

The Albemarle-Pamlico National Estuary Partnership (APNEP) strongly endorses the City of Virginia Beach and partners' application to Round 4 of The Virginia Community Flood Preparedness Fund (CFPF). The proposal is to support construction of the Back Bay Marsh Terrace Restoration Project.

APNEP relies on regional partnerships and collaboration to implement our 2012-2022 Comprehensive Conservation & Management Plan (CCMP) within the waterways of our congressionally designated "estuary of national significance." The proposed partnership between the City of Virginia Beach and the U.S. Fish and Wildlife Service will also advance our 2020 Memorandum of Understanding between Virginia and North Carolina to protect the ecosystem resources in the shared waterways between our two states. The project also addresses a "high priority" area for restoring and enhancing vulnerable marshes with high flood risk reduction benefits and habitat value, as identified by Audubon's Currituck Sound Coalition Marsh Conservation Plan released in 2021.

The marsh terrace project employs the use of natural features to build resilience to flooding in the Back Bay watershed. The project offers coastal resilience and habitat protection and conservation co-benefits including preserving marsh islands, restoring Submerged Aquatic Vegetation, migratory bird and fish habitat, reducing flow that could exacerbate wind tide flooding in local communities, and filling a gap in prior applied research on predominantly fresh water coastal lagoons. These features support the following CCMP actions:

- A2.3: Support research on adapting to impacts associated with climate change and sea level rise.
- C3.2: Develop and implement a coordinated wetland restoration strategy.
- C3.3: Develop and implement a submerged aquatic vegetation (SAV) restoration strategy.
- D3.3: Provide assistance to state, regional, and local governments to incorporate climate change and sea level rise considerations into their planning processes.

In closing, we strongly support the full funding of the City of Virginia Beach's proposal to Round 4 of The Virginia Community Flood Preparedness Fund (CFPF). Please contact Steve Anderson, Partnership Coordinator, at (919) 707-8743 with questions.

Sincerely,

W. Crowell

William L. Crowell, Jr., Ph.D., AICP, CEE
Director

Attachment 5: Copy of the Current Floodplain Ordinance

ORD-3685

AN ORDINANCE TO AMEND SECTIONS 1.1, 1.2, 1.3, 1.8, 2.1, 2.2, 2.3, 2.4, 2.8, 2.11, 3.1, 4.1, 4.2, 4.3, 4.4, 4.6, 4.8, 4.9, 4.10, 5.1, 6.1, AND 6.3 OF APPENDIX K, FLOODPLAIN ORDINANCE OF THE CITY CODE PERTAINING TO HOUSEKEEPING THE DELETION OF PUBLIC WORKS REQUIREMENTS AND THE ADDITION OF A COASTAL A ZONE AND A COASTAL HIGH HAZARD ZONE

Sections Amended: 1.1, 1.2, 1.3, 1.8, 2.1, 2.2, 2.3, 2.4, 2.8, 2.11, 3.1, 4.1, 4.2, 4.3, 4.4, 4.6, 4.8, 4.9, 4.10, 5.1, 6.1, and 6.3 of Appendix K, Floodplain Ordinance

WHEREAS, the public necessity, convenience, general welfare and good zoning practice so require;

BE IT ORDAINED BY THE CITY COUNCIL OF THE CITY OF VIRGINIA BEACH, VIRGINIA:

That Sections 1.1, 1.2, 1.3, 1.8, 2.1, 2.2, 2.3, 2.4, 2.8, 2.11, 3.1, 4.1, 4.2, 4.3, 4.4, 4.6, 4.8, 4.9, 4.10, 5.1, 6.1, and 6.3 of Appendix K, Floodplain Ordinance is hereby amended and reordained to read as follows:

APPENDIX K FLOODPLAIN ORDINANCE

ARTICLE I. GENERAL PROVISIONS

Sec. 1.1. Statutory authorization and purpose.

A. This ordinance is adopted pursuant to the authority granted to localities by Code of Virginia § ~~10.1-600 et seq~~ 15.2-984.

B. The city council finds the purpose of these provisions is to prevent the loss of life and property, the creation of health and safety hazards, the disruption of commerce and governmental services, the extraordinary and unnecessary expenditure of public funds for flood protection and relief, and the impairment of the tax base by:

1. Regulating uses, activities, and development that, alone or in combination with other existing or future uses, activities, and development, will cause unacceptable increases in flood heights, velocities, and frequencies;

2. Restricting or prohibiting certain uses, activities, and development from locating within districts subject to flooding;
3. Requiring all uses, activities, and developments that do occur in flood-prone districts be protected or flood-proofed against flooding and flood damage;

4. Protecting individuals from buying land and structures that are unsuited for intended purposes because of flood hazards; and

5. Acknowledging that the tide data over the last one hundred (100) years shows that Virginia Beach is facing an increased danger of flooding caused by both sea level rise and subsidence and has adopted the Sea Level Wise Adaptation Report as part of the Comprehensive Plan.

Sec. 1.2. Applicability.

These provisions shall apply to all privately and publicly owned lands within the jurisdiction of the City of Virginia Beach and identified as areas ~~of special flood hazard~~ at risk of flooding by the City of Virginia Beach or shown ~~according to~~ on the Flood Insurance Rate Map (FIRM) or included on the flood insurance study (FIS) that ~~is~~ are provided to the City of Virginia Beach by the Federal Emergency Management Agency (FEMA) and dated January 16, 2015 ~~or identified as floodplains subject to special restrictions in section 4.10 of this ordinance~~.

Sec. 1.3. Definitions.

. . . .

City manager. The City Manager of the City of Virginia Beach, or his designees.

Design Flood Elevation (regulatory flood protection elevation). The base flood elevation plus the freeboard required by this ordinance.

. . . .

Recreational vehicle. A vehicle that is:

1. Built on a single chassis;
2. Four hundred (400) square feet or less when measured at the largest horizontal projection;
3. Designed to be self-propelled or permanently towable by a light duty truck; and
4. Designed primarily not for use as a permanent dwelling but as temporary living quarters for recreational camping, travel, or seasonal use.

~~*Regulatory flood protection elevation (design flood elevation)*. The base flood elevation plus the freeboard required by this ordinance.~~

. . . .

Sec. 1.8. Penalty for violations.

Any person who fails to comply with any of the requirements or provisions of this ordinance or directions of the ~~d~~Directors of ~~p~~Planning ~~or public works~~ or any authorized employee of the City of Virginia Beach shall be guilty of the appropriate violation and subject to the penalties therefore. Any violation of the provision of this ordinance shall be punishable by a fine of not more than one hundred dollars ($100.00). Each person shall be deemed guilty of a separate offense for each and every day or portion thereof during which any violation of any of the provisions of this ordinance is committed.

The Virginia Uniform Statewide Building Code (VA USBC) addresses building code violations and the associated penalties in ~~section 104 and section 115~~ VA USBC § 104 and § 115. Violations and associated penalties of the Zoning Ordinance for the City of Virginia Beach are addressed in § 104 of the Zoning Ordinance.

In addition to the above penalties, all other actions are hereby reserved, including an action in equity for the proper enforcement of this ordinance. The imposition of a fine or penalty for any violation of, or noncompliance with, this ordinance shall not excuse the violation or noncompliance or permit it to continue, and all such persons shall be required to correct or remedy such violations within a reasonable time. Any structure constructed, reconstructed, enlarged, altered, or relocated in noncompliance with this ordinance may be declared by the City of Virginia Beach to be a public nuisance and abatable as such. Flood insurance may be withheld from structures constructed in violation of this ordinance.

ARTICLE II. ADMINISTRATION

Sec. 2.1. Designation of the floodplain administrator.

The City Manager of the City of Virginia Beach is hereby appointed the floodplain administrator to administer and implement this ordinance. The floodplain administrator has delegated the duties and responsibilities set forth in this ordinance to the ~~departments of public works and planning, as specified below~~ Department of Planning and Community Development.

Sec. 2.2. Duties and responsibilities of the ~~department of public works~~ floodplain administrator or his designee.

The duties and responsibilities of the ~~department of public works~~ floodplain administrator of his designee shall include but are not limited to:

A. Interpreting floodplain boundaries and providing available base flood elevation and flood hazard information;

B. Verifying that applicants proposing an alteration of a watercourse have notified adjacent communities, the department of conservation and recreation (division of dam safety and floodplain management), and other appropriate agencies (Virginia Department of Environmental Quality (VADEQ), United States Army Corps of Engineers (USACE), etc.) and have submitted copies of such notifications to FEMA;

C. Advising applicants for new construction or substantial improvement of structures that are located within an area of the coastal barrier resources system established by the Coastal Barrier Resources Act that Federal flood insurance is not available on such structures; areas subject to this limitation are shown on FIRMs as coastal barrier resource system areas or otherwise protected areas;

D. Submitting to FEMA, or requiring applicants to submit to FEMA, data and information necessary to maintain FIRMs, including hydrologic and hydraulic engineering analyses prepared by or for the city, within six (6) months after such data and information becomes available if the analyses indicate changes in base flood elevations;

E. Maintaining and permanently keeping records that are necessary for the administration of these regulations, including:

1. ~~flood~~ Flood insurance studies, FIRMs (including historic studies and maps and current effective studies and maps) and letters of map change; and

2. Documentation supporting issuance and denial of permits, Elevation Certificates, documentation of the elevation (in relation to the datum on the FIRM) to which structures have been floodproofed, inspection records, other required design certifications, variances, and records of enforcement actions taken to correct violations of these regulations.

F. Notifying FEMA when the corporate boundaries of the City of Virginia Beach have been modified and:

1. Providing a map that clearly delineates the new corporate boundaries or the new area for which the authority to regulate pursuant to this ordinance has either been assumed or relinquished through annexation; and

2. If the FIRM for any annexed area includes SFHAs that have flood zones with regulatory requirements that are not set forth in this

ordinance, prepare amendments to this ordinance to adopt the FIRM and appropriate requirements, and submit the amendments to the city council for adoption; such adoption shall take place at the same time as or prior to the date of annexation and a copy of the amended ordinance shall be provided to the department of conservation and recreation (division of dam safety and floodplain management) and FEMA.

G. Upon the request of FEMA, completing and submitting a report concerning participation in the NFIP, which may request information regarding the number of buildings in the SFHA, the number of permits issued for development in the SFHA, and the number of variances issued for development in the SFHA.

H. Reviewing applications for permits to determine whether proposed activities will be located in the SFHA;

I. Reviewing applications to determine whether proposed activities will be reasonably safe from flooding and requiring new construction and substantial improvements to meet the requirements of this ordinance;

J. Reviewing applications to determine whether all necessary permits have been obtained from the federal, state, or local agencies from which prior or concurrent approval is required; in particular, permits from state agencies for any construction, reconstruction, repair, or alteration of a dam, reservoir, or waterway obstruction (including bridges, culverts, structures), any alteration of a watercourse, or any change of the course, current, or cross section of a stream or body of water, including any change to the SFHAs of free-flowing non-tidal waters of the state;

K. Approving applications and issuing permits to develop in flood hazard areas if the provisions of this ordinance have been met, or disapproving applications if the provisions of this ordinance have not been met;

L. Granting administrative variances pursuant to section 6.1 of this ordinance;

M. Inspecting, or causing to be inspected, buildings, structures, and other development for which permits have been issued to determine compliance with this ordinance or to determine if non-compliance has occurred or violations have been committed;

N. Reviewing elevation certificates and requiring incomplete or deficient certificates to be corrected;

O. Maintaining and permanently keeping documentation supporting the issuance and denial of permits, elevation certificates, documentation of the elevation (in relation to the datum on the FIRM) to which structures have been flood proofed, and other required design certifications, variances, and records of enforcement actions taken to correct violations of this ordinance;

P. Enforcing the provisions of this ordinance, investigating violations, issuing notices of violations or stop work orders, and requiring permit holders to take corrective action;

Q. Advising the city council regarding the intent of this ordinance and, for each application for a variance, preparing a staff report and recommendation; and

R. Administering the requirements related to proposed work on existing buildings:

1. Making determinations as to whether buildings and structures that are located in flood hazard areas and that are damaged by any cause have been substantially damaged; and

2. Making reasonable efforts to notify owners of substantially damaged structures of the need to obtain a permit to repair, rehabilitate, or reconstruct, and prohibit the non-compliant repair of substantially damaged buildings except for temporary emergency protective measures necessary to secure a property or stabilize a building or structure to prevent additional damage.

S. Undertaking, as determined appropriate by the floodplain administrator due to the circumstances, other actions that may include but are not limited to: issuing press releases, public service announcements, and other public information materials related to permit requests and repair of damaged structures; coordinating with other federal, state, and local agencies to assist with substantial damage determinations; providing owners of damaged structures information related to the proper repair of damaged structures in SFHAs; and assisting property owners with documentation necessary to file claims for increased cost of compliance coverage under National Flood Insurance Program (NFIP) flood insurance policies; and

T. It is the duty of the city floodplain administrator to take into account flood, mudslide, and flood-related erosion hazards, to the extent that they are known, in all official actions relating to land management and use throughout the entire jurisdictional area of the city, whether or not those

hazards have been specifically delineated geographically (e.g., via mapping or surveying).

~~Sec. 2.3. Duties and responsibilities of the department of planning.~~ Reserved.

~~The duties and responsibilities of the department of planning shall include but are not limited to:~~

~~A.~~ ~~Reviewing applications for permits to determine whether proposed activities will be located in the SFHA;~~

~~B.~~ ~~Reviewing applications to determine whether proposed activities will be reasonably safe from flooding and requiring new construction and substantial improvements to meet the requirements of this ordinance;~~

~~C.~~ ~~Reviewing applications to determine whether all necessary permits have been obtained from the federal, state, or local agencies from which prior or concurrent approval is required; in particular, permits from state agencies for any construction, reconstruction, repair, or alteration of a dam, reservoir, or waterway obstruction (including bridges, culverts, structures), any alteration of a watercourse, or any change of the course, current, or cross section of a stream or body of water, including any change to the SFHAs of free-flowing non-tidal waters of the state;~~

~~D.~~ ~~Approving applications and issuing permits to develop in flood hazard areas if the provisions of this ordinance have been met, or disapproving applications if the provisions of this ordinance have not been met;~~

~~E.~~ ~~Granting administrative variances pursuant to section 6.1 of this ordinance;~~

~~F.~~ ~~Inspecting, or causing to be inspected, buildings, structures, and other development for which permits have been issued to determine compliance with this ordinance or to determine if non-compliance has occurred or violations have been committed;~~

~~G.~~ ~~Reviewing elevation certificates and requiring incomplete or deficient certificates to be corrected;~~

~~H.~~ ~~Maintaining and permanently keeping documentation supporting the issuance and denial of permits, elevation certificates, documentation of the elevation (in relation to the datum on the FIRM) to which structures have been flood proofed, and other required design certifications, variances, and records of enforcement actions taken to correct violations of this ordinance;~~

~~I. Enforcing the provisions of this ordinance, investigating violations, issuing notices of violations or stop work orders, and requiring permit holders to take corrective action;~~

~~J. Advising the city council regarding the intent of this ordinance and, for each application for a variance, preparing a staff report and recommendation; and~~

~~K. Administering the requirements related to proposed work on existing buildings:~~

~~1. Making determinations as to whether buildings and structures that are located in flood hazard areas and that are damaged by any cause have been substantially damaged; and~~
~~2. Making reasonable efforts to notify owners of substantially damaged structures of the need to obtain a permit to repair, rehabilitate, or reconstruct, and prohibit the non-compliant repair of substantially damaged buildings except for temporary emergency protective measures necessary to secure a property or stabilize a building or structure to prevent additional damage.~~

~~Sec. 2.4. Shared duties and responsibilities.~~ <u>Reserved.</u>

~~The duties and responsibilities shared by the departments of public works and Planning shall include but are not limited to:~~

~~A. Undertaking, as determined appropriate by the floodplain administrator due to the circumstances, other actions that may include but are not limited to: issuing press releases, public service announcements, and other public information materials related to permit requests and repair of damaged structures; coordinating with other federal, state, and local agencies to assist with substantial damage determinations; providing owners of damaged structures information related to the proper repair of damaged structures in SFHAs; and assisting property owners with documentation necessary to file claims for increased cost of compliance coverage under National Flood Insurance Program (NFIP) flood insurance policies; and~~

~~B. It is the duty of the city floodplain administrator to take into account flood, mudslide, and flood-related erosion hazards, to the extent that they are known, in all official actions relating to land management and use throughout the entire jurisdictional area of the city, whether or not those hazards have been specifically delineated geographically (e.g., via mapping or surveying).~~

. . . .

Sec. 2.8. Interpretation of district boundaries.

Initial interpretations of the boundaries of the floodplain districts shall be made by the floodplain administrator. Should a dispute arise concerning the boundaries of any of the districts~~, the city council shall make the necessary determination. The person questioning or contesting the location of the district boundary shall be given a reasonable opportunity to present his case to the city council and to submit his own technical evidence if he so desires~~ a surveyor shall provide either an elevation certificate or recent survey showing topographic elevations and delineating the Special Flood Hazard Area.

. . . .

Sec. 2.11. Appeals to decisions made by the floodplain administrator.

It is further provided that any decision of the floodplain administrator or his designee may be modified, reversed, or affirmed by the city council upon appeal by any aggrieved party to such decision, if such appeal is filed with the floodplain administrator within thirty (30) days of such decision through the application for a Floodplain Variance outlined in Section VI of this ordinance.

ARTICLE III. ESTABLISHMENT OF FLOODPLAIN DISTRICTS

Sec. 3.1. Description of floodplain districts.

A. Special flood hazard areas (SFHA). The SFHAs shall include land in the floodplain subject to a one (1) percent or greater chance of being flooded in any given year. The basis for the delineation of these districts shall be the FIS and the FIRM for the City of Virginia Beach prepared by FEMA, Federal Insurance Administration, dated January 16, 2015, and any subsequent revisions or amendments thereto.

The boundaries of the SFHAs are established as shown on the FIRM, which is declared to be a part of this ordinance and shall be kept on file at the City of Virginia Beach Department of ~~Public Works~~ Planning and Community Development, and include the following districts:

1. The Floodway District is in an AE Zone and is delineated, for the purposes of this ordinance, using the criterion that certain areas within the floodplain must be capable of carrying the waters of the one (1) percent annual chance flood without increasing the water surface elevation of that flood more than one (1) foot at any point. The areas included in this district are specifically defined in Table 7 of the above-referenced FIS and shown on the accompanying FIRM.

2. The AE or AH Zones on the FIRM accompanying the FIS shall be those areas for which one (1) percent annual chance flood elevations have been provided and the floodway has not been delineated.

3. The A Zone on the FIRM accompanying the FIS shall be those areas for which no detailed flood profiles or elevations are provided, but the one (1) percent annual chance floodplain boundary has been approximated.

4. The AO Zone on the FIRM accompanying the FIS shall be those areas of shallow flooding identified as AO on the FIRM.

5. ~~Reserved.~~ The Coastal A Zone on the FIRM accompanying the FIS shall be those areas labeled as AE and are located seaward of the limit of moderate wave action (LiMWA) line.

6. The VE or V Zones on FIRMs accompanying the FIS shall be those areas that are known as coastal high hazard areas, extending from offshore to the inland limit of a primary frontal dune along an open coast and any other area subject to high velocity wave action from storm or seismic sources.

B. ~~Floodplain subject to special restrictions~~ *Local Flood Hazard Areas*. The City of Virginia Beach may identify and regulate local flood hazard or ponding areas that are not delineated on the FIRM. These areas are ~~identified in section 4.10 and may be delineated on a map using best available topographic data and locally derived information such as flood of record, historic high water marks, or approximate study methodologies~~ identified as follows:~~.~~

a. *Other areas of flood risk*. The X and the X(Shaded) Zone on the FIRM where the City of Virginia Beach Stormwater Master Plan has identified areas, outside SFHAs delineated on the FIRM, that area susceptible to flooding. The most recent updated version of the modeling shall be used to identify areas that are likely to experience flooding.

b. *Floodplain Subject to Special Restrictions*. The Floodplain Subject to Special Restrictions is identified in section 4.10 and includes areas in the southern part of the city which are characterized by wind tides, low topography, and poorly draining soils.

ARTICLE IV. FLOODPLAIN DISTRICT PROVISIONS

Sec. 4.1. Permit and application requirements.

. . . .

B. Site plans and permit applications. All applications for development within any floodplain district and all building permits issued within ~~the~~ any floodplain district shall incorporate the following information:

1. For any addition, conversion of any non-habitable space to habitable space, or the construction or installation of a new accessory structure that requires a building permit.

   a. A physical survey, performed after the effective date of the FIRM that:

      i. accurately depicts current improvements on the property;
      ii. provides a flood zone determination and BFE or flood depth at the stie; and
      iii. delineates the location of the flood zones on the property.

   b. For structures located in the SFHA delineated on the FIRM, a current elevation certificate sealed by a licensed design professional.

2. For new construction and any substantial improvement of the principal structure:

   a. a proposed site plan sealed by a registered design professional that provides:

      ~~1~~i. The elevation of the base flood at the site;

      ~~2~~ii. The elevation of the lowest floor (including basement) or, in V Zones, the lowest horizontal structural member;

      ~~3~~iii. For structures to be flood-proofed (non-residential only), the elevation to which the structure will be flood-proofed; and

      4iv. Topographic information showing existing and proposed ground elevations.

Sec. 4.2. General standards.

. . . .

5. Electrical, heating, ventilation, plumbing, air conditioning equipment, and other service facilities, including duct work, shall be designed and/or ~~located so as to prevent water from entering or accumulating within the components during conditions of flooding~~ or above the design flood elevation.

6. New and replacement water supply systems shall be designed to minimize or eliminate infiltration of flood waters into the system.

7. New and replacement sanitary sewage systems shall be designed to minimize or eliminate infiltration of flood waters into the systems and discharges from the systems into flood waters.

8. On-site waste disposal systems shall be located and constructed to avoid impairment to them or contamination from them during flooding.

9. No use shall be permitted if such use will increase the amounts of potentially damaging materials, including those likely to be injurious to health, that might be transported in floods.

10. For properties located in SFHAs delineated on the FIRM, an elevation certificate and, if applicable, a flood-proofing certificate shall be provided to the Floodplain Administrator prior to any foundation inspection, final inspections, and the issuance of any certificates of occupancy, in order to assure compliance with these floodplain regulations.

11. Prior to any proposed alteration or relocation of any channels or of any watercourse or stream within the city, a permit shall be obtained from the USACE, VADEQ, the Virginia Marine Resources Commission, and the Wetlands Board through the joint permit application process. Furthermore, notification of the proposal shall be given by the applicant to all affected adjacent jurisdictions, the department of conservation and recreation (division of dam safety and floodplain management), other required agencies, and FEMA.

12. The flood carrying capacity within an altered or relocated portion of any watercourse shall be maintained.

~~B. In all SFHAs, the following additional provisions shall apply:~~

~~1. Prior to any proposed alteration or relocation of any channels or of any watercourse or stream, within the city a permit shall be obtained from the USACE, VADEQ, the Virginia Marine Resources Commission, and the Wetlands Board through the joint permit application process. Furthermore, notification of the proposal shall be given by the applicant to all affected adjacent jurisdictions, the department of conservation and recreation (division of dam safety and floodplain management), other required agencies, and FEMA.~~

~~2. The flood carrying capacity within an altered or relocated portion of any watercourse shall be maintained.~~

~~3. Sand dunes, barrier beaches, and other natural protective barriers shall remain intact to provide protection against wind, waves, and erosion drainage. Any person who desires to use or alter any coastal primary sand dune, other than for the purpose of conducting the activities specified in section 1602 of the Zoning Ordinance of the City of Virginia Beach, shall first obtain a permit from the USACE, VADEQ, the Virginia Marine Resources Commission, and the Wetlands Board through the joint permit application process.~~

Sec. 4.3. Elevation and construction requirements.

In all ~~SFHAs where base flood elevations have been provided in the FIS or generated by a licensed professional in accordance with section 4.6 of this ordinance~~ floodplain districts, with the exception of Coastal A and Coastal High Hazard (VE) zones, the following provisions shall apply:

A. Residential construction requirements. ~~New construction or substantial improvement of any residential structure or manufactured home in Zones AE, AH, and A with detailed base flood elevations shall have the lowest floor, including basement, elevated to a minimum of two (2) feet above the base flood level.~~ The lowest flood, including basement, shall be set to the higher of the following:

i. A minimum of two (2) feet above the base flood elevation established on the most recent FIRM or by the most recent FIS or,

ii. A minimum of one (1) foot above the 100-year HGL elevation measured at the nearest existing or proposed public drainage structure or BMP, in the City Stormwater Master Plan.

B. Non-residential construction requirements. New construction or substantial improvement of any commercial, industrial, or non-residential building or manufactured home shall have the lowest floor, including basement, elevated as ~~minimum of two (2) feet above the base flood level~~ established in Section 4.3 A of this ordinance. Buildings ~~located in AE or AH Zones~~ may be flood-proofed in lieu of being elevated provided that all areas of the building components below the ~~elevation corresponding to the base flood elevation plus a minimum of two (2) feet freeboard~~ design flood elevation are watertight with walls substantially impermeable to the passage of water, and use structural components having the capability of resisting hydrostatic and hydrodynamic loads and the effect of buoyancy. A professional engineer or architect licensed by the Commonwealth of Virginia shall certify that the standards of this subsection are satisfied. Such certification, including the specific elevation (in relation to NAVD88) to which such structures are flood proofed, shall be maintained by the building official.

C. ~~Space below the lowest floor requirements. In Zones A, AE, AH, and AO,~~ ~~f~~Fully enclosed areas of new construction or substantially improved existing structures that are below the ~~regulatory~~ design flood protection elevation shall:

1. Not be designed or used for human habitation, but shall only be used for parking of vehicles, building access, or limited storage of maintenance equipment used in connection with the premises. Access to the enclosed area shall be the minimum necessary to allow for parking of vehicles (garage door), limited storage of maintenance equipment (standard exterior door), or entry to the living area (stairway or elevator).

2. Be constructed entirely of flood resistant materials below the ~~regulatory~~ design flood ~~protection~~ elevation.

3. Space below the lowest floor of SFHAs delineated on the FIRM shall ~~I~~include measures to automatically equalize hydrostatic flood forces on walls by allowing for the entry and exit of floodwaters. To meet this requirement, the openings shall either be certified by a professional engineer or architect licensed by the Commonwealth of Virginia or meet or exceed the following minimum design criteria:

. . . .

Sec. 4.4. Floodway requirements.

. . . .

B. The placement of new or replacement manufactured homes (mobile homes) is prohibited.

~~C.~~ ~~The following uses and structures may be permitted in the floodway district, subject to the requirements of articles III, IV, V, and VI of this ordinance:~~

~~1.~~ ~~Public and private outdoor recreational facilities;~~

~~2.~~ ~~Agricultural uses, including farming, grazing, and the raising of poultry or livestock; provided, that poultry or livestock shall not be housed within five hundred (500) feet of any residential, apartment, or hotel district;~~

~~3.~~ ~~Open uses, such as public and private roadways, off street parking, or loading and unloading areas related to uses in adjoining districts;~~

4. ~~Commercial mining, soil removal, and sand pits subject to regulations applicable to extractive industries as set forth in the conditional use provisions of the Zoning Ordinance of the City of Virginia Beach;~~

5. ~~Public improvements, such as dams, levees and channel improvements, and utilities installations and substations, including temporary storage of materials, except flammable, toxic or noxious materials, and temporary location of maintenance installations; and~~

6. ~~Uses and structures customarily accessory and clearly incidental and subordinate to uses listed above, including in connection with agricultural uses; roadside stands for the sale of agricultural products produced on the premises; provided that:~~

   a. ~~Only one (1) such stand shall be permitted per lot;~~

   b. ~~No such stand shall exceed five hundred (500) square feet in floor area; and~~

   c. ~~No such stand on the street frontage shall be erected within twenty (20) feet of the property line.~~

. . . .

Sec. 4.6. A Zone requirements.

. . . .

B. The floodplain administrator reserves the right to require a hydrologic and hydraulic analysis for any development and to determine the base flood elevation. When such base flood elevation data is utilized, the lowest floor shall be elevated to minimum of two (2) feet above the base flood level. During the permitting process, the floodplain administrator shall obtain:

   1. The elevation of the lowest floor (including the basement) of all new and substantially improved structures; and

   2. If the structure has been flood-proofed in accordance with the requirements of this ordinance, the elevation (in relation to NAVD88) to which the structure has been flood-proofed.

C. ~~When the data is not available from any source, the lowest floor of the structure shall be elevated to not less than two (2) feet above the highest adjacent grade.~~

Sec. 4.8. ~~Reserved~~ X and X(Shaded) Zone requirements. (Other Areas of Flood Risk).

A. *Residential construction requirements*. The lowest floor, including basements, shall be set to a minimum of one (1) foot above the 100-year HGL elevation measured at the nearest existing or proposed public drainage structure or BMP, in the City Stormwater Master Plan.

B. *Non-residential construction requirements*. New construction or substantial improvement of any commercial, industrial, or non-residential building or manufactured home shall have the lowest floor, including basement, elevated as established in Section 4.8 A of this ordinance above. Buildings may be flood-proofed in lieu of being elevated provided that all areas of the building components below the design flood elevation are watertight with walls substantially impermeable to the passage of water, and use structural components having the capability of resisting hydrostatic and hydrodynamic loads and the effect of buoyancy. A professional engineer or architect licensed by the Commonwealth of Virginia shall certify that the standards of this subsection area satisfied. Such certification, including the specific elevation (in relation to NAVD88) to which such structures are flood proofed, shall be maintained by the building official.

Sec. 4.9. – Coastal High Hazard (~~V and~~ VE Zone) requirements.

The following provisions shall apply within ~~V and VE Zones~~ Coastal A Zones and Coastal High Hazard Areas:

A. All new construction and substantial improvements, including to manufactured homes, shall be elevated on pilings or columns so that:

1. The bottom of the lowest horizontal structural member of the lowest floor (excluding the pilings or columns) is elevated to a minimum of ~~two~~ three (~~2~~3) feet above the base flood ~~level~~ elevation; and

2. The pile or column foundation and structure attached thereto is anchored to resist flotation, collapse, and lateral movement due to the effects of wind and water loads acting simultaneously on all building components. Wind and water loading values shall each have a one (1) percent chance of being equaled or exceeded in any given year.

B. A professional engineer or architect licensed by the Commonwealth of Virginia shall develop or review the structural design, specifications, and plans for the construction and shall certify that the design and methods of construction to be used are in accordance with accepted standards of practice for meeting the provisions of article IV, section 4.6 A. A V Zone

Design Certificate shall be submitted to Permits and Inspections with plans for a building permit.

. . . .

I. ~~The man-made alteration of sand dunes, which would increase potential flood damage, is prohibited.~~ Sand dunes, barrier beaches, and other natural protective barriers shall remain intact to provide protection against wind, waves, and erosion drainage. Any person who desires to use or alter any coastal primary sand dune or beaches, other than for the purpose of conducting the activities specified in Article 1600, Section 1602 of the Zoning Ordinance of the City of Virginia Beach, shall first obtain a permit, or authorization, from the USACE, VADEQ, the Virginia Marine Resources Commission, and the Wetlands Board through the joint permit application process.

J. Manufactured homes are prohibited.

Sec. 4.10. Floodplain subject to special restrictions.

A. All ~~FIRM delineated~~ SFHAs that ultimately drain to Back Bay or the Currituck Sound ~~located in the following areas~~ shall be identified as a floodplain subject to special restrictions~~:~~.

~~1. North Landing River and its tributaries south of Lynnhaven Parkway;~~

~~2. West Neck Creek and its tributaries south of Shipps Corner Road, London Bridge Road, and the portion of Dam Neck Road east of its intersection with London Bridge Road; and~~

~~3. Bays, creeks, lakes, guts, coves, wetlands, marshes and swamps and their tributaries comprising the Back Bay and Small Coastal South watersheds south of South Birdneck Road and east of Princess Anne Road and General Booth Boulevard.~~

B. The following provisions shall apply within the floodplain subject to special restrictions:

1. Notwithstanding any provision of this ordinance to the contrary, no filling shall be permitted, including filling with material excavated from the same floodplain except for:

a. The purpose of public roadway or other similar public works construction undertaken by the Department of Public Works or Virginia Department of Transportation, or their agent for

construction. This construction includes flood protection and flood mitigation projects;

b. The maintenance, alteration, or relocation of bona fide agricultural ditches, swales, or agricultural pathways or those ditches required for proper lot drainage;

c. For shoreline stabilization or maintenance projects, such as riprap revetment, bulkheads, or other treatment used to stabilize and protect the banks of waterways, the city manager or his designee may approve the placement of fill provided the following criteria are met:

i. A joint permit application is submitted;

ii. The alignment of the stabilization structure is along the escarpment or in line with adjacent stabilization structures; ~~and~~

iii. If there is an existing shoreline stabilization structure, any proposed replacement structure shall be no more than six (6) inches higher than the existing structure; and

~~iii~~iv. Fill must be the minimum necessary to support the stabilization project.

2. The city manager, or his designee, may approve the placement of fill provided that the following criteria are met:

a. Proposed fill within the floodplain:

i. Shall be mitigated to result in no decrease in flood storage volume on the site;

ii. Shall be mitigated entirely on the same site that will incur the fill;

iii. Shall be contiguous to the existing floodplain that is being filled; and

iv. Shall be limited to the smallest amount of area and volume possible to correct irregularities within the boundary of the project.

b. The combined areas of fill and mitigation shall not exceed five (5) percent of the total area within the floodplain located on the site that will incur the fill.

3. Residential dwelling structures shall not be located within the floodplains subject to special restrictions on lots created after October 23, 2001. Residential dwelling structures located in ~~local flood hazard areas as of~~ a SFHA and constructed prior to October 23, 2001 may be expanded with attached additions to a total footprint of less than one thousand (1,000) square feet; such additions shall also comply with the requirements set forth in article V of this ordinance.

. . . .

ARTICLE V. EXISTING STRUCTURES IN FLOODPLAIN AREAS

Sec. 5.1. Existing structures.

A structure or use of a structure or premises that lawfully existed prior to the adoption of this ordinance, but which is not in conformity with this ordinance, may be continued subject to the following conditions:

A. Any existing structures in the floodway area shall not be expanded or enlarged unless it has been demonstrated through hydrologic and hydraulic analyses performed in accordance with standard engineering practices that the proposed expansion or enlargement would not result in any increase in the base flood elevation.

B. Any modification, alteration, repair, reconstruction, or improvement of any kind to a structure and/or use located in any floodplain ~~areas~~ district to an extent or amount of less than fifty (50) percent of its market value shall conform to the VA USBC and meet the freeboard height in effect at the start of construction for the original structure.

C. Any modification, alteration, repair, reconstruction, or improvement of any kind to a structure and/or use, in any floodplain ~~area~~ district to an extent or amount of fifty (50) percent or more of its market value shall be undertaken only in full compliance with this ordinance and shall require the entire structure to conform to the VA USBC.

ARTICLE VI. VARIANCES AND APPEALS

Sec. 6.1. Administrative variances.

The floodplain administrator shall approve or deny an application requesting an administrative variance after receipt of a complete application. Administrative variances may only be granted for the following uses, development, or redevelopment:

A. As defined in section 4.10, floodplains subject to special restrictions, for filling only.

B. Any structure or use sustaining damage not caused by flood to an extent or amount of fifty (50) percent or more of its market value to allow the structure to be rebuilt to the freeboard height in effect at the start of construction for the original structure. If the structure is a pre-FIRM structure, full compliance with the current VAUSBC freeboard above the base flood elevation is required. Structures that are utilizing an approved land management plan for their on-site waste disposal may be allowed to continue the use of the land management plan as long as it is approved by the city and the health department, even for damage or destruction resulting from flood.

C. As defined in section 4.8 B, X and X(Shaded) Zone requirements. (Other Areas of Flood Risk), and 4.3 A(ii) when the required finished floor is higher than the BFE plus two feet of freeboard, where the floodplain administrator, in consultation with the Development Services Center, has determined that the proposed stormwater engineering design will approximately mitigate any impacts to the finished floor of the nonresidential development.

Sec. 6.3. Application process.

A. Applications for variances from the requirements of this ordinance shall be made to the city council and filed with the director of planning. The fee for such applications shall be ~~six hundred fifty dollars~~ seven hundred eighty ($~~650~~780.00). Such fee shall include all costs of notifications and advertising. Except in cases in which such fee is waived, the director shall not accept any application not accompanied by payment of the required fee. The procedure for the advertising, hearing and determination of applications for floodplain variances shall be in accordance with the requirements pertaining to applications for subdivision variances, as set forth in section 9.4 of the subdivision ordinance. In cases in which a variance application is filed by reason of a natural disaster that is the subject of a federal declaration of emergency, application and associated advertising fees shall be waived and such application shall be given expedited processing to the maximum practical extent.

B. All applications shall be accompanied by the following:

1. A separate map, on a 1″ = 100′ or greater scale, identifying all proposed land disturbance, including fill and mitigation areas, and the limits of the existing and proposed SFHAs, tidal and non-tidal wetlands, Southern Rivers Watershed Management Area Buffer, and CBPA Resource Protection Area Buffer; and

2. A preliminary floodplain study addressing the physical and environmental characteristics of the floodplain located on adjoining properties and in the general area. Such study shall be sufficient to show that the variance, if granted, will meet the standards defined in section 6.~~3~~4 and in addition thereto, shall:

   a. Contain supporting data and calculations required for a Preliminary Stormwater Engineering Analysis as appropriate~~,~~ ~~given the preliminary nature of the floodplain study~~;

   b. Comply with the Public Works Design Standards Manual; and

   c. Be certified by a professional engineer, architect, surveyor, landscape architect or practitioner of a related field having a valid license issued by the Commonwealth of Virginia or who is exempt from licensure pursuant to applicable provisions of the Virginia Code.

Adopted by the Council of the City of Virginia Beach, Virginia, on the 1st day of February, 2022.

Attachment 6: Copy of Monitoring/Maintenance Plan

Dewberry

[DRAFT] Annual Monitoring Plan and Post-Construction Monitoring Report

Marsh Restoration in Back Bay, Virginia Beach, VA

Prepared by: Dewberry Engineers, Inc.

[July 6, 2023]

[REPORT VERSION [DRAFT]]

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INTRODUCTION

This project is intended to implement one of the nature-based projects proposed in Virginia Beach's "Sea Level Wise" (SLW) Adaptation Strategy[1] adopted by the Virginia Beach City Council in June 2020. The SLW Adaptation Strategy presents a holistic framework for addressing flood risks across the City, consisting of four general strategies – natural mitigations, engineered defenses, adapted structures, and prepared communities. These strategies were applied to each major watershed in the City and tailored to their unique characteristics and risk profiles. The adaptation vision for the Lower Southern Rivers Drainage Basin, where the proposed project is located, focuses on employing natural mitigation methodologies to strategically reduce flow into and within Back Bay, along with an integrated system of defense structures and complementary adaptation measures, such as land-use strategies, to improve flood storage and overall coastal resiliency. The Bonney Cove area of Back Bay, where the project site is proposed, is particularly suitable for the use of nature-based strategies given the low elevations of marshlands and documented historic degradation of habitat. Participants at the 'near-neighbor' public engagement meetings held during the SLW Adaptation Strategy development were supportive of these types of strategies.

The City has several dedicated Capital Improvement Program (CIP) initiatives for the Lower Southern Rivers Drainage Basin for implementation of these strategies. The City's Stormwater Green Infrastructure CIP has obligated approximately $421,700 in contracts to support field investigations, environmental assessments, and engineering designs of the project – a true indication of the City's commitment to nature-based approaches and the critical first step in a broader effort. During the General Election on November 2, 2021, Virginia Beach residents voted to authorize $567.5 million dollars in debt to fund the design and construction of 21 Phase 1 projects in the citywide Flood Protection Program. [2] The Back Bay Marsh Terrace project is included under the Stormwater Green Infrastructure Master Project.[3] Other Southern Watershed projects that received funding under the Flood Protection Program include the West Neck Creek Bridge City-Wide Sea Level Rise Strategy, the Pungo Ferry Road Improvements, and the Sandbridge/New Bridge Intersection Improvements projects.

Outside of this project, the Virginia Beach City Council has recently funded a $5.2 million dollar voluntary acquisition program to encourage flood-prone properties to apply for a buyout to enable the City to convert parcels to open space to serve as flood storage and a marsh migration buffer. The City's

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[1] City of Virginia Beach Sea Level Wise Adaptation Strategy webpage: https://www.vbgov.com/government/departments/public-works/comp-sea-level-rise/Pages/default.aspx

[2] City of Virginia Beach Flood Protection Program webpage: https://www.vbgov.com/government/departments/public-works/flood-protection-program/Pages/Flood-Protection-Program.aspx.

[3] Stormwater Green Infrastructure Page: https://www.vbgov.com/government/departments/public-works/flood-protection-program/Pages/Stormwater-Green-Infrastructure-.aspx

Stormwater Green Infrastructure CIP is also supporting the implementation of other natural and nature-based projects across the City, including a wetland and floodplain restoration project along the Eastern Branch of the Elizabeth River.

An assessment of restoration opportunities in the City's Lower Southern Rivers Drainage Basin with dual flood reduction and habitat restoration benefits identified the Bonney Cove area as a potential project site for several reasons. The Bonney Cove site has experienced significant historical ecological degradation. Historical shoreline data from 1869 indicates approximately 50% of present-day open water in Bonney Cove (260 acres) was previously marsh (Figure 1). Loss of the marsh island habitat within Bonney Cove has resulted in the opening of a secondary channel allowing increased flow exchange between the upper and lower bays. In comparison to shore-adjacent restoration, off-shore marsh restoration leveraging hydraulic modeling identified Bonney Cove as a location where marsh restoration has the potential to reduce the propagation of floodwaters through key pathways within Back Bay. The United States Fish and Wildlife Service (USFWS) and the Virginia Department of Wildlife Resources (VDWR) also identified Bonney Cove as a restoration priority as this area serves as an ideal location for Submerged Aquatic Vegetation (SAV) reestablishment and vital habitat for migratory birds and fish.

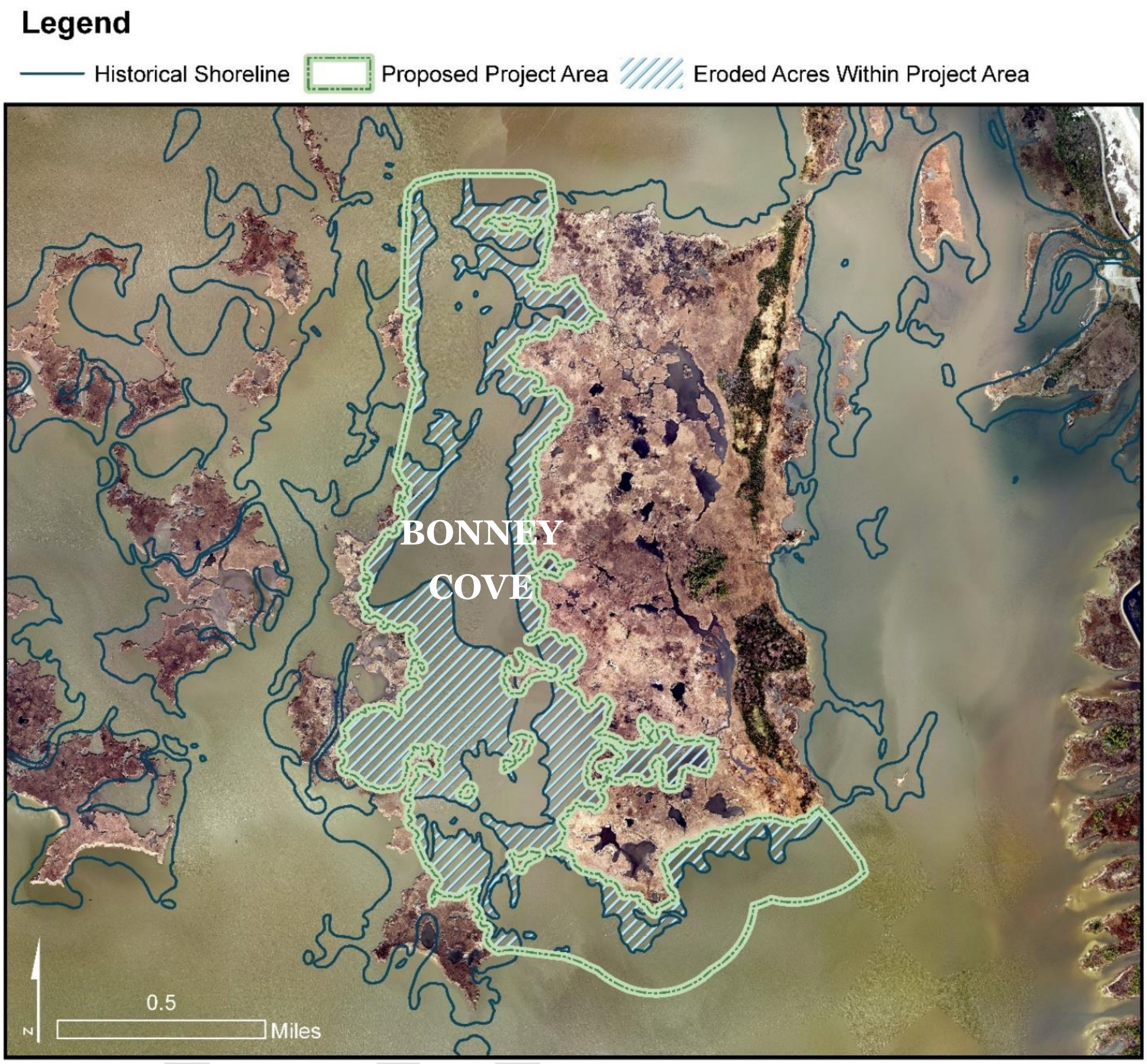

Figure 1: Historical marsh erosion within the project area.

The project is situated within the Bonney Cove area of Back Bay, spanning the western and southern lengths of Long Island, as shown in Figure 1.

Project Background

Marsh island restoration through terracing was identified as a particularly viable solution given Back Bay’s shallow bottom and the historical loss of habitat. The marsh terraces are narrow man-made islands that will be arranged across areas that were historically marsh but are now shallow open water. A series of these islands, or terraces, are typically arranged in a chevron pattern. The overall field of terraces dissipates waves and slows down water moving through the area. In turn, the calmer water allows more sunlight to penetrate to the shallow bottom, promoting establishment and growth of marsh

and SAV habitats.   Further, as opposed to one continuous marsh platform, marsh terraces maximize habitat for a variety of fish and wildlife species.

The Preferred Alternative includes the creation of 41 individual marsh terraces totaling approximately 25,000 linear feet (or an approximately 47-acre footprint) across Bonney Cove. These 47 acres of terraces are comprised of approximately 13 acres of emergent (low and high marsh) vegetated habitat, 14 acres of upland vegetated habitat, and 16 acres of submerged terrace habitat. Approximately 310 acres of suitable SAV habitat will remain in between the terraces.

Terrace Construction and Orientation

Terrace construction will begin in the northern extent of the project site, and the contractor will work towards the southern extent of the site. The contractor will complete each terrace, including installing plants, before moving to the next. Marsh terrace construction will occur over two years (2025 to 2026) and will pause annually between October 31st and March 1st to limit disturbance to wintering waterfowl and migration, in accommodation of BBNWR's requirement. Approximately 20 terraces will be constructed in 2025 ("Phase 1"), and 21 terraces will be constructed in 2026 ("Phase 2"). The following sections summarize the proposed design and construction approach.

Terraces will be generally oriented perpendicular to the predominant wind direction (south-southwest) to maximize wave energy reduction. The terraces will be segmented in a chevron (duck-wing) pattern to create the most favorable fish and swimming crustacean (termed "nekton") habitat, facilitate adequate circulation, and maintain navigability throughout the project area. The terraces will not be connected to the adjacent marsh to maintain a physical open water barrier to deter the invasion of Common Reed (*Phragmites australis*) stands.

The terraces will be spaced at approximately 300-foot intervals in the northern and southern quarters and span 15 feet in width, and at least 600-foot intervals in the center and span 30 feet in width. This arrangement will lessen the amount of open water and subsequent wave action at the northern and southern ends of the site and provide space for marine-based construction equipment. The design team reviewed the final spacing layout of the terraces to ensure navigability of a watercraft through the project site which will be required for post-construction monitoring, any needed maintenance, as well as community recreational access.

The terraces would consist of a sand filled core encapsulated by a high-strength blend of woven and non-woven geotextile fabrics ("geobags"). The sand for this material would need to come from offsite sources. Back Bay is too shallow to accommodate conventional barges for material placement. To avoid extensive impacts to the bottom of the bay, the slurry basin will pump sand for the project from the proposed Shipps Cabin Road staging area to Bonney Cove. The slurry pipeline will consist of approximately 10,424 linear feet of 12" diameter HDPE fused/welded pipeline that will be assembled on land and floated into its proposed alignment within Back Bay. The pipe would be marked by floats

every 5 feet and temporary signage as reasonable. It is anticipated the pipeline will be submerged to the bottom of the bay at channel crossings and adjacent to a duck hunting cabin adjacent to the alignment. By establishing a floating pipeline, it will limit disturbances to the subaqueous bottomlands along the alignment and allow for the retraction of the pipeline during the winter inactive periods and inclement weather events. Booster stations would be placed approximately every mile. These booster stations would consist of a pontoon mounted diesel engine pump capable of moving the sand slurry from the laydown area to the site. Given the distance to the site, four or five of these booster stations are anticipated to be necessary to create the sand cores of the terrace. It is estimated that 450 Gallons Per Minute (GPM) of sand slurry would be pumped through the pipe.

Once the cores are in place, long reach excavators would travel along the tops of the terraces and begin to shape the cross slopes. Appropriate materials for establishing vegetation atop the terraces will be primarily sourced from materials dredged during the Sandbridge Road Nimmo Parkway Phase VII-A project located immediately north of Back Bay (VMRC 15-1564, USACE IP NAO-2015-00151). Materials will be tested and screened to remove organics prior to application to the terraces. As needed, dredging sites adjacent to the proposed terrace locations that are confirmed to be devoid of SAV will be utilized to provide supplemental soil materials to top the proposed terraces[4]. It was determined that the in-situ bay sediment would be suitable for vegetation growth. The marsh terraces would be covered with 1 to 3 feet of suitable fill, depending on crest widths. Jute netting will cover the topsoil to control erosion and promote vegetation establishment. Coir logs will be places along the terrace slope controls to further promote vegetation establishment along the slope.

SAV Plantings

The City has partnered with Virginia Polytechnic Institute and State University ("Virginia Tech") to evaluate opportunities for restoring populations of native Wild Celery (*Vallisneria americana*) in Back Bay. The Virginia Tech research team has developed an innovative technique to grow Wild Celery in an aquaculture center that results in larger, mature plants that can better withstand Back Bay's turbidity. Once transplanted, plants are surrounded by cages to prevent predation. These founder colonies can be used for propagation throughout Back Bay. After terrace construction, the City will transplant Wild Celery in an area adjacent to the site. This founder colony will be used to strategically transplant Wild Celery in between the terraces for 5 years after construction (2026 – 2029) with the ultimate goal of establishing 10 acres of SAV vegetation in between the marsh terraces.

[4] The 60% preliminary design showed preliminary siting of these dredge areas based on avoidance of existing SAV habitat; however, pre-construction surveys of SAV would be required to re-delineate these dredging areas.

Terrace Plantings – Upland and Marsh Vegetation

The terraces' intertidal perimeter will be planted with appropriate emergent estuarine plant species (e.g., Saltmarsh Cordgrass [*Spartina alterniflora*] and Salt Meadow Hay [*Spartina patens*]) and brackish plant species (e.g., Big Cordgrass [*Spartina cynosuroides*]). These plants will be installed as soon as possible after construction to stabilize planting areas and protect the terrace from erosion. In addition to emergent grass, woody growth (i.e., shrubs and trees) within the terrace crest will be incorporated to protect the terraces' surfaces from rain and wind erosion and hold the landform together through substantial root systems.

Appropriate native species were identified based on the review of the reference marshes surrounding the project site and a review of water levels in Back Bay. Since the Bay's water levels are not affected by lunar tides and instead by wind-driven fluctuations, the project team evaluated average water elevations at the U.S. Geological Survey (USGS) Beggars Bridge Creek Gauge (Gauge ID 0204300267) from 2016 – 2021 to determine ranges of inundation to achieve functional marsh elevations throughout the project life, defined as:

- *Mean Low Water (MLW)*: the average low water at the site (10th Percentile: -0.62 ft NAVD88)
- *Mean High Water (MHW)*: the average high water at the site (95th Percentile: 1.22 ft NAVD88)
- *Mean Tide Level (MTL)*: halfway between MLW and MHW (0.3 ft NAVD88)
- *Upper Limit of Wetlands (ULW)*: approximately 1.5 times the mean tide range at the site (2.76 ft NAVD88)

These elevations were correlated to suitability for low marsh, high marsh, and upland species, as shown in Table 1.

Table 1: Proposed planting elevation zones.

Planting Zone	Definition	Elevation Range	Elevation (feet NAVD88)	Percentage of record where water reaches these elevations
Low Marsh	Marsh that is flooded frequently but exposed sometimes	MTL - MHW	0.3 – 1.2 ft	48%
High Marsh	Marsh that is generally only flooded during higher-than average water conditions	MHW – ULW	1.2 to 2.8 ft	7%
Upland Habitat	Habitat that is rarely flooded, only during extreme conditions	> ULW	> 2.8 ft	0%

Five planting schemas were identified to provide the highest possible environmental benefit in terms of erosion control, habitat diversity, and fetch reduction. The wider (30-foot) terraces will be planted with Bald Cypress (*Taxodium districhum*) trees capable of withstanding rising water levels. The full list of species and quantities is provided in the 95% design plan set.

The final engineered design component is the strategic placement of rock on the exposed perimeter terraces on the project site's north, west, and southern extents. The need for the rock armor was determined through analysis of wind data both from NOAA and ASCE-7-10 50-year return period anticipated 3-second gust values. These values were used to calculate fetch-generated waves at the project site. The calculations performed confirmed that armored protection would be required to protect the proposed terraces from the forces created by wave action. The stone sizes required for these features (Class II rip rap) were calculated following the procedures laid out in the USACE Coastal Engineering Manual (CEM) and Virginia Institute of Marine Science (VIMS) Living Shoreline Design Guidelines for Shore Protection in Virginia's Estuarine Environments. Two calculation methods, Hudson (1974) and Van Der Meer (1988), from the CEM were utilized to evaluate the range of acceptable rock armor for the exposed perimeter. These two methods calculate the armor stone size based on several design inputs including initial wave height, allowable damage level, revetment slope, and breaking versus non-breaking waves. The two methods often result in corresponding values that are used by the engineer to make an experienced determination on the final rock armor sizing. The rock armor will serve as a nature-based design element by acting as a substrate for the Wild Celery grass that has proven to be successful for SAV establishment in Back Bay (see Figure 2).

Figure 2: Example Back Bay SAV experiment; photo courtesy of Virginia Tech.

Monitoring Goals and Objectives

Annual post-construction monitoring of the site is required by the Virginia Marine Resource Commission (VMRC) (TBD) Permit (VMRC #XXXX-XXXX) and the U.S. Army Corps of Engineers (USACE) Individual Permit (NOA-20XX-XXXXX). [Insert details of the relevant permits and permit conditions]. The following goals, objectives, and metrics were established to enable consistent tracking of the primary living shoreline project components across each monitoring year.

1. **Monitoring Goal 1**: Establishment of a Sustainable Coastal Marsh Island System
   a. Objective 1a: Establish Emergent Marsh Habitat
      - Metric: For each monitoring year, the project area should maintain or increase the overall coverage of emergent marsh vegetation. There should be no significant signs of herbivory or invasive species establishment.

   b. Objective 1b: Establish Upland Habitat
      - Metric: For each monitoring year, the project area should maintain or increase the overall coverage of upland vegetation. There should be no significant signs of herbivory or invasive species establishment.
2. **Monitoring Goal 2**: Stability of Marsh Terraces
   a. Objective 2: Marsh Terrace Structures
      - Metric: For each monitoring year, the terrace structures should show no significant signs of damage, deterioration or extreme settlement.
3. **Monitoring Goal 3**: Establishment of a Sustainable SAV Community
   a. Objective 3: Establish SAV Communities

- Metric: For each monitoring year, the SAV planting areas should maintain or increase the overall coverage of SAV vegetation. There should be no significant signs of herbivory or invasive species establishment.

MONITORING PLAN

The monitoring plan includes stakeholders, a schedule for the annual monitoring inspections, the monitoring strategy/sampling plan, and approach for addressing any needs for maintenance.

Monitoring Stakeholders

An Environmental Scientist from Dewberry Engineers Inc. will perform the annual monitoring inspections and provide a copy of the monitoring report to the City of Virginia Beach, USACE, VDEQ, VMRC, and the City of Virginia Beach Wetlands Board as necessary. As owners of the project, the City of Virginia Beach will review monitoring recommendations and perform corrective actions as necessary.

Annual Inspection Schedule

Monitoring inspections should be conducted annually, during the peak growing season, which is defined by VMRC as between June and August. To enable consistent tracking of project performance from year to year, annual monitoring inspections will be conducted prior to the end of the growing season in September of each year, with annual reports to be submitted to regulatory stakeholders prior to November 30th [or an annual date defined in the permit conditions] of each year. The following outlines the monitoring inspection schedule and deliverables.

Phase 1 Post-Construction As-Built Report (Date: Prior to December 31st, 2025)

To serve as a baseline for the post-construction annual monitoring, an as-built report for the Phase 1 terraces will be completed following the construction of each phase of terraces and submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following.

- Coordinates and diagrams of established transects, as well as site photographs from photo stations 1-40 as defined in the Methods section.
- Final location of all planted vegetation (upland plantings, high marsh plantings and low marsh plantings).
- Final grade topographic surveys (plan, profile, and cross sections).
- Discussion of the project design versus as-built conditions.

Phase 2 Post-Construction As-Built Report (Date: Prior to December 31st, 2026)

To serve as a baseline for the post-construction annual monitoring, an as-built report for the Phase 2 terraces will be completed following the construction of each phase of terraces and submitted to the

City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following.

- Coordinates and diagrams of established transects, as well as site photographs from photo stations 41-80 as defined in the Methods section.
- Final location of all planted vegetation (upland plantings, high marsh plantings and low marsh plantings).
- Final location and extent of SAV plantings.
- Final grade topographic surveys (plan, profile, and cross sections).
- Discussion of the project design versus as-built conditions.

Year 1a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2026)

At the end of the first full growing season following planting of the Phase 1 terraces, a Year 1a monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 40 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 1 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion; it is anticipated that the wetland planting contractor will provide a one-year post construction maintenance and guarantee period for the wetland plantings.

Year 1b/2a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2027)

At the end of the first full growing season following planting of the Phase 2 terraces following planting, and the second full growing season of the Phase 1 terraces, a Year 1b/2a monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 1 conditions (for Phase 2 terraces) and to Year 2 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).

- Estimated percent cover and change in coverage from planted conditions to Year 1 conditions for SAV planting quadrants
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion; it is anticipated that the wetland planting contractor will provide a one-year post construction maintenance and guarantee period for the wetland plantings.

Year 2b/3a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2028)

At the end of the second full growing season of the Phase 2 terraces following planting, and the third full growing season of the Phase 1 terraces, a Year 2b/3a monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 2 conditions (for Phase 2 terraces) and to Year 3 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- Estimated percent cover and change in coverage from planted conditions to Year 2 conditions for SAV planting quadrants
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

Year 3b/4a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2029)

At the end of the third full growing season of the Phase 2 terraces following planting, and the fourth full growing season of the Phase 1 terraces, a Year 3b/4a monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 3 conditions (for Phase 2 terraces) and to Year 4 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).

- Estimated percent cover and change in coverage from planted conditions to Year 3 conditions for SAV planting quadrants
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

Year 4b/5a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2030)

At the end of the fourth full growing season of the Phase 2 terraces following planting, and the fifth full growing season of the Phase 1 terraces, a Year 4b/Final (Year 5a) monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 4 conditions (for Phase 2 terraces) and to Year 5 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- Estimated percent cover and change in coverage from planted conditions to Year 4 conditions for SAV planting quadrants
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

Year 5b Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2031)

At the end of the fifth full growing season of the Phase 2 terraces following planting, a Final (Year 5b) monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 41 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 5 conditions (for Phase 2 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- Estimated percent cover and change in coverage from planted conditions to Year 5 conditions for SAV planting quadrants

- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

Monitoring Strategy

The monitoring strategy consists of established transects with photo stations and quadrants that cover the area between transects. This approach enables monitoring of the four primary features of the living shoreline: uplands, low-marsh plantings, high-marsh plantings, and SAV*.

*Note: The planting scheme for SAV has not yet been established but it is anticipated that some SAV will be planted along the submerged portions of the marsh terraces. If more suitable planting locations are determined to be between terraces, separate transects will be established and sampled to track SAV survival apart from the proposed terrace transects.

Transects/Photo Points

A total of eighty (80) transects will be established across the project site, with 10 transects located along each of 8 terraces. Transects will span perpendicular to the length of each terrace from the ridge to the edge of the planted/vegetated area. See Figures 3 and 4 for graphic depictions of the proposed transect locations and layouts. Terraces were selected using a random stratified method to ensure representative terraces in each location within the project area (North Interior, North Exterior, South Interior, South Exterior), and of each planting scheme, were represented in the proposed monitoring plan. The selected terraces are as follows:

- North Interior: T-110, T-113
- North Exterior: T-100, T-106
- South Interior: T-124, T-131
- South Exterior: T-123, T-140

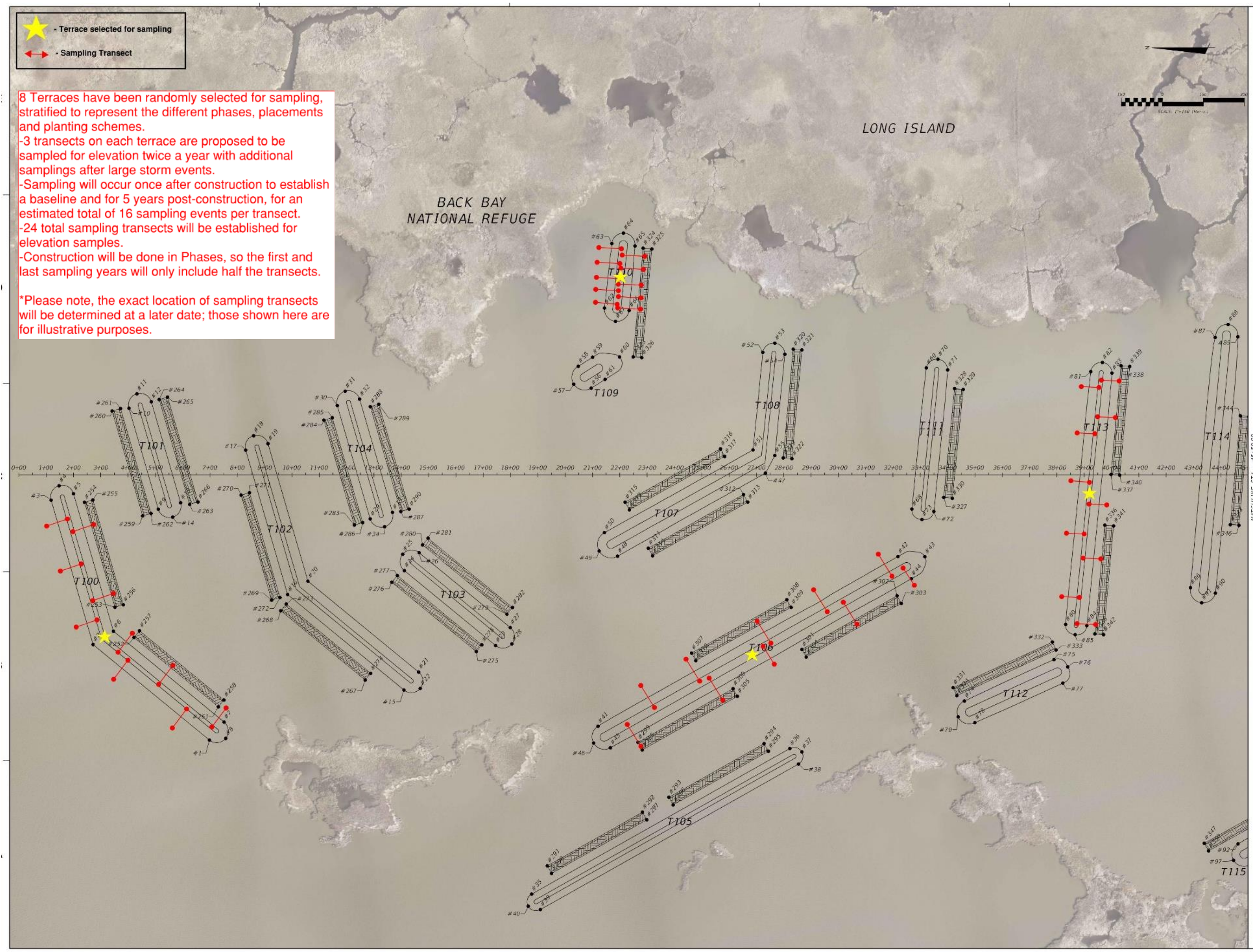

Figure 3: Monitoring design site plan – North Terraces

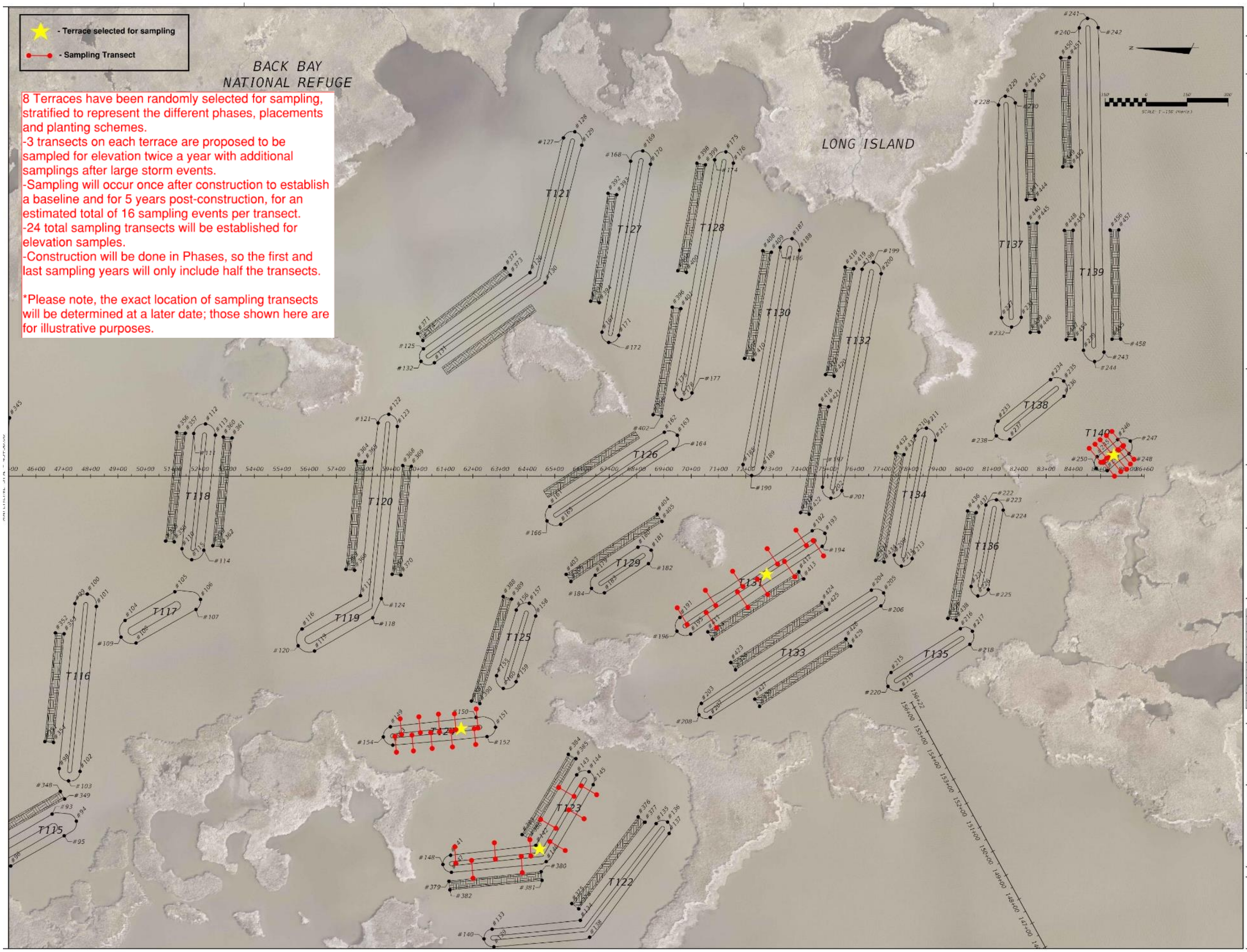

Figure 4: Monitoring design site plan – South Terraces

Permanent photo stations will be established at each quadrant along each transect to capture the design features/established habitats and vegetation. Figure 5 shows the general proposed locations (indicated by the red arrows/labels) for each quadrant and photograph station along each transect. Photos were shot from each photo location on [DATE]. These photos will be collected annually and compiled in Appendix B.

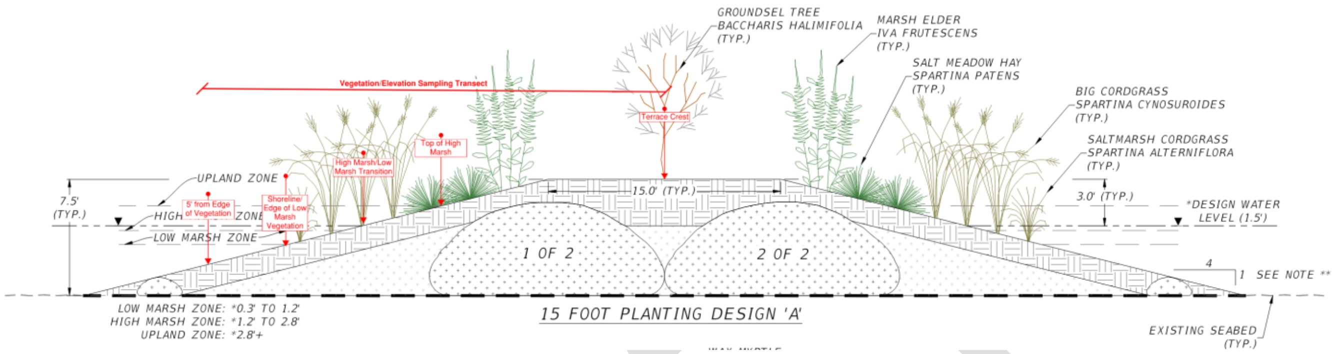

Figure 5: Photo station layout example

Quadrants

To estimate percent cover of vegetation, four (4) quadrants along each of ten (10) transects will be established on the eight selected terraces to allow for estimates of habitat coverage and planting survival. Estimates of coverage and survival were compared to post-construction conditions to evaluate changes.

Further, the following guiding questions were established to monitor overall project performance, presence of invasive species, and identify any needs for maintenance:

1. Are there specific problem areas where plants are dying or appear unhealthy?
2. Were any signs of herbivory observed?
3. Are there any undesirable plant species present?
4. Condition of the terrace structures: Is there any observed settlement, dislodged stone, significant debris etc.?
5. If an updated survey was conducted, are there any significant changes in the profile of the marsh terraces?
6. Does the upland portion of each terrace show any significant signs of erosion or loss of vegetation?

MONITORING RESULTS

Table 2: Low Marsh Vegetation Percent Cover Monitoring Results (Example Table – Terrace 1).

		Estimated Percent Coverage						Percent Change in Coverage (from Baseline)				
Terrace/ Transect	Photo Station Reference	Baseline (2024)	Year 1 (2025)	Year 2 (2026)	Year 3 (2027)	Year 4 (2028)	Year 5 (2029)	Baseline to Year 1	Baseline to Year 2	Baseline to Year 3	Baseline to Year 4	Baseline to Year 5
1 - 1	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
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Overall		Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.

Table 3: High Marsh Vegetation Percent Cover Monitoring Results (Example Table – Terrace 1).

		Estimated Percent Coverage						Percent Change in Coverage (from Baseline)				
Terrace/ Transect	Photo Station Reference	Baseline (2024)	Year 1 (2025)	Year 2 (2026)	Year 3 (2027)	Year 4 (2028)	Year 5 (2029)	Baseline to Year 1	Baseline to Year 2	Baseline to Year 3	Baseline to Year 4	Baseline to Year 5
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1 - 9	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 10	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
Overall		**Choose an item.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**

Table 4: General Observations for Wetland Planting Areas on the Marsh Terraces (Example Table – Terrace 1)

Monitoring Questions	Terrace/Transect									
	1 - 1	1 - 2	1 - 3	1 - 4	1 - 5	1 - 6	1 - 7	1 - 8	1 - 9	1 - 10
Are there specific problem areas where plants are dying or appear unhealthy?	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.
Were any herbivory issues observed?	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.
Are there any undesirable plant species present?	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.
If updated survey was conducted, are there any significant changes in the profile of the living shoreline system?	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.

Table 5: General Observations for the Unplanted Structural Components of the Marsh Terraces (Example Table – Terrace 1)

Terrace/Transect										
Monitoring Questions	1 - 1	1 - 2	1 - 3	1 - 4	1 - 5	1 - 6	1 - 7	1 - 8	1 - 9	1 - 10
Are there any structural issues with the planted terrace structures (e.g. observed settlement, loss of topsoil, etc.)?	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.
Is there any observed growth in SAV on or adjacent to the marsh terraces?	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.

Are there any structural issues with the rock armoring on the terraces (e.g. observed settlement, dislodged stone, significant debris, etc.)?	YES ☐ NO ☒ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☒ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.

MAINTENANCE RECOMMENDATIONS

The following table outlines the recommendations for maintenance, including estimated quantities and specific guidance, based on the results of the [YEAR] monitoring results.

Table 6: Maintenance Recommendations Checklist

Design Feature/ Monitoring Objective	Maintenance Elements	Location & Estimated Quantity	Specific Guidance
Terrace Upland and Wetland Habitats and Wetland Soils – Monitoring Objectives 1a/1b	☐ Replace plants	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Add new plants	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Remove debris	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Remove invasive vegetation	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Add sand to eroding areas	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Replace waterfowl barrier	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.

Design Feature/ Monitoring Objective	Maintenance Elements	Location & Estimated Quantity	Specific Guidance
Terrace Structures & Stone Armoring, Monitoring Objective 2a/2b	☐ Re-place dislodged stones	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Add additional stone to address settlement	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Remove debris	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Repair sand cores or other structural elements	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
SAV Establishment, Monitoring Objective 3	☐ Replace plants	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Add new plants	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.

APPENDIX A: AS-BUILT PLANS

[Page left intentionally blank; as-built plans will be included in the Year 1 monitoring report]

APPENDIX B: MONITORING PHOTOGRAPHS

Table 7: Terrace 1 Transect 1 Photographs

Photograph from Photo Location 1A	Photograph from Photo Location 1B
Photograph from Photo Location 1C	Additional photos of any problem areas.

Table 8: Terrace 1 Transect 2 Photographs

Photograph from Photo Location 2A	Photograph from Photo Location 2B
Photograph from Photo Location 2C	Additional photos of any problem areas.

Table 9: Terrace 1 Transect 3 Photographs

Photograph from Photo Location 3A	Photograph from Photo Location 3B
Photograph from Photo Location 3C	Additional photos of any problem areas.

Table 10: Terrace 1 Transect 4 Photographs

Photograph from Photo Location 4A	Photograph from Photo Location 4B
Photograph from Photo Location 4C	Additional photos of any problem areas.

Table 11: Terrace 1 Transect 5 Photographs

Photograph from Photo Location 5A	Photograph from Photo Location 5B
Photograph from Photo Location 5C	Additional photos of any problem areas.

Table 12: Terrace 1 Transect 6 Photographs

Photograph from Photo Location 6A	Photograph from Photo Location 6B
Photograph from Photo Location 6C	Additional photos of any problem areas.

Table 13: Terrace 1 Transect 7 Photographs

Photograph from Photo Location 7A	Photograph from Photo Location 7B
Photograph from Photo Location 7C	Additional photos of any problem areas.

Table 14: Terrace 1 Transect 7 Photographs

Photograph from Photo Location 7A	Photograph from Photo Location 7B
Photograph from Photo Location 7C	Additional photos of any problem areas.

Table 15: Terrace 1 Transect 8 Photographs

Photograph from Photo Location 8A	Photograph from Photo Location 8B
Photograph from Photo Location 8C	Additional photos of any problem areas.

Table 16: Terrace 1 Transect 9 Photographs

Photograph from Photo Location 9A	Photograph from Photo Location 9B
Photograph from Photo Location 9C	Additional photos of any problem areas.

Table 17: Terrace 1 Transect 10 Photographs

Photograph from Photo Location 9A	Photograph from Photo Location 9B
Photograph from Photo Location 9C	Additional photos of any problem areas.

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2023 Virginia Community Flood Preparedness Fund

Marsh Restoration in Back Bay, Virginia Beach

CITY OF VIRGINIA BEACH

Table of Contents

Appendix A – Application Form

Applicants must have prior approval from the Department to submit <u>applications, forms, and supporting documents by mail in lieu of the WebGrants portal.</u>

Appendix A: Application Form for Grant and Loan Requests for All Categories

Virginia Department of Conservation and Recreation
Virginia Community Flood Preparedness Fund Grant Program

Name of Local Government:

Category Being Applied for (check one):

☐ **Capacity Building/Planning**

☑ **Project**

☐ **Study**

NFIP/DCR Community Identification Number (CID) 515531

Name of Authorized Official and Title: Toni Utterback, Stormwater Engineering Center Administrator

Signature of Authorized Official: Katie E Shannon for Toni Utterback

Mailing Address (1): 2875 Sabre Street, Suite 250

Mailing Address (2): ______

City: Virginia Beach **State:** Virginia **Zip:** 23452

Telephone Number: (757) 385-8746 **Cell Phone Number:** (____) ______

Email Address: TPUtterback@vbgov.com

Contact and Title (If different from authorized official): C.J. Bodnar, Technical Services Program Manager

Type text here

Mailing Address (1): 2875 Sabre Street, Suite 250

Mailing Address (2): ______________________________

City: Virginia Beach **State:** Virginia **Zip:** 23452

Telephone Number: (757) 385-8430 **Cell Phone Number:** (____) ______________

Email Address: CBodnar@vbgov.com

Is the proposal in this application intended to benefit a low-income geographic area as defined in the Part 1 Definitions? Yes ____ No ✓

Categories (select applicable activities that will be included in the project and used for scoring criterion):

Capacity Building and Planning Grants

☐ Floodplain Staff Capacity.

☐ Resilience Plan Development

- ☐ Revisions to existing resilience plans and modifications to existing comprehensive and hazard mitigation plans.
- ☐ Resource assessments, planning, strategies, and development.
  - Policy management and/or development.
  - Stakeholder engagement and strategies.

☐ Other: ______________________________

Study Grants (Check All that Apply)

☐ Studies to aid in updating floodplain ordinances to maintain compliance with the NFIP, or to incorporate higher standards that may reduce the risk of flood damage. This must include establishing processes for implementing the ordinance, including but not limited to, permitting, record retention, violations, and variances. This may include revising a floodplain ordinance when the community is getting new Flood Insurance Rate Maps (FIRMs), updating a floodplain ordinance to include floodplain setbacks, freeboard, or other

higher standards, RiskMAP public noticing requirements, or correcting issues identified in a Corrective Action Plan.

- ☐ Revising other land use ordinances to incorporate flood protection and mitigation goals, standards, and practices.
- ☐ Conducting hydrologic and hydraulic (H&H) studies of floodplains. *Changes to the base flood, as demonstrated by the H&H must be submitted to FEMA within 6 months of the data becoming available.*
- ☐ Studies and Data Collection of Statewide and Regional Significance.
- ☐ Revisions to existing resilience plans and modifications to existing comprehensive and hazard.
- ☐ Other relevant flood prevention and protection project or study.

Project Grants and Loans (Check All that Apply – Hybrid Solutions will include items from both the "Nature-Based" and "Other" categories)

Nature-based solutions

- ☐ Acquisition of property (or interests therein) and/or structures for purposes of allowing floodwater inundation, strategic retreat of existing land uses from areas vulnerable to flooding; the conservation or enhancement of natural flood resilience resources; or acquisition of structures, provided the acquired property will be protected in perpetuity from further development, <u>and where the flood mitigation benefits will be achieved as a part of the same project as the property acquisition.</u>
- ☑ Wetland restoration.
- ☐ Floodplain restoration.
- ☐ Construction of swales and settling ponds.
- ☑ Living shorelines and vegetated buffers.
- ☐ Permanent conservation of undeveloped lands identified as having flood resilience value by *ConserveVirginia* Floodplain and Flooding Resilience layer or a similar data driven analytic tool, or the acquisition of developed land for future conservation.
- ☐ Dam removal.
- ☐ Stream bank restoration or stabilization.
- ☐ Restoration of floodplains to natural and beneficial function.

Other Projects

- ☐ Structural floodwalls, levees, berms, flood gates, structural conveyances.
- ☐ Storm water system upgrades.
- ☐ Medium and large-scale Low Impact Development (LID) in urban areas.

- ☐ Developing flood warning and response systems, which may include gauge installation, to notify residents of potential emergency flooding events.
- ☐ Dam restoration.
- ☐ Beneficial reuse of dredge materials for flood mitigation purposes
- ☐ Removal or relocation of structures from flood-prone areas where the land will not be returned to open space.
- ☐ Acquisition of property (or interests therein) and/or structures for purposes of allowing floodwater inundation, strategic retreat of existing land uses from areas vulnerable to flooding; the conservation or enhancement of natural flood resilience resources; or acquisition of structures, provided the acquired property will be protected in perpetuity from further development, <u>and where the flood mitigation benefits will **not be** achieved as a part of the same project as the property acquisition.</u>
- ☐ Other project identified in a DCR-approved Resilience Plan.

Location of Project or Activity (Include Maps): Bonney Cove in Back Bay, Virginia Beach

NFIP Community Identification Number (CID#) : 515531

Is Project Located in an NFIP Participating Community? ☑ Yes ☐ No

Is Project Located in a Special Flood Hazard Area? ☑ Yes ☐ No

Flood Zone(s) (If Applicable): Zone VE (EL 5 Feet), Zone AE (EL 4 Feet), Zone Open Water

Flood Insurance Rate Map Number(s) (If Applicable): 5155310215G and 5155310220G

Total Cost of Project: $53,378,490

Total Amount Requested $5,000,000

Amount Requested as Grant $5,000,000

Amount Requested as Project Loan (not including short-term loans for up-front costs) ____________________

Amount Requested as Short-Term loan for Up-Front Costs (not to exceed 20% of amount requested as Grant) __________________________

For projects, planning, capacity building, and studies in low-income geographic areas: Are you requesting that match be waived? □ Yes □ No

<u>Additional Information for Loan Requests</u>
Requested Loan Security: ______________________________

(General Obligation, Lease, Revenue, Special Fund Revenue, and/or Moral obligation from other government entity)

Desired loan term: __________________________________

Since the date of your latest financial statements, did the applicant issue any new debt? ______
(If yes, provide details)

Is there any pending or potential litigation by or against the applicant? ______________

Attach five years of current audited financial statements (FY18-22) or refer to website if posted
(Not necessary for existing VRA borrowers)

Attach FY2024 adopted budget or refer to website

Attach current Capital Improvement Plan

Attach adopted Financial Policies

Attach a list of the ten largest employers in the Applicant's jurisdiction.

Attach a list of the ten largest taxpayers in the Applicant's jurisdiction

Appendix B: Budget Form

Appendix B: Budget Narrative Template

Applicant Name: Community Flood Preparedness Fund & Resilient Virginia Revolving Loan Fund Detailed Budget Narrative Period of Performance: June 2024 through June 2027 Submission Date: November 12, 2023	
Grand Total State Funding Request	$ 5,000,000
Grand Total Local Share of Project	$ 38,356,966
National Fish and Wildlife Foundation Grants Federal Funding (if applicable)	$ 10,021,524
Project Grand Total	$ 53,378,490
Locality Cost Match	% 71.85

Breakout By Cost Type	Personnel	Fringe	Travel	Equipment	Supplies	Contracts	Indirect Costs	Other Costs	Total
Federal Share (if applicable)								10,021,524	10,021,524
Local Share								37,330,166	37,330,166
State Share								5,000,000	5,000,000
Pre-Award/Startup								276,800	276,800
Maintenance								750,000	750,000
Total	$	$	$	$	$	$	$	$53,378,490	$ 53,378,490

1. Federal Share represents National Fish and Wildlife Foundation (NFWF) Grants. NFWF is not a federal agency.
2. Local Share represents the total project cost less design and implementation (monitoring and initial maintenance) costs.
3. State Share represents the CFPF grant request.
4. Pre-Award costs represent project design costs.
5. Maintenance costs represent implementation (monitoring and initial maintenance costs).

Scope of Work Narrative

Introduction

The City of Virginia Beach ("City") is pleased to submit the Marsh Restoration in Back Bay project for consideration under the Flood Prevention and Protection Projects category in the 2023 Virginia Community Flood Preparedness Fund. The City has made significant investments in the study of historical flooding data, current and future hydrology, and the projected increase in flood frequency due to changing rainfall patterns and sea level rise. These studies culminated in Virginia Beach's Resilience Plan, socialized as "Sea Level Wise,"[1] which includes a conceptual suite of projects focused on flood control and resilience. The Virginia Beach Resilience Plan leverages four overarching adaptation strategies to identify actionable projects for each of the City's four unique major watersheds. This project represents the first adaptation project to advance to construction to implement the City's Resilience Plan.

The adaptation strategy for the Southern Rivers Watershed, which includes Back Bay, is presented in Figure 1. The strategy focuses on employing natural mitigation methods, an integrated system of defense structures, and complementary measures, such as land-use strategies. Collectively these approaches are designed to strategically reduce flow into and within Back Bay and improve flood storage and overall coastal resiliency. Marsh restoration was identified as a key resilience-building strategy as part of an extensive evaluation of structural and non-structural alternatives. Marsh restoration provides multiple benefits of flood risk reduction, enhanced habitat, and improved water quality.

As part of the Virginia Coastal Resilience Master Planning Framework, a precursor to the first phase of the Virginia Coastal Resilience Master Plan (CRMP), the Commonwealth of Virginia identified guiding principles for a statewide resilience strategy. One of these guiding principles is recognizing the importance of protecting and enhancing natural infrastructure and prioritizing nature-based infrastructure.[2] The City's marsh restoration project aligns with this principle and was highlighted as an exemplary nature-based project in the CRMP (refer to pages 178-179).[3]

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[1] City of Virginia Beach (2020). Virginia Beach Sea Level Wise Adaptation Strategy (Website).

[2] Office of Governor Ralph S. Northam Commonwealth of Virginia. (2020). Virginia Coastal Resilience Master Planning Framework (PDF).

[3] Office of Governor Ralph S. Northam Commonwealth of Virginia. (2021). Virginia Coastal Resilience Master Plan Phase 1 (PDF).

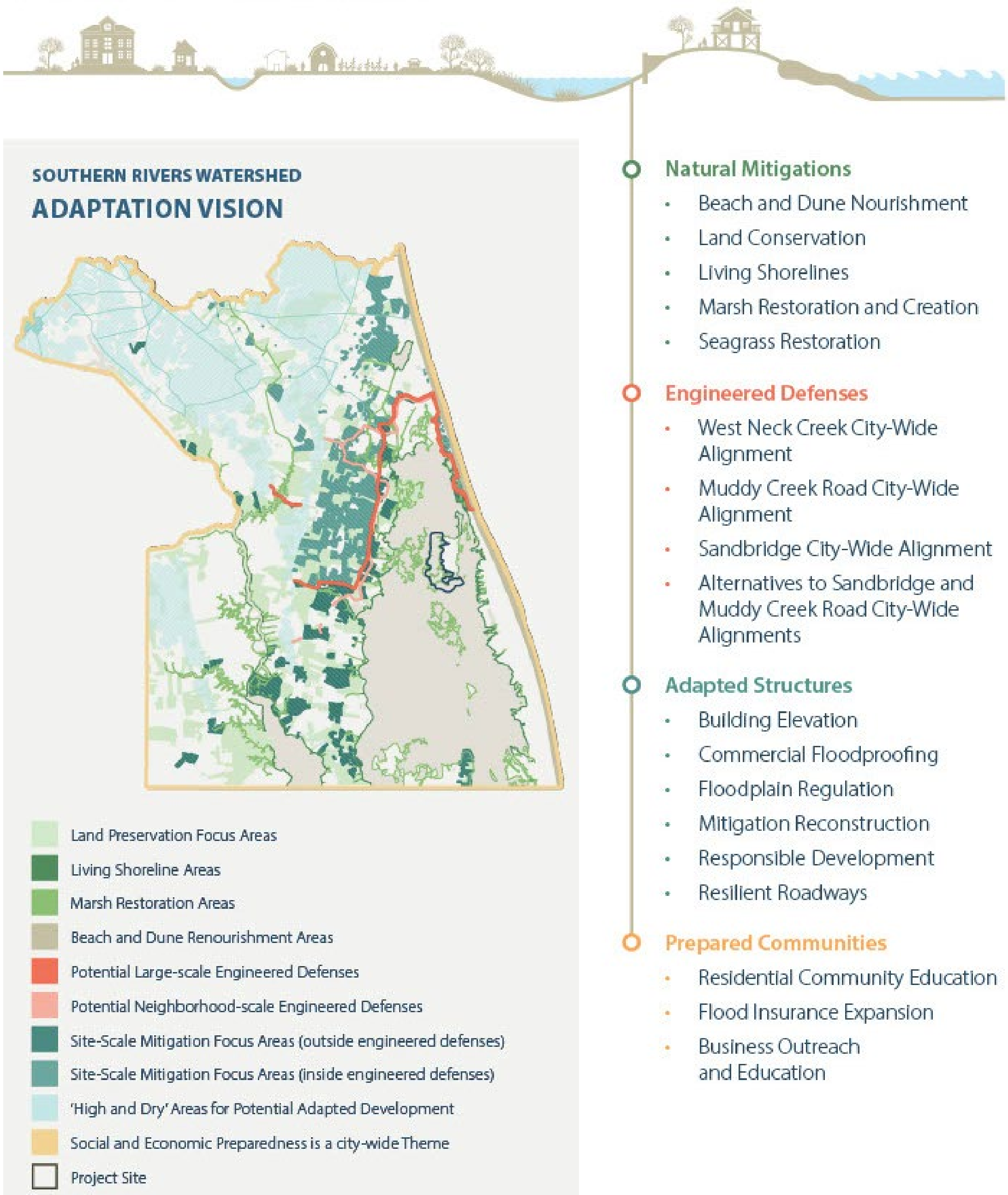

Figure 1: Adaptation Vision for the Southern Rivers Watershed.

Hydraulic modeling analysis identified Bonney Cove as a location where marsh restoration has the potential to reduce the propagation of floodwater through key pathways within Back Bay (Figure 2). The City prioritized this project as the first to advance to construction due to its significant benefits to community and habitat resilience.

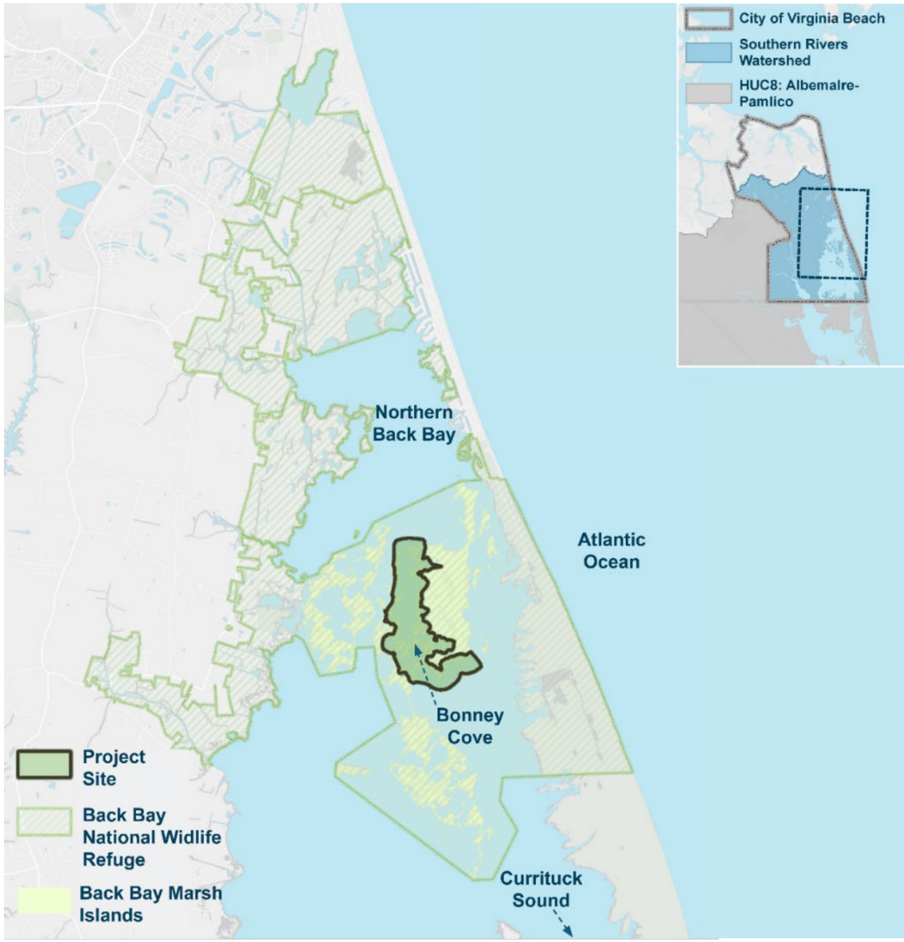

Figure 2: Project site location map.

This project represents a collaborative effort between the City's Department of Public Works alongside other City departments, public constituents, local nonprofits, and state and federal agencies. In selecting the project location and developing the design approach, the City has coordinated closely with the Back Bay National Wildlife Refuge (BBNWR), part of the U.S. Fish and Wildlife Service (USFWS), and the Virginia Department of Wildlife Resources (VDWR). Environmental organizations committed to stewardship of Back Bay have also contributed input throughout the design process, including the Back Bay Restoration Foundation (BBRF), Friends of Back Bay, the Back Bay National Wildlife Refuge Society, and the Albemarle-Pamlico National Estuary Partnership (APNEP). Project field investigations involved local support from Old Dominion University (ODU) and others, and outside expertise from Louisiana. The National Fish and Wildlife Foundation (NFWF) provided grant funding under the National Coastal Resilience Fund (NCRF) to support design, permitting, and environmental assessments. Broad support of the project is demonstrated by contributions from the organizations noted above along with other stakeholders engaged in the restoration effort.

Needs and Problems

Specific Problem Being Solved – Habitat Degradation and "Wind Tide" Flooding

Marshes are vital to the Southern Rivers Watershed for the ecological and flood reduction benefits they provide. The Southern Rivers Watershed contains 90% of the City's land area under an elevation of three feet, making this area particularly susceptible to flood impacts. As illustrated in Figure 3, sustained southerly winds push water up from the Albemarle-Pamlico Sound through the Currituck Sound and into Back Bay, creating a phenomenon referred to locally as "wind tide flooding". Marsh habitat loss has contributed to the opening of a secondary channel in Bonney Cove that has increased water flow during wind tide and other flood events to areas with high community exposure.

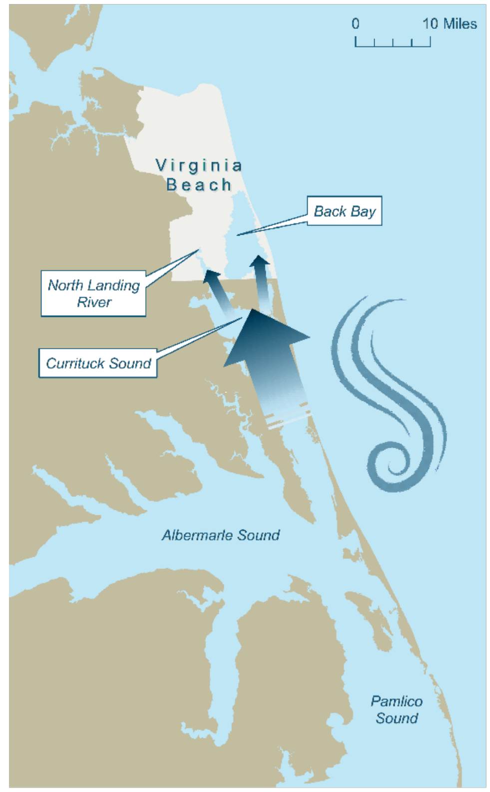

Figure 3: Flood pathways in the Southern Rivers Watershed.

Within today's marsh system, it takes between two to five days of sustained southerly winds to cause flooding, depending on the wind speed and direction. Over the last four years, more than five wind tide flooding events have occurred in this area. The increasing frequency of flooding events is primarily attributed to a foot of relative sea level rise in the last 50 years and degradation of marsh and seagrass habitat.

This marsh restoration project aims to address the challenges of habitat degradation and "wind tide" flooding by stabilizing two critically eroding marsh islands, decreasing turbidity to promote the growth of aquatic vegetation, and providing flood risk reduction benefits through increased friction and wave attenuation.

Factors Contributing to the Identified Problem

This growing flood risk in the Southern Rivers Watershed can be attributed mainly to the reduced friction in the water column from the increased water depth and eroded vegetation, which allows water to move more quickly through key hydraulic pathways. Another term for this is "fetch", which is defined as the open water distance over which a given wind can blow and generate higher waves without obstruction. Unmitigated, the continued loss of these marsh island systems and aquatic vegetation is expected to result in more frequent and intense wind tide flooding events.

Emergent Marsh Degradation

Approximately 50% of former marshland at the site (260 acres) has eroded into open water leading to the opening of a wide secondary channel ("Bonney Cove") that is about two miles

long and half a mile wide (Figure 4). The southern exposed edge of the adjacent marsh islands is exposed to approximately 1.5 miles of fetch in the predominant wind direction.

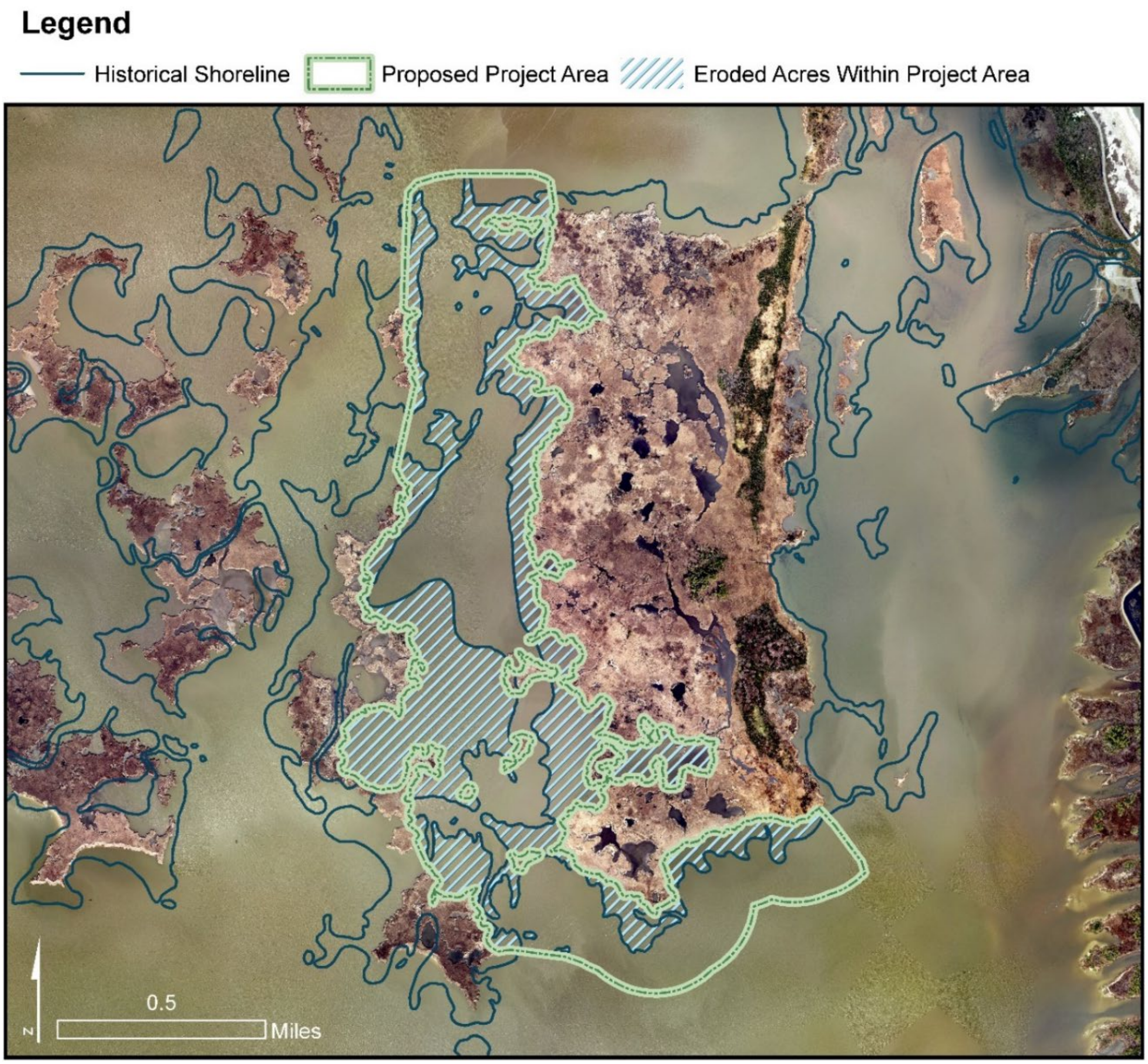

Figure 4: Historical marsh erosion within the project area.

Submerged Aquatic Vegetation (SAV) Loss

SAV used to be abundant at the site (around 45% coverage, overall) but is now extremely sparse, ranging from 0% to 10% coverage across the site, on average. Field studies conducted by the VDWR show that wind-driven waves and high flow velocities are the primary drivers of this loss, particularly in the last 5 years as shown in Figure 5.

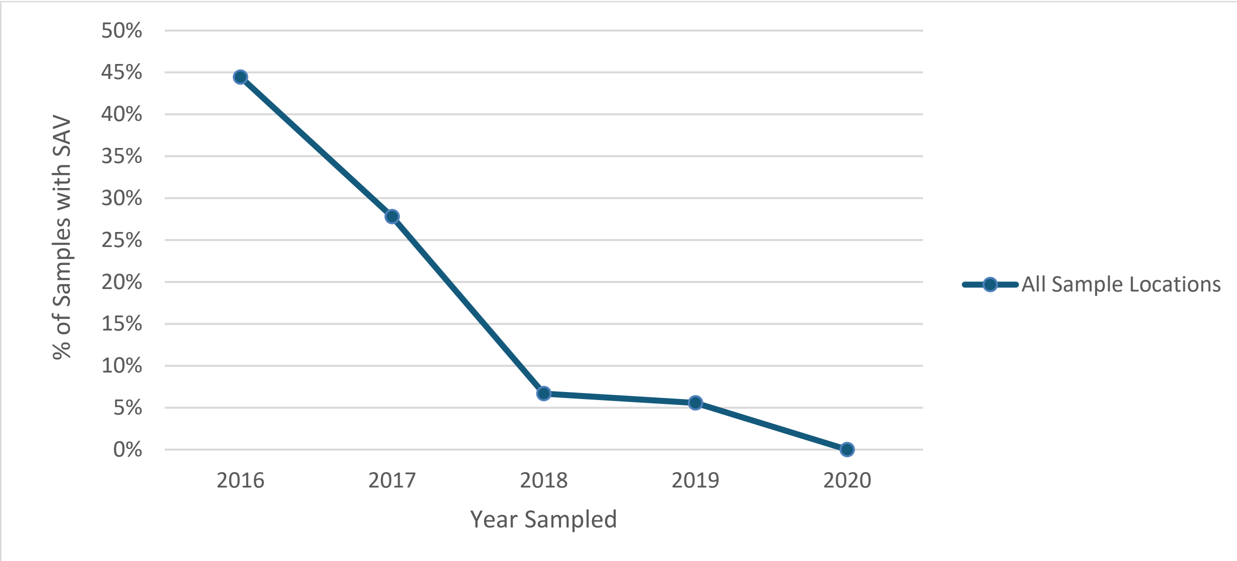

Figure 5: SAV sampling data from VDWR within the project vicinity.

Why is the Project Needed Locally/Regionally?

Pilot Project

The City's design concept for the marsh restoration project leverages "marsh terracing," an innovative coastal engineering technique widely used in Texas and Louisiana to convert shallow subtidal bottom to marsh. This technique has not yet been implemented along the U.S. East Coast and has not yet been implemented in the Mid-Atlantic region. Through the export of proven expertise from successful marsh terraces, this project would lay the foundation for future projects in the region, Virginia, and other states along the East Coast. The project would document detailed cost estimates, demonstrate effective construction practices for large-scale marsh creation projects, identify best sources for local/regional materials, and establish partnerships with permitting officials at various levels of government. The City has outlined a preliminary sequencing plan for marsh island restoration projects in Back Bay to strategically close hydraulic pathways and address priority restoration areas as shown in Figure 6. Some of these projects would require coordination with the State of North Carolina to realize its broader resilience efforts.

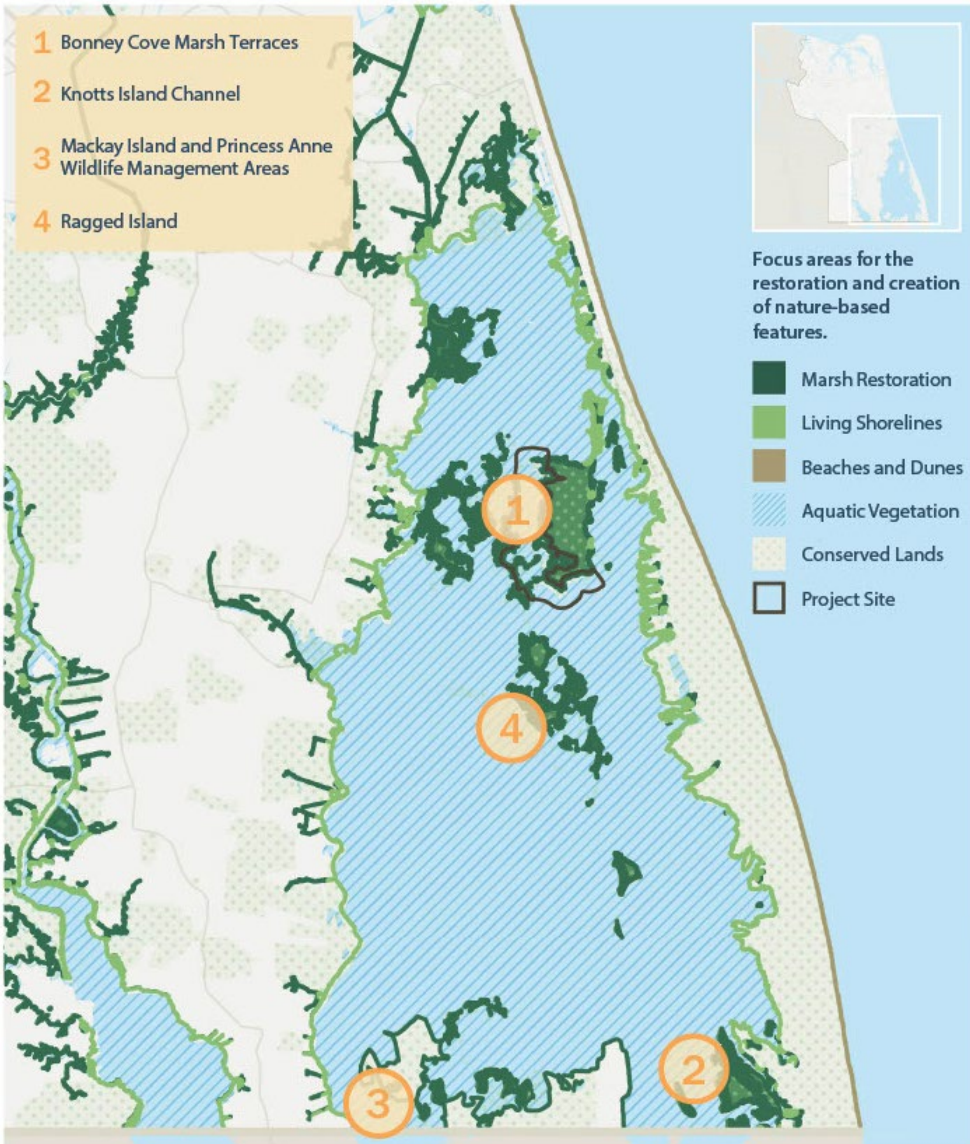

Figure 6: Preliminary Sequencing Restoration Plan.

Virginia Coastal Resilience Master Plan Exemplary Project

The CRMP impact assessment shows a high vulnerability of nature-based features to coastal flood hazards that is consistent with the City's analysis. In the Hampton Roads region, the CRMP impact assessment estimates a decrease from 40,600 acres to 2,940 acres of tidal wetlands by 2080, representing a 93% decline in tidal wetlands.[4] Back Bay was identified as a hotspot for tidal wetland loss, emphasizing the critical location of the City's marsh restoration effort. Specifically, the Virginia CRMP impact assessment shows that portions of tidal wetlands within the project area have "High" and "Very High" impact levels, which indicates areas of tidal marsh

[4] Office of Governor Ralph S. Northam Commonwealth of Virginia and Virginia Department of Conservation and Recreation (2021). Virginia Coastal Resilience Master Plan Phase 1 (PDF).

that are anticipated to be lost through inundation causing conversion to open water (Figure 7).

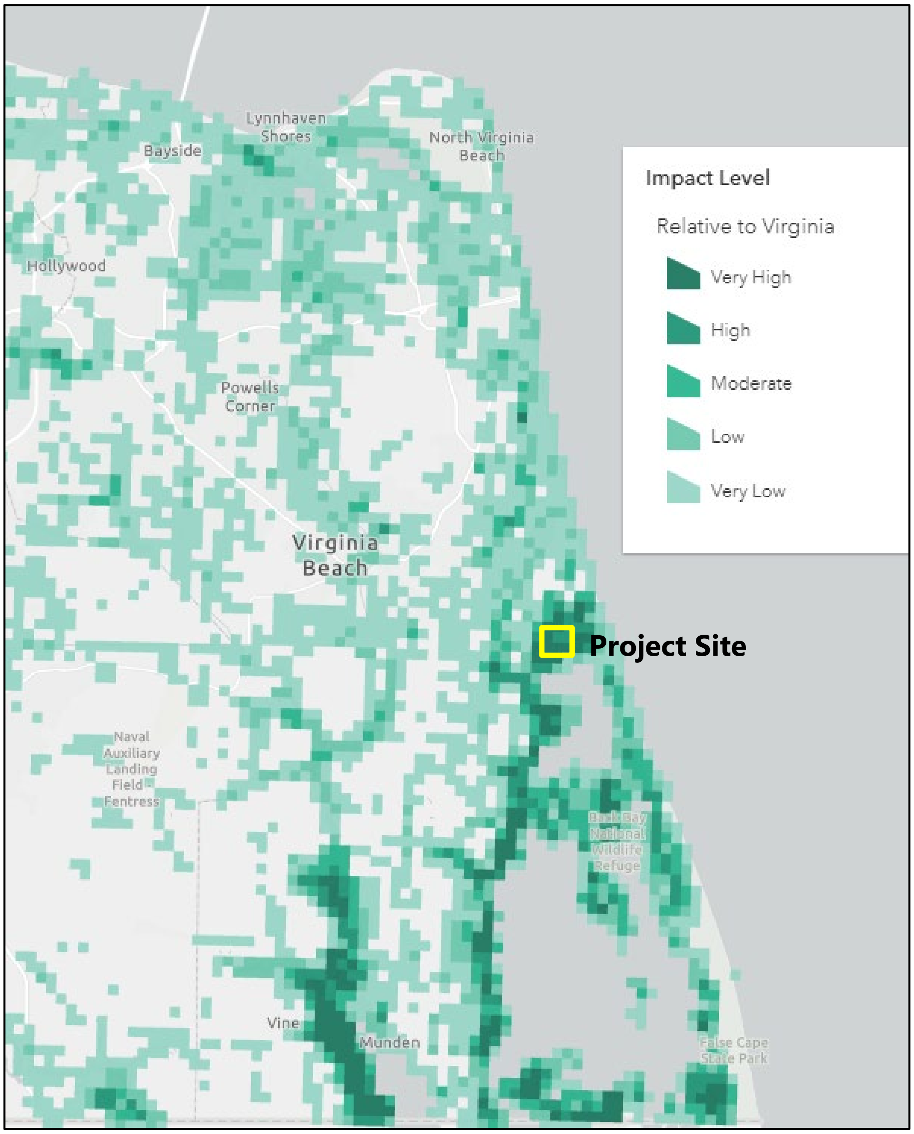

Figure 7: Virginia CRMP Impact Assessment for Tidal Wetlands.

Currituck Sound Coalition High Priority Area

In coordination with Audubon North Carolina, the Currituck Sounds Coalition designated the project site as a High Priority Area for restoring and enhancing vulnerable and degraded marshes with "high flood risk reduction benefits and habitat value" as shown in Figure 8[5].

[5] Audubon North Carolina. (2021). Currituck Sound Coalition Marsh Conservation Plan. (PDF)

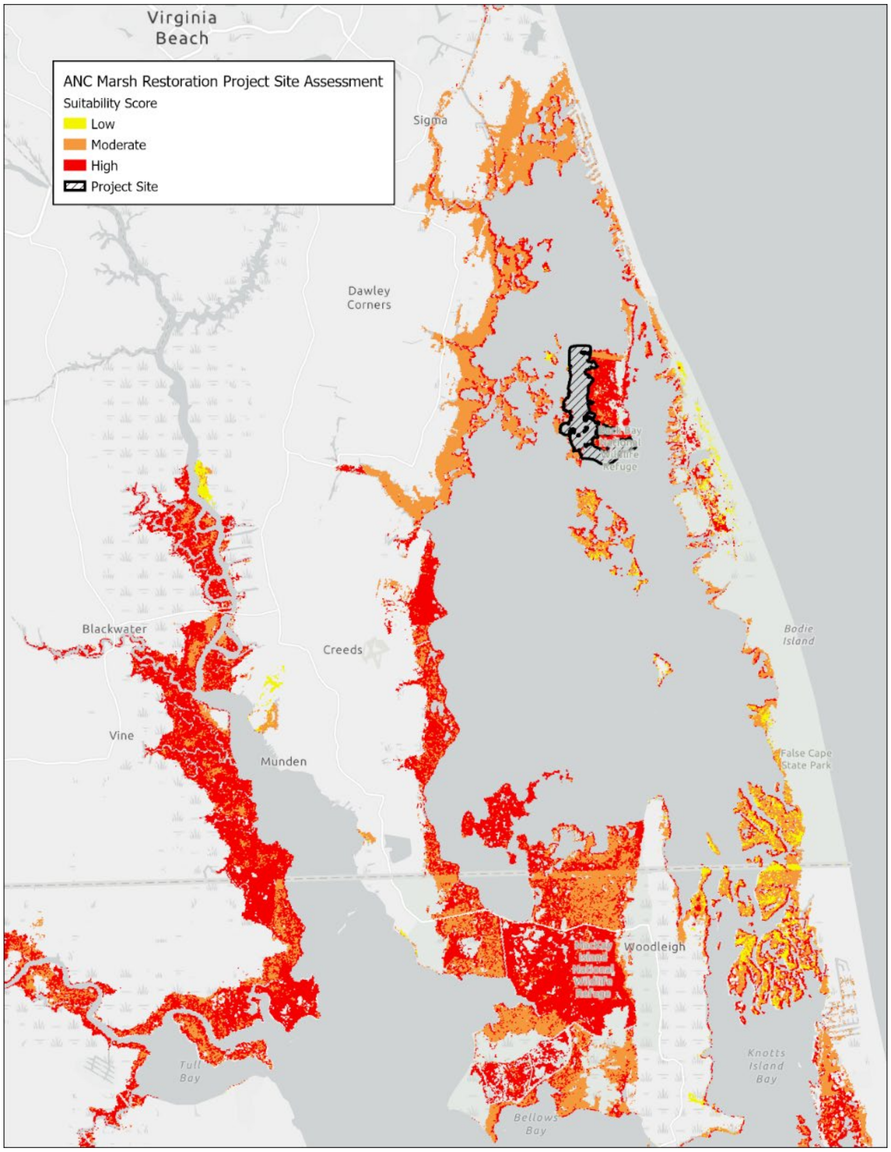

Figure 8: Audubon North Carolina Marsh Restoration Project Site Assessment

Ecological Core for Flood Resilience

The Virginia Department of Conservation and Recreation Natural Heritage Data Explorer provides data from ConserveVirginia v3.0 and other data to support conservation planning. The following map in Figure 9 displays Ecological Cores and the Floodplains and Flooding Resilience Category layer (blue polygon) from ConserveVirginia. The project area contains "High" (C3) and "General" (C5) Ecological Cores and is within the boundaries of the Floodplain and Flooding Resilience area.

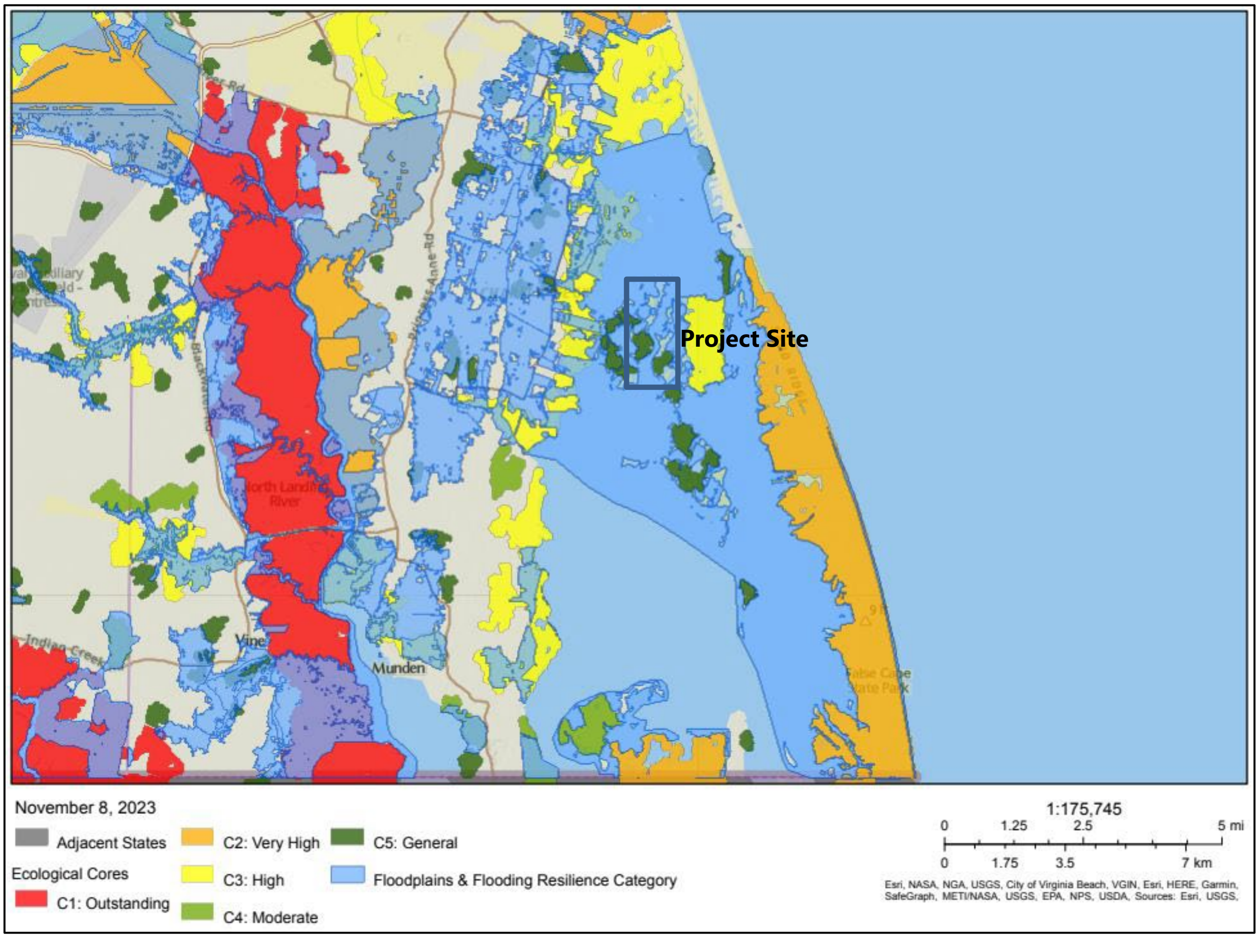

Figure 9: Virginia Natural Heritage Data Explorer Ecological Cores and ConserveVirginia Data.

The safety threats, or environmental concerns related to flood risk.

The City's risk assessment forecasts that approximately 70% of the remaining marsh (730 acres) surrounding the project site will convert to open water with three feet of sea level rise if unmitigated. Fragmentation of this adjacent marsh would result in about eight miles of fetch acting on the southern extent of the site in the predominant wind direction. Without these central marsh islands, the northern shorelines of Back Bay would be exposed to 12 miles of fetch from the Knotts Island Channel at the Virginia-North Carolina boundary. This condition would leave the fringing marshes highly vulnerable to accelerated erosion.

How does the project decrease the risk to public safety through flood risk reduction?

Construction of the forty-one individual marsh terraces, totaling 27,000 linear feet (a 51-acre footprint), across Bonney Cove offers a nature-based technique that will stabilize and protect the marsh island in the center of the bay and reduce erosion of the fringing marsh systems to the north. Numerical modeling was leveraged to quantify specific erosion reduction benefits of the project for wave heights and flow velocities:

- **Wave Height Reduction**: The marsh terraces are expected to reduce wave heights within the project site by approximately 45%. This reduction is consistent with other field studies, which have found that average wave heights within two terraced sites were 37% to 48% lower than those observed at the reference site (Brasher 2015). Wave energy reduction is anticipated to increase the potential for sediment deposition on the terraces' leeward side, leading to the growth of new emergent marsh and reducing erosion of adjacent marsh. Approximately five miles of marsh island shoreline around Bonney Cove will benefit directly from the erosion reduction associated with the computed wave attenuation.
- **Flow Velocity Reduction**: The marsh terraces reduce flow velocity within the project area. This reduction in velocity will reduce bottom shear stress, decrease turbidity, increase light penetration into the water column and promote the growth of SAV. Reducing bottom shear stress will make conditions more suitable for SAV growth between the terraces. Field studies of marsh terraces in Texas and Louisiana document an approximately 45% to 56% reduction in turbidity and the emergence of SAV in the years following terrace construction (Brasher 2015).
- **Wind Shear Stress Reduction**: Although not included as a parameter within the numerical modeling effort, the bald cypress trees planted on the terraces within the middle of the site are expected to reduce wind speed within the project site. This will further reduce wind-generated waves within the project site on the terraces' leeward and windward sides. Research shows that trees that grow to at least 30 feet at maturity result in lower wind speeds of up to 60 to 150 ft on the windward side and up to 900 ft on the leeward side (USDA).

How does the project protect or conserve natural resources?

The proposed project aims to restore marsh island communities in Bonney Cove that have historically provided environmental and flood reduction benefits to the communities in northern Back Bay. As illustrated in Figure 10, when an intact marsh begins to fragment and convert to open water, fetch increases and enables greater wave energy, increasing marsh erosion rates, and ultimately accelerating conversion to an ever-expanding body of open water. Strategic marsh restoration and creation in Bonney Cove would help mitigate the cycle of marsh island erosion and loss of SAV currently occurring in Back Bay, thereby protecting the remaining marsh islands and reducing fetch and wave energy.

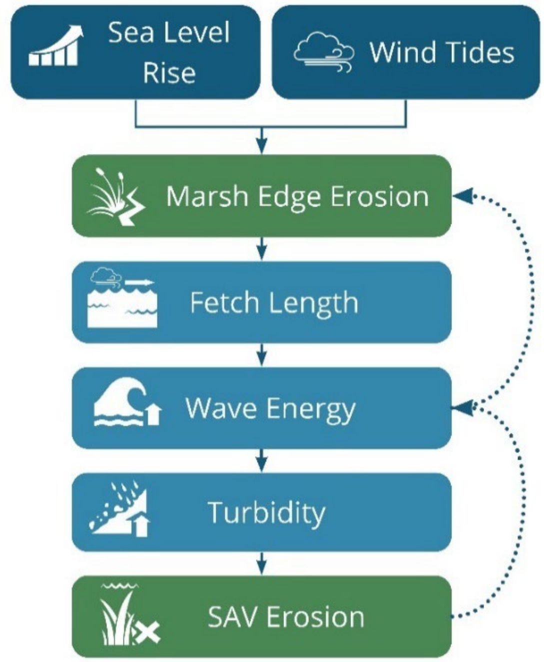

Figure 10: Cycle of marsh erosion, SAV loss, and increased wind-driven flooding.

The primary objective of this project is to create a sustainable coastal marsh island system in Back Bay through reclamation of historically lost marsh habitat and protection of existing marsh complexes from erosion. This restoration effort aims to provide multiple benefits of reduced flood impacts, enhanced fish and wildlife habitat, and improved water quality. The project is designed to achieve the following outcomes:

- Decrease turbidity to create conditions that promote the growth of emergent vegetation and aquatic grasses;
- Maximize habitat value for ecologically important fish and wildlife populations (e.g. Largemouth Bass, Bluegill, Yellow Perch, Striped Bass, Blueback Herring, Alewife, American Eel, etc.); and,
- Reduce fetch, wave heights, and flow velocities to mitigate erosion of fringing marsh systems that provide a buffer for the low-lying neighborhoods and roads that experience frequent flooding in northern Back Bay.

The City selected marsh terracing as the preferred restoration approach because the design is compatible with Back Bay's shallow bottom and the historical loss of habitat. Marsh terraces are narrow, man-made islands placed in shallow open water to restore previous marsh environments. Typically arranged in a chevron pattern, the overall field of marsh terraces dissipates waves, decreases turbidity, and slows down the moving water. The resulting calmer water conditions allow more sunlight to penetrate to the shallow bottom, promoting the establishment and growth of marsh seagrass and ultimately improving habitat quality for fish and wildlife. Further, as opposed to one continuous marsh platform, marsh terraces maximize habitat for a variety of fish and wildlife species, as illustrated in Figure 11.

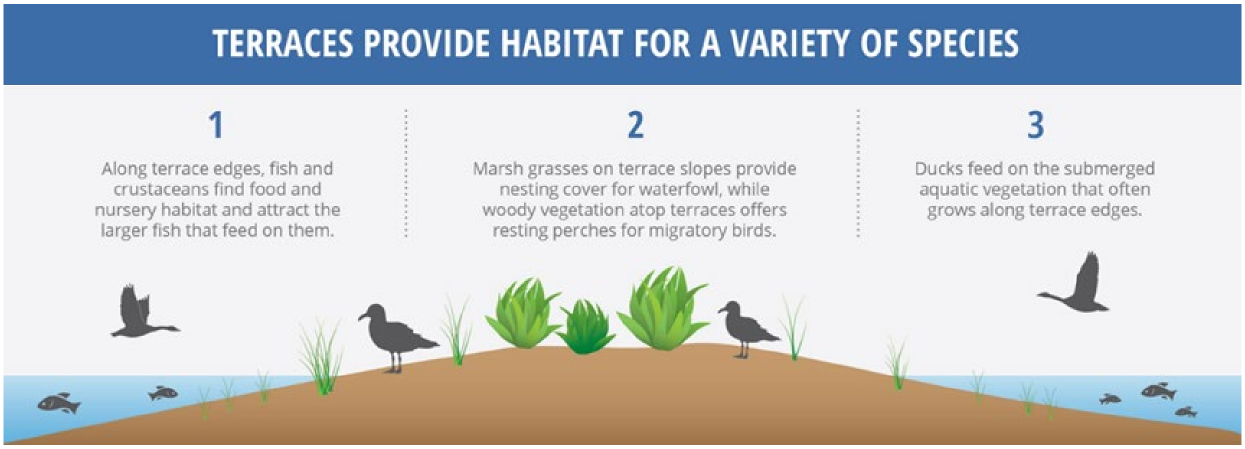

Figure 11: Conceptual diagram of marsh terraces.

Groups to be targeted who might directly benefit from this flood risk reduction effort.

The northern Back Bay communities adjacent to the project area and interested stakeholders have been engaged in the planning effort through public meetings. These meetings provided an opportunity for the community to provide feedback on the 30% and 95% designs and artistic renderings. We anticipate the project to benefit properties and infrastructure assets in northern Back Bay, including the following:

- **Reduce erosion rates along approximately 8 miles of shoreline by reducing wind and wave energy north of the project site.** Most of the properties along this reach of shoreline are not protected by traditional erosion risk reduction measures, such as bulkheads. Maintaining a naturalized shoreline while protecting fringe marsh is a priority of the City and its project partners. This approach will ensure that these marsh systems can migrate landward in response to sea level rise.
- **Reduce flood risk to commercial and residential properties north of the project site.** There are approximately 70 commercial and 2,350 residential structures within the two census block groups surrounding the project site. Around 635 of those structures are vulnerable to flooding during a 50-year event today. With three feet of sea level rise, approximately 2,060 structures are expected to be vulnerable to flooding during a 50-year return period event, representing about 85% of the residential structures within the project vicinity. These numbers underscore the importance of implementing the proposed project alongside complimentary flood risk reduction projects.
- **Reduce the magnitude and duration of flooding along critical access roads and critical facilities.** In addition to Muddy Creek Road, two other critical access roads are anticipated to benefit from delayed flooding. This includes Shipps Cabin Road (intersecting with Muddy Creek Road) and Sandpiper Road, which runs parallel to the eastern bank of Back Bay and provides ingress/egress out of the Sandbridge community (Figure 12).

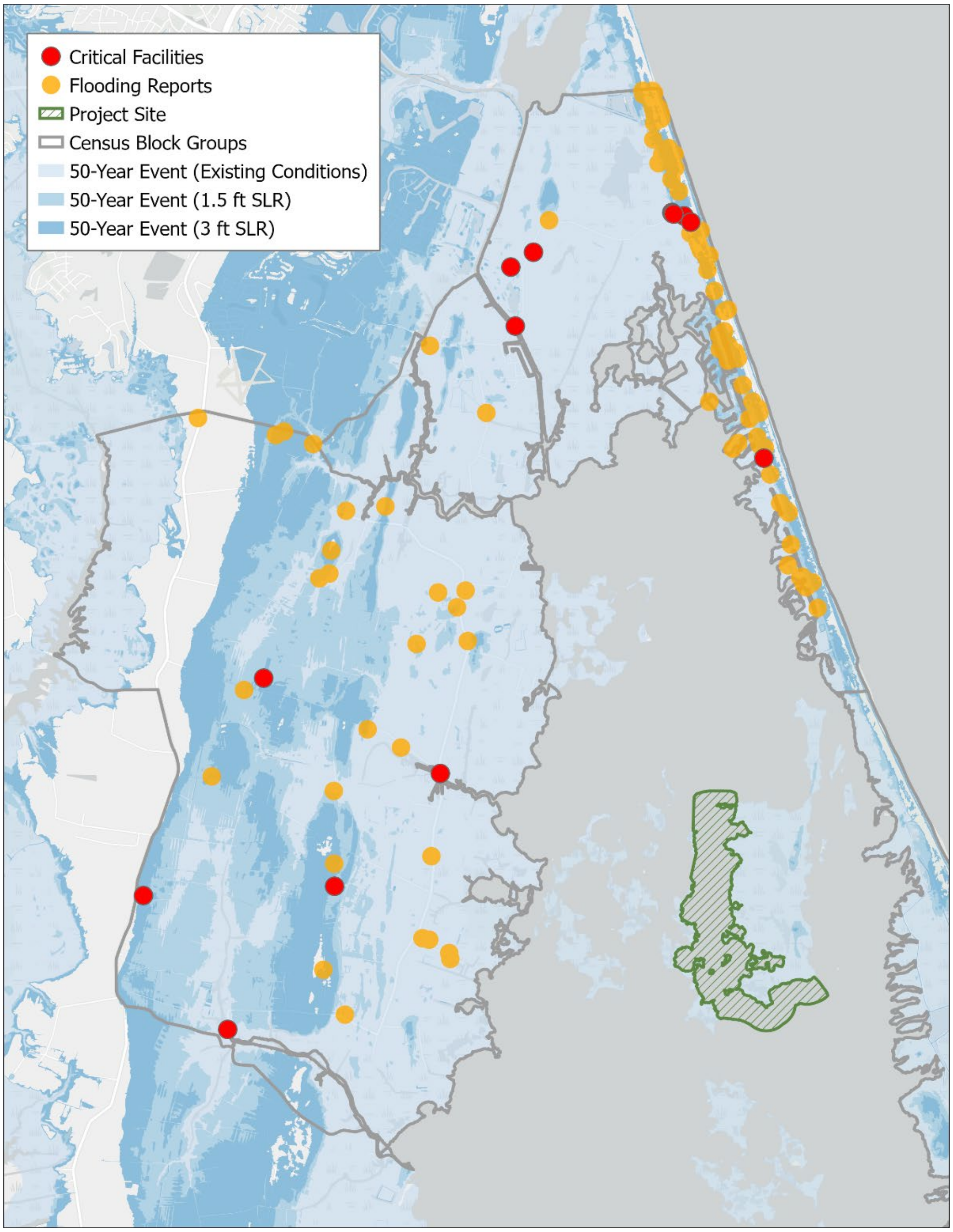

Figure 12: Critical facilities and flooding reports within project vicinity.

What would happen (or not happen) if the applicant does not receive funding?

If this project does not advance from design to construction, erosion of the adjacent marsh would continue to occur, resulting in fragmented habitat lacking the capacity to reduce wave action and slow water velocities. It is anticipated that wind-driven flooding events will continue to increase in frequency, resulting in increasing flooding of the low-lying properties and roadways surrounding northern Back Bay.

Alternatives Analysis

The proposed project offers the best approach for addressing the needs and problem statement outlined in this Scope of Work narrative. The project would result in the creation of 46.5 acres of marsh terraces, which would produce a net gain of approximately 16 acres of low/high marsh habitat by the end of the project construction compared to the No Action Alternative. The integrated system of marsh terrace ridges and perimeter rock armoring would stabilize the two critically eroding marsh islands (Long Island to the east, and a series of smaller unnamed islands to the west) from continued degradation. The tall terrace design improves the functionality and resiliency of the marsh system while also providing diversified habitat for fish and wildlife in the form of increased marsh edge as sea level rises. Numerical modeling of the preferred alternative demonstrated that the project would decrease wave heights and decrease the overall flow velocity of water moving through the project site, reducing water exchange in Back Bay during flooding events, encouraging sediment deposition, mitigating wave effects and consequent erosion, and result in localized water quality benefits. The proposed terraces would not only create a platform for vegetation growth within the marsh, but also reduce wave fetch in these large open water areas. The reduction in wave energy would lead to improved water clarity to promote the growth of SAV in the area between the terraces (approximately 310 acres).

Dredging in between the terraces to obtain sediment for the terrace cap would ensure no invasive vegetation is introduced into Back Bay, which is a high priority of the USFWS and VRMC. The dredging areas would also create valuable fish habitat to attract signature Back Bay fish and wildlife populations such as Largemouth Bass. The proposed dredging areas in between the terraces was evaluated and not anticipated to increase erosion of the adjacent marsh system. Furthermore, dredging in-situ material for building terraces is a widely accepted approach in Gulf Coast region marsh creation/terracing projects, as determined through conversations with project owners in Louisiana. Some terrace cap material will also be obtained from the Nimmo VII-A project. Through export of proven expertise from successful marsh terracing projects, this project would lay the foundation for future similar projects in the region through the development of detailed cost estimates, identification of best sources for local/regional materials, and establishment of partnerships with permitting officials at various levels of government.

Goals and Objectives

The overarching goal of this project is to construct the City's first nature-based adaptation project in the Southern Rivers Watershed and one of the CRMP's exemplary nature-based projects. This project aims to stabilize two critically eroding marsh islands from further degradation, decrease turbidity to promote the growth of aquatic vegetation, and provide flood risk reduction benefits through increased friction and wave attenuation. Table 1 below provides a high-level overview of the specific objectives established to solve the problem/need identified – specifically habitat degradation and wind tide flooding along with measure(s) of success. A more detailed description of these objectives is provided in the Supporting Documentation section.

Table 1: Overview of Project Objectives.

Objectives	Description	Measure(s) of Success	Timing of Measures
Objective 1	Create a Construction Access and Staging Area	a. Secured permits for construction. b. Contractor Selection. c. Construction of Staging Area.	a. December 2023 b. April-May 2023 c. June 2023 -February 2024
Objective 2	Restore Marsh and Aquatic Vegetation	a. Secured permits for construction. b. Restoration of 46.5 acres of habitat.	a. December 2023 b. March - October 2025 and March – October 2026
Objective 3	Engage Stakeholders and Disseminate Effective Practices	Number of people meaningfully engaged in the process of the project within the agreement period.	Continuous through period of performance.

Work Plan

Current Status and Ongoing Activities

The marsh terrace project design is progressing and will be ready for construction in the CFPF grant timeline. Table 2 summarizes ongoing tasks related to the project and an anticipated schedule for completion.

Table 2: Completed, ongoing, and anticipated activities leading up to construction.

Activity	Description	Schedule
Stakeholder Scoping Workshop	In November 2020, the City hosted a virtual workshop to receive initial input from project stakeholders.	Completed (Fall 2020)
Site Characterization and Vegetation Survey	In fall 2020, a site characterization and vegetation survey within Bonney Cove was conducted under a USFWS Special Use Permit (SUP). The purpose of the survey was to document existing emergent marsh and submerged aquatic vegetation (SAV) species composition and percent coverage within the proposed project area. MAP Environmental, Inc. conducted a literature review of marsh terracing projects in the Gulf Coast region to identify effective practices for project planning and design.	Completed (Fall 2020)
Bathymetric Survey	An updated bathymetric survey of Bonney Cove, also covered under a USFWS SUP, was completed in March 2021. This data serves as an input to identify appropriate design elevations to determine quantities of materials necessary to build the proposed marsh terraces and for numerical modeling of project alternatives.	Completed (Spring 2021)
Geotechnical Investigation	A geotechnical investigation of Bonney Cove was conducted in the spring of 2021. The permitted survey, (Virginia Marine Resources Commission (VMRC) Permit No. 2020-2286, U.S. Army Corps of Engineers (USACE) Permit No. 2020-02439, and USFWS SUP) included the collection of 10 soil borings in locations that avoided aquatic vegetation habitat. The soil samples were retrieved by drilling with a specialized airboat-mounted drill rig which was essential for drilling in shallow areas as it avoids disruption to bottom habitat. The soil samples were analyzed to determine the suitability and physical characteristics of the soils within the project area. Additional soil analysis was conducted to determine the suitability of Back Bay sediments for building components of the marsh terraces.	Completed (Spring 2021)

Activity	Description	Schedule
Water Quality and Hydrodynamic Survey	ODU conducted a water quality and hydrodynamic survey of Bonney Cove in the spring of 2021. The USFWS permitted survey collected water samples and deployment/retrieval of hydrodynamic sensors (pressure sensors, acoustic Doppler current profilers, and optical backscatter sensors) at three sampling points in Bonney Cove. Sensor equipment was deployed for two one-month periods (3/10/2021 – 4/12/2021 and 5/19/2021 – 6/8/2021). The water level, wave, and current data served as an input to the numerical model calibration. The water quality parameters (including pH, salinity, temperature, dissolved oxygen, chlorophyll, and turbidity) will serve as a reference to compare pre-and post-construction water quality conditions.	Completed (Summer 2021)
30% Design	Dewberry leveraged the field-collected data to establish design criteria for the project to ensure that it will be resilient in the face of changing future conditions during wind-tide events. Artistic design renderings were developed to enable stakeholders to visualize the implemented project.	Completed (Fall 2021)
Public Engagement – 30% Design	The City held a public information meeting on October 14, 2021, at Creeds Elementary School. The project team delivered a 10-minute presentation of the proposed project followed by an open-format discussion where participants reviewed the preliminary (30%) designs and artistic renderings and submitted comments regarding environmental and community impacts.	Completed (Fall 2021)
Numerical Modeling	Numerical modeling has been completed to evaluate the proposed project's impact on water levels, wave heights, and flow velocities within and surrounding the project area. Potential water quality impacts were also evaluated. The numerical modeling effort involved the development of an XBeach model, which is a nearshore model that accounts for wave-vegetation interactions based on field-derived drag coefficients.	Completed (Winter 2021)
Environmental Assessment and Scoping	In coordination with the USFWS and with technical assistance from Dewberry, the City evaluated the potential environmental impacts of the project. The draft environmental assessment document was distributed to key stakeholders with jurisdictional authority or a vested interest in the project for review and comment.	Completed (Summer 2023)

Activity	Description	Schedule
60% Design	After numerical modeling and stakeholder review of the 30% design, the engineering design plans were advanced from 30% to 60%.	Completed (Spring 2023)
95% Design and Public Engagement	The engineering design team prepared 95% engineering design plans to address comments on the 60% plan set. The City held a second public information meeting from 6:00 – 7:30 p.m. on July 13, 2023, at the Senior Resource Center in Virginia Beach where the project team delivered a 10-minute presentation of the proposed project followed by an open-format discussion where participants reviewed the 95% designs, updated artistic renderings, and submitted comments.	Completed (Fall 2023)
Construction Permit Applications Submitted	The City submitted the Joint Permit Applications for the proposed project, including the initial post-construction monitoring plan, to VMRC and the USACE in August 2023.	Completed (Summer 2023)
Modeling of Potential Adverse Impacts	In response to public concerns, the City performed additional numerical modeling of both northerly and southerly wind events and reviewed water level responses at locations in Back Bay for any potential adverse impacts. No adverse impacts were found for either type of event.	Completed (Fall 2023)
Publication of Frequently Asked Questions	The City will be publishing findings for the potential adverse impacts modeling, along with other responses to public concerns raised at the question in a Frequently Asked Questions webpage in November 2023.	In Progress (Fall 2023)
100% Design	The engineering design team prepared and submitted the 100% engineering design plans to the City for review. The plans will be finalized on receipt of any comments from the permitting process, anticipated to occur by end of 2023.	In Progress (Fall 2023)
Contractor Procurement	The engineering team will provide final plans, specifications, and construction estimates (PS&E). The City will prepare the bid Request for Proposal (RFP), provide Bid Packages, and review bids obtained, and select a construction contractor.	Planned (Winter 2023 - Spring 2024

What are the major activities and tasks?

The key activities and tasks to be competed under the agreement period are summarized in Table 3. Please refer to the Supporting Documentation section for a more detailed description of these activities and tasks.

Table 3: Overview of Activities and Tasks.

Activities	Description	Tasks
Activity 1	Construction Staging Area Preparation and Construction	1. Mobilize equipment 2. Stabilize road, establish construction staging area, abutments, install pre-engineered bridge, construct ramp to water and slurry basins. 3. Establish traffic flagging stations. 4. Install pipe and booster stations.
Activity 2	Marsh Terrace Construction	1. Construct 41 terraces (2-phased approach). 2. Demobilize equipment.
Activity 3	Stakeholder Engagement	1. Develop project marketing materials. 2. Attend and document engagement activities.

Who is responsible for completing the activities and tasks?

Responsibility for completing the project's activities and tasks lies with a collaborative effort led by the City's Department of Public Works. To ensure the successful execution of the project, the City has assembled a diverse team of consultants, advisors and subject matter experts. For a comprehensive understanding of the specific roles and responsibilities of each entity involved in carrying out the proposed scope of work, please refer to the *Supporting Documentation – Approach, Milestones, and Deliverables – Project Partner*s section of this report, which provides a detailed description of how each team member contributes to the project's overall success.

What is the timeframe for accomplishing activities and tasks?

An overview of the planned project timeline is shown in Figure 13. Grant activities will initiated in Summer 2024 with construction of the staging area and material acquisition. Please refer to the *Supporting Documentation – Approach, Milestones, and Deliverables –Milestone Schedule* section of this report for a detailed outline for each activity and associated deliverables.

Figure 13. Timeline overview for project implementation.

Identify the required partners to ensure success and where they are represented in the workplan.

A diverse team of consultants, advisors, and subject matter experts, led by the City's Department of Public Works, has been assembled to complete the project's activities and tasks. Please refer to the *Supporting Documentation – Approach, Milestones, and Deliverables – Project Partner*s section of this report for a detailed description of each team member's role, responsibilities, and contribution to the project's overall success.

Deliverables

An overview of the project deliverables is provided in Table 4. Please refer to the *Supporting Documentation – Approach, Milestones, and Deliverables* section of this report for more detail.

Table 4: Summary of Deliverables.

Activities	Deliverables
Activity 1: Construction Staging Area Preparation and Construction	1. Material acquisition. 2. Progression and completion of the construction staging area, with daily inspections to monitor progress. 3. Documented progress and completion through quarterly reports to DCR.
Activity 2: Marsh Terrace Construction	1. Progression and completion of the 2025 and 2026 construction phases, including plantings, with daily inspections to monitor progress. 2. Demobilization and removal of equipment from construction staging area. 3. Documented progress and completion through quarterly reports to DCR.
Activity 3: Stakeholder Engagement and Lessons-Learned Dissemination	1. Project marketing materials. 2. Records documenting number of stakeholders engaged during the outreach activities.

Maintenance plan tied to the identified viability of the project. Plan for sustaining the project after the agreement period (if applicable)

The City has developed a draft Annual Monitoring Plan and Post-Construction Monitoring Report that was submitted along with the Joint Permit Application for the project. See Attachment 5 for a copy of the draft report.

Project maintenance will be addressed by the City of Virginia Beach's Public Works Stormwater Operations Group. Any maintenance issues identified by the monitoring effort or other observers will be flagged to the Operations Group to address. The City intends to maintain the construction staging area to support future project maintenance needs. After completion of the monitoring program, the City will perform inspections every 2-5 years and make any repairs needed for the life of the project.

Evaluation

Indicators of Success

Indicators of success for this project have been identified during the development of the monitoring plan. Three (3) indicators of success were defined in relation to the primary objectives of the project (as defined elsewhere in this document), and include:

- The establishment of a sustainable coastal marsh island system.
- Stability of the marsh terrace structures.
- Establishment of a sustainable SAV community.

What data will be collected and how will it be used to measure success?

Data collection for the project has been detailed in the proposed monitoring plan and includes two sets of data: one set associated with as-built surveys to establish baseline reference conditions for subsequent monitoring efforts, and monitoring data to assess the success of the project in meeting the indicators defined above. Baseline and monitoring data will be compiled in an annual report and distributed to permitting agencies, and stakeholders as appropriate, to fulfill monitoring requirements and ensure success criteria are being met and maintenance needs are addressed.

Baseline data, which is proposed to be collected after the completion of each of two phases of terrace installation, will include the following data:

- Coordinates and diagrams of established transects, as well as site photographs from photo stations established along each sampling transect, as defined in the Methods section of the monitoring plan.
- Final location of all planted vegetation (upland plantings, high marsh plantings and low marsh plantings).
- Final location and extent of SAV plantings.
- Final grade topographic surveys (plan, profile, and cross sections).
- Discussion of the project design versus as-built conditions.

Monitoring data will be collected at the end of the full growing season during each monitoring year and include the following:

- Site photographs from photo stations defined in the Methods section of the monitoring report.
- Estimated percent cover and change in coverage from the as-built conditions to sampling year conditions for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- Estimated percent cover and change in coverage from planted conditions to sampling year conditions for SAV planting quadrants

- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

This monitoring data will be used to define success by tracking the establishment of the proposed vegetative communities on and between the proposed marsh terraces as well as the structural integrity of the marsh terrace structures themselves. Vegetation cover thresholds for each year will be defined to ensure planted communities are appropriately established on each marsh terrace. Acceptable measures of deviation will be defined for structural elements to ensure design requirements are met. Maintenance and mitigation measures defined in the monitoring plan will be implemented as required if success criteria are not met during any particular monitoring year.

How was cost effectiveness evaluated and measured against the expected outcomes?

Through a BCA approach using FEMA methods and ecosystem service valuations, a BCR of 1.17 was calculated for the project. This BCR is greater than 1, indicating the project can be considered cost-effective. The project also provides an additional $9.2M in value over the current estimated project costs.

A description of the BCA analysis and methods is provided in the following Benefit Cost Analysis Section.

What products, services, meetings, outreach efforts etc. will be conducted and how will success be measured?

The City is firmly dedicated to fostering meaningful engagement with project partners and external stakeholders throughout the project, with the goal of raising awareness about the project's approach and its benefits and enhancing the likelihood of its successful adoption in other areas within the region and the state.

Activity 4, titled "Stakeholder Engagement and Lessons-Learned Dissemination," provides a comprehensive outline of the City's outreach strategy, encompassing proposed deliverables and outreach endeavors. This strategic plan entails the development of project marketing materials, along with the facilitation of presentations and meetings with local and regional stakeholders, as well as participation in state and national-level conferences.

To gauge the effectiveness of our efforts, the City will employ metrics to track and document the number of individuals engaged throughout the project. This information will be regularly communicated to DCR to serve as a key performance indicator for project success.

For a more detailed breakdown of the tasks and deliverables associated with Activity 4, please refer to the Supporting Documentation section of this application.

Project Progress Monitoring Plan

The City's Project Progress Monitoring Plan is designed to guarantee the seamless and effective execution of the project. We have established a robust internal system to oversee the entire project lifecycle, ensuring that all key stakeholders are aligned with the project's objectives, activities, deliverables, and schedule.

The process commences with a kickoff meeting involving all project partners, where we collectively set the stage for the project. During this meeting, we thoroughly review the project's objectives and scope, ensuring that everyone is on the same page. This initial step is instrumental in fostering a shared understanding of the project's vision and goals among all involved parties.

In addition to the kickoff meeting, we place a strong emphasis on quality assurance and control. We meticulously assess each contractor's quality management system to ensure that well-defined procedures are in place to maintain the highest standards of quality throughout the project. This dedication to quality is paramount to delivering a successful project that meets the City's standards and the expectations of our stakeholders.

The City is committed to ongoing and transparent communication with our design and construction contractors, as well as our advisory stakeholders. Regular meetings will be held to monitor progress, address any potential challenges, and ensure the project adheres to the proposed milestone schedule and deliverables as outlined in this grant application. This proactive approach to project monitoring allows us to stay on track, identify and address issues promptly, and uphold our commitment to the successful completion of the project.

Supporting Documentation

Project Information

The following sections provide details regarding the project site and highlight the impacted population, residential and commercial structures, and critical facilities. This section also provides an overview of the historical, existing, and projected flood conditions in and around the project site.

Population

As shown in Figure 14, two census block groups (518100454.121 and 518100464.001) adjacent to Back Bay are within the extent of the anticipated project benefits. The total population of these two block groups is 3,531.[6] The residential population has grown approximately 1.8% in the past two decades. The median household income in 2021 dollars is $99,078. There are approximately 2,500 residential housing units, of which 43.1% are owner-occupied, 11.4% are renter-occupied, and 45.5% are vacant. The high percentage of vacant housing units can likely be attributed to seasonal rentals within the Sandbridge Resort Area. The race and ethnicity demographics of the community are 94.4% White, 1.4% Black, 3.4% Hispanic, and less than 1% Asian and American Indian.

[6] Population, household income, housing units, and demographic data obtained from Esri ArcGIS Community Analyst (2022). Esri forecasts for 2021 based on U.S. Census Bureau 2010 data.

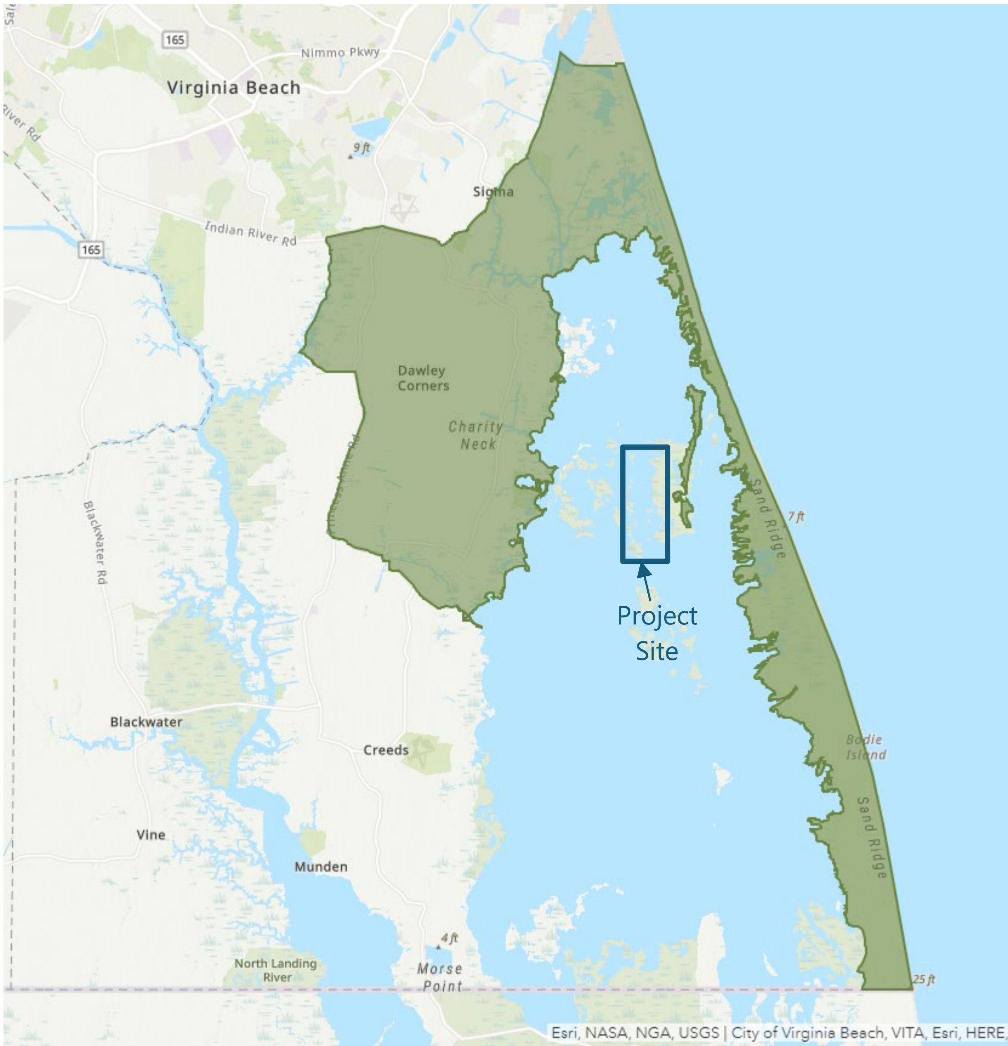

Figure 14: Census block groups selected for population estimates.

Historic Flooding Data and Hydrologic Studies Projecting Flood Frequency

Historical and Existing Flood Data

The project is located within a Federal Emergency Management Agency (FEMA) mapped Special Flood Hazard Area (SFHA), as shown in Figure 15 and Figure 16. Based on the City's current flood maps (effective January 16, 2015), the project site's flood zones are VE, AE, and Open Water. Portions of the site are within Otherwise Protected areas.

The following maps provide an overview of the existing flood hazards for the project area, including the northern boundary (Figure 15) and southern boundary (Figure 16). Based on the City's current flood maps (effective January 16, 2015), the project site contains VE and AE flood zones and Open Water.

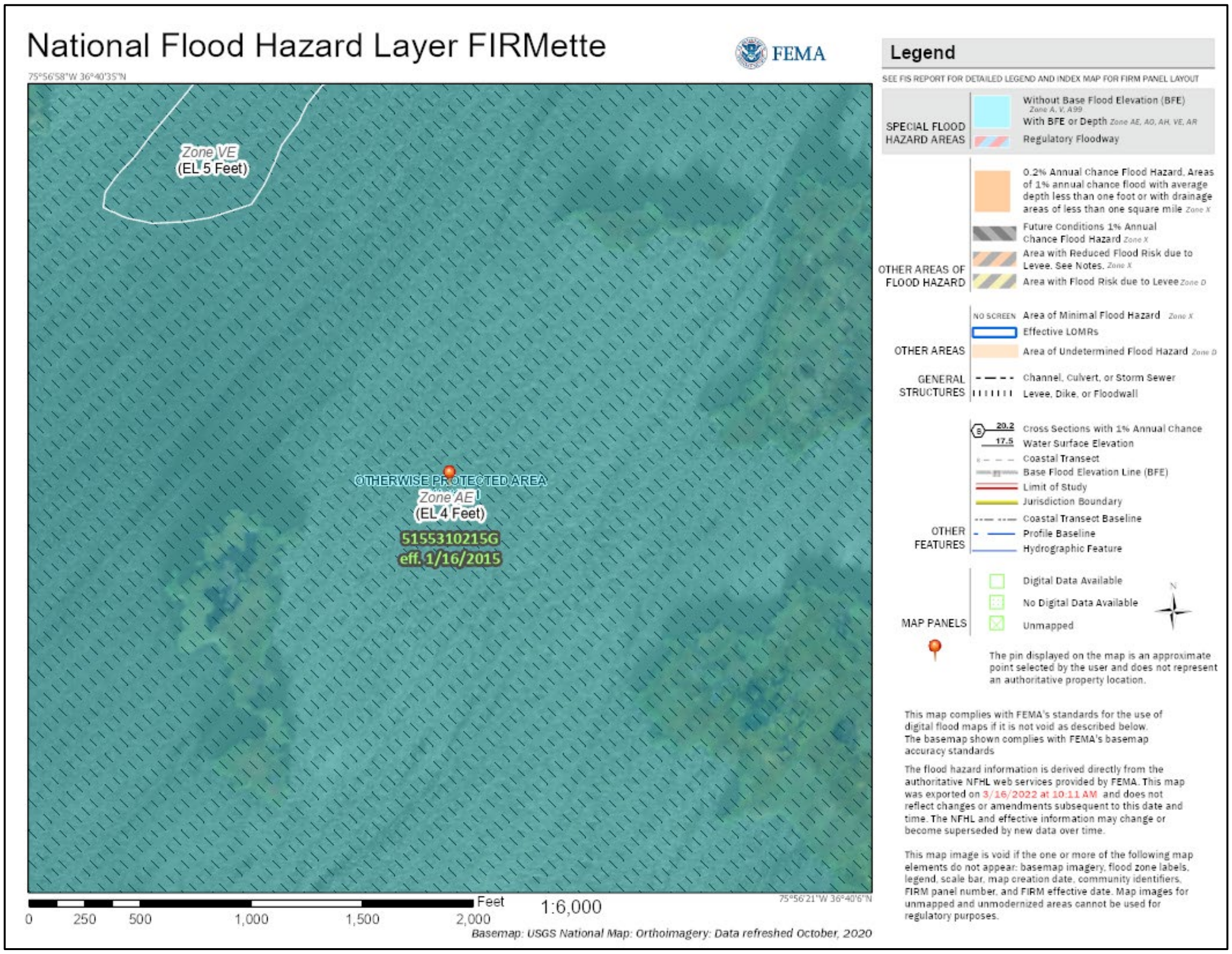

Figure 15: FIRMette for the project area (northern boundary).

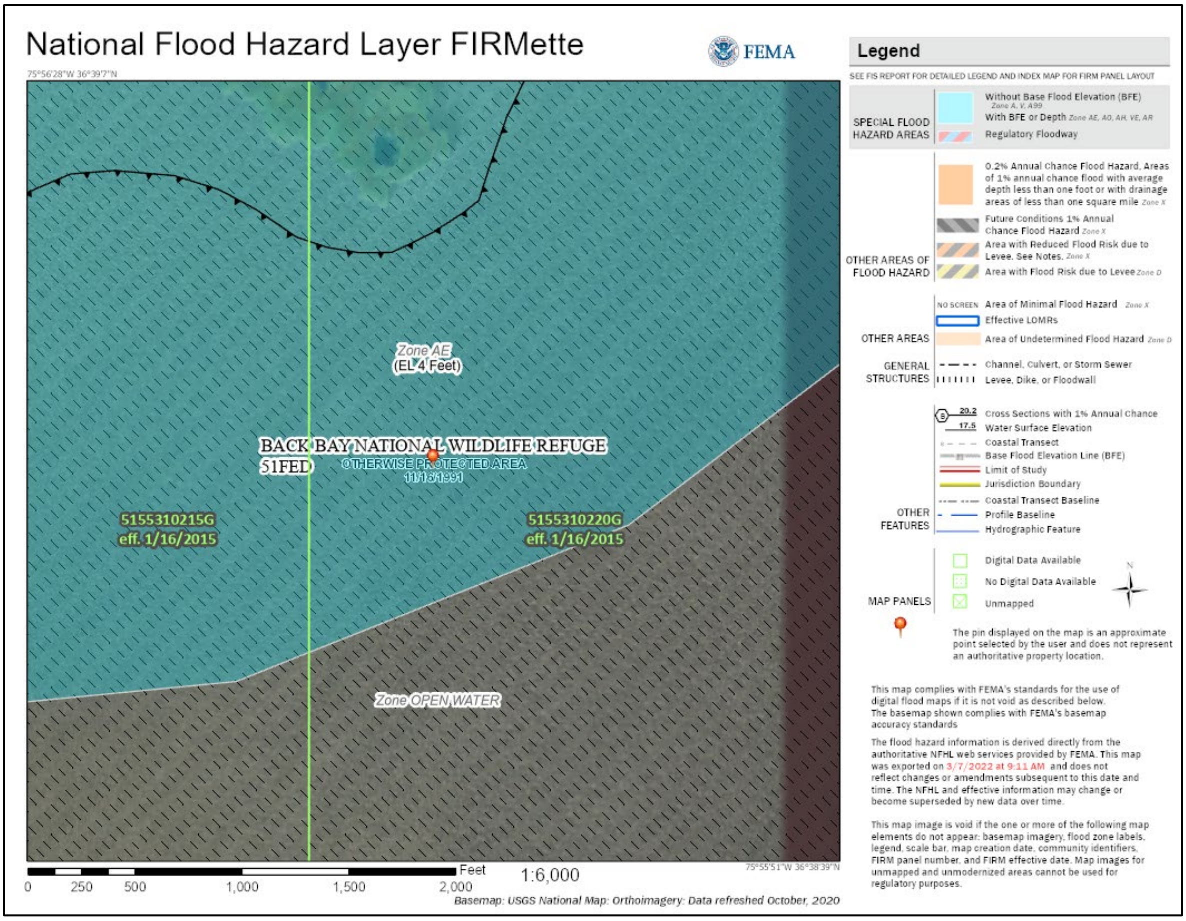

Figure 16: FIRMette for the project area (southern boundary).

The City maintains records of where residents report flood issues and what type of flooding is causing the issue. Residents regularly report flood issues through a hotline, which are then recorded in a flood event database. The census block groups adjacent to the project area reported 111 flood issues associated with heavy rain or high tide between 2001 and 2019. Critical facilities and flood incidences are relatively concentrated in the Sandbridge Resort Area.

Projected Flood Frequency

The USFWS, the City, and other stakeholders have made significant investments in detailed assessments, sophisticated computer models, and water level gauges to better understand historical and future wind tide flooding. Figure 17 displays the projected flood pathways under the 10-year and 100-year storm event under a 3 feet sea level rise scenario surrounding the project site.

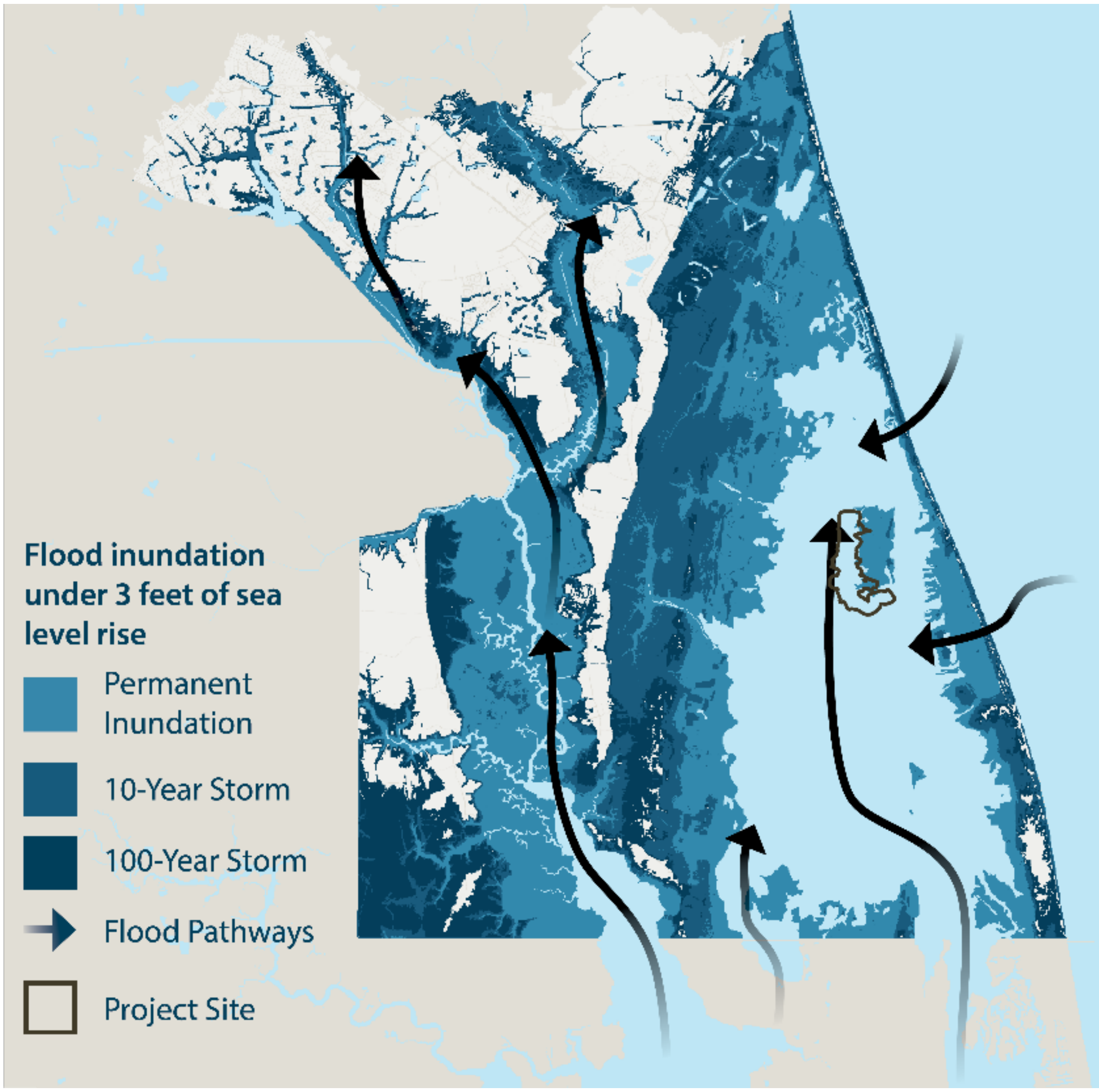

Figure 17: Flood pathways into the Southern Rivers Watershed with 3 feet of sea level rise.

Numerical modeling also shows that as sea levels continue to rise, a shorter duration wind event will produce more wind-induced flooding in less time. The three lines in Figure 18 represent the water level response to a sustained 15-mph wind for each sea level rise scenario. With the existing marsh system today (blue line), it takes approximately five days of sustained southerly wind to cause flooding. With 1.5 feet (yellow line) and 3 feet (red line) of sea level rise, the peak water level could be reached two to three days sooner, respectively. Model simulations showed that marsh island creation across Back Bay would help delay the onset of flooding by several days, which would allow the City and residents more preparation time[7].

[7] City of Virginia Beach. (2018). Analysis of Marsh Response to Sea Level Rise (PDF).

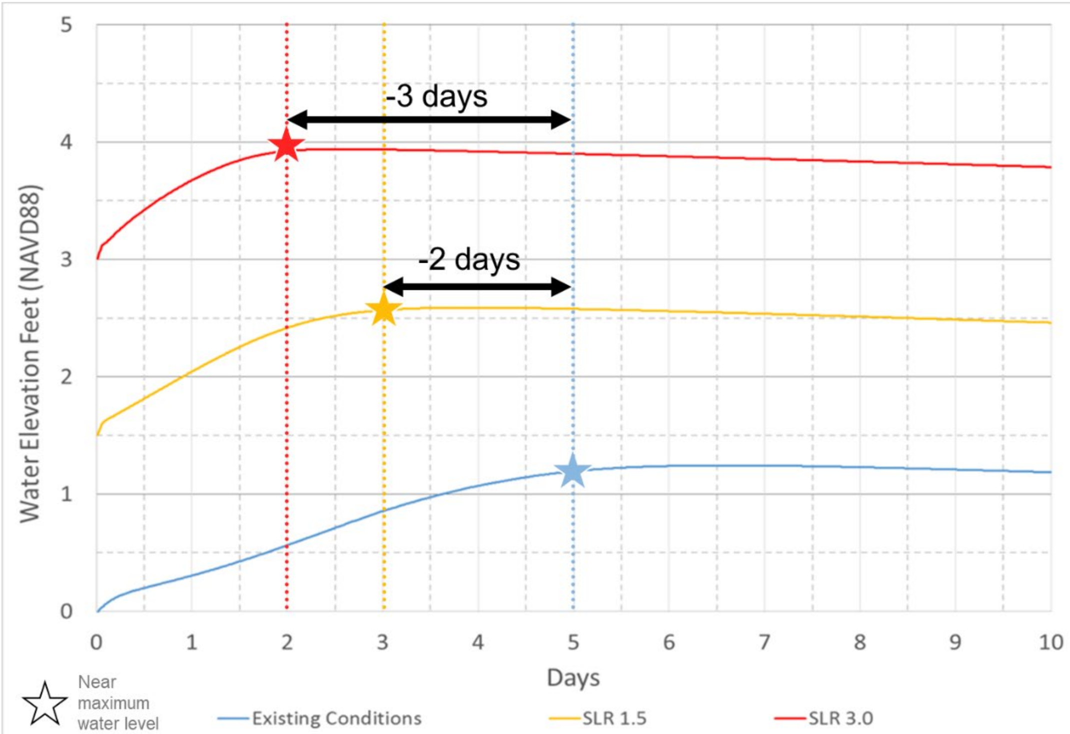

Figure 18: Water-level response under sustained 15-mph southerly wind.

The City analyzed future marsh conditions using the Sea Level Affecting Marshes Model (SLAMM).[7] Figure 19 illustrates areas likely to experience accelerated degradation of marsh in Back Bay due to rising water levels. If no action is taken, substantial marsh loss is projected in Bonney Cove under 3 feet of sea level rise. Within a 1-mile radius of Bonney Cove, the City's SLAMM model predicts that approximately 730 additional acres could be eroded into open water in response to sea level rise. This represents more than a 70% reduction as compared to the existing marsh system surrounding Bonney Cove today. It is also presumed that open water areas would continue to experience high levels of turbidity, which will continue to negatively affect SAV communities in Back Bay.

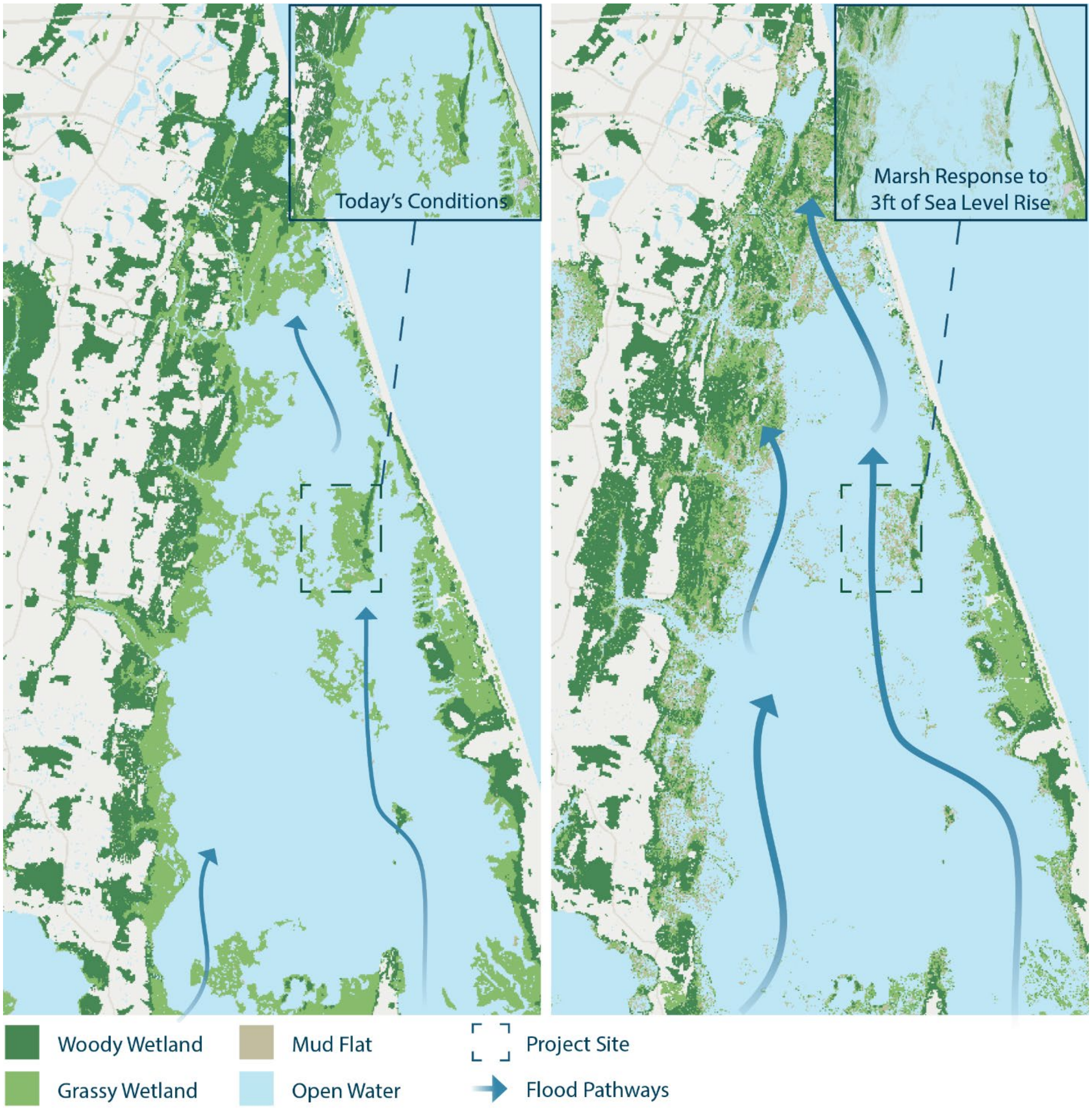

Figure 19: Comparison of current marsh conditions to future marsh conditions with 3 feet of sea level rise.

The proposed project site in Bonney Cove has a predominant south-southwest wind direction, which contributes to significant wave generation in the large unobstructed open-water areas and provides a continuous source of scouring and erosion in those areas. Marsh loss is likely to continue in the project area, creating a negative feedback cycle as continued fragmentation of the marsh would further deteriorate the remaining stands of healthy marsh and increase fetch. Today, the site faces low to medium fetch exposure, but in the future, the site could experience high to very high fetch exposure, as defined by the Virginia Institute of Marine Science (VIMS)

Shoreline Design Guidelines for Shore Protection in Virginia's Estuarine Environments.[8] Projections of increasing fetch at the site, along with the transects used for the wind fetch analysis, are summarized in Figure 20.

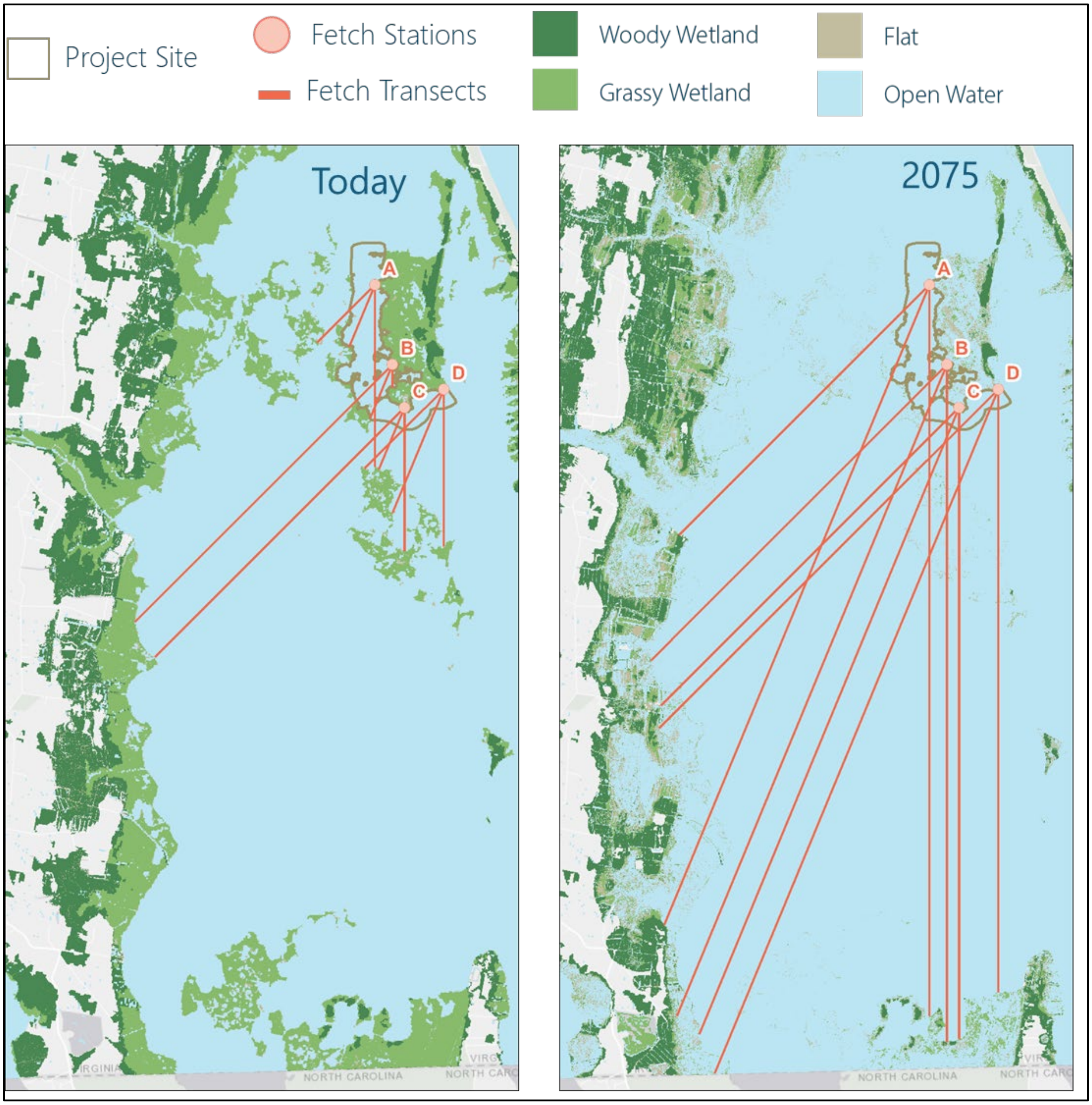

Figure 20: Wind fetch analysis of project area.

The following table displays specific values of fetch distances and classifications that correspond with the transects displayed in Figure 20 above.

[8] Virginia Institute of Marine Science. (2010). Living Shoreline Design Guidelines for Shore Protection in Virginia's Estuarine Environments; Version 1.2 (PDF).

Table 5: Measurements of fetch transects referenced in Figure 20.

Fetch Transect	Length, Miles (Today)	Classification	Length, Miles (3 feet SLR)	Classification
A-SW	0.9	Low	3.7	High
A-SSW	0.7	Low	7.3	Very High
A-S	1.9	Medium	7.7	Very High
B-SW	3.8	Medium	4.4	High
B-SSW	0.6	Low	7.4	Very High
B-S	0.2	Very Low	7.2	Very High
C-SW	3.7	Medium	4.4	High
C-SSW	0.7	Low	7.2	Very High
C-S	1.5	Medium	6.7	Very High
D-SW	1.2	Medium	5.1	Very High
D-SSW	1.4	Medium	7.8	Very High
D-S	1.7	Medium	6.4	Very High

No Adverse Impact

The City conducted additional hydraulic numerical modeling to identify any potential adverse impacts in response to concerns raised during a public meeting in July 2023. The City utilized a Danish Hydraulic Institute MIKE FLOOD model developed for stormwater master planning activities in Lower Southern Rivers Watershed of Virginia Beach. This model encompasses the entirety of Back Bay and extends into North Carolina's Currituck Sound. Model performance has been validated against observations from multiple flood events.

The effort looked at water level and velocities in response to a historical southerly wind tide flood in May 2017 and a northerly wind event associated with Tropical Storm Ophelia in September 2022. These events were ran with model grids depicting with- and without project conditions, considering the 100% project design specifications. The northerly wind event was

included to address concerns from residents of Knott's Island, at the southern end of Back Bay. Both the terrace field and the construction staging area were included in the with-project condition. The modeling found that there were no increases in water levels to areas within Back Bay or to Knotts Island. Negligible changes in water velocity (0.2 ft/s or less) were observed in the channel to the west of the terrace field. No increases in water levels were observed in the area of the construction staging area.

Local Government to Provide its Share of the Cost

The City of Virginia Beach is fully prepared to cover the cost share of the proposed project, as highlighted in the attached budget narrative, "Amount of Cash Funds Available." The funding for the grant match is contained within the City budget.

Benefit-Cost Analysis

FEMA recognizes the economic value of restoration projects and has provided ecosystem service economic valuations for benefit cost considerations. The approach and values used here are consistent with FEMA Benefit-Cost-Assessment (BCA) toolkit approaches and ecosystem service valuations published in "FEMA Ecosystem Service Value Updates, June 2022[9]." The 2022 FEMA guidance provides methods and values for various nature-based projects, including coastal wetlands. The valuations recognize ecosystem services for coastal wetlands including aesthetic value, climate regulation (carbon sequestration), flood and storm hazard reduction, habitat, recreation/tourism, water filtration and supply benefits of coastal wetland features.

Feasibility and Effectives Criteria

The project meets FEMA's Feasibility and Effectives Criteria for a Coastal Wetland as defined in the 2022 guidance, including:

- Land cover associated with the project is a "Estuarine and Marine Wetland" as classified for NWI for remaining marsh within and adjacent to the study area. The area of the project is also a historical marsh.
- The project demonstrates "ecosystem restoration" by using the terrace approach to recover degraded, damaged, and destroyed wetlands and submerged aquatic vegetation in the Back Bay ecosystem.
- The project meetings EPA concepts of restoration through direct creation of marshes (the terraces themselves) and enhancement of the ecosystem (reduction of water turbidity to enhance growth of submerged aquatic vegetation).
- The project will result in notable increased health and function of the local ecosystem in the "after mitigation" scenario through reduction of wave heights, water flow, and significantly decreased turbidity within the project area, as well as reduction of wave heights to adjacent areas.

[9] FEMA Ecosystem Service Value Updates, June 2022 (PDF).

- The project approach was aligned with established principles and techniques on wetland restoration, as outlined in the Coastal Wetlands and Tidal Flats section of the International Guidelines on Natural and Nature-base Features for Flood Risk Management10.

Design Life

As mentioned, the project useful life is 30-years. The FEMA 2022 guidance allows 50-years a typical lifespan; however, as stated in the project description, the elevation of the terraces was set based on a 30-year design life and estimated settlement.

Ecosystem Services Valuation

- The 2022 guidance values ecosystem services for coastal wetlands at $8,955 in 2021 U.S. dollars (USD), per acre, per year.
- The project will restore 46.5 acres of intertidal and upland marsh through direct creation of the marsh terraces. The project will also promote the growth of SAV in between the terraces, an area estimated at 310 acres. This provide for a total project benefit area of (46.5 + 310) = 356.5 acres.
- Project benefits occur over a period of time into the future; while most of the project costs are incurred up front and in the present. FEMA conducts its BCAs on a net present value basis, meaning the present value of the benefits gained from the project over the life of the project are compared to the total project cost to establish the BCR. Because project benefits accumulate over time, project benefits are calculated on an average annual basis ("annualized") and then multiplied by a Present Value Coefficient (PVC) to determine the present value of the annualized benefits.
- The present value coefficient is calculate as follows:

$$PVC = \left[\frac{1-(1-r)^{-T}}{r}\right]$$

  where *r* is the discount rate and *T* is the useful life of the project. The CFPF 2023 Grant Manual does not specify a discount rate for the benefits calculation; therefore, the latest FEMA program grant guidance was reviewed. For the 2023 FEMA Building Resilient Infrastructure and Communities (BRIC) and Floodplain Mitigation Assistance Grant Program (FMA) cycles FEMA has established a set discount rate of 3%[11]. The 3% discount rate provides for a PVC of 19.60 for a 30-year lifecycle for the project.
- Project benefits were calculated by:

$$Benefits = PVC \times Project\ Area \times Coastal\ Wetland\ Benefits$$

- The benefit cost ratio (BCR) was calculated as:

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[10] International Guidelines on Natural and Nature-Based Features for Flood Risk Management - Engineering With Nature (dren.mil)

[11] FEMA Fact Sheet. Notice of Funding Opportunity for Fiscal Year 2023 Building Resilient Infrastructure and Communities Program (PDF).

$$BCR = \frac{Benefits}{Costs}.$$

A summary of the calculated values is provided in the below table:

Table 6. Summary of BCA parameters and results.

Project Area	Benefits (acre / year, 2021 USD)	Project Lifespan	Benefits, 3% discount rate	Project Cost	BCR, 3% discount rate
356.5	8,954	30	$62,566,588	$53,378,490	1.17

The calculated BCR for the project was 1.17, based on the FEMA ecosystem services valuation approach. This BCR is greater than 1, indicating the project can be considered cost-effective. The project also provides an additional $9.19M in value over the project cost.

Local Floodplain Management Regulations

The City recognizes the vital importance of floodplains in the natural movement of water through the community. Appendix K of the Virginia Beach Code of Ordinances regulates development in the community's floodplains. The City requires that a permit is obtained for any construction or development in the Special Flood Hazard Area. For more information and details regarding the City's floodplain management and ordinances, please refer to the following:

- Link to current floodplain ordinance: Virginia Beach Floodplain Ordinance.

In addition, a copy of the current floodplain ordinance has been included in *Part IV, Section E5*. For further information regarding the City's hazard mitigation and comprehensive planning, please refer to the following:

- Link to current hazard mitigation plan: Regional Hazard Mitigation Planning.
- Link to current comprehensive plan: Virginia Beach Comprehensive Planning.

Other Necessary Information to Establish Project Priority

Repetitive Loss and/or Severe Repetitive Loss Properties

The repetitive loss database shows 113 repetitive loss and severe repetitive loss properties within the two census block groups (518100454.121 and 518100464.001) associated with the project area.

Residential and/or Commercial Structures

A detailed economic flood loss assessment presented in the City's Resilience Plan showed that approximately 45% of the entire future risk exposure in the City is concentrated in the Southern Rivers watershed. Of that risk, 65% is concentrated in three communities north of Back Bay

(Figure 21).[12] Under a "no action" scenario, average annualized flood losses would increase from $974 thousand, representing present day conditions, to $6 million with 1.5 feet of sea level rise as anticipated by 2050. This figure equals an increase of six times present day conditions. With 3 feet of sea level rise as anticipated by 2080, annualized losses are expected to drastically increase to $80 million, more than 80 times today's conditions.

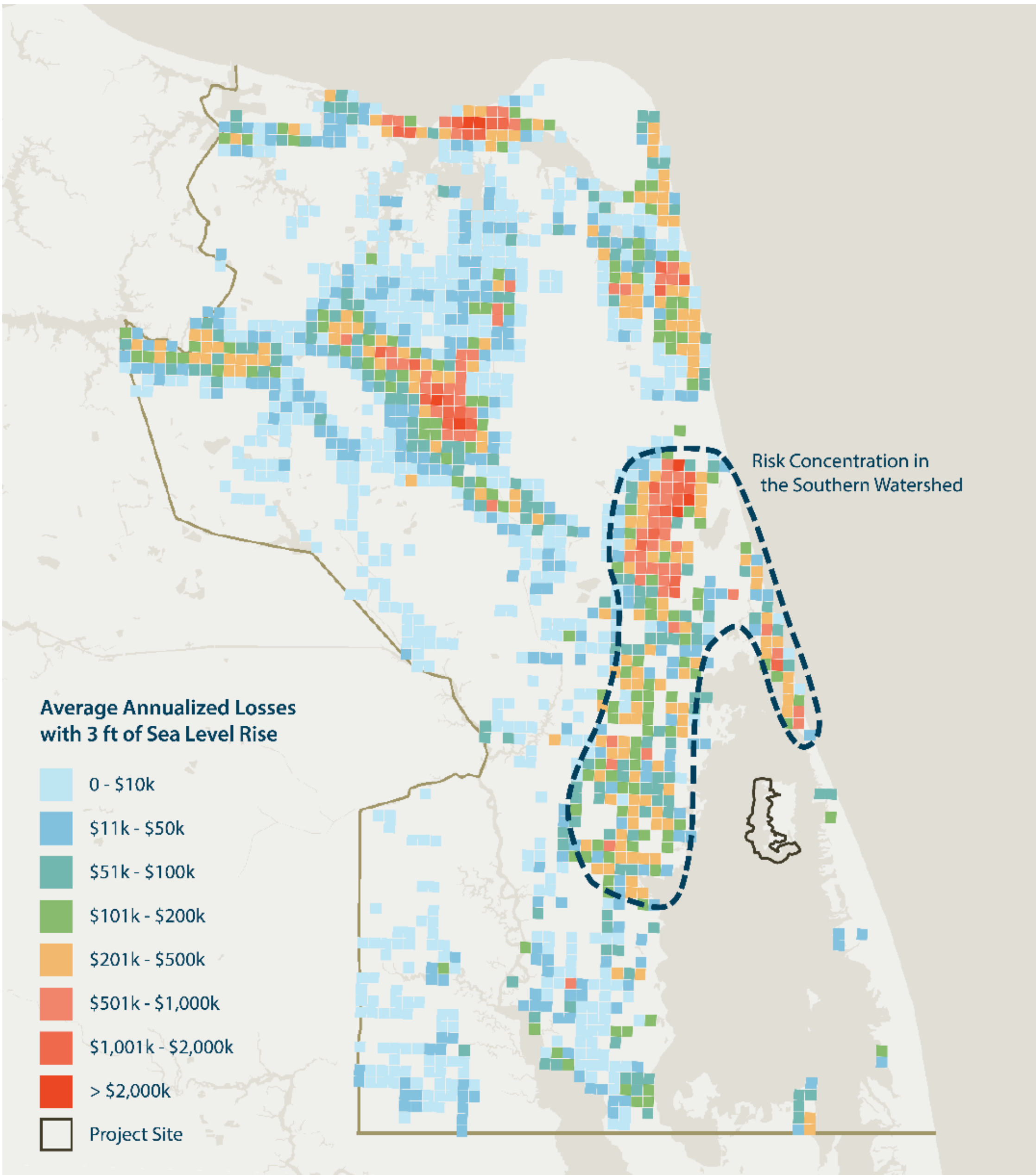

Figure 21: Concentration of average annualized losses estimated with 3 feet of sea level rise under a "no action" scenario presented in the City's Resilience Plan.

[12] City of Virginia Beach. (2020). Coastal Flooding and Economic Loss Analysis (PDF).

Within the two census block groups adjacent to Back Bay near the project area, there are approximately 70 commercial structures and 2,350 residential structures. Of those structures, approximately 635 structures are vulnerable to flooding during a 50-year event today. With 3 feet of sea level rise, approximately 2,060 structures are expected to be vulnerable during a 50-year event, representing approximately 85% of the residential structures within the project vicinity. These numbers underscore the importance of implementing the proposed project alongside complimentary flood risk reduction projects.

Critical Facilities

The two census block groups near the project site include 10 critical facilities. Table 7 summarizes critical facilities by type, total number, and the number of facilities exposed to the 50-year storm scenario under current and future "no action" scenarios. Under current 50-year storm conditions, 2 communication facilities and 1 electric power station would be exposed to flooding. With 3 feet of sea level rise, the number of critical facilities exposed to flooding increases to 9 total facilities.

Table 7: Summary of critical facilities located in the selected census block groups and flood hazard exposure to the 50-year storm event under current conditions and with 1.5 feet and 3 feet of sea level rise.

Type of Facility	Number of Facilities	Current 50-year storm	50-year storm with 1.5 feet sea level rise	50-year storm with 3 feet sea level rise
Communication	3	2 (66%)	2 (66%)	3 (100%)
Electric Power	1	1 (100%)	1 (100%)	1 (100%)
Fire Station	1	0	0	0
Potable Water	2	0	2 (100%)	2 (100%)
School	1	0	0	1 (100%)
Wastewater Treatment	2	0	0	2 (100%)

Need for Assistance

The City of Virginia Beach has invested significant time, money, and staff resources in understanding, communicating, and planning for the threats of sea level rise and recurrent flooding to the community. The City is ready to begin the implementation of adaptation measures, and the marsh terrace project is the first project to advance to construction from the City's Resilience Plan. The project represents the first step in restoring Back Bay and the larger Albemarle-Pamlico estuary, and serves as a pilot for additional restoration projects. Virginia Beach understands that flood mitigation costs are substantial and is seeking funds to support project implementation alongside dedicated resources procured by the City. The City's

Department of Public Works Stormwater Engineering Center has closely coordinated with the City's Department of Planning & Community Development throughout the design and permitting process. The Department of Public Works will oversee the construction of the marsh terrace project, including providing construction inspectors to monitor that the project is built to the City's design standards and technical specifications. Additionally, the City has access to necessary software, including AutoCAD and ArcGIS Desktop, and support from consultants to augment the City's technical capabilities.

Examples of City staff who will support the project include the following:

- Program Manager for the Technical Services Division of the Stormwater Engineering Center.
- Project Manager for Green Infrastructure Projects for the Technical Services Division of the Stormwater Engineering Center.
- Environmental Planner / Certified Floodplain Manager from the Wetlands & Shoreline Construction Team of the Planning Administration Division of the Department of Planning & Community Development.
- Planning Evaluation Coordinator from the Chesapeake Bay Preservation Area & Southern Rivers Watershed Team of the Planning Administration Division of the Department of Planning & Community Development.
- Full-time Construction Inspector assigned exclusively to this project from the City's Construction Bureau or under contract with the City Public Works Engineering Division.
- Grant Coordinator from the City's Public Works Engineering Division.

Additional staffing will be provided as needed to ensure project success.

This project benefits communities in northern Back Bay with a high concentration of flood losses (as shown in Figure 21). These communities contribute significantly to Virginia Beach's rural economy, including agriculture, forestry, fishing, hunting, and eco-tourism. In Hampton Roads, these industries contribute a combined $100 million in gross domestic product.[13] Protection of vulnerable natural infrastructure, such as the marshes in Back Bay, is critical to ensuring these industries can continue to thrive within the region.

Alternatives

Several other alternatives were considered but not advanced due to technical and environmental limitations. These alternatives are briefly summarized below.

[13] Office of Governor Ralph S. Northam Commonwealth of Virginia and Virginia Department of Conservation and Recreation. (2021). Virginia Coastal Resilience Master Plan Phase 1 (PDF); data referenced sourced from the US Bureau of Economic Analysis. (2019).

Alternative 1 - No Action Alternative

Under this alternative, no action would be taken to restore marsh habitat in the shallow open water channel of Bonney Cove. Erosion of the adjacent marsh would continue to occur, resulting in fragmented habitat lacking the capacity to reduce wave action and slow water velocities. It is anticipated that wind-driven flooding events will continue to increase in frequency, resulting in increasing flooding of the low-lying properties and roadways surrounding northern Back Bay.

Alternative 2 - Alternative Terrace Configuration Design(s)

Several configuration alternatives for the terraces were considered during the design process. These included four alternative layouts with different spacing and terrace top widths:

- **Alternative 2a** (Figure 22): Terraces would be spaced at approximately 300-foot intervals and have a top width of 15 feet. Between the base of the terraces, there would be approximately 220 feet for potential establishment of SAV habitat.
- **Alternative 2b** (Figure 23): Terraces would be spaced at approximately 300-foot intervals and have a top width of 30 feet. Between the base of the terraces, there would be approximately 200 feet for potential establishment of SAV habitat.
- **Alternative 2c** (Figure 24): Terraces would be spaced at approximately 600-foot intervals and have a top width of 15 feet. Between the base of the terraces, there would be approximately 520 feet for potential establishment of SAV habitat.
- **Alternative 2d** (Figure 25): Terraces would be spaced at approximately 600-foot intervals and have a top width of 30 feet. Between the base of the terraces, there would be approximately 500 feet for potential establishment of SAV habitat.

A common feature across all of these design alternatives was a breakwater that spanned the entire length of the southern extent of Long Island and a northern breakwater that spanned the northern exposed section of the project site.
Alternative 2a and 2b were eliminated due to constructability concerns regarding the quantity of sediment that would be required and due to the limited amount of room for SAV establishment in between the terraces (approximately 220- and 200- feet of potential SAV habitat between terraces for Alternative 2a and 2b, respectively).

Alternatives 2c and 2d were discussed extensively amongst the project team; however, it was ultimately determined that they did not maximize the opportunity for species diversity (by including both smaller and larger terraces). These alternatives were combined to form the preferred alternative presented in this document. Additional refinements that were made to these alternatives include the removal of the perimeter breakwater, as the proposed design elevation evaluated in the geotechnical analysis revealed stability issues with these large features.

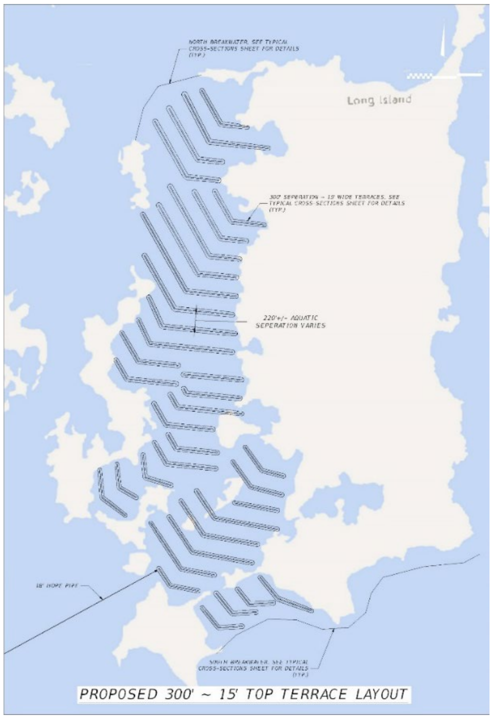

Figure 22: Alternative 2a.

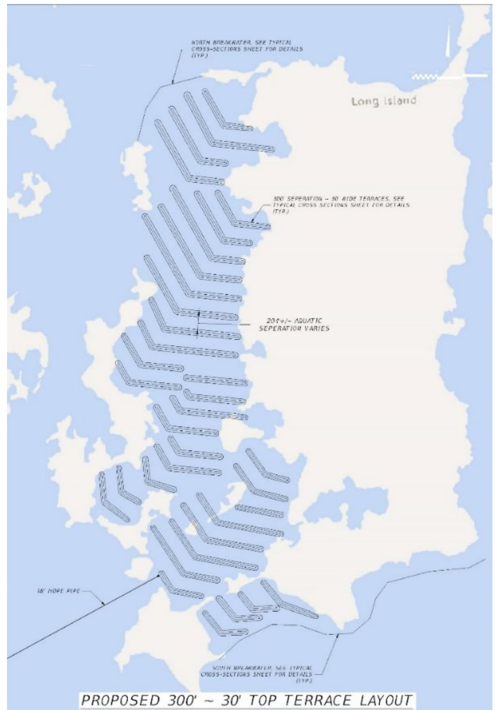

Figure 23: Alternative 2b.

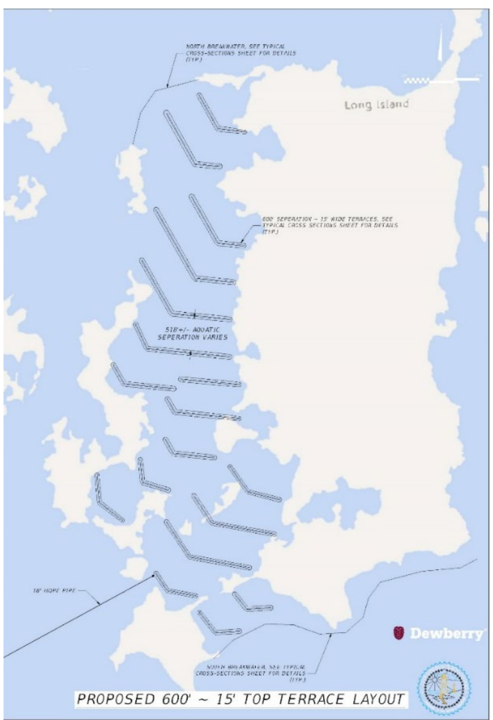

Figure 24: Alternative 2c.

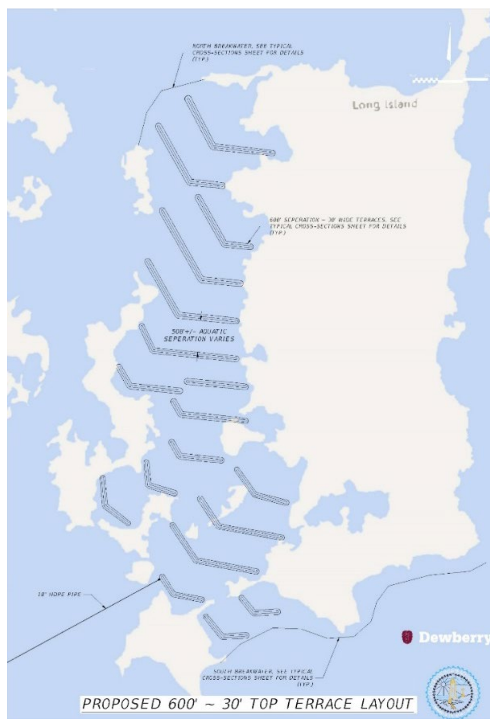

Figure 25: Alternative 2d.

Alternative Terrace Core Material Sources and Transportation – Alternative 3

In the proposed alternative with sand cores, a no-dredging alternative was considered. However, in order to successfully complete the project and establish the vegetation desired, material would need to be sourced, blended, transported, and placed. The City helped identify two potential borrow sources of material: Bow Creek Golf Course (Figure 26) and the Whitehurst Dredged Material Management Area (DMMA) (Figure 27).

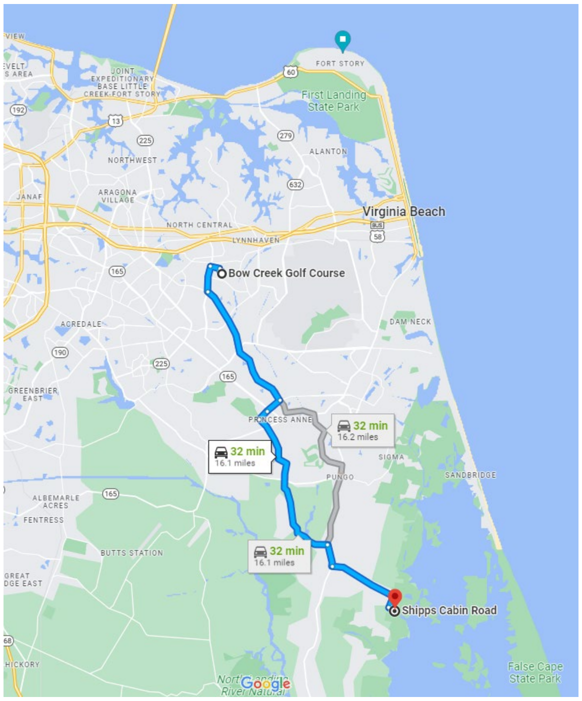

Figure 26: Distance from Bow Creek Golf Course to the proposed Shipps Cabin staging area.

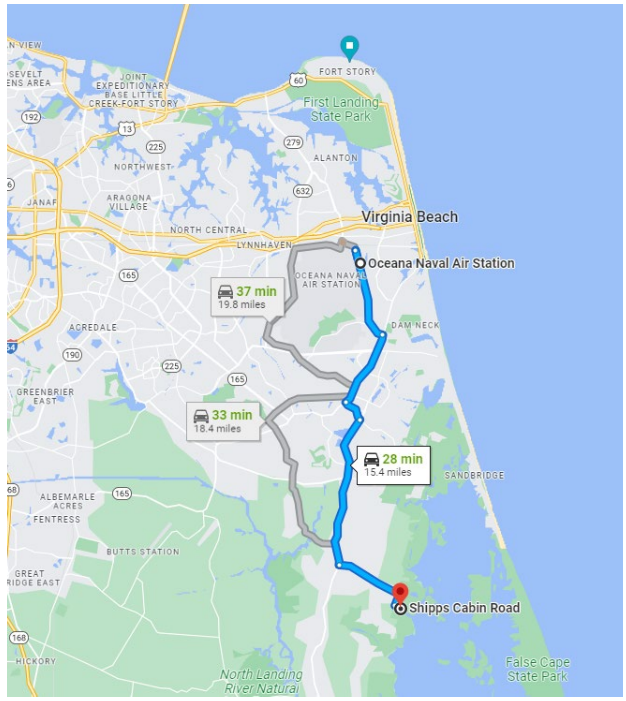

Figure 27: Distance from Whitehurst DMMA to the proposed Shipps Cabin staging area.

Bow Creek Golf Course: Bow Creek Golf Course is located approximately 16 miles from the proposed Shipps Cabin staging area. In the next few years, The Bow Creek Golf Course is scheduled to be converted into a Stormwater Park as one of 21 projects funded by the City's Stormwater Flood Protection Program. Large quantities of materials will be removed from the site for use within the City. The material from Bow Creek would need to be excavated, screened, and tested for foreign seeds and contaminants. Most likely, this material would have to be processed before it could be loaded again on dump trucks and hauled approximately 16 miles to a potential staging area where it would be loaded again on shallow draft barges.

Whitehurst DMMA: The Whitehurst DMMA is a similar distance to the proposed Shipps Cabin Road Construction Staging Area. The material at Whitehurst may not have to be processed as much; however, it would need to be tested for foreign seeds and contaminants. Because of the organic components in this soil and the need for the material to establish vegetation on the terraces, this material is not able to be hydraulically blended and pumped to the site. Therefore, this material would need to be loaded on shallow draft barges and then

placed by mechanical means. Further, the amount of material needed to cap the proposed terraces is approximately 110,000 cubic yards which equates to roughly 5,500 quad-axle dump trucks traveling city streets and damaging other infrastructure.

Barging of all materials was considered. Dewberry conducted meetings, site investigations, and talked with both industry leaders in maritime construction and locals who know the water in Back Bay. A typical 35-foot by 95-foot construction barge drafts approximately 7 feet. This type of barge is not able to be trucked to the landing site, nor is it able to be brought into Back Bay. There are truckable barges, but again the drafts of those barges can be in the 4 to 5 feet range when loaded and would require dredging a channel for access. Shallow draft barges can be used in Back Bay that only draft 1 to 3 feet, and they would need to be off-loaded from a staging site. To bring any materials such as stone, sandy fill, or terrace cap material by barge around Knotts Island is not feasible. The actual channel into the southern point of Back Bay has a height restriction due to the causeway serving Knotts Island.

Continuous Marsh Platform – Alternative 4

A continuous marsh platform to fill in the areas of historical marsh would help to restore this eroded habitat but would not provide conditions suitable for SAV establishment or optimize the wave/flow velocity attenuation through the project area. Furthermore, for a single marsh platform across Bonney Cove, the amount of material required would be more than 3 or 4 million cubic yards of material. To achieve that volume of material by dredging, significant areas of existing SAV present in Back Bay would need to be impacted. As the geotechnical report indicated, the existing material of the project site and surrounding areas is not capable of supporting itself in a constructed arrangement and would slough off back into the water. Further, providing this amount of material without dredging would require bringing external sediment sources into Back Bay, which could introduce invasive species. Finally, while the platform will reclaim marshland, it is not anticipated to establish extensive areas appropriate for SAV reestablishment and would eliminate deeper water areas preferred by some endemic wildlife species.

Goals and Objectives

The overarching goal of this project is to construct the City's first nature-based adaptation project in the Southern Rivers Watershed and one of the CRMP's exemplary nature-based projects. This project aims to stabilize two critically eroding marsh islands from further degradation, decrease turbidity to promote the growth of aquatic vegetation and provide flood risk reduction benefits through increased friction and wave attenuation. The following section summarizes the objectives through which this goal will be realized.

Objective 1 – Create a Construction Access and Staging Area

The project's first objective is to employ a construction approach that is compatible with the shallow nature of Back Bay and the large quantity of material required to build the marsh terraces. The engineering team performed a constructability review of suitable landing sites to

stage construction operations for the terraces. A property located at the end of Shipps Cabin Road (Figure 28) was identified as the preferred staging and construction access location for the following reasons:

- Shipps Cabin Road Construction Staging Area Proximity to site (2 miles).
- Shipps Cabin Road Construction Staging Area Proximity to sand borrow sources.
- Shipps Cabin Road between Muddy Creek Road and the Construction Staging Area is in disrepair and was identified as an opportunity to improve the condition of the road as part of the construction activities.

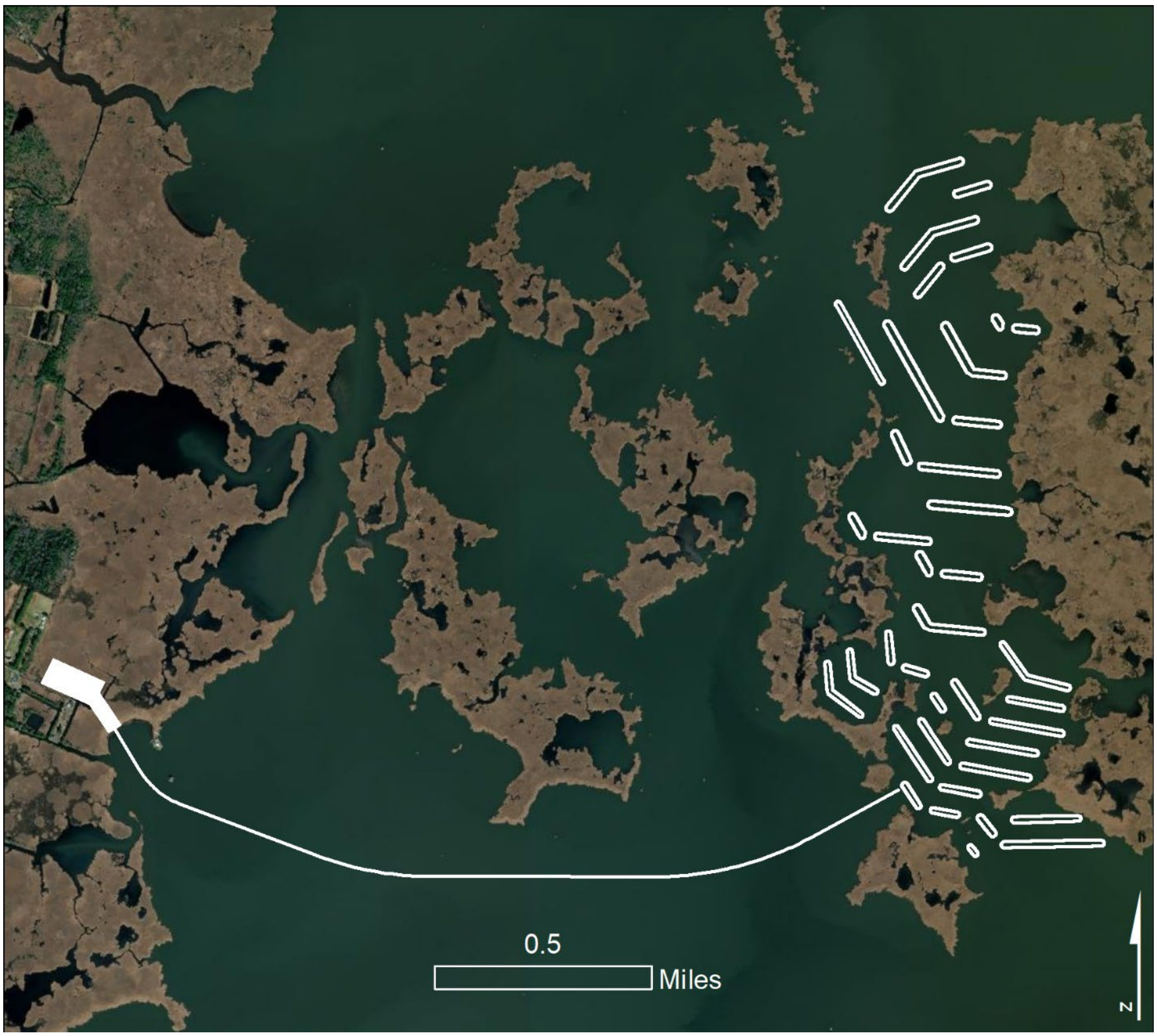

Figure 28: Proposed Construction Access.

On completion of the project, the City plans to retain the staging area for future monitoring and maintenance needs for the project. This future use is consistent with the sentiments of local stakeholders, as communicated during public engagement meetings for the study.

Expected Benefits:

- Enables constructability of the marsh terraces.
- Enable access to the project for post-construction monitoring and future marsh restoration projects.

Objective 2 – Restore Marsh and Aquatic Vegetation

The second objective of the project is to restore marsh and aquatic vegetation for habitat and flood resilience. Specifically, the City's construction of the marsh terraces will result in the restoration of approximately 46 acres of habitat within Back Bay, consisting of:

- 10 acres of low marsh habitat; low marsh plantings would include Big Cordgrass (*Spartina cynosuroides*) and Saltmarsh Cordgrass (*Spartina alterniflora*).
- 6 acres of high marsh habitat; high marsh plantings would include Black Needlerush (*Juncus roemerianus*) and Salt Meadow Hay (*Spartina patens*).
- 14 acres of upland vegetated habitat; upland vegetation would include Arrow-leaf Tearthumb (*Persicaria sagittate*), Groundsel Tree (*Baccharis halimifolia*), Wax Myrtle (*Myrica cerifera*), and Bald Cypress (*Taxodium distichum*).
- 16 acres of submerged terrace habitat anticipated to create suitable conditions for the emergence of SAV.

Additionally, approximately 310 acres of open water SAV habitat would remain between the proposed marsh terraces, and it is anticipated that construction of the terraces would create conditions within the project area favorable to the re-establishment of SAV populations.

Expected Benefits:

- Reduce wave heights, flow velocities, and wind sheer stress within the project area to protect marsh islands from continued erosion.
- Restore the natural buffer that helps protect low-lying neighborhoods and critical access roads from wind-driven flooding.
- Improved water quality by removing excess nutrients.
- Lowered transport of suspended sediment and prevention of resuspension of fine sediments in the water.
- Reduced flow velocity and absorbing wave/wind energy to reduce shoreline erosion.
- Creation of habitat (nursery and feeding areas) for fish (such as Largemouth Bass, Bluegill Yellow Perch, Striped, Blueback Herring, Alewife, and American Eel), migratory waterfowl (such as the Canvasback Duck [*Aythya vallisineria*]), and other aquatic animals.

Objective 3 – Engage Stakeholders and Disseminate Effective Practices

The City is committed to continued meaningful engagement with project partners and external stakeholders throughout the restoration and monitoring phases to ensure transferability to other sites in the region and state.

Expected Benefits:

- Ensure that the lessons from this project can be transferred and scaled to other sites in the state or region.

Approach, Milestones, and Deliverables

The following approach, milestones, and deliverables lay out a plan of action. The milestone schedule follows in *Section B: Milestone Schedule*.

Approach & Deliverables

Activity 1 – Construction Staging Area Preparation and Construction

Activity 1 involves preparing the Shipps Cabin Road property as a construction staging area. Construction activities will include stabilization of the road, laying geotextile to stabilize the ground under the construction staging area, filling with material for the construction staging area, adding fencing, creating bridge abutments and installing a temporary bridge and ramp for waterfront construction access, construction of slurry basins, and establishment of traffic flagging stations.

In the final step, the contractor will install pipe to pump the slurry material from the Shipps Cabin staging area to Bonney Cove. The pipe will be floated with subaqueous tie-downs at channels and certain points of access to maintain boat crossings. Those subaqueous locations will be marked by a buoy every 10 feet and temporary signage as reasonable. The contractor will install two booster stations along the alignment, one approximately half-way between the landing and Bonney Cove, and one at the edge of Bonney Cove. These booster stations will consist of a pontoon-mounted diesel engine pump capable of moving the sand slurry from the construction staging area to the site. It is estimated that 150 CY per hour of sand slurry would be pumped through the pipe in a 60:40 ratio. Additional booster stations may be required for manifolding and supplying slurry stations to individual terraces.

Relevant Objective(s): Objective 1

Deliverables:

- Conduct daily inspections to monitor construction progress of the Shipps Cabin Road Construction Staging Area preparation.

Assumptions:

- It is anticipated that the Shipps Cabin Road Construction Staging Area construction activities can occur simultaneously with material production in Year 1 (2024).

Activity 2 – Marsh Terrace Construction

Once the Shipps Cabin Construction Staging Area preparation is complete, marsh terrace construction activities can commence. The contractor will construct the terraces according to the 100% Final PS&E documents. The most recent engineering designs and design report are available upon request; they are not included as an attachment to this proposal due to file size. Figure 29 shows the overall layout of the terraces, and Figure 30 and Figure 31 show the project renderings. Terrace construction will begin in the northern extent of the project site at Terrace #100, noted in Figure 29, and the contractor will work south towards Terrace #140. The contractor will complete each terrace (including installation of plants) before moving onto the next.

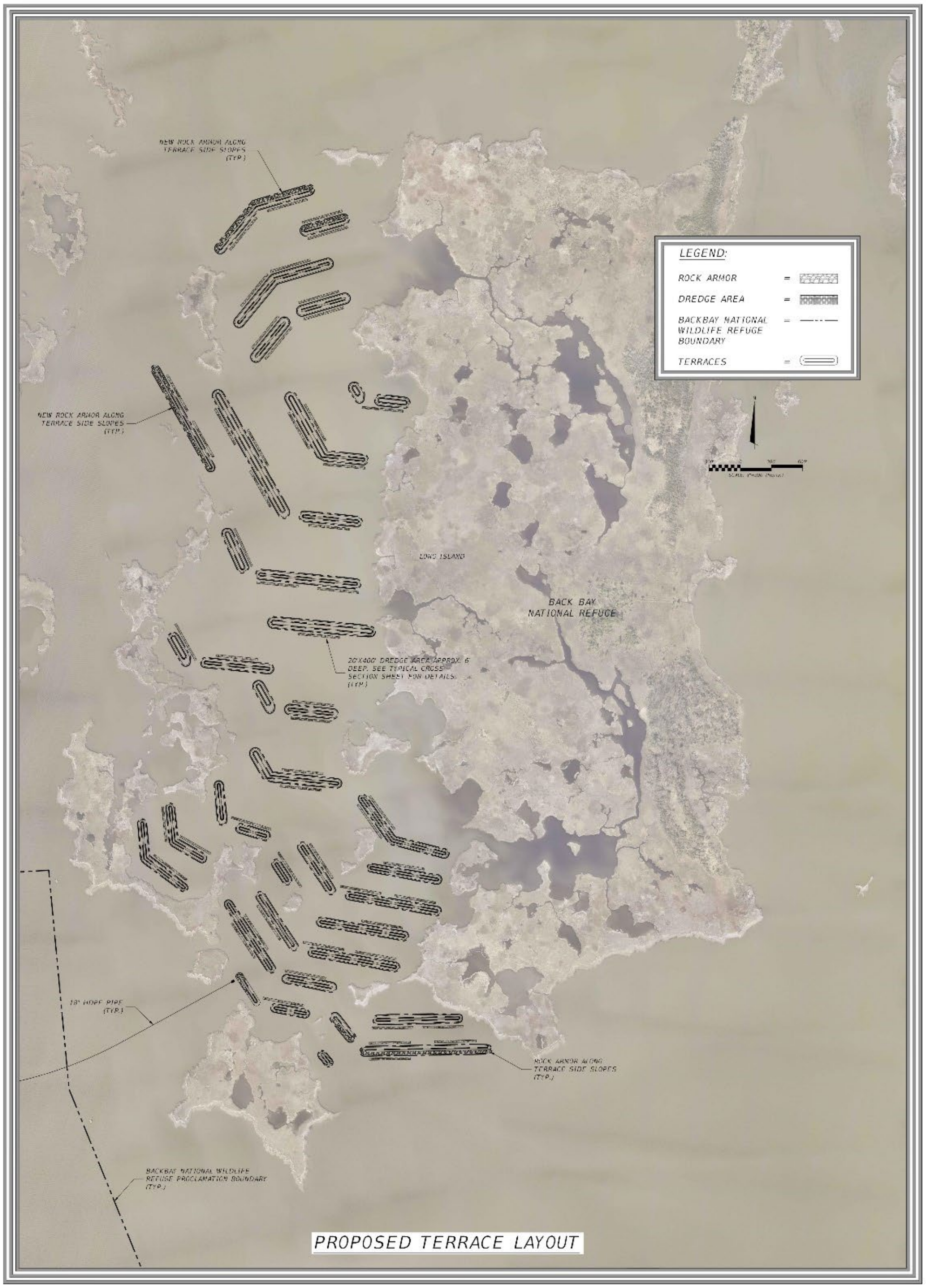

Figure 29: Marsh terrace layout across Bonney Cove.

Figure 30: Marsh terrace design rendering.

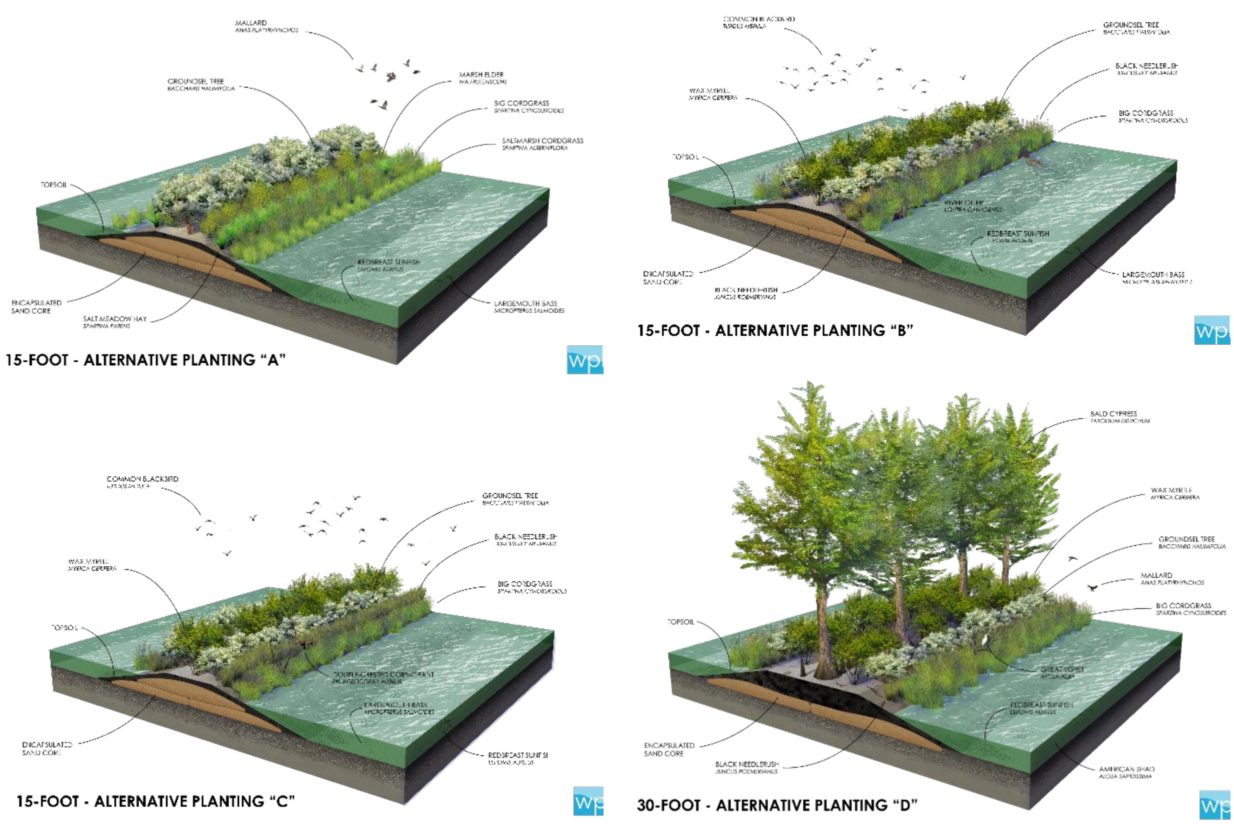

Figure 31: Marsh terrace cross-section design renderings.

The following section provides a high-level description of the proposed design and

construction approach.

Terrace Orientation:

The orientation of the terraces will be perpendicular to the predominant wind direction (south-southwest) to maximize wave energy reduction. The terraces in the northern extent of the project site will be angled perpendicular to a north-northwest wind direction. The terraces would be segmented in a chevron pattern (duck-wing pattern) to provide the most favorable fish and swimming crustacean (termed "nekton") habitat while also allowing adequate circulation to promote sedimentation and maintaining navigability throughout the project area. The terraces would not be connected to the adjacent marsh; this gap, or physical open water barrier, is intended to deter the invasion of Common Reed (*Phragmites australis*) stands from adjacent marshes.

Spacing:

The terraces would be spaced at approximately 300-foot intervals in the northern and southern quarters, and then 600-foot or greater intervals in the center. This arrangement aims to lessen the open water and subsequent wave action at the northern and southern ends of the site and allow adequate construction space for marine-based construction equipment.

Terrace Elevation and Width:

To achieve a sustainable marsh elevation throughout the project life, the marsh terraces would initially be built to a higher elevation during construction and allowed to settle to the desired target elevation over time. Taller terraces improve the functionality and resiliency of the system while also providing diversified habitat for fish and wildlife. The goal is that, by the end of the 30-year design life and with 1.5 feet of relative sea level rise, the terraces will be at or above the elevation of a moderate wind tide event (when Back Bay water levels are anticipated to reach +3.0 feet NAVD88 over the design water level). This threshold was determined to ensure the terraces would not be fully overtopped during a future wind tide event and maintain resiliency to anticipated sea level rise. The 1.5 feet sea level rise scenario is consistent with the near-term planning scenarios identified in the City's Resilience Plan to represent conditions from 2035 to 2050 and adopted by the Hampton Roads Planning District Commission (HRPDC) as part of resolution number 2018-01.

The terraces would have a top width of 15 or 30 feet and be built to an elevation of +4.5 to +5.0 feet NAVD88, depending on the width of the crest, underlying soils, and local bottom depth, with side slopes of 4 horizontal to 1 vertical (4H:1V). The +4.5- to +5.0-foot elevation is calculated based on a target elevation of +3.0 feet NAVD88 or higher at the end of the project's 30-year design life and an estimated settlement of approximately 1 to 2 feet, depending on where the terrace is located. The geotechnical investigation revealed that terraces in the site's southern portion are expected to experience greater settlement than those to the north.

Terrace Composition:

The terraces would consist of a sand-filled core that is encapsulated by a high-strength blend of woven and non-woven geotextile fabrics. The sand for this material will come from nearby offsite sources and be pumped through the 1-inch diameter pipe described in Activity 2. Once the cores are in place, long-reach excavators would travel along the tops of the terraces and begin to shape the cross slopes. Existing adjacent material devoid of SAV would be mechanically dredged and placed over the sand-filled cores. The marsh terraces would be covered with 1 to 3 feet of suitable fill, depending on crest widths, and then planted with native emergent and brackish plant species to stabilize the terraces and provide wind-driven flood reduction benefits.

Relevant Objective(s): Objective 2

Deliverables:

- Conduct daily inspections to monitor construction progress of the marsh terraces.

Assumptions:

- It is anticipated that construction of the terraces will occur in two phases over two years from 2025 through 2026, with the following assumptions:
    - Construction activities are not permitted within BBNWR from October 31 through February 28, annually, to limit disturbance to wintering waterfowl and migration during those months.

Activity 3 – Stakeholder Engagement and Lessons-Learned Dissemination

As the first large scale terracing project on the Atlantic coast, the City recognizes the importance of documenting lessons learned and effective practices during each of the proposed activities: contractor procurement, construction, and post-construction monitoring. The City plans to develop a set of project marketing materials (PowerPoint presentations, StoryMap, information flyers, etc.) to cover key topics, such as:

- Lessons learned during contractor procurement, construction, and post-construction monitoring.
- Effective practices for contractor procurement, bid development, and evaluation. This project is expected to require a highly specialized contractor given the complexity of the project, very shallow water depths, and distance of the site from available construction access and staging areas.
- Guidance for identifying the best sources for local and regional materials for building the terraces and developing a project construction schedule with enough lead time for producing the quantity of material needed for large-scale marsh creation projects.
- Effective practices for developing a post-construction monitoring plan for marsh terraces that a) aligns with permitting, grant, and other requirements and b) enables quantification of project benefits and areas for improvement.

- Effective practices for communicating project benefits based on a combination of field data collection, numerical modeling, and post-construction monitoring.

The City plans to leverage the materials to facilitate dissemination to key stakeholders to increase likelihood of transferability of the approach to other areas in the region and state. The City's plan for engagement is summarized in the following table. In addition to these efforts, the City is committed to collaborating with DCR to identify any additional opportunities to help socialize the project's innovative design and lessons learned.

Table 8: Summary of opportunities for City, regional, state, and national stakeholder engagement; expected benefits.

	Description of Proposed Outreach Activities

CITY	• Facilitate internal municipal awareness, coordination, and approval to gain budgetary approval for funding to expand the approach to other sites in Back Bay (such as "The Great Narrows", Mackay Island and Princess Anne Wildlife Management Areas, and Ragged Island) through presentations to the:
	  o Virginia Beach City Council
	  o City Manager Working Group for SLR and Recurrent Flooding, comprised of representatives from all City departments, to facilitate awareness, coordination, and action to advance the project to the restoration phase.
	• City of Virginia Beach Management Leadership Team (MLT), which includes the City Manager, Deputy City Managers, and Department heads from across the City.

REGION	• Collaborate with the National Audubon Society and Albemarle-Pamlico National Estuarine Partnership (APNEP) to:
	  o Highlight the marsh terrace project as a success story in the next iteration of the Currituck Sound Coalition Marsh Conservation Plan.
	  o Explore opportunities for marsh terrace projects in the Knotts Island Channel, a key flood pathway into Back Bay, as well as other locations in the Currituck and Albemarle-Pamlico Sound.
	• Share lessons learned to regional and state stakeholders, improving knowledge-based, awareness, and capacity for future efforts through presentations to:
	  o Hampton Roads Adaptation Forum – a regional dialogue for academics, non-profits, consultants, and municipalities committed to resilience measures.
	  o The Hampton Roads Planning District Commission (HRPDC) Coastal Resiliency Committee .
	  o Regional conferences on green infrastructure, coastal resilience, and SLR adaptation.
	• Collaborate with Wetlands Watch, a regional non-profit organization committed to the protection of wetlands using nature-based solutions, to socialize the project and disseminate lessons learned.

	Description of Proposed Outreach Activities
STATE	• Continue to coordinate with the Virginia Department of Conservation and Recreation (DCR) to: o Promote the project as a success story for the State Coastal Master Plan (CRMP), which highlighted the project as an "exemplary" resilience project that aligns with the Commonwealth's objective to protect and enhance the state's natural infrastructure. o Incorporate project updates and lessons learned on the CRMP website is an excellent mechanism for dissemination to all coastal Planning District Commissions (PDCs)/Regional Commissions (RCs) across the state. • Continue to collaborate with The Nature Conservancy (TNC), a national player in guiding the implementation of nature-based strategies, to help disseminate lessons learned on project implementation. The City has engaged in early discussions with TNC about partnering to host a state-level workshop that would draw from the network of TNC's local and regional chapters • Presentations at state-level conferences on water resources, floodplain management, and resilience, such as hosted by Resilient Virginia and Virginia Lakes and Watersheds Association.
NATION	• Disseminate lessons learned/effective practices through presentations at 1-2 relevant national conferences such as Restore America's Estuaries, Association of State Floodplain Managers, or the American Shore and Beach Preservation Association, etc. • Leverage working relationships and existing contract work with the U.S. Army Corps of Engineers and partners to integrate lessons learned into the International Natural and Nature-Based Feature Design Guidelines to promote consideration of marsh terraces within similar Back Bay environments (for example, in North Carolina, Maryland, New Jersey, and New York).

Relevant Objective(s): Objective 3

Deliverables:

- Project marketing materials.
- Records documenting number of stakeholders engaged during outreach activities.

Activities Not Included Under this Grant

Submerged Aquatic Vegetation Transplant Plan: The City will evaluate opportunities for restoring native submerged aquatic vegetation populations in Back Bay, such as Wild Celery (*Vallisneria americana*), through consultations with subject matter experts. After terrace construction, the City will formulate a plan for planting submerged aquatic vegetation in between the terraces in coordination with identified partners and the construction contractor.

Post-Construction Monitoring: Post-construction monitoring and inspections will occur for a minimum of five (5) years following construction. Given the period of performance for the CFPF grant, post-construction monitoring activities have not been included in this application.

Milestone Schedule

The scope of work proposed in this grant application are scheduled to occur between June 2024 and June 2027. Work activities are anticipated to complete in December 2026; however, the proposed schedule extends through June 2027 for contingency. The project's expected progression is shown in the following milestone schedule, noting deliverables for each milestone:

2024 Activities

- *1st Quarter **(pre-grant period activities):***
  - 100% Final PS&E
  - Submit Bid Documents
- *2nd Quarter (pre-grant period activities):*
  - Final Bid Coordination/Acceptance
  - Construction NTP
- ***Begin Year 1 Grant Activities – 2nd Quarter 2024:***
  - Mobilization for Shipps Cabin Road Construction Staging Area
  - Initiation of Marsh Terrace Material Production
- *3rd Quarter:*
  - Construction NTP and Mobilization for Slurry Basin Installation
- *4th Quarter:*
  - Completion of Shipps Cabin Road Construction Staging Area and Slurry Basin Construction

2025

- *1st Quarter*
  - Completion of Marsh Terrace Material Production
  - Construction Mobilization for Marsh Terraces (beginning on March 1, 2025)
  - Oversight, Management, and Inspection Services of Slurry Basin Installation
- ***Begin Year 2 Grant Activities - 2nd Quarter 2025***
  - Construction of Marsh Terraces #100 – 105
- *3rd Quarter*
  - Construction of Marsh Terraces #106 – 114
- *4th Quarter*
  - Construction of Marsh Terraces #115 – 119
  - Marsh Terrace Construction Demobilization (to accommodate break in construction period from October 31, 2025 – February 28, 2026)

2026

- *1st Quarter*
  - Construction Re-Mobilization for Marsh Terraces (beginning on March 1, 2026)
- ***Begin Year 3 Grant Activities - 2nd Quarter 2026***

  - Construction of Marsh Terraces #120 – 134
- *3rd Quarter*
  - Construction of Marsh Terraces #135 – 140
- *4th Quarter*
  - Shipps Cabin Road Construction Staging Area Final Improvements & Demobilization

2027

- *1st and 2nd Quarter*
  - *Contingency for any delays experienced through end of 2026*

End Year 3 Grant Activities

Project Partners

The following table highlights the specific project partners, their roles, and their capabilities concerning the proposed project.

Table 9: Potential Project Partners.

Entity	Role	Description
U.S. Fish and Wildlife Service, Back Bay National Wildlife Refuge	Project Partner / Advisor / Adjacent Land Owner	BBNWR owns the land adjacent to the project footprint and monitors migratory bird hunting within Presidential Proclamation boundaries. BBNWR has coordinated with the City on project design and will continue to be involved during project construction as a stakeholder and advisor.
Virginia Department of Wildlife Resources	Project Advisory / Stakeholder	The City has coordinated closely with VDWR on project design. Furthermore, VDWR has been monitoring SAV distribution in Back Bay for decades and will be a critical partner for identifying native seagrass species and techniques for restoration based on extensive experience from previous SAV restoration projects in Back Bay.
Virginia Beach Department of Planning & Community Development	Permit Compliance	The City's Department of Public Works has been in close coordination with the City's Department of Planning & Community Development throughout the design and permitting process. Continued involvement and coordination during construction and post-construction monitoring is anticipated.
Dewberry	Engineering Contractor	Engineering consultant to support the City with contractor procurement and construction administration.
To be Determined	Construction Contractors	Construction contractor for the Shipps Cabin Road Construction Staging Area and marsh terrace construction activities.

Entity	Role	Description
Friends of Back Bay	Project Advisory / Stakeholder	Friends of Back Bay was formed in the 1980s to lead efforts to expand and conserve BBNWR, including securing millions in funding to support the Refuge's expansion. The City has coordinated with the BBNWR Society throughout the design and permitting process and will continue this coordination through construction and post-construction monitoring.
Back Bay National Wildlife Refuge Society	Project Advisory / Stakeholder	The Back Bay National Wildlife Refuge Society (BBNWR Society) is an independent, 501(c)(3) non-profit group dedicated to supporting the mission of the USFWS National Wildlife Refuge System and specifically promoting awareness of the BBNWR through education and participation. The City has coordinated with BBNWR Society throughout the design and permitting process and will continue this coordination through construction and post-construction monitoring.
Back Bay Restoration Foundation	Project Advisory / Stakeholder	Back Bay Restoration Foundation (BBRF) is an independent, 501(c)(3) non-profit group focusing on growing concerns about issues such as recurrent flooding, sea level rise, and development in the Southern Rivers Watershed. The group aims to serve as an advocate for the Bay and surrounding residents. The City has coordinated with BBRF throughout the design and permitting process and will continue this coordination through construction and post-construction monitoring.

Relationship to Other Projects

This project represents the first nature-based project in the Southern Rivers Watershed to advance to design and construction to implement the City's Wise Resilience Plan. The project is also an aspect of the Stormwater Green Infrastructure aspect of the City's Flood Protection Plan. The City has received a $3M award from the CFPF to support another project in the Stormwater Green Infrastructure element of the Flood Protection Program – the Elizabeth River Wetland and Floodplain Restoration Project (Round 1 CFPF Grant Awards).

The City has also received two NFWF NRCF grants from the Marsh Restoration in Back Bay project. Approximately $135,000 in NFWF NRCF funding was awarded in 2020 for the previous phase (design and permitting) for the project. The City continues to meet the obligations and period of performance of this NFWF grant. In 2022, the NFWF NRCF awarded $9,886,400 to support construction activities.

In its Resilience Plan, Virginia Beach identifies an adaptation approach for the Southern Rivers Watershed that emphasizes natural mitigation methods and integrated systems of defenses. As a natural mitigation strategy, the marsh terrace project aims to serve as a first line of defense during flood events, reducing wind-driven fetch, wave energy, and flow velocities to protect the important marsh buffer surrounding the shorelines of Back Bay. Other projects are also needed to provide multi-layered flood protection to northern Back Bay communities (Figure 32). Several

of these projects are highlighted below. It should be noted that the projects described below are either not yet funded or will be funded in the future through the City's Capital Improvement Program.

Figure 32: Southern Rivers Watershed Adaptation Vision.

Marsh island restoration serves as a critical first line of defense of the multi-layered protection system in the Southern Rivers Watershed. The following map (Figure 33) shows the structural adaptation projects proposed for the Southern Rivers Watershed, including the Muddy Creek Road and Sandbridge flood defense systems. The City's numerical modeling shows that, if implemented, there is potential for small increases in flooding outside of these structural protection systems.[14] This emphasizes the need for complimentary measures, including the marsh terrace project, land acquisition, and conservation efforts, to mitigate this residual risk.

[14] City of Virginia Beach (2020). City-wide Structural Alternatives for Coastal Flood Protection (PDF).

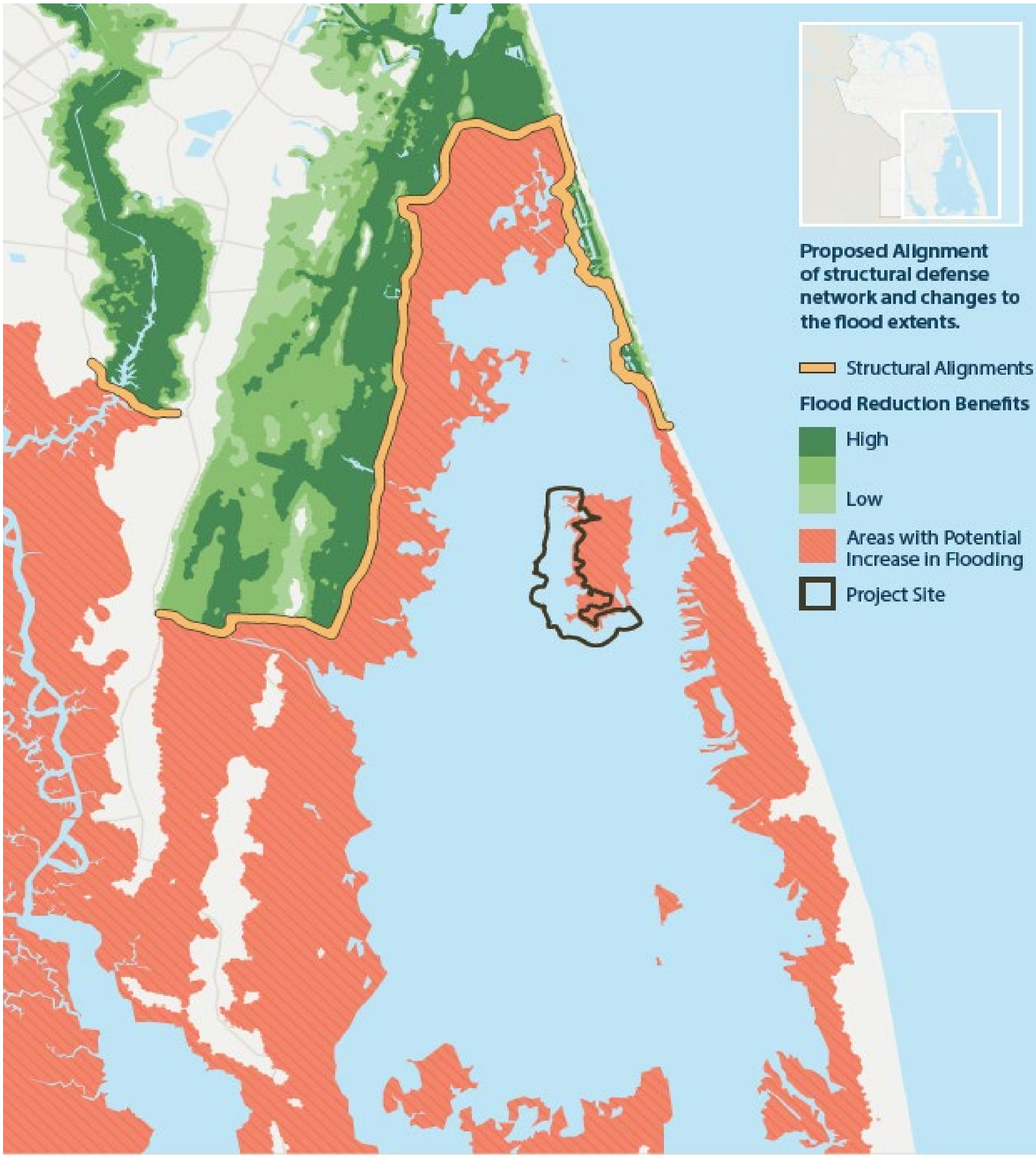

Figure 33: Structural adaptation projects proposed for the Southern Rivers Watershed, including the Muddy Creek Road and Sandridge flood defense systems.

Backside of Sandbridge Flood Defense System

Protection of the Sandbridge resort community from increasing coastal flood hazards would require a complex and expensive structural protection system because of the manufactured land configuration on the backside of Sandbridge. The proposed protection system includes elevating Sandbridge Road and constructing a network of seawalls, levees, and gates along the Back Bay shoreline of Sandbridge. This project does not have designated funding at this time.

Hell Point Creek Flood Defense System

As part of the integrated Sandbridge City-Wide flood defense network, a storm surge barrier across Hell Point Creek could block flood waters originating from Back Bay. Sandbridge Road would also need to be raised to ensure floodwaters could not flank the system. This project does not have designated funding at this time.

Sandbridge/New Bridge Intersection Improvements

Road and shoulder improvements are planned to increase safety at the New Bridge Road/Sandbridge Road intersection and reduce the need for road closures due to flooding from the adjacent Ashville Creek.

Muddy Creek Road Flood Defense System

Muddy Creek Road provides access to important rural and agricultural communities and Back Bay and the Wildlife Refuge. Muddy Creek Road is one of the lowest-lying roadways in all of Virginia Beach and frequently floods. This City-Wide Structural Alternative Flood Protection analysis identified this roadway as a critical location to provide flood protection. The proposed system, known as the Muddy Creek Road Alignment, would transform much of Muddy Creek Road into a levee, with the road on the top. The City's numerical modeling effort shows that the Muddy Creek Road Flood Defense System could potentially increase flood risk to the east of Muddy Creek Road, as shown in Figure 33. Therefore, the implementation of nature-based strategies suitable to the low-lying shorelines of Back Bay is essential to mitigate these impacts. This project does not have designated funding at this time.

Voluntary Acquisition Program

Virginia Beach City Council has recently funded a $2.0 million City-wide voluntary acquisition program to encourage flood-prone property owners to apply for a buyout. Parcels acquired by the City, in the Southern Rivers Watershed, would then be converted to open space to serve as flood storage and a marsh migration buffer.

Stormwater Master Plan

The City Council initiated an update of the City's Stormwater Master Plan in 2014. This effort is interchanging information with aspects of the City's Resilience Plan to account for the impact of sea level rise on the stormwater system's performance. Specific stormwater drainage improvement projects are included within the Lower Southern Rivers Watershed Drainage Basin.

Virginia Coastal Resilience Master Plan

The CRMP highlighted the marsh terrace project as an exemplary nature-based resilience project. The CRMP emphasizes Virginia Beach's strategic use of multiple funding streams to implement a large-scale nature-based project. DCR’s contribution to the project’s construction could be highlighted as a success story for implementation of the CRMP.

Audubon North Carolina Currituck Sound Coalition Marsh Conservation Plan

In coordination with Audubon North Carolina, the Currituck Sounds Coalition identified marsh restoration priorities based on criteria for siting restoration projects, including vulnerability to sea level rise, historic increase in surface water, and distance to hardened shorelines. This assessment identified Virginia Beach's marsh terrace project site as a high-priority area for restoration. There is an opportunity to highlight this project as a success story in the next iteration of the Audubon's Marsh Conservation Plan, which is slated to be updated every three years.

Maintenance Plan

Standard maintenance measures have been defined as part of the draft Annual Monitoring Plan and Post-Construction Monitoring Report developed for this project. See Attachment 5 for a copy of the draft report.

Subsequent to the monitoring period, project maintenance will be addressed by the City's Public Works Stormwater Operations Group, who will also respond to any maintenance issues identified by the monitoring effort or other observers. The City intends to maintain the construction staging area to support future project maintenance needs. The City will perform inspections every 2-5 years and make any repairs needed for the life of the project after completion of the initial monitoring program.

As described by the draft Annual Monitoring Plan and Post-Construction Monitoring Report, maintenance measures include the replacement of plantings (including upland, marsh and SAV plantings), the removal of debris from the terraces, the removal of invasive vegetation identified in the planting areas, the addition of sediment to eroding areas of the terraces, and the replacement of waterfowl barriers as necessary. In addition, structural maintenance measures that might be identified and prescribed during monitoring efforts include replacement of dislodged stones, addition of stone to address structure settlement, and general repair of sand cores or other structural elements.   As proposed, these measures would become conditions of the wetland permits required for this project, in addition to standard commitments and requirements defined by the permitting agencies.

In addition to the commitments made in the monitoring plan, and those anticipated to be defined during the permitting process, it is the assumption that the placement of the proposed marsh terrace structures in state waters (subaqueous bottoms) will require the City to maintain the marsh terraces in perpetuity. As previously defined through coordination with VMRC, the City would obtain a compensable interest in the property that has been filled on top of state-owned subaqueous bottomlands (i.e. the terraces). As such, the City would be responsible for maintaining the proposed marsh terraces structures to ensure they fulfill their intended functions, as defined in the objectives and indicators of success previously defined in this proposal.

Criteria

The project receives a total score of **65 Points**. An explanation of how the project meets each

of the applicable scoring criteria contained in Appendix D is provided below.

Eligible Project (Type)

Category/Points: Wetland/floodplain restoration, Living shorelines and vegetated buffers (25 Points)

Explanation: Marsh terraces are considered a type of wetland restoration or a component of a living shoreline project:

- Wetland Restoration: Wetland restoration aims to reestablish or enhance natural wetland ecosystems. Marsh terraces can be constructed in areas where wetlands have been degraded or lost, and they help to recreation or support wetland functions. They provide habitat for various species, improve water quality, and can contribute to the overall health and resilience of a wetland ecosystem.
- Living Shoreline Project: Living shorelines are designed to protect shorelines from erosion while also promoting ecological and environmental benefits. Marsh terraces are often used as a component of living shoreline projects. They can serve as a buffer against wave action, stabilize shorelines, and create suitable habitat for marsh and aquatic species.

Social Vulnerability Index Score

Category/Points: Low Social Vulnerability (0 Points)

Explanation: Based on the Virginia Flood Risk Information System (VFRIS) Social Vulnerability Index Layer, the Social Vulnerability Index scores of the communities located in the two census block groups adjacent to Back Bay near the project site are -1.07 and -0.43 (an average of -0.75), which falls into the Low Social Vulnerability category.

Community Scale Benefits

Category/Points: More than one census block group (30 Points)

Explanation: As documented in the *Supporting Documentation - Project Information – Population* section of this document, the project is anticipated to benefit two census block groups (518100454.121 and 518100464.001).

Expected Lifespan of Project

Category/Points: Over 20 Years (10 Points)

Explanation: As documented in the *Supporting Documentation – Approach, Milestones, and Deliverables – Activity 3 (Marsh Terrace Construction)* section, the marsh terraces have a 30-year design life.

Budget Narrative

The following budget narrative details the proposed project expenditures. See Appendix B for completed budget spreadsheet.

Estimated Total Project Cost

The current estimated total project cost is **$53,378,490.** This estimate includes design, site acquisition for the construction staging area, construction, inspections and support, implementation, and contingencies, as shown in the below table. The design engineer's opinion of probable cost for construction is provided

Project Activity	Capital Improvement Program Estimate
Design	$276,800
Site Acquisition	$50,000
Construction	$41,839,900
Inspections and Support	$5,609,200
Implementation	$750,000
Contingencies	$4,852,590
Total:	$53,378,490

Funds Requested from the Fund

The City is requesting a total of **$5,000,000.00** in funding from the CFPF Round 4. These funds will support contractual services of the engineering consultant and construction contractor to execute Activity 2 (Construction Staging Area Preparation and Construction) and Activity 3 (Marsh Terrace Construction). No support is requested for City personnel.

These funds will be used to support ongoing construction activities through 2024-2026. Example activities include contractor construction services, mobilization/demobilization, construction staging area construction, slurry pipe installation, portions of the terrace materials, and waterfowl barriers. Construction costs are based on a detailed estimate from the design engineer that includes detailed breakdown of estimated quantities and costs from the 95% design package using industry standards for the anticipated aspects of the project construction. The City has withheld the detailed estimate as it provides information that would affect bidding on the construction.

Amount of Funds Available

The City as prime recipient is providing a cash match of $38,356,966 from funds fully programmed and available from the City's Flood Protection Program Capital Improvement Program to support the project. The Flood Protection Program is supported by a related bond referendum that provided $567.5M to fund more than 40 projects identified for Phase 1 of the Program. The program is tightly managed by the City, an independent contractor, and has a resident oversight board. The City is fully confident these funds will be available for constructing this project.

The City's dedicated funds will provide cash match to cover contractual services to support Activity 1 (Construction Staging Area Preparation and Construction), Activity 2 (Marsh Terrace Construction), Activity 3 (Stakeholder Engagement and Dissemination), and all related City support and direct overhead costs related for the project.

The National Fish and Wildlife Foundation is also supporting the project through two grant awards from the National Coastal Resilience Fund. This includes an initial award of $135,124 in 2020 for design and a second award of $9,886,400 in 2022 to support construction. The 2022 grant funds are dedicated to purchasing the native vegetation and a portion of the materials needed to build the marsh terraces.

A summary of project costs, funds available, and funds requested is provided below:

Item	Amount
Project Cost:	$53,378,490.00
Funding Sources Available	
NFWF Grant:	$10,021,524.00
CFPF Grant Request:	$5,000,000
City Funds Available:	$38,356,96600
Total Project Funding:	**$53,378,490.00**

Authorization to Request for Funding

Please refer to *attachment* for the documentation authorizing the funding request.

Attachment 1: Virginia Beach Resilience Plan DCR Approval

Matthew J. Strickler
Secretary of Natural Resources

Clyde E. Cristman
Director

COMMONWEALTH *of* VIRGINIA
DEPARTMENT OF CONSERVATION AND RECREATION

Rochelle Altholz
Deputy Director of Administration and Finance

Russell W. Baxter
Deputy Director of Dam Safety & Floodplain Management and Soil & Water Conservation

Nathan Burrell
Deputy Director of Government and Community Relations

Thomas L. Smith
Deputy Director of Operations

July 20, 2021

Toni Utterback, P.E.
Department of Public Works
2875 Sabre Street, Suite 250
Virginia Beach, VA 23452

RE: Virginia Beach Resilience Plan Second Submission - CFPF

Dear Ms. Utterback:

Thank you for the resubmission of the Sea Level Wise Adaptation Plan for City of Virginia Beach. After careful review and consideration, the Virginia Department of Conservation and Recreation has deemed the Plan complete and meets all the criteria outlined in the June 2021 Community Flood Preparedness Grant Manual. This approval will remain in effect for a period of three years, ending on July 31, 2024.

The following elements were evaluated as part of this review:

1. **Element 1: It is project-based with projects focused on flood control and resilience. DCR RESPONSE**

    a. Project-based: Four watersheds—each with a defined geographic area, analysis of community social and environmental characteristics, types of flooding, and a tailored flood resilience strategy with discrete projects identified.

Projects focused on flood control and resilience include:

Neighborhood	Flood Control Project
Elizabeth River	City-wide alignment, living shoreline, marsh restoration, land conservation
Lynnhaven	Chesapeake Bay alignment, Lesner Bridge Neighborhood alignment (East & West), beach & dune nourishment, ecological revetments, shellfish reef restoration, seagrass restoration
Oceanfront	Atlantic Oceanfront alignment, Rudee Heights alignment
Southern Rivers	West Neck Creek city-wide alignment, Muddy Creek Road city-wide alignment, Sandbridge city-wide alignment

**additional projects listed within the Sea Level Wise Adaptation Strategy.*

2. **Element 2: It incorporates nature-based infrastructure to the maximum extent possible. DCR RESPONSE**

   a. Nature-based infrastructure: Flood mitigation projects throughout the city incorporate nature-based solutions and were identified for maximum use within specific watersheds.

3. **Element 3: It includes considerations of all parts of a locality regardless of socioeconomics or race. DCR RESPONSE**
   a. All parts of a locality: Locality divided into four watersheds, covering the entirety of the jurisdictional boundary.
   b. Social vulnerability: Social implications of flood hazards and analysis of populations at-risk documented.
   c. Demographic Analysis: Demographic and Population Vulnerability Analysis conducted by Dewberry and incorporated into the Plan.

4. **Element 4: It includes coordination with other local and inter-jurisdictional projects, plans, and activities and has a clearly articulated timeline or phasing for plan implementation. DCR RESPONSE**
   a. Coordination with other projects, plans, and activities: Contains the planning processes and frameworks which outline local and regional plans used by the City and address resilience; and how they have been integrated for flood adaptation planning.
   b. Clearly articulated timeline or phasing for plan implementation: Program phases clearly articulated and described in detail—Impact assessment, Adaptation research, Strategy development, and Long-term implementation.

5. **Element 5: Is based on the best available science, and incorporates climate change, sea level rise, storm surge (where appropriate), and current flood maps.**
   a. Technically backed water-resources analysis, sea level rise projections, storm surge, and climate change incorporated into strategic approach.

VA DCR looks forward to working with you as you work to make Virginia Beach a more resilient community. If you have questions or need additional assistance, please contact us at cfpf@dcr.virginia.gov. Again, thank you for your interest in the Community Flood Preparedness Fund.

Sincerely,

Wendy Howard Cooper, Director
Dam Safety and Floodplain Management

cc: Darryl Glover, DCR

Attachment 2: Authorization to request funding from the Fund from governing body or chief executive of the local government

City of Virginia Beach

DEPARTMENT OF BUDGET AND MANAGEMENT SERVICES
(757) 385-8234
(757) 385-1857 FAX

VBgov.com
MUNICIPAL CENTER
BUILDING 1, 3RD FLOOR
2401 COURTHOUSE DRIVE
VIRGINIA BEACH, VA 23456-9001

INTER-OFFICE MEMORANDUM

DATE: November 1, 2023

TO: Patrick A. Duhaney, City Manager

FROM: Stuart McCrery, Budget and Policy Analyst KJ for SM

SUBJECT: Application for Virginia Community Flood Preparedness Fund Grant

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The Department of Public Works is requesting permission to apply for the Virginia Community Flood Preparedness Fund Grant from the Virginia Department of Conservation and Recreation. The Virginia Community Flood Preparedness Fund was established in the 2020 session of the General Assembly. Money in this fund comes from the auction of carbon allowances through the Regional Greenhouse Gas Initiative. It was established to provide support to localities across Virginia to reduce the impacts of flooding, including flooding driven by climate change.

Public Works is requesting a total of $5,000,000 to construct marsh terraces in Back Bay to promote wetland restoration and mitigate frequent flooding. The City has already made significant investments into this project through CIP project 100551 "Stormwater Green Infrastructure."

This grant also requires a local match of 30% for projects that implement nature-based solutions; however, the City has more than met this requirement through its current appropriations to CIP project 1000551 "Stormwater Green Infrastructure" which currently total over $49 million from the Referendum and other grant awards.

Budget & Management Services recommends this grant application for approval. Please indicate approval or disapproval below. Applications are due by November 12, 2023.

11/1/2023

Approve (Date) Disapprove (Date)

Attachment 3: Virginia Beach Floodplain Administrator Support Letter

City of Virginia Beach

VBgov.com

DEPARTMENT OF PLANNING & COMMUNITY DEVELOPMENT
PHONE (757) 385-4621
FAX (757) 385-5667
VA Relay Number TTY: 711

2875 SABRE STREET, SUITE 500
VIRGINIA BEACH, VA 23452-7385

November 7, 2023

Division of Dam Safety and Floodplain Management
600 East Main Street, 24th Floor
Richmond, Virginia 23219

RE: Community Flood Preparedness Fund – Marsh Terrace Creation, Back Bay

The proposed project is located in both open water and a Federal Emergency Management Agency (FEMA) mapped Special Flood Hazard Area (SFHA). Hydraulic modeling analysis identified Bonney Cove as a location where marsh restoration has the potential to reduce the propagation of floodwater through key pathways within Back Bay. This project aims to stabilize two critically eroding marsh islands that serve as a key flood pathway into northern Back Bay, promote the growth of aquatic vegetation, and provide flood risk reduction benefits to communities in the surrounding area. Within the two census block groups that would benefit from this project, there are 113 repetitive loss and severe repetitive loss properties.

If I can provide any further information or assistance, please call me at 757-385-4621, or e-mail me at wmcnamar@vbgov.com.

Sincerely,

Whitney McNamara

Whitney McNamara, CFM
Floodplain Administrator and CRS Coordinator

Attachment 4: Letters of Support

Back Bay Restoration Foundation

PO Box 57041 • Virginia Beach, Virginia • 23457• 757-818-4829

November 6, 2023

Department of Conservation and Recreation
Dam Safety and Floodplain Management
600 E. Main St., 24th Floor
Richmond, VA 23219

Re: Virginia Community Flood Preparedness Fund Grant

Grantors:

The Back Bay Restoration Foundation (BBRF), is a 35 year-old non-profit watershed organization, founded in 1986 by a group of local citizens concerned about deterioration of the Back Bay watershed visible then through decreases in Submerged Aquatic Vegetation (SAV), fish, and waterfowl. BBRF is the only voice solely dedicated to conserving and improving Virginia Beach's two Southern Watersheds; namely, the Back Bay and North Landing River watersheds. Our efforts focus on education, stewardship and outreach to conserve the largest watersheds in Virginia Beach. We team with other non-profits, and city, state and federal agencies to work toward best solutions for the future of the Back Bay and North Landing River watersheds. BBRF strives to raise awareness, addressing issues that negatively affect these watersheds such as sea level rise, land subsidence and land use changes.

Back Bay is a historical, nationally significant, watershed. With the Back Bay National Wildlife Refuge (NWR) and significant State conservation lands at its core, the watershed was recognized as an Aquatic Resource of National Importance (ARNI) in 2008 by both the US Fish and Wildlife Service and the US Army Corps of Engineers. Back Bay is a wind-tidal oligohaline estuary and is located at the northern tip of the Albemarle/Pamlico estuarine system, the second largest estuarine complex in the United States. The Albemarle/Pamlico estuarine system was designated as an Estuary of National Significance in 1987 and selected to be studied as part of the Environmental Protection Agency's National Estuary Program. Back Bay is a shallow-water aquatic ecosystem with an average depth of four feet. Winds can influence the water depth by as much as three feet.

BBRF supports the City of Virginia Beach's application for Round 4 of VADCR's Community Flood Preparedness Fund. We were strong advocates of the City's successful applications to the National Fish and Wildlife Foundation (NFWF), and have seen what they accomplished with the initial NFWF funding they received. With the combined funding of NFWF, the City of Virginia Beach, and this application for DCR funding, their project of creating a Marsh Terrace Network to Achieve Restoration and Flood Resilience has overachieved by any measure. From community engagement and the NEPA process to conceptual and preliminary designs as described in the recent Army Corps Public Notice, the City has been productive and completely transparent.

As noted above, the City's community engagement and partnerships with organizations like ours has been transparent and resulted in broad support. Although the current project is localized in its first application, we expect the results will significantly mitigate SLR, land subsidence and wind tides in Back Bay. Similarly, this restoration will provide the biotic building blocks to maintain the watershed's national importance for wildlife. The innovative designs proposed will inform future projects at the landscape level. Although innovative, we believe the project is technically sound based on BBRF's 35 years of experience in habitat restoration.

Please feel free to contact us for further information.

Jared Brandwein

Jared Brandwein

Executive Director
Back Bay Restoration Foundation

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Back Bay National Wildlife Refuge
1324 Sandpiper Road
Virginia Beach, VA 23456

October 30, 2023

Wendy Howard Cooper
Division of Dam Safety and Floodplain Management
600 East Main Street, 24th Floor
Richmond, Virginia 23219

Dear Ms. Cooper,

The City of Virginia Beach is proposing to install marsh terraces in the waters of Back Bay adjacent to Back Bay National Wildlife Refuge. This project is expected to reduce wave energy and thus decrease the speed of erosion of remaining islands in the project area, many of which are managed by the U.S. Fish and Wildlife Service and provide habitat for migratory birds and other species. Additionally, the addition of multiple vegetative structures added to the bay will supplement habitat and provide nesting grounds for multiple species.

The mission of the U.S. Fish and Wildlife Service is *working with others to conserve, protect, and enhance fish, wildlife, plants, and their habitats for the continuing benefit of the American people*. Although much work is conducted on federal property to achieve this mission, the Service equally coordinates with external partners to further mutual goals. The proposed marsh terrace project is an excellent example of local and federal government coordination, and we support the City of Virginia Beach's proposed project.

Megan Reed

Megan Reed
Refuge Manager

Albemarle-Pamlico
National Estuary Partnership

Our mission is to identify, protect, and restore
the significant resources of the Albemarle-Pamlico estuarine system.

October 26, 2023

Wendy Howard Cooper
Virginia Dept. of Conservation and Recreation
Division of Dam Safety and Floodplain Management
600 E. Main St., 24th Floor
Richmond, VA 23219

Dear Wendy,

The Albemarle-Pamlico National Estuary Partnership (APNEP) strongly endorses the City of Virginia Beach and partners' application to Round 4 of The Virginia Community Flood Preparedness Fund (CFPF). The proposal is to support construction of the Back Bay Marsh Terrace Restoration Project.

APNEP relies on regional partnerships and collaboration to implement our 2012-2022 Comprehensive Conservation & Management Plan (CCMP) within the waterways of our congressionally designated "estuary of national significance." The proposed partnership between the City of Virginia Beach and the U.S. Fish and Wildlife Service will also advance our 2020 Memorandum of Understanding between Virginia and North Carolina to protect the ecosystem resources in the shared waterways between our two states. The project also addresses a "high priority" area for restoring and enhancing vulnerable marshes with high flood risk reduction benefits and habitat value, as identified by Audubon's Currituck Sound Coalition Marsh Conservation Plan released in 2021.

The marsh terrace project employs the use of natural features to build resilience to flooding in the Back Bay watershed. The project offers coastal resilience and habitat protection and conservation co-benefits including preserving marsh islands, restoring Submerged Aquatic Vegetation, migratory bird and fish habitat, reducing flow that could exacerbate wind tide flooding in local communities, and filling a gap in prior applied research on predominantly fresh water coastal lagoons. These features support the following CCMP actions:

- A2.3: Support research on adapting to impacts associated with climate change and sea level rise.
- C3.2: Develop and implement a coordinated wetland restoration strategy.
- C3.3: Develop and implement a submerged aquatic vegetation (SAV) restoration strategy.
- D3.3: Provide assistance to state, regional, and local governments to incorporate climate change and sea level rise considerations into their planning processes.

In closing, we strongly support the full funding of the City of Virginia Beach's proposal to Round 4 of The Virginia Community Flood Preparedness Fund (CFPF). Please contact Steve Anderson, Partnership Coordinator, at (919) 707-8743 with questions.

Sincerely,

W. Crowell Jr.

William L. Crowell, Jr., Ph.D., AICP, CEE
Director

1601 Mail Service Center, Raleigh, North Carolina 27699-1601
Phone/Fax: 919-707-8633 | www.apnep.org

Attachment 5: Copy of the Current Floodplain Ordinance

ORD-3685

AN ORDINANCE TO AMEND SECTIONS 1.1, 1.2, 1.3, 1.8, 2.1, 2.2, 2.3, 2.4, 2.8, 2.11, 3.1, 4.1, 4.2, 4.3, 4.4, 4.6, 4.8, 4.9, 4.10, 5.1, 6.1, AND 6.3 OF APPENDIX K, FLOODPLAIN ORDINANCE OF THE CITY CODE PERTAINING TO HOUSEKEEPING THE DELETION OF PUBLIC WORKS REQUIREMENTS AND THE ADDITION OF A COASTAL A ZONE AND A COASTAL HIGH HAZARD ZONE

Sections Amended: 1.1, 1.2, 1.3, 1.8, 2.1, 2.2, 2.3, 2.4, 2.8, 2.11, 3.1, 4.1, 4.2, 4.3, 4.4, 4.6, 4.8, 4.9, 4.10, 5.1, 6.1, and 6.3 of Appendix K, Floodplain Ordinance

WHEREAS, the public necessity, convenience, general welfare and good zoning practice so require;

BE IT ORDAINED BY THE CITY COUNCIL OF THE CITY OF VIRGINIA BEACH, VIRGINIA:

That Sections 1.1, 1.2, 1.3, 1.8, 2.1, 2.2, 2.3, 2.4, 2.8, 2.11, 3.1, 4.1, 4.2, 4.3, 4.4, 4.6, 4.8, 4.9, 4.10, 5.1, 6.1, and 6.3 of Appendix K, Floodplain Ordinance is hereby amended and reordained to read as follows:

APPENDIX K FLOODPLAIN ORDINANCE

ARTICLE I. GENERAL PROVISIONS

Sec. 1.1. Statutory authorization and purpose.

A. This ordinance is adopted pursuant to the authority granted to localities by Code of Virginia § ~~10.1-600 et seq~~ 15.2-984.

B. The city council finds the purpose of these provisions is to prevent the loss of life and property, the creation of health and safety hazards, the disruption of commerce and governmental services, the extraordinary and unnecessary expenditure of public funds for flood protection and relief, and the impairment of the tax base by:

1. Regulating uses, activities, and development that, alone or in combination with other existing or future uses, activities, and development, will cause unacceptable increases in flood heights, velocities, and frequencies;

2. Restricting or prohibiting certain uses, activities, and development from locating within districts subject to flooding;
3. Requiring all uses, activities, and developments that do occur in flood-prone districts be protected or flood-proofed against flooding and flood damage;

4. Protecting individuals from buying land and structures that are unsuited for intended purposes because of flood hazards; and

5. Acknowledging that the tide data over the last one hundred (100) years shows that Virginia Beach is facing an increased danger of flooding caused by both sea level rise and subsidence<u> and has adopted the Sea Level Wise Adaptation Report as part of the Comprehensive Plan</u>.

Sec. 1.2. Applicability.

These provisions shall apply to all privately and publicly owned lands within the jurisdiction of the City of Virginia Beach and identified as areas ~~of special flood hazard~~ <u>at risk of flooding by the City of Virginia Beach or shown</u> ~~according to~~ <u>on </u>the Flood Insurance Rate Map (FIRM) <u>or included on the flood insurance study (FIS)</u> that ~~is~~ <u>are</u> provided to the City of Virginia Beach by the Federal Emergency Management Agency (FEMA) and dated January 16, 2015 ~~or identified as floodplains subject to special restrictions in section 4.10 of this ordinance~~.

Sec. 1.3. Definitions.

. . . .

City manager. The City Manager of the City of Virginia Beach, or his designees.

<u>*Design Flood Elevation (regulatory flood protection elevation)*. The base flood elevation plus the freeboard required by this ordinance.</u>

. . . .

Recreational vehicle. A vehicle that is:

1. Built on a single chassis;
2. Four hundred (400) square feet or less when measured at the largest horizontal projection;
3. Designed to be self-propelled or permanently towable by a light duty truck; and
4. Designed primarily not for use as a permanent dwelling but as temporary living quarters for recreational camping, travel, or seasonal use.

~~*Regulatory flood protection elevation (design flood elevation)*. The base flood elevation plus the freeboard required by this ordinance.~~

. . . .

Sec. 1.8. Penalty for violations.

Any person who fails to comply with any of the requirements or provisions of this ordinance or directions of the ~~d~~Directors of ~~p~~Planning ~~or public works~~ or any authorized employee of the City of Virginia Beach shall be guilty of the appropriate violation and subject to the penalties therefore. Any violation of the provision of this ordinance shall be punishable by a fine of not more than one hundred dollars ($100.00). Each person shall be deemed guilty of a separate offense for each and every day or portion thereof during which any violation of any of the provisions of this ordinance is committed.

The Virginia Uniform Statewide Building Code (VA USBC) addresses building code violations and the associated penalties in ~~section 104 and section 115~~ VA USBC § 104 and § 115. Violations and associated penalties of the Zoning Ordinance for the City of Virginia Beach are addressed in § 104 of the Zoning Ordinance.

In addition to the above penalties, all other actions are hereby reserved, including an action in equity for the proper enforcement of this ordinance. The imposition of a fine or penalty for any violation of, or noncompliance with, this ordinance shall not excuse the violation or noncompliance or permit it to continue, and all such persons shall be required to correct or remedy such violations within a reasonable time. Any structure constructed, reconstructed, enlarged, altered, or relocated in noncompliance with this ordinance may be declared by the City of Virginia Beach to be a public nuisance and abatable as such. Flood insurance may be withheld from structures constructed in violation of this ordinance.

ARTICLE II. ADMINISTRATION

Sec. 2.1. Designation of the floodplain administrator.

The City Manager of the City of Virginia Beach is hereby appointed the floodplain administrator to administer and implement this ordinance. The floodplain administrator has delegated the duties and responsibilities set forth in this ordinance to the ~~departments of public works and planning, as specified below~~ Department of Planning and Community Development.

Sec. 2.2. Duties and responsibilities of the ~~department of public works~~ floodplain administrator or his designee.

The duties and responsibilities of the ~~department of public works~~ floodplain administrator of his designee shall include but are not limited to:

A. Interpreting floodplain boundaries and providing available base flood elevation and flood hazard information;

B. Verifying that applicants proposing an alteration of a watercourse have notified adjacent communities, the department of conservation and recreation (division of dam safety and floodplain management), and other appropriate agencies (Virginia Department of Environmental Quality (VADEQ), United States Army Corps of Engineers (USACE), etc.) and have submitted copies of such notifications to FEMA;

C. Advising applicants for new construction or substantial improvement of structures that are located within an area of the coastal barrier resources system established by the Coastal Barrier Resources Act that Federal flood insurance is not available on such structures; areas subject to this limitation are shown on FIRMs as coastal barrier resource system areas or otherwise protected areas;

D. Submitting to FEMA, or requiring applicants to submit to FEMA, data and information necessary to maintain FIRMs, including hydrologic and hydraulic engineering analyses prepared by or for the city, within six (6) months after such data and information becomes available if the analyses indicate changes in base flood elevations;

E. Maintaining and permanently keeping records that are necessary for the administration of these regulations, including:

1. ~~flood~~ Flood insurance studies, FIRMs (including historic studies and maps and current effective studies and maps) and letters of map change; and

2. Documentation supporting issuance and denial of permits, Elevation Certificates, documentation of the elevation (in relation to the datum on the FIRM) to which structures have been floodproofed, inspection records, other required design certifications, variances, and records of enforcement actions taken to correct violations of these regulations.

F. Notifying FEMA when the corporate boundaries of the City of Virginia Beach have been modified and:

1. Providing a map that clearly delineates the new corporate boundaries or the new area for which the authority to regulate pursuant to this ordinance has either been assumed or relinquished through annexation; and

2. If the FIRM for any annexed area includes SFHAs that have flood zones with regulatory requirements that are not set forth in this

ordinance, prepare amendments to this ordinance to adopt the FIRM and appropriate requirements, and submit the amendments to the city council for adoption; such adoption shall take place at the same time as or prior to the date of annexation and a copy of the amended ordinance shall be provided to the department of conservation and recreation (division of dam safety and floodplain management) and FEMA.

G. Upon the request of FEMA, completing and submitting a report concerning participation in the NFIP, which may request information regarding the number of buildings in the SFHA, the number of permits issued for development in the SFHA, and the number of variances issued for development in the SFHA.

H. Reviewing applications for permits to determine whether proposed activities will be located in the SFHA;

I. Reviewing applications to determine whether proposed activities will be reasonably safe from flooding and requiring new construction and substantial improvements to meet the requirements of this ordinance;

J. Reviewing applications to determine whether all necessary permits have been obtained from the federal, state, or local agencies from which prior or concurrent approval is required; in particular, permits from state agencies for any construction, reconstruction, repair, or alteration of a dam, reservoir, or waterway obstruction (including bridges, culverts, structures), any alteration of a watercourse, or any change of the course, current, or cross section of a stream or body of water, including any change to the SFHAs of free-flowing non-tidal waters of the state;

K. Approving applications and issuing permits to develop in flood hazard areas if the provisions of this ordinance have been met, or disapproving applications if the provisions of this ordinance have not been met;

L. Granting administrative variances pursuant to section 6.1 of this ordinance;

M. Inspecting, or causing to be inspected, buildings, structures, and other development for which permits have been issued to determine compliance with this ordinance or to determine if non-compliance has occurred or violations have been committed;

N. Reviewing elevation certificates and requiring incomplete or deficient certificates to be corrected;

O. Maintaining and permanently keeping documentation supporting the issuance and denial of permits, elevation certificates, documentation of the elevation (in relation to the datum on the FIRM) to which structures have been flood proofed, and other required design certifications, variances, and records of enforcement actions taken to correct violations of this ordinance;

P. Enforcing the provisions of this ordinance, investigating violations, issuing notices of violations or stop work orders, and requiring permit holders to take corrective action;

Q. Advising the city council regarding the intent of this ordinance and, for each application for a variance, preparing a staff report and recommendation; and

R. Administering the requirements related to proposed work on existing buildings:

1. Making determinations as to whether buildings and structures that are located in flood hazard areas and that are damaged by any cause have been substantially damaged; and

2. Making reasonable efforts to notify owners of substantially damaged structures of the need to obtain a permit to repair, rehabilitate, or reconstruct, and prohibit the non-compliant repair of substantially damaged buildings except for temporary emergency protective measures necessary to secure a property or stabilize a building or structure to prevent additional damage.

S. Undertaking, as determined appropriate by the floodplain administrator due to the circumstances, other actions that may include but are not limited to: issuing press releases, public service announcements, and other public information materials related to permit requests and repair of damaged structures; coordinating with other federal, state, and local agencies to assist with substantial damage determinations; providing owners of damaged structures information related to the proper repair of damaged structures in SFHAs; and assisting property owners with documentation necessary to file claims for increased cost of compliance coverage under National Flood Insurance Program (NFIP) flood insurance policies; and

T. It is the duty of the city floodplain administrator to take into account flood, mudslide, and flood-related erosion hazards, to the extent that they are known, in all official actions relating to land management and use throughout the entire jurisdictional area of the city, whether or not those

hazards have been specifically delineated geographically (e.g., via mapping or surveying).

~~Sec. 2.3. Duties and responsibilities of the department of planning.~~ Reserved.

~~The duties and responsibilities of the department of planning shall include but are not limited to:~~

~~A. Reviewing applications for permits to determine whether proposed activities will be located in the SFHA;~~

~~B. Reviewing applications to determine whether proposed activities will be reasonably safe from flooding and requiring new construction and substantial improvements to meet the requirements of this ordinance;~~

~~C. Reviewing applications to determine whether all necessary permits have been obtained from the federal, state, or local agencies from which prior or concurrent approval is required; in particular, permits from state agencies for any construction, reconstruction, repair, or alteration of a dam, reservoir, or waterway obstruction (including bridges, culverts, structures), any alteration of a watercourse, or any change of the course, current, or cross section of a stream or body of water, including any change to the SFHAs of free-flowing non-tidal waters of the state;~~

~~D. Approving applications and issuing permits to develop in flood hazard areas if the provisions of this ordinance have been met, or disapproving applications if the provisions of this ordinance have not been met;~~

~~E. Granting administrative variances pursuant to section 6.1 of this ordinance;~~

~~F. Inspecting, or causing to be inspected, buildings, structures, and other development for which permits have been issued to determine compliance with this ordinance or to determine if non-compliance has occurred or violations have been committed;~~

~~G. Reviewing elevation certificates and requiring incomplete or deficient certificates to be corrected;~~

~~H. Maintaining and permanently keeping documentation supporting the issuance and denial of permits, elevation certificates, documentation of the elevation (in relation to the datum on the FIRM) to which structures have been flood proofed, and other required design certifications, variances, and records of enforcement actions taken to correct violations of this ordinance;~~

~~I. Enforcing the provisions of this ordinance, investigating violations, issuing notices of violations or stop work orders, and requiring permit holders to take corrective action;~~

~~J. Advising the city council regarding the intent of this ordinance and, for each application for a variance, preparing a staff report and recommendation; and~~

~~K. Administering the requirements related to proposed work on existing buildings:~~

~~1. Making determinations as to whether buildings and structures that are located in flood hazard areas and that are damaged by any cause have been substantially damaged; and~~
~~2. Making reasonable efforts to notify owners of substantially damaged structures of the need to obtain a permit to repair, rehabilitate, or reconstruct, and prohibit the non-compliant repair of substantially damaged buildings except for temporary emergency protective measures necessary to secure a property or stabilize a building or structure to prevent additional damage.~~

~~Sec. 2.4. Shared duties and responsibilities.~~ <u>Reserved.</u>

~~The duties and responsibilities shared by the departments of public works and Planning shall include but are not limited to:~~

~~A. Undertaking, as determined appropriate by the floodplain administrator due to the circumstances, other actions that may include but are not limited to: issuing press releases, public service announcements, and other public information materials related to permit requests and repair of damaged structures; coordinating with other federal, state, and local agencies to assist with substantial damage determinations; providing owners of damaged structures information related to the proper repair of damaged structures in SFHAs; and assisting property owners with documentation necessary to file claims for increased cost of compliance coverage under National Flood Insurance Program (NFIP) flood insurance policies; and~~

~~B. It is the duty of the city floodplain administrator to take into account flood, mudslide, and flood-related erosion hazards, to the extent that they are known, in all official actions relating to land management and use throughout the entire jurisdictional area of the city, whether or not those hazards have been specifically delineated geographically (e.g., via mapping or surveying).~~

. . . .

Sec. 2.8. Interpretation of district boundaries.

Initial interpretations of the boundaries of the floodplain districts shall be made by the floodplain administrator. Should a dispute arise concerning the boundaries of any of the districts~~, the city council shall make the necessary determination. The person questioning or contesting the location of the district boundary shall be given a reasonable opportunity to present his case to the city council and to submit his own technical evidence if he so desires~~ a surveyor shall provide either an elevation certificate or recent survey showing topographic elevations and delineating the Special Flood Hazard Area.

. . . .

Sec. 2.11. Appeals to decisions made by the floodplain administrator.

It is further provided that any decision of the floodplain administrator or his designee may be modified, reversed, or affirmed by the city council upon appeal by any aggrieved party to such decision, if such appeal is filed with the floodplain administrator within thirty (30) days of such decision through the application for a Floodplain Variance outlined in Section VI of this ordinance.

ARTICLE III. ESTABLISHMENT OF FLOODPLAIN DISTRICTS

Sec. 3.1. Description of floodplain districts.

A. Special flood hazard areas (SFHA). The SFHAs shall include land in the floodplain subject to a one (1) percent or greater chance of being flooded in any given year. The basis for the delineation of these districts shall be the FIS and the FIRM for the City of Virginia Beach prepared by FEMA, Federal Insurance Administration, dated January 16, 2015, and any subsequent revisions or amendments thereto.

The boundaries of the SFHAs are established as shown on the FIRM, which is declared to be a part of this ordinance and shall be kept on file at the City of Virginia Beach Department of ~~Public Works~~ Planning and Community Development, and include the following districts:

1. The Floodway District is in an AE Zone and is delineated, for the purposes of this ordinance, using the criterion that certain areas within the floodplain must be capable of carrying the waters of the one (1) percent annual chance flood without increasing the water surface elevation of that flood more than one (1) foot at any point. The areas included in this district are specifically defined in Table 7 of the above-referenced FIS and shown on the accompanying FIRM.

2. The AE or AH Zones on the FIRM accompanying the FIS shall be those areas for which one (1) percent annual chance flood elevations have been provided and the floodway has not been delineated.

3. The A Zone on the FIRM accompanying the FIS shall be those areas for which no detailed flood profiles or elevations are provided, but the one (1) percent annual chance floodplain boundary has been approximated.

4. The AO Zone on the FIRM accompanying the FIS shall be those areas of shallow flooding identified as AO on the FIRM.

5. ~~Reserved.~~ The Coastal A Zone on the FIRM accompanying the FIS shall be those areas labeled as AE and are located seaward of the limit of moderate wave action (LiMWA) line.

6. The VE or V Zones on FIRMs accompanying the FIS shall be those areas that are known as coastal high hazard areas, extending from offshore to the inland limit of a primary frontal dune along an open coast and any other area subject to high velocity wave action from storm or seismic sources.

B. ~~Floodplain subject to special restrictions~~ *Local Flood Hazard Areas*. The City of Virginia Beach may identify and regulate local flood hazard or ponding areas that are not delineated on the FIRM. These areas are ~~identified in section 4.10 and may be delineated on a map using best available topographic data and locally derived information such as flood of record, historic high water marks, or approximate study methodologies~~ identified as follows:~~.~~

a. *Other areas of flood risk*. The X and the X(Shaded) Zone on the FIRM where the City of Virginia Beach Stormwater Master Plan has identified areas, outside SFHAs delineated on the FIRM, that area susceptible to flooding. The most recent updated version of the modeling shall be used to identify areas that are likely to experience flooding.

b. *Floodplain Subject to Special Restrictions*. The Floodplain Subject to Special Restrictions is identified in section 4.10 and includes areas in the southern part of the city which are characterized by wind tides, low topography, and poorly draining soils.

ARTICLE IV. FLOODPLAIN DISTRICT PROVISIONS

Sec. 4.1. Permit and application requirements.

. . . .

B. Site plans and permit applications. All applications for development within any floodplain district and all building permits issued within ~~the~~ any floodplain district shall incorporate the following information:

1. For any addition, conversion of any non-habitable space to habitable space, or the construction or installation of a new accessory structure that requires a building permit.

   a. A physical survey, performed after the effective date of the FIRM that:

      i. accurately depicts current improvements on the property;
      ii. provides a flood zone determination and BFE or flood depth at the stie; and
      iii. delineates the location of the flood zones on the property.

   b. For structures located in the SFHA delineated on the FIRM, a current elevation certificate sealed by a licensed design professional.

2. For new construction and any substantial improvement of the principal structure:

   a. a proposed site plan sealed by a registered design professional that provides:

      ~~1~~i. The elevation of the base flood at the site;

      ~~2~~ii. The elevation of the lowest floor (including basement) or, in V Zones, the lowest horizontal structural member;

      ~~3~~iii. For structures to be flood-proofed (non-residential only), the elevation to which the structure will be flood-proofed; and

      4iv. Topographic information showing existing and proposed ground elevations.

Sec. 4.2. General standards.

. . . .

5. Electrical, heating, ventilation, plumbing, air conditioning equipment, and other service facilities, including duct work, shall be designed and/or ~~located so as to prevent water from entering or accumulating within the components during conditions of flooding~~ or above the design flood elevation.

6. New and replacement water supply systems shall be designed to minimize or eliminate infiltration of flood waters into the system.

7. New and replacement sanitary sewage systems shall be designed to minimize or eliminate infiltration of flood waters into the systems and discharges from the systems into flood waters.

8. On-site waste disposal systems shall be located and constructed to avoid impairment to them or contamination from them during flooding.

9. No use shall be permitted if such use will increase the amounts of potentially damaging materials, including those likely to be injurious to health, that might be transported in floods.

10. For properties located in SFHAs delineated on the FIRM, an elevation certificate and, if applicable, a flood-proofing certificate shall be provided to the Floodplain Administrator prior to any foundation inspection, final inspections, and the issuance of any certificates of occupancy, in order to assure compliance with these floodplain regulations.

11. Prior to any proposed alteration or relocation of any channels or of any watercourse or stream within the city, a permit shall be obtained from the USACE, VADEQ, the Virginia Marine Resources Commission, and the Wetlands Board through the joint permit application process. Furthermore, notification of the proposal shall be given by the applicant to all affected adjacent jurisdictions, the department of conservation and recreation (division of dam safety and floodplain management), other required agencies, and FEMA.

12. The flood carrying capacity within an altered or relocated portion of any watercourse shall be maintained.

~~B. In all SFHAs, the following additional provisions shall apply:~~

~~1. Prior to any proposed alteration or relocation of any channels or of any watercourse or stream, within the city a permit shall be obtained from the USACE, VADEQ, the Virginia Marine Resources Commission, and the Wetlands Board through the joint permit application process. Furthermore, notification of the proposal shall be given by the applicant to all affected adjacent jurisdictions, the department of conservation and recreation (division of dam safety and floodplain management), other required agencies, and FEMA.~~

~~2. The flood carrying capacity within an altered or relocated portion of any watercourse shall be maintained.~~

~~3. Sand dunes, barrier beaches, and other natural protective barriers shall remain intact to provide protection against wind, waves, and erosion drainage. Any person who desires to use or alter any coastal primary sand dune, other than for the purpose of conducting the activities specified in section 1602 of the Zoning Ordinance of the City of Virginia Beach, shall first obtain a permit from the USACE, VADEQ, the Virginia Marine Resources Commission, and the Wetlands Board through the joint permit application process.~~

Sec. 4.3. Elevation and construction requirements.

In all ~~SFHAs where base flood elevations have been provided in the FIS or generated by a licensed professional in accordance with section 4.6 of this ordinance~~ floodplain districts, with the exception of Coastal A and Coastal High Hazard (VE) zones, the following provisions shall apply:

A. Residential construction requirements. ~~New construction or substantial improvement of any residential structure or manufactured home in Zones AE, AH, and A with detailed base flood elevations shall have the lowest floor, including basement, elevated to a minimum of two (2) feet above the base flood level.~~ The lowest flood, including basement, shall be set to the higher of the following:

i. A minimum of two (2) feet above the base flood elevation established on the most recent FIRM or by the most recent FIS or,

ii. A minimum of one (1) foot above the 100-year HGL elevation measured at the nearest existing or proposed public drainage structure or BMP, in the City Stormwater Master Plan.

B. Non-residential construction requirements. New construction or substantial improvement of any commercial, industrial, or non-residential building or manufactured home shall have the lowest floor, including basement, elevated as ~~minimum of two (2) feet above the base flood level~~ established in Section 4.3 A of this ordinance. Buildings ~~located in AE or AH Zones~~ may be flood-proofed in lieu of being elevated provided that all areas of the building components below the ~~elevation corresponding to the base flood elevation plus a minimum of two (2) feet freeboard~~ design flood elevation are watertight with walls substantially impermeable to the passage of water, and use structural components having the capability of resisting hydrostatic and hydrodynamic loads and the effect of buoyancy. A professional engineer or architect licensed by the Commonwealth of Virginia shall certify that the standards of this subsection are satisfied. Such certification, including the specific elevation (in relation to NAVD88) to which such structures are flood proofed, shall be maintained by the building official.

C. ~~Space below the lowest floor requirements. In Zones A, AE, AH, and AO, f~~Fully enclosed areas of new construction or substantially improved existing structures that are below the ~~regulatory~~ design flood protection elevation shall:

1. Not be designed or used for human habitation, but shall only be used for parking of vehicles, building access, or limited storage of maintenance equipment used in connection with the premises. Access to the enclosed area shall be the minimum necessary to allow for parking of vehicles (garage door), limited storage of maintenance equipment (standard exterior door), or entry to the living area (stairway or elevator).

2. Be constructed entirely of flood resistant materials below the ~~regulatory~~ design flood ~~protection~~ elevation.

3. Space below the lowest floor of SFHAs delineated on the FIRM shall ~~I~~include measures to automatically equalize hydrostatic flood forces on walls by allowing for the entry and exit of floodwaters. To meet this requirement, the openings shall either be certified by a professional engineer or architect licensed by the Commonwealth of Virginia or meet or exceed the following minimum design criteria:

. . . .

Sec. 4.4. Floodway requirements.

. . . .

B. The placement of new or replacement manufactured homes (mobile homes) is prohibited.

~~C. The following uses and structures may be permitted in the floodway district, subject to the requirements of articles III, IV, V, and VI of this ordinance:~~

~~1. Public and private outdoor recreational facilities;~~

~~2. Agricultural uses, including farming, grazing, and the raising of poultry or livestock; provided, that poultry or livestock shall not be housed within five hundred (500) feet of any residential, apartment, or hotel district;~~

~~3. Open uses, such as public and private roadways, off street parking, or loading and unloading areas related to uses in adjoining districts;~~

~~4.~~ ~~Commercial mining, soil removal, and sand pits subject to regulations applicable to extractive industries as set forth in the conditional use provisions of the Zoning Ordinance of the City of Virginia Beach;~~

~~5.~~ ~~Public improvements, such as dams, levees and channel improvements, and utilities installations and substations, including temporary storage of materials, except flammable, toxic or noxious materials, and temporary location of maintenance installations; and~~

~~6.~~ ~~Uses and structures customarily accessory and clearly incidental and subordinate to uses listed above, including in connection with agricultural uses; roadside stands for the sale of agricultural products produced on the premises; provided that:~~

~~a.~~ ~~Only one (1) such stand shall be permitted per lot;~~

~~b.~~ ~~No such stand shall exceed five hundred (500) square feet in floor area; and~~

~~c.~~ ~~No such stand on the street frontage shall be erected within twenty (20) feet of the property line.~~

. . . .

Sec. 4.6. A Zone requirements.

. . . .

B. The floodplain administrator reserves the right to require a hydrologic and hydraulic analysis for any development and to determine the base flood elevation. When such base flood elevation data is utilized, the lowest floor shall be elevated to minimum of two (2) feet above the base flood level. During the permitting process, the floodplain administrator shall obtain:

1. The elevation of the lowest floor (including the basement) of all new and substantially improved structures; and

2. If the structure has been flood-proofed in accordance with the requirements of this ordinance, the elevation (in relation to NAVD88) to which the structure has been flood-proofed.

~~C.~~ ~~When the data is not available from any source, the lowest floor of the structure shall be elevated to not less than two (2) feet above the highest adjacent grade.~~

Sec. 4.8. ~~Reserved~~ X and X(Shaded) Zone requirements. (Other Areas of Flood Risk).

A. *Residential construction requirements*. The lowest floor, including basements, shall be set to a minimum of one (1) foot above the 100-year HGL elevation measured at the nearest existing or proposed public drainage structure or BMP, in the City Stormwater Master Plan.

B. *Non-residential construction requirements*. New construction or substantial improvement of any commercial, industrial, or non-residential building or manufactured home shall have the lowest floor, including basement, elevated as established in Section 4.8 A of this ordinance above. Buildings may be flood-proofed in lieu of being elevated provided that all areas of the building components below the design flood elevation are watertight with walls substantially impermeable to the passage of water, and use structural components having the capability of resisting hydrostatic and hydrodynamic loads and the effect of buoyancy. A professional engineer or architect licensed by the Commonwealth of Virginia shall certify that the standards of this subsection area satisfied. Such certification, including the specific elevation (in relation to NAVD88) to which such structures are flood proofed, shall be maintained by the building official.

Sec. 4.9. – Coastal High Hazard (~~V and~~ VE Zone) requirements.

The following provisions shall apply within ~~V and VE Zones~~ Coastal A Zones and Coastal High Hazard Areas:

A. All new construction and substantial improvements, including to manufactured homes, shall be elevated on pilings or columns so that:

1. The bottom of the lowest horizontal structural member of the lowest floor (excluding the pilings or columns) is elevated to a minimum of ~~two~~ three (~~2~~3) feet above the base flood ~~level~~ elevation; and

2. The pile or column foundation and structure attached thereto is anchored to resist flotation, collapse, and lateral movement due to the effects of wind and water loads acting simultaneously on all building components. Wind and water loading values shall each have a one (1) percent chance of being equaled or exceeded in any given year.

B. A professional engineer or architect licensed by the Commonwealth of Virginia shall develop or review the structural design, specifications, and plans for the construction and shall certify that the design and methods of construction to be used are in accordance with accepted standards of practice for meeting the provisions of article IV, section 4.6 A. A V Zone

Design Certificate shall be submitted to Permits and Inspections with plans for a building permit.

. . . .

I. ~~The man-made alteration of sand dunes, which would increase potential flood damage, is prohibited.~~ Sand dunes, barrier beaches, and other natural protective barriers shall remain intact to provide protection against wind, waves, and erosion drainage. Any person who desires to use or alter any coastal primary sand dune or beaches, other than for the purpose of conducting the activities specified in Article 1600, Section 1602 of the Zoning Ordinance of the City of Virginia Beach, shall first obtain a permit, or authorization, from the USACE, VADEQ, the Virginia Marine Resources Commission, and the Wetlands Board through the joint permit application process.

J. Manufactured homes are prohibited.

Sec. 4.10. Floodplain subject to special restrictions.

A. All ~~FIRM delineated~~ SFHAs that ultimately drain to Back Bay or the Currituck Sound ~~located in the following areas~~ shall be identified as a floodplain subject to special restrictions~~:~~.

~~1. North Landing River and its tributaries south of Lynnhaven Parkway;~~

~~2. West Neck Creek and its tributaries south of Shipps Corner Road, London Bridge Road, and the portion of Dam Neck Road east of its intersection with London Bridge Road; and~~

~~3. Bays, creeks, lakes, guts, coves, wetlands, marshes and swamps and their tributaries comprising the Back Bay and Small Coastal South watersheds south of South Birdneck Road and east of Princess Anne Road and General Booth Boulevard.~~

B. The following provisions shall apply within the floodplain subject to special restrictions:

1. Notwithstanding any provision of this ordinance to the contrary, no filling shall be permitted, including filling with material excavated from the same floodplain except for:

a. The purpose of public roadway or other similar public works construction undertaken by the Department of Public Works or Virginia Department of Transportation, or their agent for

construction. This construction includes flood protection and flood mitigation projects;

b. The maintenance, alteration, or relocation of bona fide agricultural ditches, swales, or agricultural pathways or those ditches required for proper lot drainage;

c. For shoreline stabilization or maintenance projects, such as riprap revetment, bulkheads, or other treatment used to stabilize and protect the banks of waterways, the city manager or his designee may approve the placement of fill provided the following criteria are met:

i. A joint permit application is submitted;

ii. The alignment of the stabilization structure is along the escarpment or in line with adjacent stabilization structures; ~~and~~

iii. If there is an existing shoreline stabilization structure, any proposed replacement structure shall be no more than six (6) inches higher than the existing structure; and

~~iii~~iv. Fill must be the minimum necessary to support the stabilization project.

2. The city manager, or his designee, may approve the placement of fill provided that the following criteria are met:

a. Proposed fill within the floodplain:

i. Shall be mitigated to result in no decrease in flood storage volume on the site;

ii. Shall be mitigated entirely on the same site that will incur the fill;

iii. Shall be contiguous to the existing floodplain that is being filled; and

iv. Shall be limited to the smallest amount of area and volume possible to correct irregularities within the boundary of the project.

b. The combined areas of fill and mitigation shall not exceed five (5) percent of the total area within the floodplain located on the site that will incur the fill.

3. Residential dwelling structures shall not be located within the floodplains subject to special restrictions on lots created after October 23, 2001. Residential dwelling structures located in ~~local flood hazard areas as of~~ a SFHA and constructed prior to October 23, 2001 may be expanded with attached additions to a total footprint of less than one thousand (1,000) square feet; such additions shall also comply with the requirements set forth in article V of this ordinance.

. . . .

ARTICLE V. EXISTING STRUCTURES IN FLOODPLAIN AREAS

Sec. 5.1. Existing structures.

A structure or use of a structure or premises that lawfully existed prior to the adoption of this ordinance, but which is not in conformity with this ordinance, may be continued subject to the following conditions:

A. Any existing structures in the floodway area shall not be expanded or enlarged unless it has been demonstrated through hydrologic and hydraulic analyses performed in accordance with standard engineering practices that the proposed expansion or enlargement would not result in any increase in the base flood elevation.

B. Any modification, alteration, repair, reconstruction, or improvement of any kind to a structure and/or use located in any floodplain ~~areas~~ district to an extent or amount of less than fifty (50) percent of its market value shall conform to the VA USBC and meet the freeboard height in effect at the start of construction for the original structure.

C. Any modification, alteration, repair, reconstruction, or improvement of any kind to a structure and/or use, in any floodplain ~~area~~ district to an extent or amount of fifty (50) percent or more of its market value shall be undertaken only in full compliance with this ordinance and shall require the entire structure to conform to the VA USBC.

ARTICLE VI. VARIANCES AND APPEALS

Sec. 6.1. Administrative variances.

The floodplain administrator shall approve or deny an application requesting an administrative variance after receipt of a complete application. Administrative variances may only be granted for the following uses, development, or redevelopment:

A. As defined in section 4.10, floodplains subject to special restrictions, for filling only.

B. Any structure or use sustaining damage not caused by flood to an extent or amount of fifty (50) percent or more of its market value to allow the structure to be rebuilt to the freeboard height in effect at the start of construction for the original structure. If the structure is a pre-FIRM structure, full compliance with the current VAUSBC freeboard above the base flood elevation is required. Structures that are utilizing an approved land management plan for their on-site waste disposal may be allowed to continue the use of the land management plan as long as it is approved by the city and the health department, even for damage or destruction resulting from flood.

C. As defined in section 4.8 B, X and X(Shaded) Zone requirements. (Other Areas of Flood Risk), and 4.3 A(ii) when the required finished floor is higher than the BFE plus two feet of freeboard, where the floodplain administrator, in consultation with the Development Services Center, has determined that the proposed stormwater engineering design will approximately mitigate any impacts to the finished floor of the nonresidential development.

Sec. 6.3. Application process.

A. Applications for variances from the requirements of this ordinance shall be made to the city council and filed with the director of planning. The fee for such applications shall be ~~six hundred fifty dollars~~ seven hundred eighty (\$~~650~~780.00). Such fee shall include all costs of notifications and advertising. Except in cases in which such fee is waived, the director shall not accept any application not accompanied by payment of the required fee. The procedure for the advertising, hearing and determination of applications for floodplain variances shall be in accordance with the requirements pertaining to applications for subdivision variances, as set forth in section 9.4 of the subdivision ordinance. In cases in which a variance application is filed by reason of a natural disaster that is the subject of a federal declaration of emergency, application and associated advertising fees shall be waived and such application shall be given expedited processing to the maximum practical extent.

B. All applications shall be accompanied by the following:

1. A separate map, on a 1″ = 100′ or greater scale, identifying all proposed land disturbance, including fill and mitigation areas, and the limits of the existing and proposed SFHAs, tidal and non-tidal wetlands, Southern Rivers Watershed Management Area Buffer, and CBPA Resource Protection Area Buffer; and

2. A preliminary floodplain study addressing the physical and environmental characteristics of the floodplain located on adjoining properties and in the general area. Such study shall be sufficient to show that the variance, if granted, will meet the standards defined in section 6.~~3~~4 and in addition thereto, shall:

    a. Contain supporting data and calculations required for a Preliminary Stormwater Engineering Analysis as appropriate~~, given the preliminary nature of the floodplain study~~;

    b. Comply with the Public Works Design Standards Manual; and

    c. Be certified by a professional engineer, architect, surveyor, landscape architect or practitioner of a related field having a valid license issued by the Commonwealth of Virginia or who is exempt from licensure pursuant to applicable provisions of the Virginia Code.

Adopted by the Council of the City of Virginia Beach, Virginia, on the 1st day of February, 2022.

Attachment 6: Copy of Monitoring/Maintenance Plan

[DRAFT] Annual Monitoring Plan and Post-Construction Monitoring Report

Marsh Restoration in Back Bay, Virginia Beach, VA

Prepared by: Dewberry Engineers, Inc.

[July 6, 2023]

[REPORT VERSION [DRAFT]]

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INTRODUCTION

This project is intended to implement one of the nature-based projects proposed in Virginia Beach's "Sea Level Wise" (SLW) Adaptation Strategy[1] adopted by the Virginia Beach City Council in June 2020. The SLW Adaptation Strategy presents a holistic framework for addressing flood risks across the City, consisting of four general strategies – natural mitigations, engineered defenses, adapted structures, and prepared communities. These strategies were applied to each major watershed in the City and tailored to their unique characteristics and risk profiles. The adaptation vision for the Lower Southern Rivers Drainage Basin, where the proposed project is located, focuses on employing natural mitigation methodologies to strategically reduce flow into and within Back Bay, along with an integrated system of defense structures and complementary adaptation measures, such as land-use strategies, to improve flood storage and overall coastal resiliency. The Bonney Cove area of Back Bay, where the project site is proposed, is particularly suitable for the use of nature-based strategies given the low elevations of marshlands and documented historic degradation of habitat. Participants at the 'near-neighbor' public engagement meetings held during the SLW Adaptation Strategy development were supportive of these types of strategies.

The City has several dedicated Capital Improvement Program (CIP) initiatives for the Lower Southern Rivers Drainage Basin for implementation of these strategies. The City's Stormwater Green Infrastructure CIP has obligated approximately $421,700 in contracts to support field investigations, environmental assessments, and engineering designs of the project – a true indication of the City's commitment to nature-based approaches and the critical first step in a broader effort. During the General Election on November 2, 2021, Virginia Beach residents voted to authorize $567.5 million dollars in debt to fund the design and construction of 21 Phase 1 projects in the citywide Flood Protection Program. [2] The Back Bay Marsh Terrace project is included under the Stormwater Green Infrastructure Master Project.[3] Other Southern Watershed projects that received funding under the Flood Protection Program include the West Neck Creek Bridge City-Wide Sea Level Rise Strategy, the Pungo Ferry Road Improvements, and the Sandbridge/New Bridge Intersection Improvements projects.

Outside of this project, the Virginia Beach City Council has recently funded a $5.2 million dollar voluntary acquisition program to encourage flood-prone properties to apply for a buyout to enable the City to convert parcels to open space to serve as flood storage and a marsh migration buffer. The City's

[1] City of Virginia Beach Sea Level Wise Adaptation Strategy webpage: https://www.vbgov.com/government/departments/public-works/comp-sea-level-rise/Pages/default.aspx

[2] City of Virginia Beach Flood Protection Program webpage: https://www.vbgov.com/government/departments/public-works/flood-protection-program/Pages/Flood-Protection-Program.aspx.

[3] Stormwater Green Infrastructure Page: https://www.vbgov.com/government/departments/public-works/flood-protection-program/Pages/Stormwater-Green-Infrastructure-.aspx

Stormwater Green Infrastructure CIP is also supporting the implementation of other natural and nature-based projects across the City, including a wetland and floodplain restoration project along the Eastern Branch of the Elizabeth River.

An assessment of restoration opportunities in the City's Lower Southern Rivers Drainage Basin with dual flood reduction and habitat restoration benefits identified the Bonney Cove area as a potential project site for several reasons. The Bonney Cove site has experienced significant historical ecological degradation. Historical shoreline data from 1869 indicates approximately 50% of present-day open water in Bonney Cove (260 acres) was previously marsh (Figure 1). Loss of the marsh island habitat within Bonney Cove has resulted in the opening of a secondary channel allowing increased flow exchange between the upper and lower bays. In comparison to shore-adjacent restoration, off-shore marsh restoration leveraging hydraulic modeling identified Bonney Cove as a location where marsh restoration has the potential to reduce the propagation of floodwaters through key pathways within Back Bay. The United States Fish and Wildlife Service (USFWS) and the Virginia Department of Wildlife Resources (VDWR) also identified Bonney Cove as a restoration priority as this area serves as an ideal location for Submerged Aquatic Vegetation (SAV) reestablishment and vital habitat for migratory birds and fish.

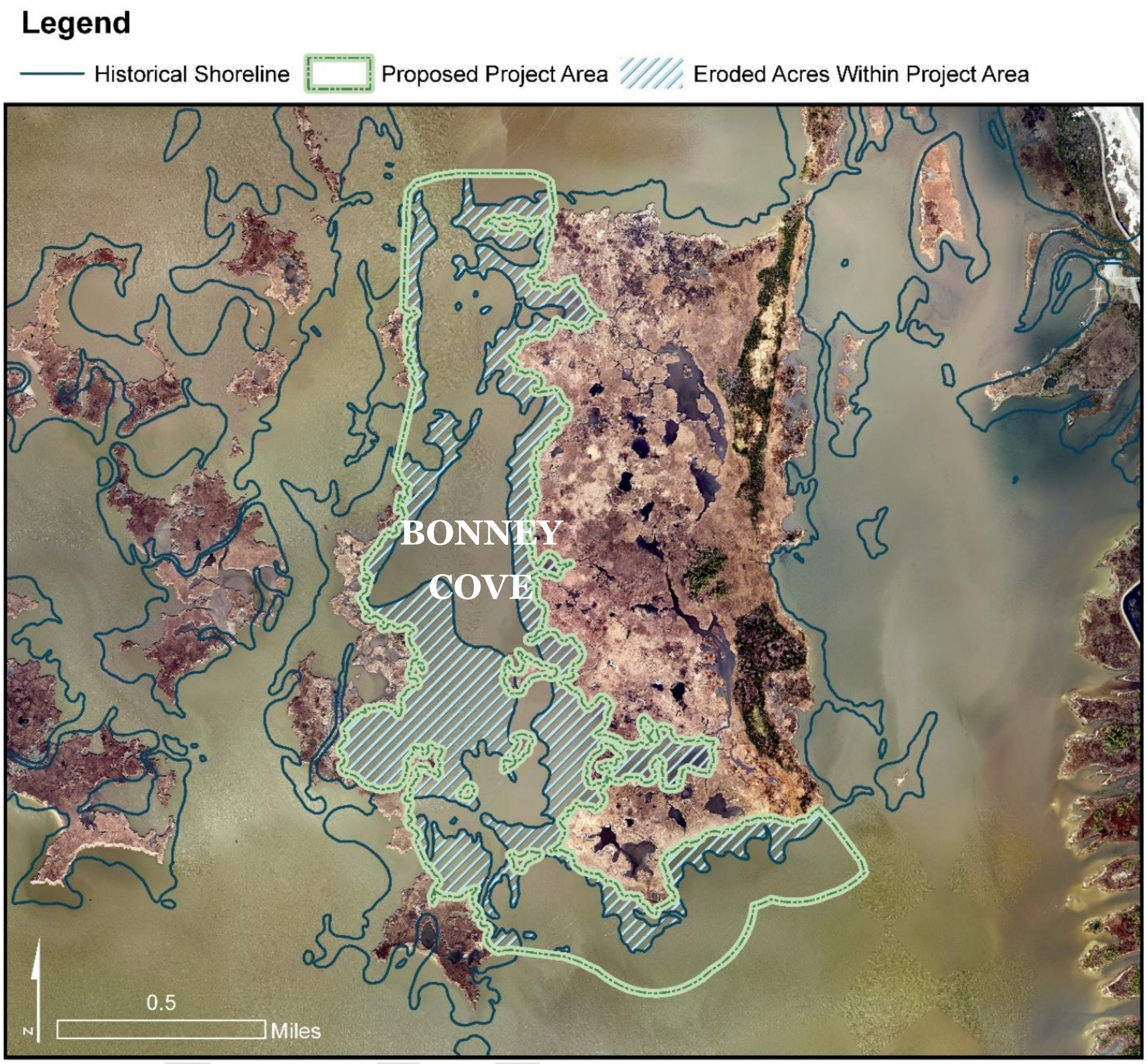

Figure 1: Historical marsh erosion within the project area.

The project is situated within the Bonney Cove area of Back Bay, spanning the western and southern lengths of Long Island, as shown in Figure 1.

Project Background

Marsh island restoration through terracing was identified as a particularly viable solution given Back Bay's shallow bottom and the historical loss of habitat. The marsh terraces are narrow man-made islands that will be arranged across areas that were historically marsh but are now shallow open water. A series of these islands, or terraces, are typically arranged in a chevron pattern. The overall field of terraces dissipates waves and slows down water moving through the area. In turn, the calmer water allows more sunlight to penetrate to the shallow bottom, promoting establishment and growth of marsh

and SAV habitats. Further, as opposed to one continuous marsh platform, marsh terraces maximize habitat for a variety of fish and wildlife species.

The Preferred Alternative includes the creation of 41 individual marsh terraces totaling approximately 25,000 linear feet (or an approximately 47-acre footprint) across Bonney Cove. These 47 acres of terraces are comprised of approximately 13 acres of emergent (low and high marsh) vegetated habitat, 14 acres of upland vegetated habitat, and 16 acres of submerged terrace habitat. Approximately 310 acres of suitable SAV habitat will remain in between the terraces.

Terrace Construction and Orientation

Terrace construction will begin in the northern extent of the project site, and the contractor will work towards the southern extent of the site. The contractor will complete each terrace, including installing plants, before moving to the next. Marsh terrace construction will occur over two years (2025 to 2026) and will pause annually between October 31st and March 1st to limit disturbance to wintering waterfowl and migration, in accommodation of BBNWR's requirement. Approximately 20 terraces will be constructed in 2025 ("Phase 1"), and 21 terraces will be constructed in 2026 ("Phase 2"). The following sections summarize the proposed design and construction approach.

Terraces will be generally oriented perpendicular to the predominant wind direction (south-southwest) to maximize wave energy reduction. The terraces will be segmented in a chevron (duck-wing) pattern to create the most favorable fish and swimming crustacean (termed "nekton") habitat, facilitate adequate circulation, and maintain navigability throughout the project area. The terraces will not be connected to the adjacent marsh to maintain a physical open water barrier to deter the invasion of Common Reed (*Phragmites australis*) stands.

The terraces will be spaced at approximately 300-foot intervals in the northern and southern quarters and span 15 feet in width, and at least 600-foot intervals in the center and span 30 feet in width. This arrangement will lessen the amount of open water and subsequent wave action at the northern and southern ends of the site and provide space for marine-based construction equipment. The design team reviewed the final spacing layout of the terraces to ensure navigability of a watercraft through the project site which will be required for post-construction monitoring, any needed maintenance, as well as community recreational access.

The terraces would consist of a sand filled core encapsulated by a high-strength blend of woven and non-woven geotextile fabrics ("geobags"). The sand for this material would need to come from offsite sources. Back Bay is too shallow to accommodate conventional barges for material placement. To avoid extensive impacts to the bottom of the bay, the slurry basin will pump sand for the project from the proposed Shipps Cabin Road staging area to Bonney Cove. The slurry pipeline will consist of approximately 10,424 linear feet of 12" diameter HDPE fused/welded pipeline that will be assembled on land and floated into its proposed alignment within Back Bay. The pipe would be marked by floats

every 5 feet and temporary signage as reasonable. It is anticipated the pipeline will be submerged to the bottom of the bay at channel crossings and adjacent to a duck hunting cabin adjacent to the alignment. By establishing a floating pipeline, it will limit disturbances to the subaqueous bottomlands along the alignment and allow for the retraction of the pipeline during the winter inactive periods and inclement weather events. Booster stations would be placed approximately every mile. These booster stations would consist of a pontoon mounted diesel engine pump capable of moving the sand slurry from the laydown area to the site. Given the distance to the site, four or five of these booster stations are anticipated to be necessary to create the sand cores of the terrace. It is estimated that 450 Gallons Per Minute (GPM) of sand slurry would be pumped through the pipe.

Once the cores are in place, long reach excavators would travel along the tops of the terraces and begin to shape the cross slopes. Appropriate materials for establishing vegetation atop the terraces will be primarily sourced from materials dredged during the Sandbridge Road Nimmo Parkway Phase VII-A project located immediately north of Back Bay (VMRC 15-1564, USACE IP NAO-2015-00151). Materials will be tested and screened to remove organics prior to application to the terraces. As needed, dredging sites adjacent to the proposed terrace locations that are confirmed to be devoid of SAV will be utilized to provide supplemental soil materials to top the proposed terraces[4]. It was determined that the in-situ bay sediment would be suitable for vegetation growth. The marsh terraces would be covered with 1 to 3 feet of suitable fill, depending on crest widths. Jute netting will cover the topsoil to control erosion and promote vegetation establishment. Coir logs will be places along the terrace slope controls to further promote vegetation establishment along the slope.

SAV Plantings

The City has partnered with Virginia Polytechnic Institute and State University ("Virginia Tech") to evaluate opportunities for restoring populations of native Wild Celery (*Vallisneria americana*) in Back Bay. The Virginia Tech research team has developed an innovative technique to grow Wild Celery in an aquaculture center that results in larger, mature plants that can better withstand Back Bay's turbidity. Once transplanted, plants are surrounded by cages to prevent predation. These founder colonies can be used for propagation throughout Back Bay. After terrace construction, the City will transplant Wild Celery in an area adjacent to the site. This founder colony will be used to strategically transplant Wild Celery in between the terraces for 5 years after construction (2026 – 2029) with the ultimate goal of establishing 10 acres of SAV vegetation in between the marsh terraces.

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[4] The 60% preliminary design showed preliminary siting of these dredge areas based on avoidance of existing SAV habitat; however, pre-construction surveys of SAV would be required to re-delineate these dredging areas.

Terrace Plantings – Upland and Marsh Vegetation

The terraces' intertidal perimeter will be planted with appropriate emergent estuarine plant species (e.g., Saltmarsh Cordgrass [*Spartina alterniflora*] and Salt Meadow Hay [*Spartina patens*]) and brackish plant species (e.g., Big Cordgrass [*Spartina cynosuroides*]). These plants will be installed as soon as possible after construction to stabilize planting areas and protect the terrace from erosion. In addition to emergent grass, woody growth (i.e., shrubs and trees) within the terrace crest will be incorporated to protect the terraces' surfaces from rain and wind erosion and hold the landform together through substantial root systems.

Appropriate native species were identified based on the review of the reference marshes surrounding the project site and a review of water levels in Back Bay. Since the Bay's water levels are not affected by lunar tides and instead by wind-driven fluctuations, the project team evaluated average water elevations at the U.S. Geological Survey (USGS) Beggars Bridge Creek Gauge (Gauge ID 0204300267) from 2016 – 2021 to determine ranges of inundation to achieve functional marsh elevations throughout the project life, defined as:

- *Mean Low Water (MLW)*: the average low water at the site (10th Percentile: -0.62 ft NAVD88)
- *Mean High Water (MHW)*: the average high water at the site (95th Percentile: 1.22 ft NAVD88)
- *Mean Tide Level (MTL)*: halfway between MLW and MHW (0.3 ft NAVD88)
- *Upper Limit of Wetlands (ULW)*: approximately 1.5 times the mean tide range at the site (2.76 ft NAVD88)

These elevations were correlated to suitability for low marsh, high marsh, and upland species, as shown in Table 1.

Table 1: Proposed planting elevation zones.

Planting Zone	Definition	Elevation Range	Elevation (feet NAVD88)	Percentage of record where water reaches these elevations
Low Marsh	Marsh that is flooded frequently but exposed sometimes	MTL - MHW	0.3 – 1.2 ft	48%
High Marsh	Marsh that is generally only flooded during higher-than average water conditions	MHW – ULW	1.2 to 2.8 ft	7%
Upland Habitat	Habitat that is rarely flooded, only during extreme conditions	> ULW	> 2.8 ft	0%

Five planting schemas were identified to provide the highest possible environmental benefit in terms of erosion control, habitat diversity, and fetch reduction. The wider (30-foot) terraces will be planted with Bald Cypress (*Taxodium districhum*) trees capable of withstanding rising water levels. The full list of species and quantities is provided in the 95% design plan set.

The final engineered design component is the strategic placement of rock on the exposed perimeter terraces on the project site's north, west, and southern extents. The need for the rock armor was determined through analysis of wind data both from NOAA and ASCE-7-10 50-year return period anticipated 3-second gust values. These values were used to calculate fetch-generated waves at the project site. The calculations performed confirmed that armored protection would be required to protect the proposed terraces from the forces created by wave action. The stone sizes required for these features (Class II rip rap) were calculated following the procedures laid out in the USACE Coastal Engineering Manual (CEM) and Virginia Institute of Marine Science (VIMS) Living Shoreline Design Guidelines for Shore Protection in Virginia's Estuarine Environments. Two calculation methods, Hudson (1974) and Van Der Meer (1988), from the CEM were utilized to evaluate the range of acceptable rock armor for the exposed perimeter. These two methods calculate the armor stone size based on several design inputs including initial wave height, allowable damage level, revetment slope, and breaking versus non-breaking waves. The two methods often result in corresponding values that are used by the engineer to make an experienced determination on the final rock armor sizing. The rock armor will serve as a nature-based design element by acting as a substrate for the Wild Celery grass that has proven to be successful for SAV establishment in Back Bay (see Figure 2).

Figure 2: Example Back Bay SAV experiment; photo courtesy of Virginia Tech.

Monitoring Goals and Objectives

Annual post-construction monitoring of the site is required by the Virginia Marine Resource Commission (VMRC) (TBD) Permit (VMRC #XXXX-XXXX) and the U.S. Army Corps of Engineers (USACE) Individual Permit (NOA-20XX-XXXXX). [Insert details of the relevant permits and permit conditions]. The following goals, objectives, and metrics were established to enable consistent tracking of the primary living shoreline project components across each monitoring year.

1. **Monitoring Goal 1**: Establishment of a Sustainable Coastal Marsh Island System
   a. Objective 1a: Establish Emergent Marsh Habitat
      - Metric: For each monitoring year, the project area should maintain or increase the overall coverage of emergent marsh vegetation. There should be no significant signs of herbivory or invasive species establishment.

   b. Objective 1b: Establish Upland Habitat
      - Metric: For each monitoring year, the project area should maintain or increase the overall coverage of upland vegetation. There should be no significant signs of herbivory or invasive species establishment.
2. **Monitoring Goal 2**: Stability of Marsh Terraces
   a. Objective 2: Marsh Terrace Structures
      - Metric: For each monitoring year, the terrace structures should show no significant signs of damage, deterioration or extreme settlement.
3. **Monitoring Goal 3**: Establishment of a Sustainable SAV Community
   a. Objective 3: Establish SAV Communities

- Metric: For each monitoring year, the SAV planting areas should maintain or increase the overall coverage of SAV vegetation. There should be no significant signs of herbivory or invasive species establishment.

MONITORING PLAN

The monitoring plan includes stakeholders, a schedule for the annual monitoring inspections, the monitoring strategy/sampling plan, and approach for addressing any needs for maintenance.

Monitoring Stakeholders

An Environmental Scientist from Dewberry Engineers Inc. will perform the annual monitoring inspections and provide a copy of the monitoring report to the City of Virginia Beach, USACE, VDEQ, VMRC, and the City of Virginia Beach Wetlands Board as necessary. As owners of the project, the City of Virginia Beach will review monitoring recommendations and perform corrective actions as necessary.

Annual Inspection Schedule

Monitoring inspections should be conducted annually, during the peak growing season, which is defined by VMRC as between June and August. To enable consistent tracking of project performance from year to year, annual monitoring inspections will be conducted prior to the end of the growing season in September of each year, with annual reports to be submitted to regulatory stakeholders prior to November 30th [or an annual date defined in the permit conditions] of each year. The following outlines the monitoring inspection schedule and deliverables.

Phase 1 Post-Construction As-Built Report (Date: Prior to December 31st, 2025)

To serve as a baseline for the post-construction annual monitoring, an as-built report for the Phase 1 terraces will be completed following the construction of each phase of terraces and submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following.

- Coordinates and diagrams of established transects, as well as site photographs from photo stations 1-40 as defined in the Methods section.
- Final location of all planted vegetation (upland plantings, high marsh plantings and low marsh plantings).
- Final grade topographic surveys (plan, profile, and cross sections).
- Discussion of the project design versus as-built conditions.

Phase 2 Post-Construction As-Built Report (Date: Prior to December 31st, 2026)

To serve as a baseline for the post-construction annual monitoring, an as-built report for the Phase 2 terraces will be completed following the construction of each phase of terraces and submitted to the

City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following.

- Coordinates and diagrams of established transects, as well as site photographs from photo stations 41-80 as defined in the Methods section.
- Final location of all planted vegetation (upland plantings, high marsh plantings and low marsh plantings).
- Final location and extent of SAV plantings.
- Final grade topographic surveys (plan, profile, and cross sections).
- Discussion of the project design versus as-built conditions.

Year 1a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2026)

At the end of the first full growing season following planting of the Phase 1 terraces, a Year 1a monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 40 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 1 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion; it is anticipated that the wetland planting contractor will provide a one-year post construction maintenance and guarantee period for the wetland plantings.

Year 1b/2a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2027)

At the end of the first full growing season following planting of the Phase 2 terraces following planting, and the second full growing season of the Phase 1 terraces, a Year 1b/2a monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 1 conditions (for Phase 2 terraces) and to Year 2 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).

- Estimated percent cover and change in coverage from planted conditions to Year 1 conditions for SAV planting quadrants
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion; it is anticipated that the wetland planting contractor will provide a one-year post construction maintenance and guarantee period for the wetland plantings.

Year 2b/3a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2028)

At the end of the second full growing season of the Phase 2 terraces following planting, and the third full growing season of the Phase 1 terraces, a Year 2b/3a monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 2 conditions (for Phase 2 terraces) and to Year 3 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- Estimated percent cover and change in coverage from planted conditions to Year 2 conditions for SAV planting quadrants
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

Year 3b/4a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2029)

At the end of the third full growing season of the Phase 2 terraces following planting, and the fourth full growing season of the Phase 1 terraces, a Year 3b/4a monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 3 conditions (for Phase 2 terraces) and to Year 4 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).

- Estimated percent cover and change in coverage from planted conditions to Year 3 conditions for SAV planting quadrants
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

Year 4b/5a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2030)

At the end of the fourth full growing season of the Phase 2 terraces following planting, and the fifth full growing season of the Phase 1 terraces, a Year 4b/Final (Year 5a) monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 4 conditions (for Phase 2 terraces) and to Year 5 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- Estimated percent cover and change in coverage from planted conditions to Year 4 conditions for SAV planting quadrants
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

Year 5b Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2031)

At the end of the fifth full growing season of the Phase 2 terraces following planting, a Final (Year 5b) monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 41 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 5 conditions (for Phase 2 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- Estimated percent cover and change in coverage from planted conditions to Year 5 conditions for SAV planting quadrants

- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

Monitoring Strategy

The monitoring strategy consists of established transects with photo stations and quadrants that cover the area between transects. This approach enables monitoring of the four primary features of the living shoreline: uplands, low-marsh plantings, high-marsh plantings, and SAV*.

*Note: The planting scheme for SAV has not yet been established but it is anticipated that some SAV will be planted along the submerged portions of the marsh terraces. If more suitable planting locations are determined to be between terraces, separate transects will be established and sampled to track SAV survival apart from the proposed terrace transects.

Transects/Photo Points

A total of eighty (80) transects will be established across the project site, with 10 transects located along each of 8 terraces. Transects will span perpendicular to the length of each terrace from the ridge to the edge of the planted/vegetated area. See Figures 3 and 4 for graphic depictions of the proposed transect locations and layouts. Terraces were selected using a random stratified method to ensure representative terraces in each location within the project area (North Interior, North Exterior, South Interior, South Exterior), and of each planting scheme, were represented in the proposed monitoring plan. The selected terraces are as follows:

- North Interior: T-110, T-113
- North Exterior: T-100, T-106
- South Interior: T-124, T-131
- South Exterior: T-123, T-140

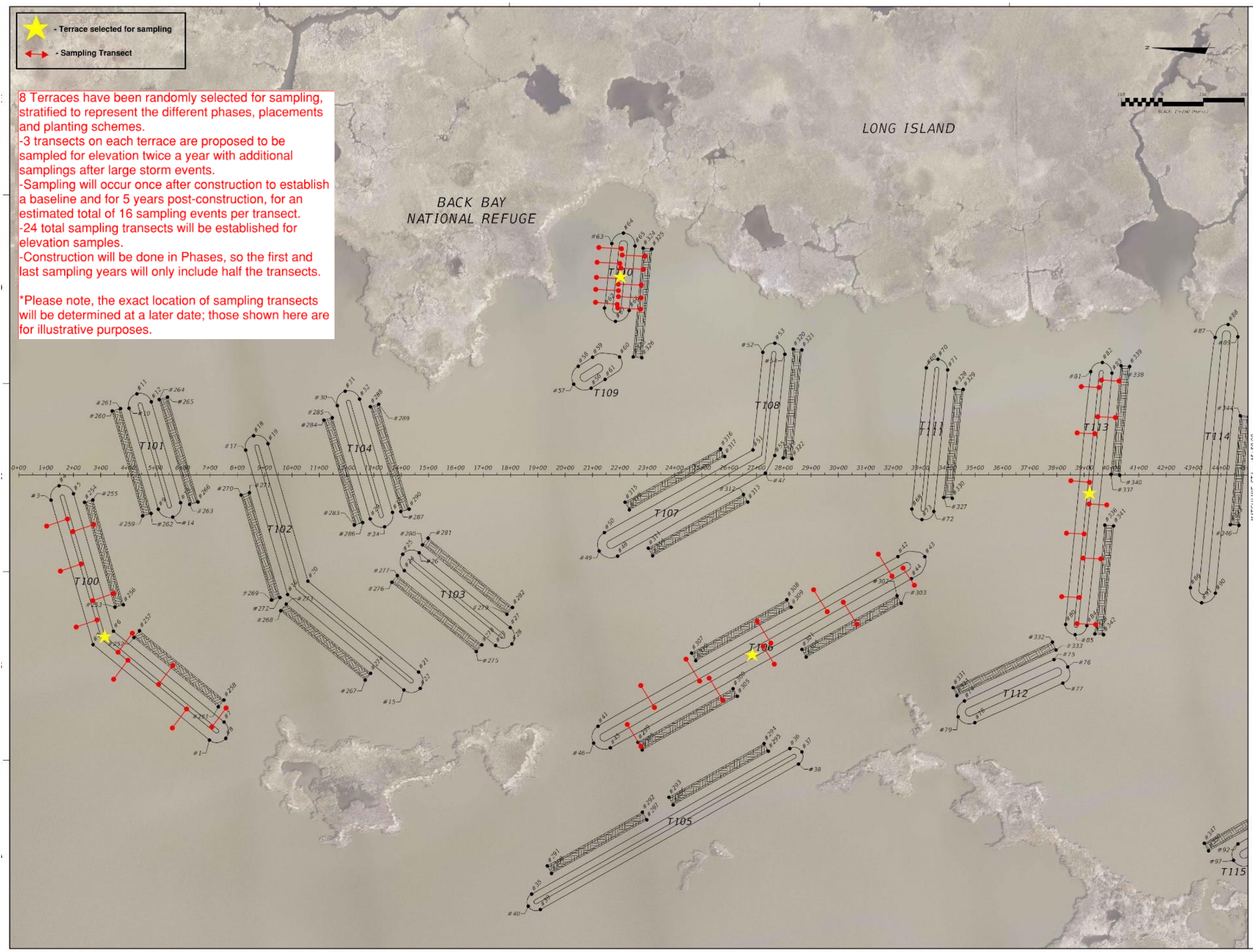

Figure 3: Monitoring design site plan – North Terraces

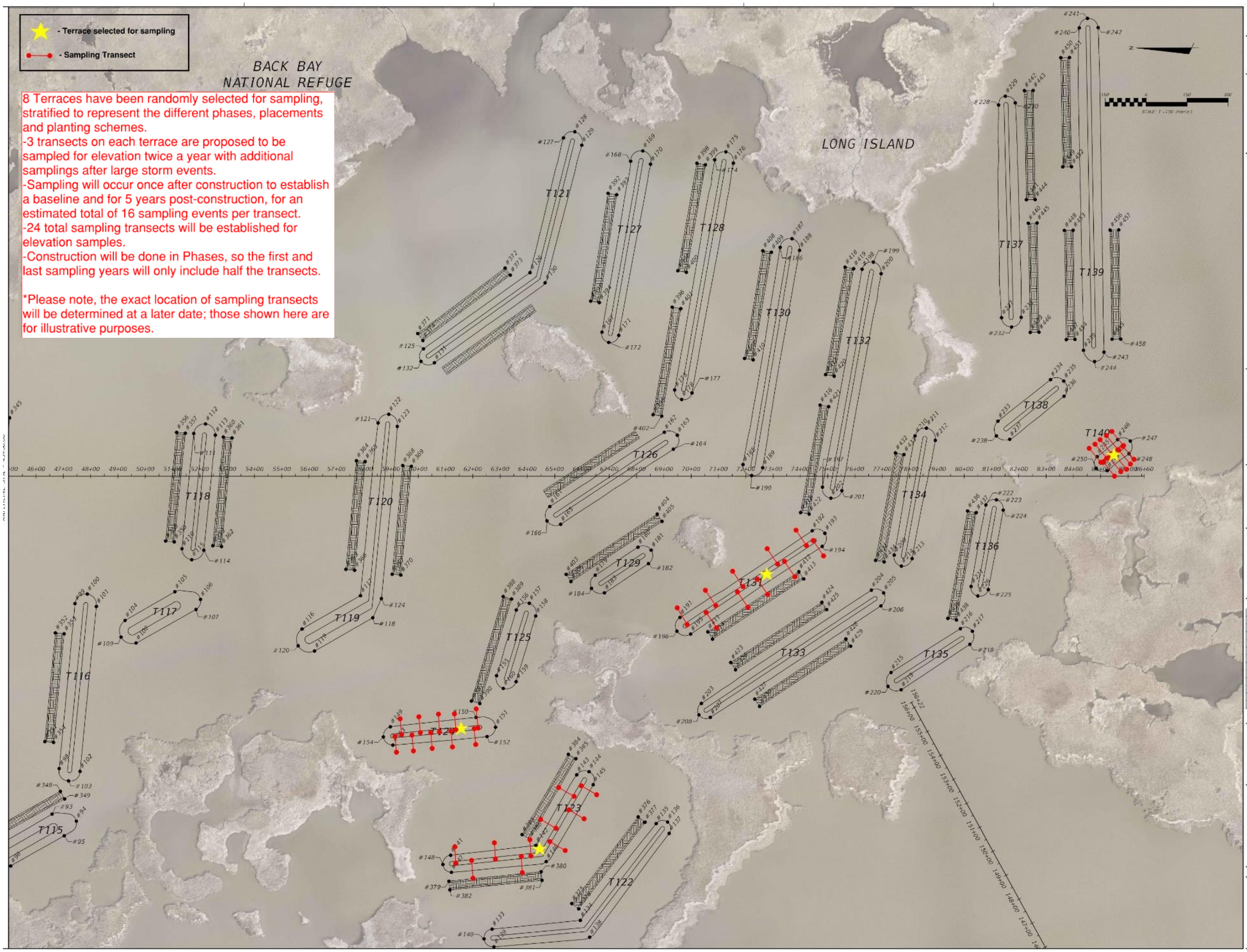

Figure 4: Monitoring design site plan – South Terraces

Permanent photo stations will be established at each quadrant along each transect to capture the design features/established habitats and vegetation. Figure 5 shows the general proposed locations (indicated by the red arrows/labels) for each quadrant and photograph station along each transect. Photos were shot from each photo location on [DATE]. These photos will be collected annually and compiled in Appendix B.

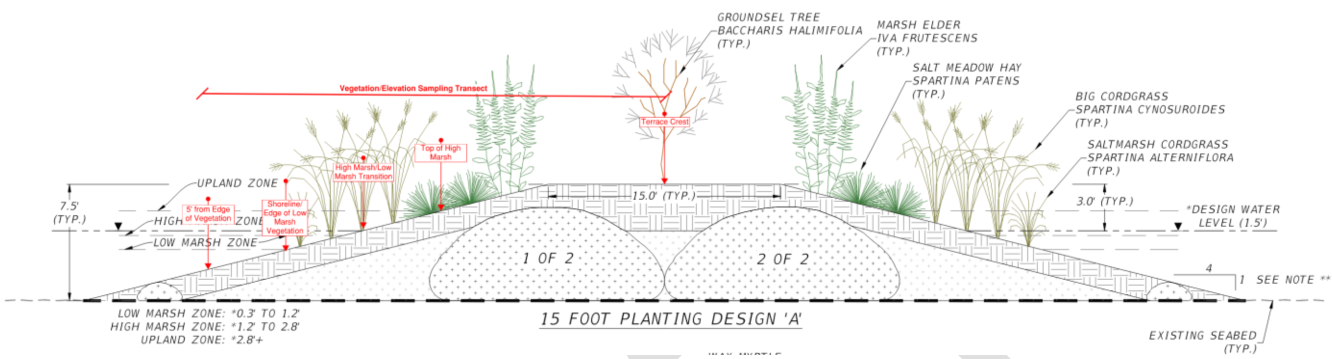

Figure 5: Photo station layout example

Quadrants

To estimate percent cover of vegetation, four (4) quadrants along each of ten (10) transects will be established on the eight selected terraces to allow for estimates of habitat coverage and planting survival. Estimates of coverage and survival were compared to post-construction conditions to evaluate changes.

Further, the following guiding questions were established to monitor overall project performance, presence of invasive species, and identify any needs for maintenance:

1. Are there specific problem areas where plants are dying or appear unhealthy?
2. Were any signs of herbivory observed?
3. Are there any undesirable plant species present?
4. Condition of the terrace structures: Is there any observed settlement, dislodged stone, significant debris etc.?
5. If an updated survey was conducted, are there any significant changes in the profile of the marsh terraces?
6. Does the upland portion of each terrace show any significant signs of erosion or loss of vegetation?

MONITORING RESULTS

Table 2: Low Marsh Vegetation Percent Cover Monitoring Results (Example Table – Terrace 1).

		Estimated Percent Coverage						Percent Change in Coverage (from Baseline)				
Terrace/ Transect	Photo Station Reference	Baseline (2024)	Year 1 (2025)	Year 2 (2026)	Year 3 (2027)	Year 4 (2028)	Year 5 (2029)	Baseline to Year 1	Baseline to Year 2	Baseline to Year 3	Baseline to Year 4	Baseline to Year 5
1 - 1	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 2	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 3	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 4	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 5	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 6	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 7	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 8	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 9	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 10	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
Overall		**Choose an item.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**

Table 3: High Marsh Vegetation Percent Cover Monitoring Results (Example Table – Terrace 1).

		Estimated Percent Coverage						Percent Change in Coverage (from Baseline)				
Terrace/ Transect	Photo Station Reference	Baseline (2024)	Year 1 (2025)	Year 2 (2026)	Year 3 (2027)	Year 4 (2028)	Year 5 (2029)	Baseline to Year 1	Baseline to Year 2	Baseline to Year 3	Baseline to Year 4	Baseline to Year 5
1 - 1	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 2	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 3	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 4	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 5	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 6	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 7	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 8	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 9	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 10	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
Overall		**Choose an item.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**

Table 4: General Observations for Wetland Planting Areas on the Marsh Terraces (Example Table – Terrace 1)

Monitoring Questions	**Terrace/Transect**									
	1 - 1	**1 - 2**	**1 - 3**	**1 - 4**	**1 - 5**	**1 - 6**	**1 - 7**	**1 - 8**	**1 - 9**	**1 - 10**
Are there specific problem areas where plants are dying or appear unhealthy?	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.
Were any herbivory issues observed?	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.
Are there any undesirable plant species present?	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.
If updated survey was conducted, are there any significant changes in the profile of the living shoreline system?	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.

Table 5: General Observations for the Unplanted Structural Components of the Marsh Terraces (Example Table – Terrace 1)

	Terrace/Transect									
Monitoring Questions	1 - 1	1 - 2	1 - 3	1 - 4	1 - 5	1 - 6	1 - 7	1 - 8	1 - 9	1 - 10
Are there any structural issues with the planted terrace structures (e.g. observed settlement, loss of topsoil, etc.)?	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.
Is there any observed growth in SAV on or adjacent to the marsh terraces?	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.

Are there any structural issues with the rock armoring on the terraces (e.g. observed settlement, dislodged stone, significant debris, etc.)?	YES ☐ NO ☒ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☒ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.

MAINTENANCE RECOMMENDATIONS

The following table outlines the recommendations for maintenance, including estimated quantities and specific guidance, based on the results of the [YEAR] monitoring results.

Table 6: Maintenance Recommendations Checklist

Design Feature/ Monitoring Objective	Maintenance Elements	Location & Estimated Quantity	Specific Guidance
Terrace Upland and Wetland Habitats and Wetland Soils – Monitoring Objectives 1a/1b	☐ Replace plants	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Add new plants	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Remove debris	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Remove invasive vegetation	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Add sand to eroding areas	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Replace waterfowl barrier	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.

Design Feature/ Monitoring Objective	Maintenance Elements	Location & Estimated Quantity	Specific Guidance
Terrace Structures & Stone Armoring, Monitoring Objective 2a/2b	☐ Re-place dislodged stones	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Add additional stone to address settlement	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Remove debris	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Repair sand cores or other structural elements	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
SAV Establishment, Monitoring Objective 3	☐ Replace plants	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Add new plants	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.

APPENDIX A: AS-BUILT PLANS

[Page left intentionally blank; as-built plans will be included in the Year 1 monitoring report]

APPENDIX B: MONITORING PHOTOGRAPHS

Table 7: Terrace 1 Transect 1 Photographs

Photograph from Photo Location 1A	Photograph from Photo Location 1B
Photograph from Photo Location 1C	Additional photos of any problem areas.

Table 8: Terrace 1 Transect 2 Photographs

Photograph from Photo Location 2A	Photograph from Photo Location 2B
Photograph from Photo Location 2C	Additional photos of any problem areas.

Table 9: Terrace 1 Transect 3 Photographs

Photograph from Photo Location 3A	Photograph from Photo Location 3B
Photograph from Photo Location 3C	Additional photos of any problem areas.

Table 10: Terrace 1 Transect 4 Photographs

Photograph from Photo Location 4A	Photograph from Photo Location 4B
Photograph from Photo Location 4C	Additional photos of any problem areas.

Table 11: Terrace 1 Transect 5 Photographs

Photograph from Photo Location 5A	Photograph from Photo Location 5B
Photograph from Photo Location 5C	Additional photos of any problem areas.

Table 12: Terrace 1 Transect 6 Photographs

Photograph from Photo Location 6A	Photograph from Photo Location 6B
Photograph from Photo Location 6C	Additional photos of any problem areas.

Table 13: Terrace 1 Transect 7 Photographs

Photograph from Photo Location 7A	Photograph from Photo Location 7B
Photograph from Photo Location 7C	Additional photos of any problem areas.

Table 14: Terrace 1 Transect 7 Photographs

Photograph from Photo Location 7A	Photograph from Photo Location 7B
Photograph from Photo Location 7C	Additional photos of any problem areas.

Table 15: Terrace 1 Transect 8 Photographs

Photograph from Photo Location 8A	Photograph from Photo Location 8B
Photograph from Photo Location 8C	Additional photos of any problem areas.

Table 16: Terrace 1 Transect 9 Photographs

Photograph from Photo Location 9A	Photograph from Photo Location 9B
Photograph from Photo Location 9C	Additional photos of any problem areas.

Table 17: Terrace 1 Transect 10 Photographs

Photograph from Photo Location 9A	Photograph from Photo Location 9B
Photograph from Photo Location 9C	Additional photos of any problem areas.

Dewberry

www.dewberry.com

Appendix B: Budget Narrative Template

Applicant Name: Community Flood Preparedness Fund & Resilient Virginia Revolving Loan Fund Detailed Budget Narrative Period of Performance: June 2024 through June 2027 Submission Date: November 12, 2023									
Grand Total State Funding Request									$ 5,000,000
Grand Total Local Share of Project									$ 38,356,966
National Fish and Wildlife Foundation Grants Federal Funding (if applicable)									$ 10,021,524
Project Grand Total									$ 53,378,490
Locality Cost Match									% 71.85
Breakout By Cost Type	Personnel	Fringe	Travel	Equipment	Supplies	Contracts	Indirect Costs	Other Costs	Total
Federal Share (if applicable)								10,021,524	10,021,524
Local Share								37,330,166	37,330,166
State Share								5,000,000	5,000,000
Pre-Award/Startup								276,800	276,800
Maintenance								750,000	750,000
Total	$	$	$	$	$	$	$	$53,378,490	$ 53,378,490

1. Federal Share represents National Fish and Wildlife Foundation (NFWF) Grants. NFWF is not a federal agency.
2. Local Share represents the total project cost less design and implementation (monitoring and initial maintenance) costs.
3. State Share represents the CFPF grant request.
4. Pre-Award costs represent project design costs.
5. Maintenance costs represent implementation (monitoring and initial maintenance costs).

2023 Virginia Community Flood Preparedness Fund

Marsh Restoration in Back Bay, Virginia Beach

CITY OF VIRGINIA BEACH

Scope of Work Narrative

Introduction

The City of Virginia Beach ("City") is pleased to submit the Marsh Restoration in Back Bay project for consideration under the Flood Prevention and Protection Projects category in the 2023 Virginia Community Flood Preparedness Fund. The City has made significant investments in the study of historical flooding data, current and future hydrology, and the projected increase in flood frequency due to changing rainfall patterns and sea level rise. These studies culminated in Virginia Beach's Resilience Plan, socialized as "Sea Level Wise,"[1] which includes a conceptual suite of projects focused on flood control and resilience. The Virginia Beach Resilience Plan leverages four overarching adaptation strategies to identify actionable projects for each of the City's four unique major watersheds. This project represents the first adaptation project to advance to construction to implement the City's Resilience Plan.

The adaptation strategy for the Southern Rivers Watershed, which includes Back Bay, is presented in Figure 1. The strategy focuses on employing natural mitigation methods, an integrated system of defense structures, and complementary measures, such as land-use strategies. Collectively these approaches are designed to strategically reduce flow into and within Back Bay and improve flood storage and overall coastal resiliency. Marsh restoration was identified as a key resilience-building strategy as part of an extensive evaluation of structural and non-structural alternatives. Marsh restoration provides multiple benefits of flood risk reduction, enhanced habitat, and improved water quality.

As part of the Virginia Coastal Resilience Master Planning Framework, a precursor to the first phase of the Virginia Coastal Resilience Master Plan (CRMP), the Commonwealth of Virginia identified guiding principles for a statewide resilience strategy. One of these guiding principles is recognizing the importance of protecting and enhancing natural infrastructure and prioritizing nature-based infrastructure.[2] The City's marsh restoration project aligns with this principle and was highlighted as an exemplary nature-based project in the CRMP (refer to pages 178-179).[3]

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[1] City of Virginia Beach (2020). Virginia Beach Sea Level Wise Adaptation Strategy (Website).
[2] Office of Governor Ralph S. Northam Commonwealth of Virginia. (2020). Virginia Coastal Resilience Master Planning Framework (PDF).
[3] Office of Governor Ralph S. Northam Commonwealth of Virginia. (2021). Virginia Coastal Resilience Master Plan Phase 1 (PDF).

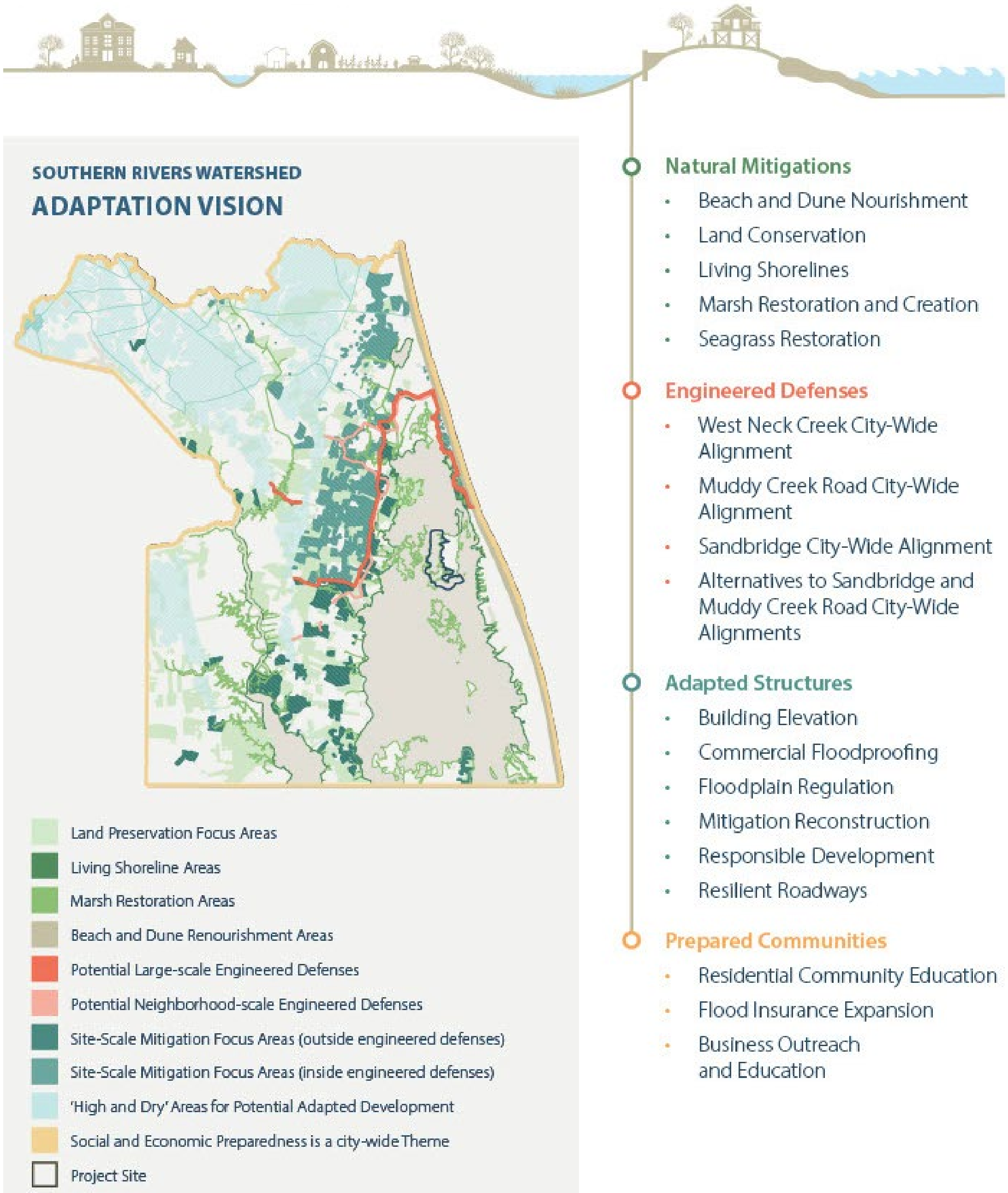

Figure 1: Adaptation Vision for the Southern Rivers Watershed.

Hydraulic modeling analysis identified Bonney Cove as a location where marsh restoration has the potential to reduce the propagation of floodwater through key pathways within Back Bay (Figure 2). The City prioritized this project as the first to advance to construction due to its significant benefits to community and habitat resilience.

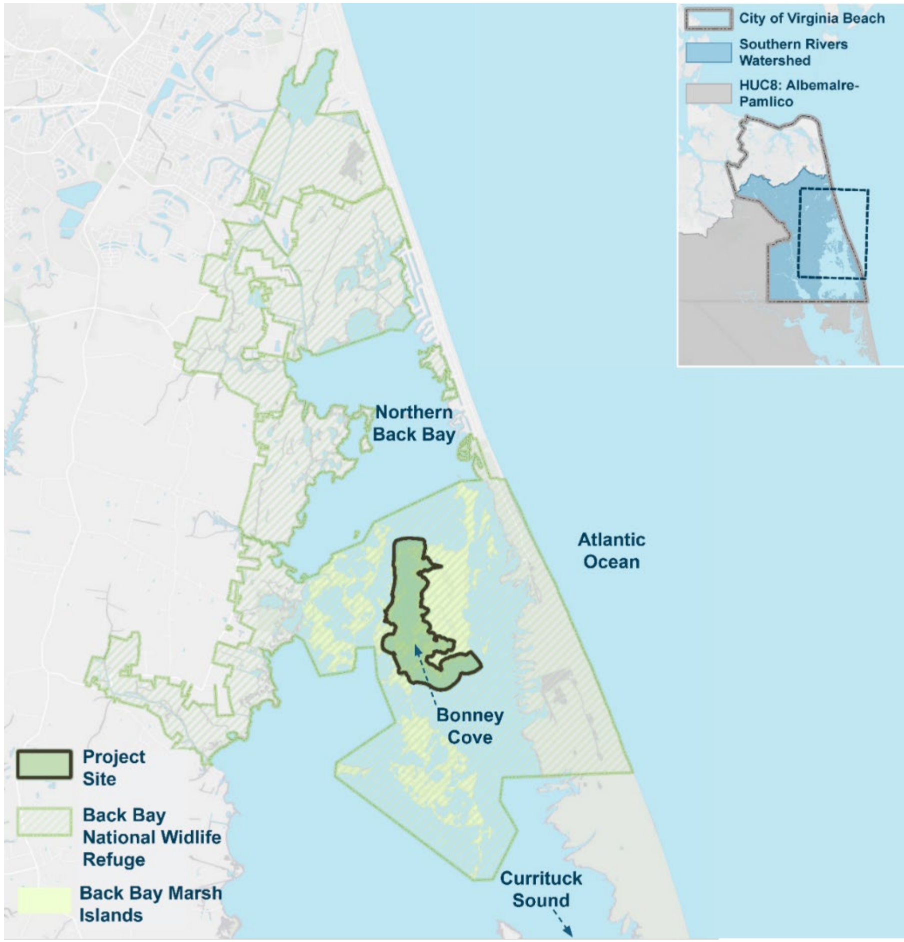

Figure 2: Project site location map.

This project represents a collaborative effort between the City's Department of Public Works alongside other City departments, public constituents, local nonprofits, and state and federal agencies. In selecting the project location and developing the design approach, the City has coordinated closely with the Back Bay National Wildlife Refuge (BBNWR), part of the U.S. Fish and Wildlife Service (USFWS), and the Virginia Department of Wildlife Resources (VDWR). Environmental organizations committed to stewardship of Back Bay have also contributed input throughout the design process, including the Back Bay Restoration Foundation (BBRF), Friends of Back Bay, the Back Bay National Wildlife Refuge Society, and the Albemarle-Pamlico National Estuary Partnership (APNEP). Project field investigations involved local support from Old Dominion University (ODU) and others, and outside expertise from Louisiana. The National Fish and Wildlife Foundation (NFWF) provided grant funding under the National Coastal Resilience Fund (NCRF) to support design, permitting, and environmental assessments. Broad support of the project is demonstrated by contributions from the organizations noted above along with other stakeholders engaged in the restoration effort.

Needs and Problems

Specific Problem Being Solved – Habitat Degradation and "Wind Tide" Flooding

Marshes are vital to the Southern Rivers Watershed for the ecological and flood reduction benefits they provide. The Southern Rivers Watershed contains 90% of the City's land area under an elevation of three feet, making this area particularly susceptible to flood impacts. As illustrated in Figure 3, sustained southerly winds push water up from the Albemarle-Pamlico Sound through the Currituck Sound and into Back Bay, creating a phenomenon referred to locally as "wind tide flooding". Marsh habitat loss has contributed to the opening of a secondary channel in Bonney Cove that has increased water flow during wind tide and other flood events to areas with high community exposure.

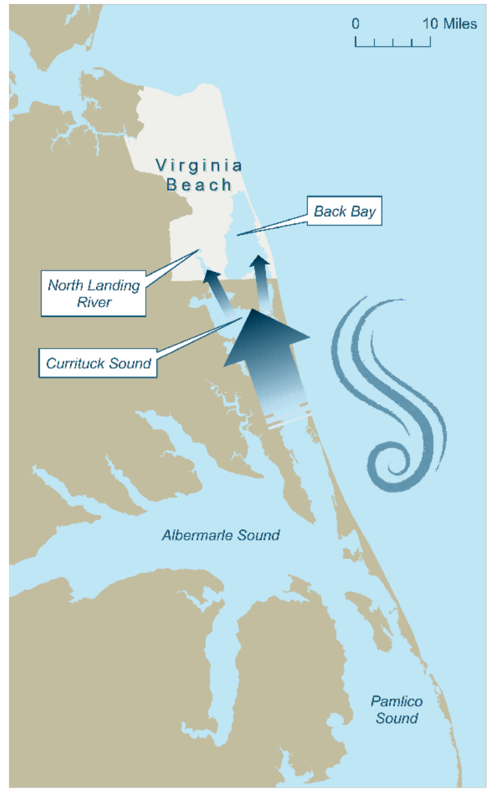

Figure 3: Flood pathways in the Southern Rivers Watershed.

Within today's marsh system, it takes between two to five days of sustained southerly winds to cause flooding, depending on the wind speed and direction. Over the last four years, more than five wind tide flooding events have occurred in this area. The increasing frequency of flooding events is primarily attributed to a foot of relative sea level rise in the last 50 years and degradation of marsh and seagrass habitat.

This marsh restoration project aims to address the challenges of habitat degradation and "wind tide" flooding by stabilizing two critically eroding marsh islands, decreasing turbidity to promote the growth of aquatic vegetation, and providing flood risk reduction benefits through increased friction and wave attenuation.

Factors Contributing to the Identified Problem

This growing flood risk in the Southern Rivers Watershed can be attributed mainly to the reduced friction in the water column from the increased water depth and eroded vegetation, which allows water to move more quickly through key hydraulic pathways. Another term for this is "fetch", which is defined as the open water distance over which a given wind can blow and generate higher waves without obstruction. Unmitigated, the continued loss of these marsh island systems and aquatic vegetation is expected to result in more frequent and intense wind tide flooding events.

Emergent Marsh Degradation

Approximately 50% of former marshland at the site (260 acres) has eroded into open water leading to the opening of a wide secondary channel ("Bonney Cove") that is about two miles

long and half a mile wide (Figure 4). The southern exposed edge of the adjacent marsh islands is exposed to approximately 1.5 miles of fetch in the predominant wind direction.

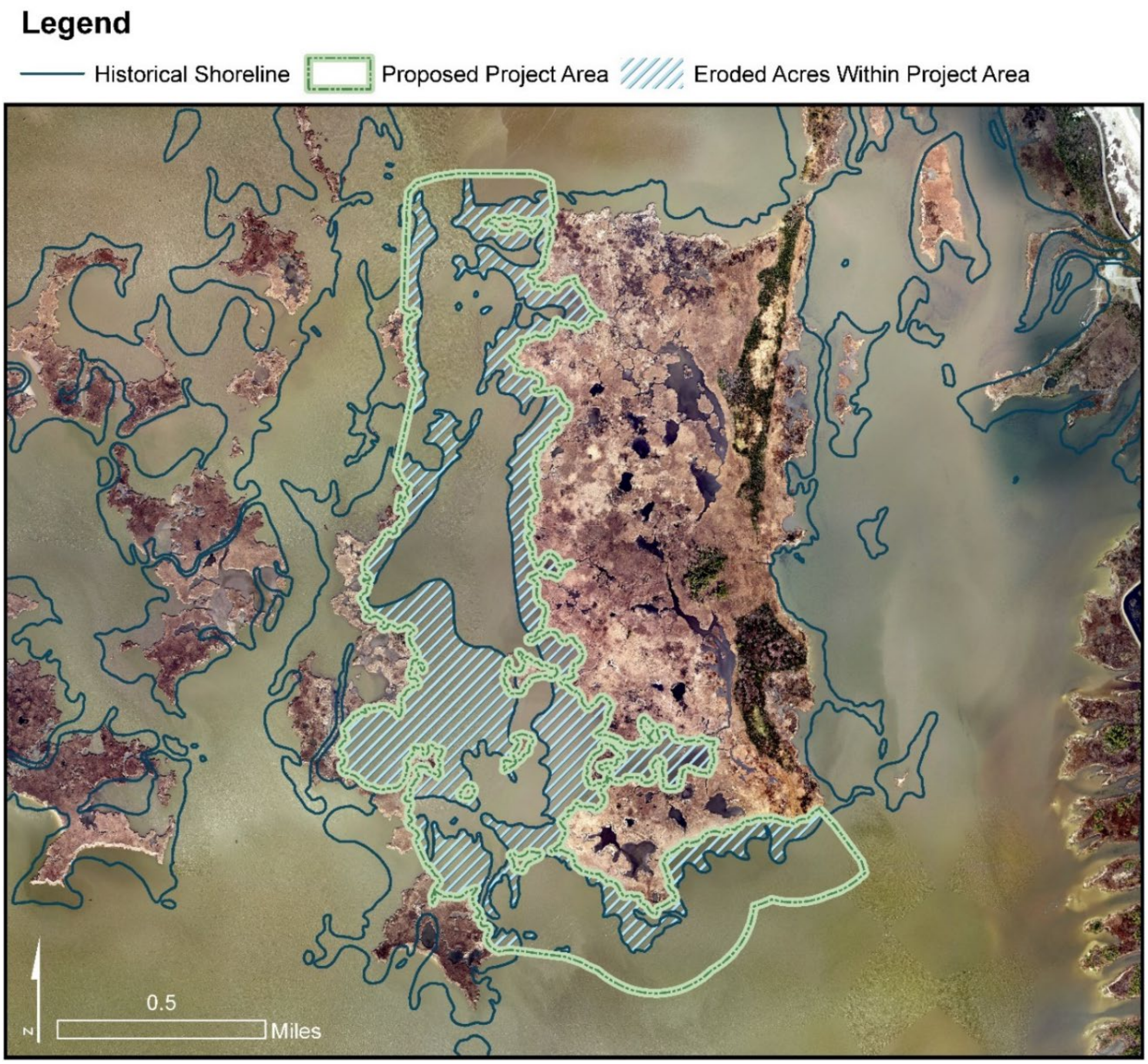

Figure 4: Historical marsh erosion within the project area.

Submerged Aquatic Vegetation (SAV) Loss

SAV used to be abundant at the site (around 45% coverage, overall) but is now extremely sparse, ranging from 0% to 10% coverage across the site, on average. Field studies conducted by the VDWR show that wind-driven waves and high flow velocities are the primary drivers of this loss, particularly in the last 5 years as shown in Figure 5.

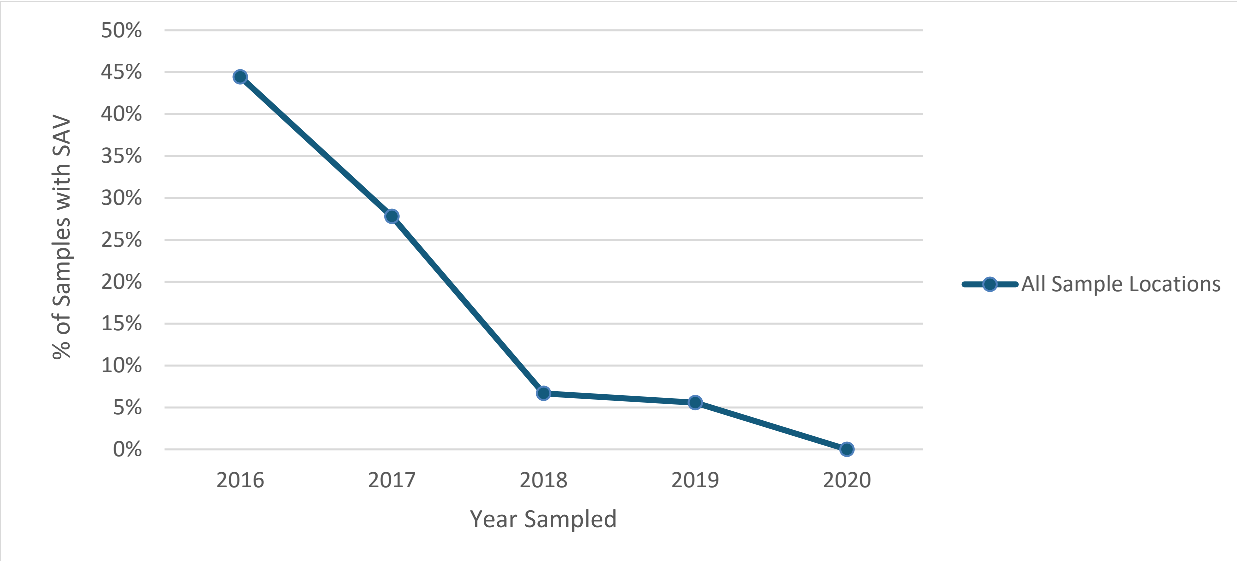

Figure 5: SAV sampling data from VDWR within the project vicinity.

Why is the Project Needed Locally/Regionally?

Pilot Project

The City's design concept for the marsh restoration project leverages "marsh terracing," an innovative coastal engineering technique widely used in Texas and Louisiana to convert shallow subtidal bottom to marsh. This technique has not yet been implemented along the U.S. East Coast and has not yet been implemented in the Mid-Atlantic region. Through the export of proven expertise from successful marsh terraces, this project would lay the foundation for future projects in the region, Virginia, and other states along the East Coast. The project would document detailed cost estimates, demonstrate effective construction practices for large-scale marsh creation projects, identify best sources for local/regional materials, and establish partnerships with permitting officials at various levels of government. The City has outlined a preliminary sequencing plan for marsh island restoration projects in Back Bay to strategically close hydraulic pathways and address priority restoration areas as shown in Figure 6. Some of these projects would require coordination with the State of North Carolina to realize its broader resilience efforts.

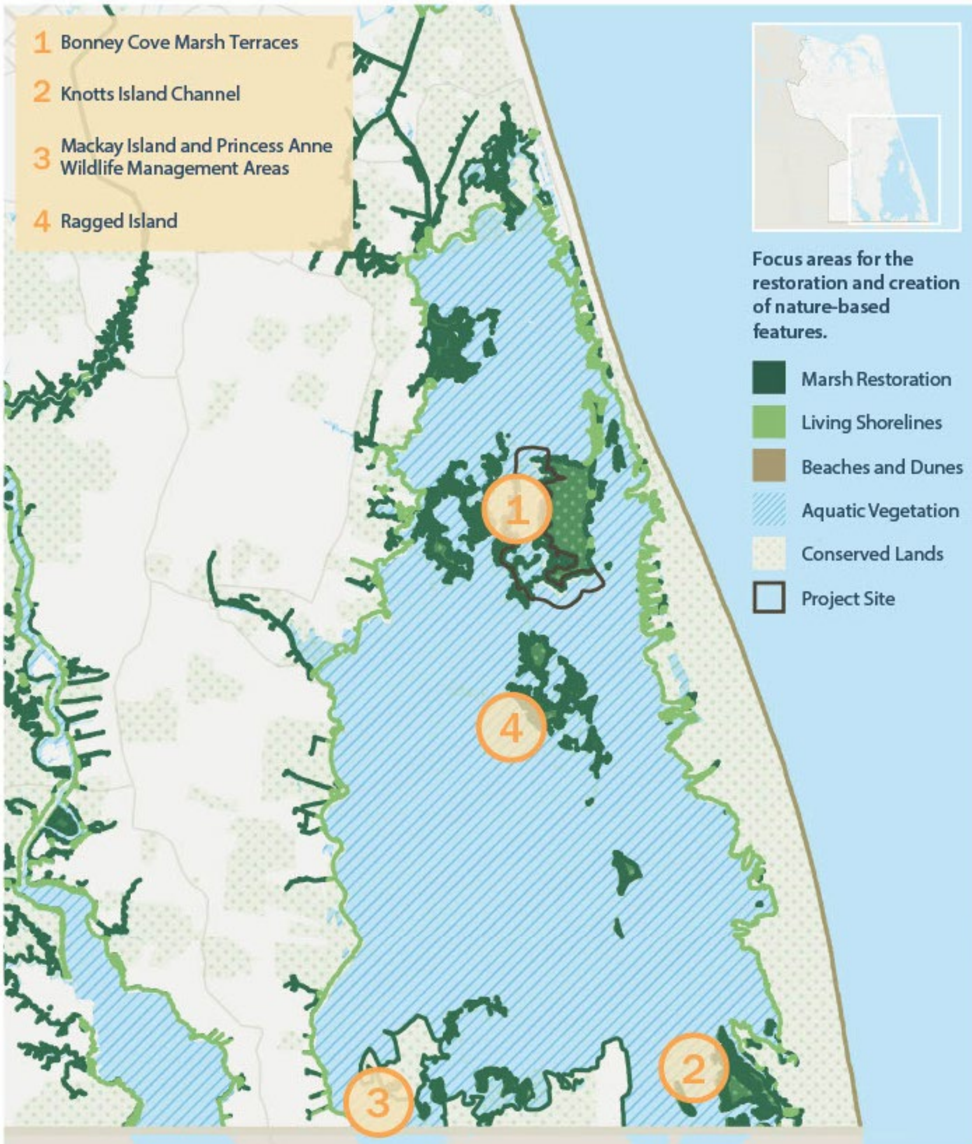

Figure 6: Preliminary Sequencing Restoration Plan.

Virginia Coastal Resilience Master Plan Exemplary Project

The CRMP impact assessment shows a high vulnerability of nature-based features to coastal flood hazards that is consistent with the City's analysis. In the Hampton Roads region, the CRMP impact assessment estimates a decrease from 40,600 acres to 2,940 acres of tidal wetlands by 2080, representing a 93% decline in tidal wetlands.[4] Back Bay was identified as a hotspot for tidal wetland loss, emphasizing the critical location of the City's marsh restoration effort. Specifically, the Virginia CRMP impact assessment shows that portions of tidal wetlands within the project area have "High" and "Very High" impact levels, which indicates areas of tidal marsh

[4] Office of Governor Ralph S. Northam Commonwealth of Virginia and Virginia Department of Conservation and Recreation (2021). Virginia Coastal Resilience Master Plan Phase 1 (PDF).

that are anticipated to be lost through inundation causing conversion to open water (Figure 7).

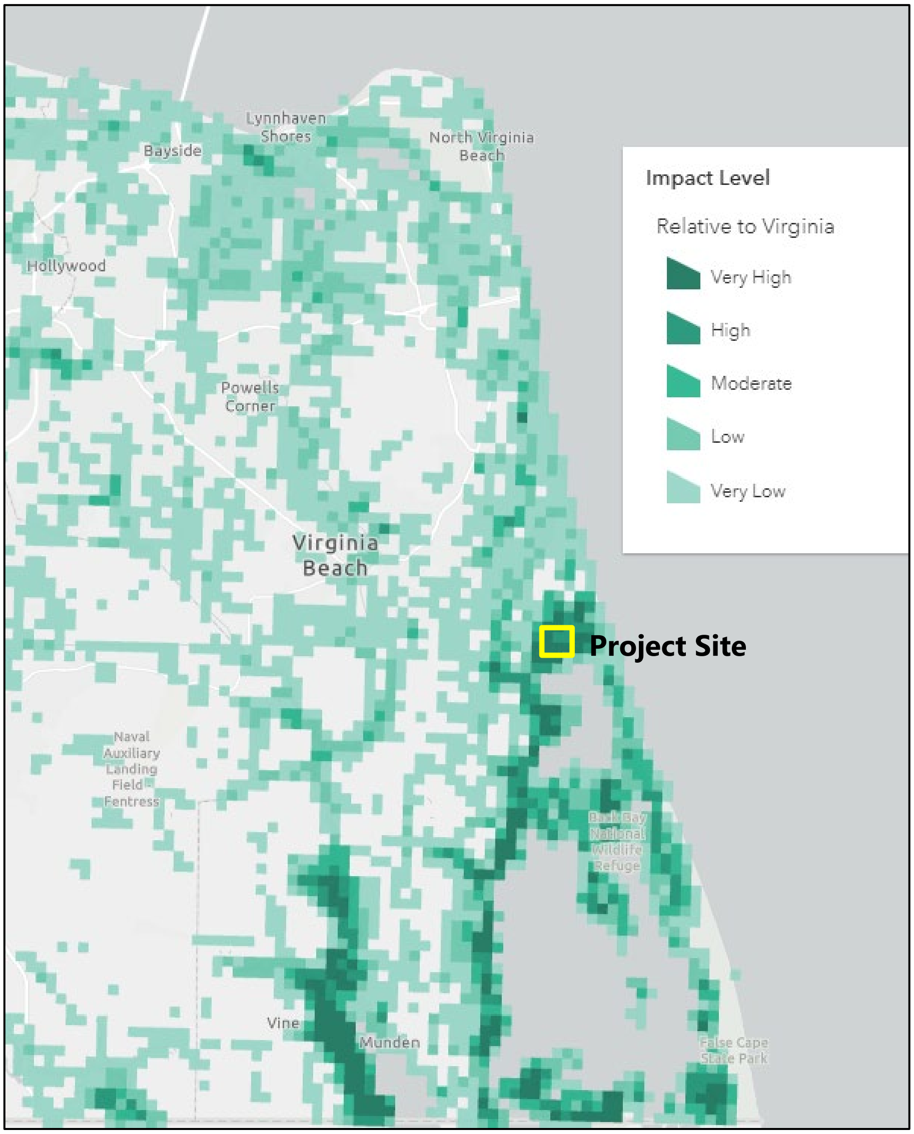

Figure 7: Virginia CRMP Impact Assessment for Tidal Wetlands.

Currituck Sound Coalition High Priority Area

In coordination with Audubon North Carolina, the Currituck Sounds Coalition designated the project site as a High Priority Area for restoring and enhancing vulnerable and degraded marshes with "high flood risk reduction benefits and habitat value" as shown in Figure 8[5].

[5] Audubon North Carolina. (2021). Currituck Sound Coalition Marsh Conservation Plan. (PDF)

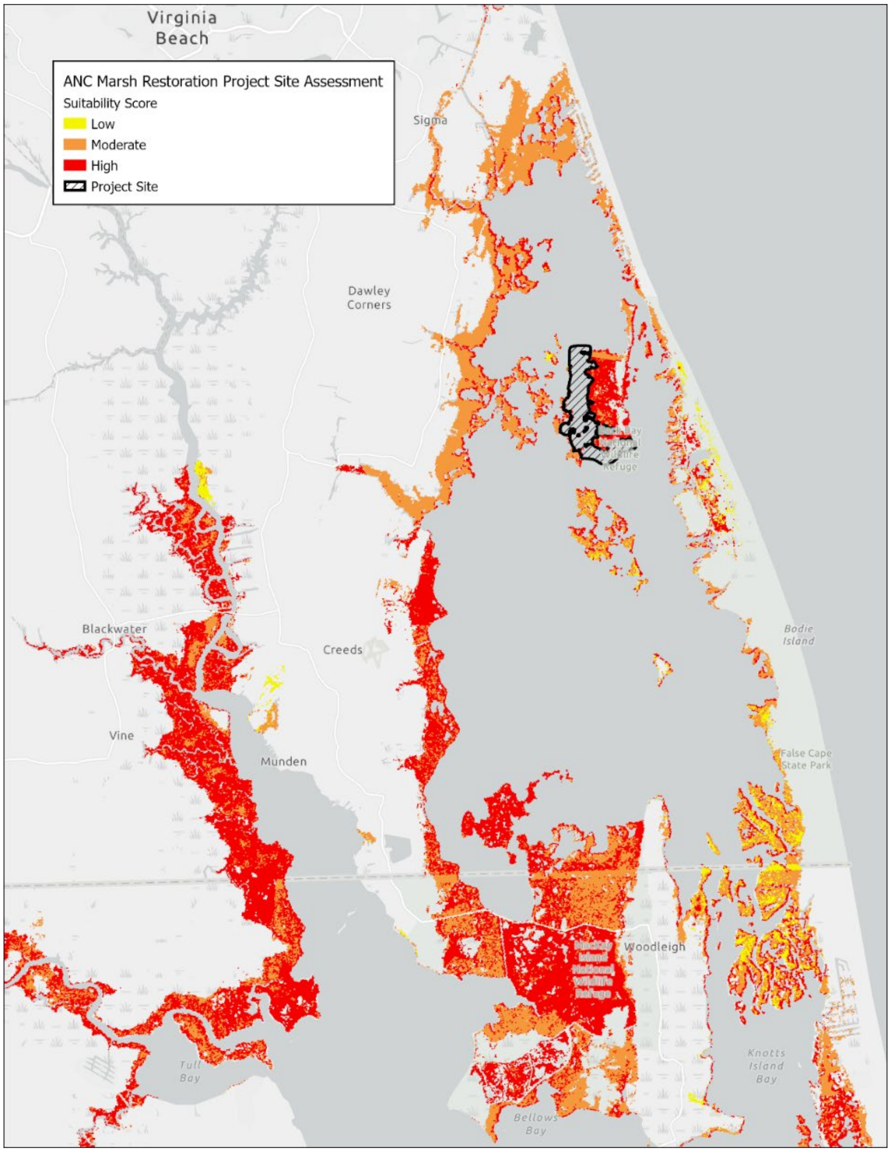

Figure 8: Audubon North Carolina Marsh Restoration Project Site Assessment

Ecological Core for Flood Resilience

The Virginia Department of Conservation and Recreation Natural Heritage Data Explorer provides data from ConserveVirginia v3.0 and other data to support conservation planning. The following map in Figure 9 displays Ecological Cores and the Floodplains and Flooding Resilience Category layer (blue polygon) from ConserveVirginia. The project area contains "High" (C3) and "General" (C5) Ecological Cores and is within the boundaries of the Floodplain and Flooding Resilience area.

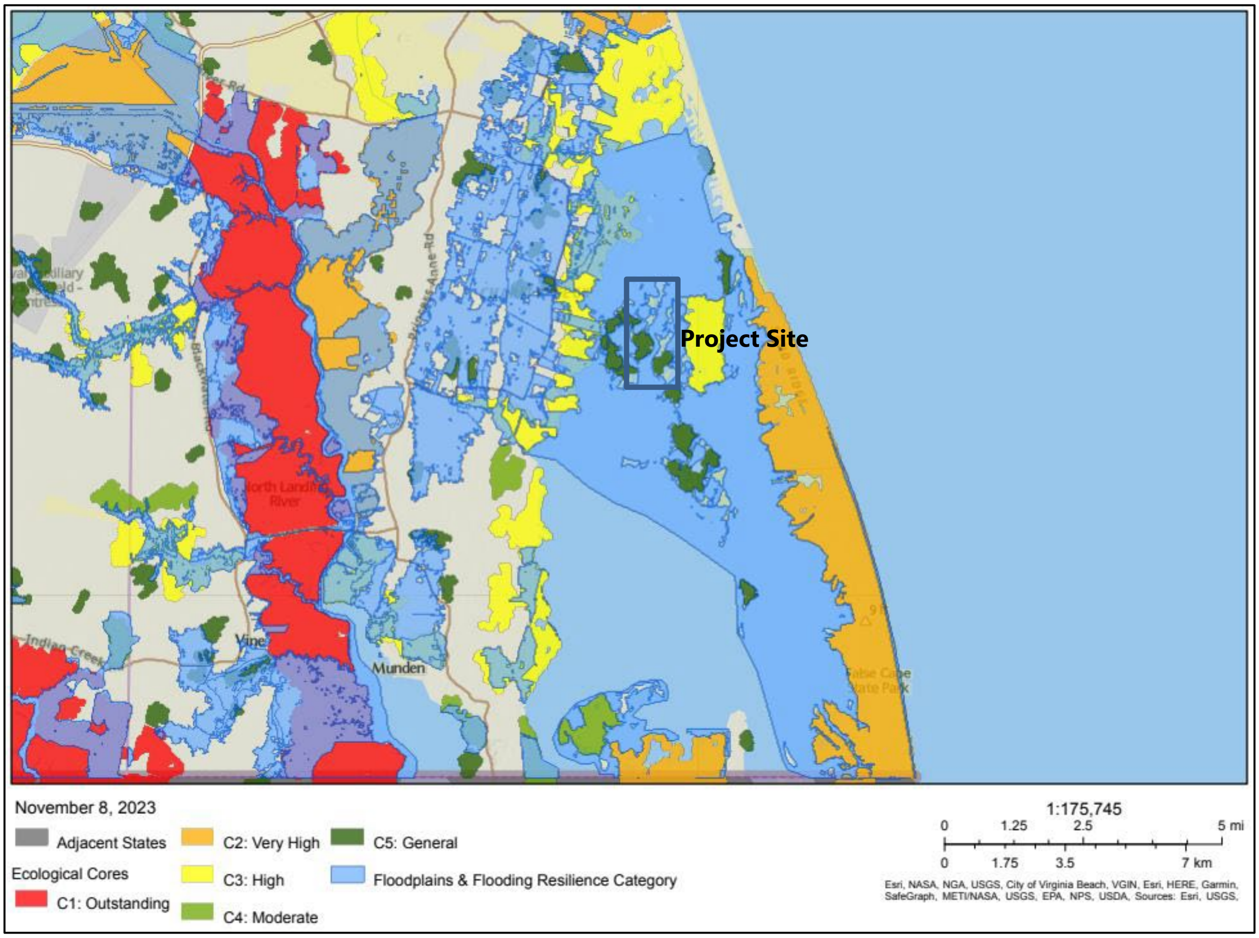

Figure 9: Virginia Natural Heritage Data Explorer Ecological Cores and ConserveVirginia Data.

The safety threats, or environmental concerns related to flood risk.

The City's risk assessment forecasts that approximately 70% of the remaining marsh (730 acres) surrounding the project site will convert to open water with three feet of sea level rise if unmitigated. Fragmentation of this adjacent marsh would result in about eight miles of fetch acting on the southern extent of the site in the predominant wind direction. Without these central marsh islands, the northern shorelines of Back Bay would be exposed to 12 miles of fetch from the Knotts Island Channel at the Virginia-North Carolina boundary. This condition would leave the fringing marshes highly vulnerable to accelerated erosion.

How does the project decrease the risk to public safety through flood risk reduction?

Construction of the forty-one individual marsh terraces, totaling 27,000 linear feet (a 51-acre footprint), across Bonney Cove offers a nature-based technique that will stabilize and protect the marsh island in the center of the bay and reduce erosion of the fringing marsh systems to the north. Numerical modeling was leveraged to quantify specific erosion reduction benefits of the project for wave heights and flow velocities:

- **Wave Height Reduction**: The marsh terraces are expected to reduce wave heights within the project site by approximately 45%. This reduction is consistent with other field studies, which have found that average wave heights within two terraced sites were 37% to 48% lower than those observed at the reference site (Brasher 2015). Wave energy reduction is anticipated to increase the potential for sediment deposition on the terraces' leeward side, leading to the growth of new emergent marsh and reducing erosion of adjacent marsh. Approximately five miles of marsh island shoreline around Bonney Cove will benefit directly from the erosion reduction associated with the computed wave attenuation.
- **Flow Velocity Reduction**: The marsh terraces reduce flow velocity within the project area. This reduction in velocity will reduce bottom shear stress, decrease turbidity, increase light penetration into the water column and promote the growth of SAV. Reducing bottom shear stress will make conditions more suitable for SAV growth between the terraces. Field studies of marsh terraces in Texas and Louisiana document an approximately 45% to 56% reduction in turbidity and the emergence of SAV in the years following terrace construction (Brasher 2015).
- **Wind Shear Stress Reduction**: Although not included as a parameter within the numerical modeling effort, the bald cypress trees planted on the terraces within the middle of the site are expected to reduce wind speed within the project site. This will further reduce wind-generated waves within the project site on the terraces' leeward and windward sides. Research shows that trees that grow to at least 30 feet at maturity result in lower wind speeds of up to 60 to 150 ft on the windward side and up to 900 ft on the leeward side (USDA).

How does the project protect or conserve natural resources?

The proposed project aims to restore marsh island communities in Bonney Cove that have historically provided environmental and flood reduction benefits to the communities in northern Back Bay. As illustrated in Figure 10, when an intact marsh begins to fragment and convert to open water, fetch increases and enables greater wave energy, increasing marsh erosion rates, and ultimately accelerating conversion to an ever-expanding body of open water. Strategic marsh restoration and creation in Bonney Cove would help mitigate the cycle of marsh island erosion and loss of SAV currently occurring in Back Bay, thereby protecting the remaining marsh islands and reducing fetch and wave energy.

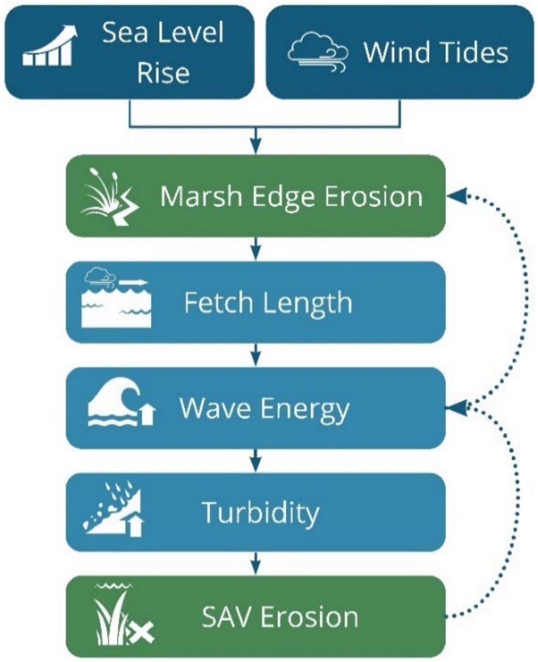

Figure 10: Cycle of marsh erosion, SAV loss, and increased wind-driven flooding.

The primary objective of this project is to create a sustainable coastal marsh island system in Back Bay through reclamation of historically lost marsh habitat and protection of existing marsh complexes from erosion. This restoration effort aims to provide multiple benefits of reduced flood impacts, enhanced fish and wildlife habitat, and improved water quality. The project is designed to achieve the following outcomes:

- Decrease turbidity to create conditions that promote the growth of emergent vegetation and aquatic grasses;
- Maximize habitat value for ecologically important fish and wildlife populations (e.g. Largemouth Bass, Bluegill, Yellow Perch, Striped Bass, Blueback Herring, Alewife, American Eel, etc.); and,
- Reduce fetch, wave heights, and flow velocities to mitigate erosion of fringing marsh systems that provide a buffer for the low-lying neighborhoods and roads that experience frequent flooding in northern Back Bay.

The City selected marsh terracing as the preferred restoration approach because the design is compatible with Back Bay's shallow bottom and the historical loss of habitat. Marsh terraces are narrow, man-made islands placed in shallow open water to restore previous marsh environments. Typically arranged in a chevron pattern, the overall field of marsh terraces dissipates waves, decreases turbidity, and slows down the moving water. The resulting calmer water conditions allow more sunlight to penetrate to the shallow bottom, promoting the establishment and growth of marsh seagrass and ultimately improving habitat quality for fish and wildlife. Further, as opposed to one continuous marsh platform, marsh terraces maximize habitat for a variety of fish and wildlife species, as illustrated in Figure 11.

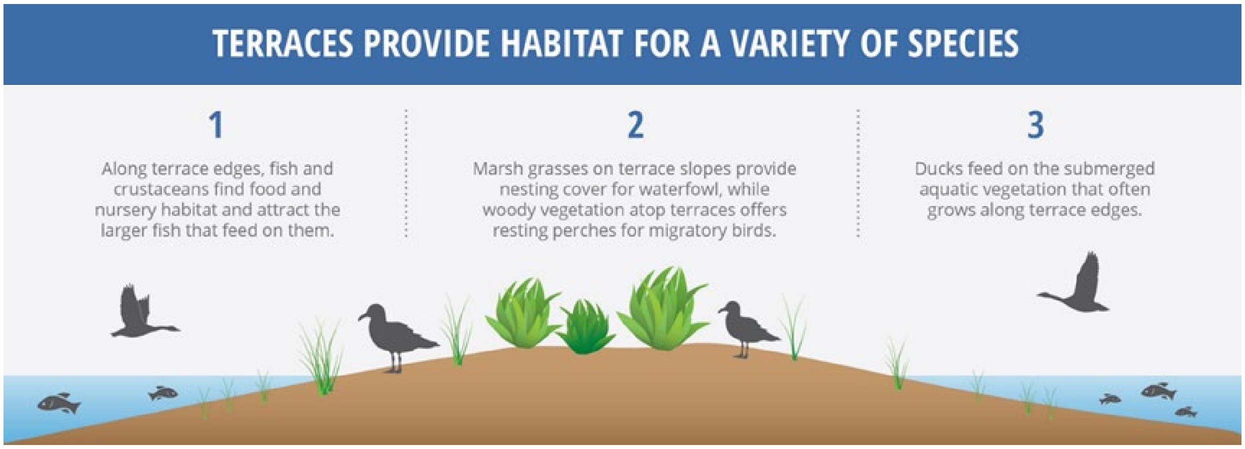

Figure 11: Conceptual diagram of marsh terraces.

Groups to be targeted who might directly benefit from this flood risk reduction effort.

The northern Back Bay communities adjacent to the project area and interested stakeholders have been engaged in the planning effort through public meetings. These meetings provided an opportunity for the community to provide feedback on the 30% and 95% designs and artistic renderings. We anticipate the project to benefit properties and infrastructure assets in northern Back Bay, including the following:

- **Reduce erosion rates along approximately 8 miles of shoreline by reducing wind and wave energy north of the project site.** Most of the properties along this reach of shoreline are not protected by traditional erosion risk reduction measures, such as bulkheads. Maintaining a naturalized shoreline while protecting fringe marsh is a priority of the City and its project partners. This approach will ensure that these marsh systems can migrate landward in response to sea level rise.
- **Reduce flood risk to commercial and residential properties north of the project site.** There are approximately 70 commercial and 2,350 residential structures within the two census block groups surrounding the project site. Around 635 of those structures are vulnerable to flooding during a 50-year event today. With three feet of sea level rise, approximately 2,060 structures are expected to be vulnerable to flooding during a 50-year return period event, representing about 85% of the residential structures within the project vicinity. These numbers underscore the importance of implementing the proposed project alongside complimentary flood risk reduction projects.
- **Reduce the magnitude and duration of flooding along critical access roads and critical facilities.** In addition to Muddy Creek Road, two other critical access roads are anticipated to benefit from delayed flooding. This includes Shipps Cabin Road (intersecting with Muddy Creek Road) and Sandpiper Road, which runs parallel to the eastern bank of Back Bay and provides ingress/egress out of the Sandbridge community (Figure 12).

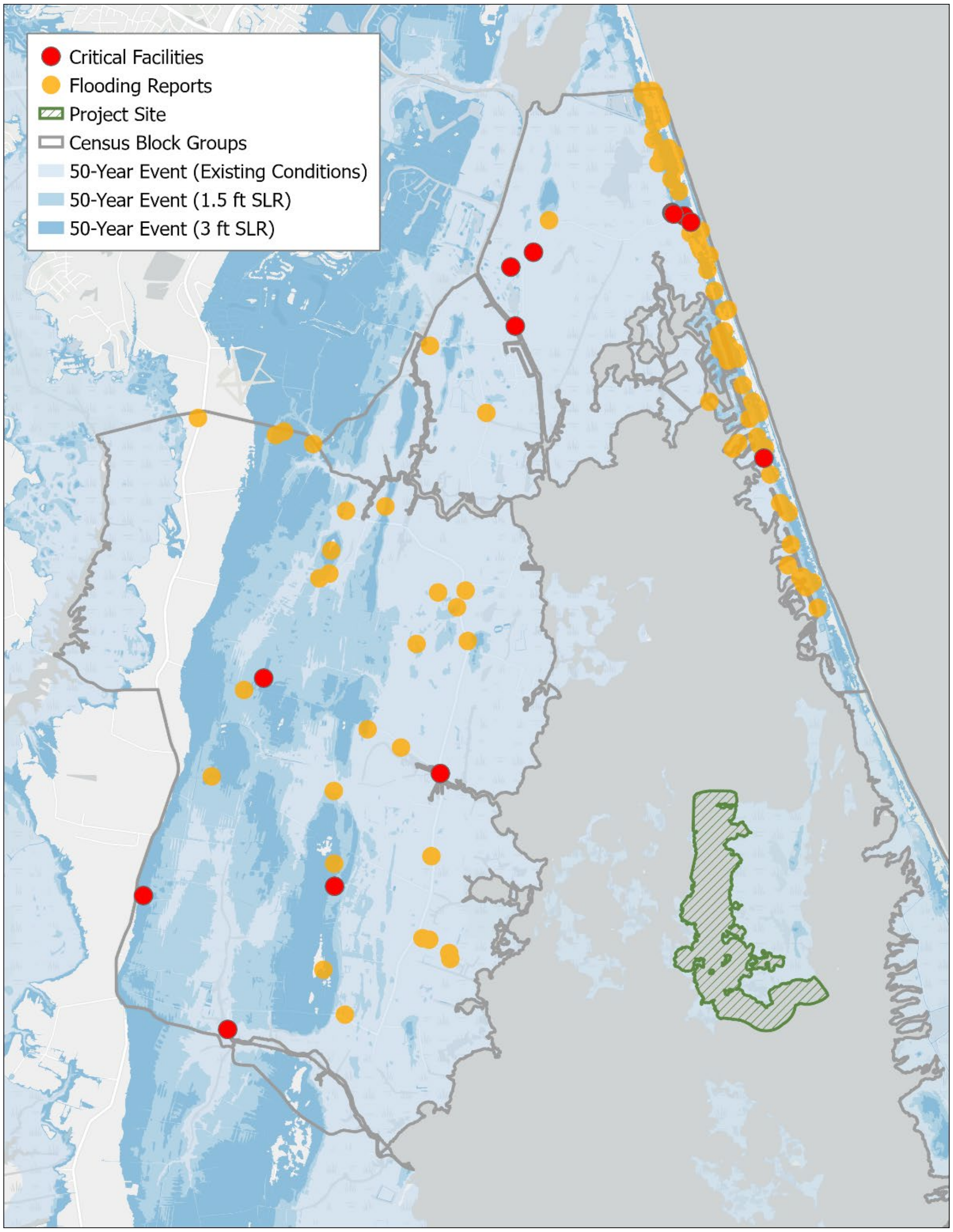

Figure 12: Critical facilities and flooding reports within project vicinity.

What would happen (or not happen) if the applicant does not receive funding?

If this project does not advance from design to construction, erosion of the adjacent marsh would continue to occur, resulting in fragmented habitat lacking the capacity to reduce wave action and slow water velocities. It is anticipated that wind-driven flooding events will continue to increase in frequency, resulting in increasing flooding of the low-lying properties and roadways surrounding northern Back Bay.

Alternatives Analysis

The proposed project offers the best approach for addressing the needs and problem statement outlined in this Scope of Work narrative. The project would result in the creation of 46.5 acres of marsh terraces, which would produce a net gain of approximately 16 acres of low/high marsh habitat by the end of the project construction compared to the No Action Alternative. The integrated system of marsh terrace ridges and perimeter rock armoring would stabilize the two critically eroding marsh islands (Long Island to the east, and a series of smaller unnamed islands to the west) from continued degradation. The tall terrace design improves the functionality and resiliency of the marsh system while also providing diversified habitat for fish and wildlife in the form of increased marsh edge as sea level rises. Numerical modeling of the preferred alternative demonstrated that the project would decrease wave heights and decrease the overall flow velocity of water moving through the project site, reducing water exchange in Back Bay during flooding events, encouraging sediment deposition, mitigating wave effects and consequent erosion, and result in localized water quality benefits. The proposed terraces would not only create a platform for vegetation growth within the marsh, but also reduce wave fetch in these large open water areas. The reduction in wave energy would lead to improved water clarity to promote the growth of SAV in the area between the terraces (approximately 310 acres).

Dredging in between the terraces to obtain sediment for the terrace cap would ensure no invasive vegetation is introduced into Back Bay, which is a high priority of the USFWS and VRMC. The dredging areas would also create valuable fish habitat to attract signature Back Bay fish and wildlife populations such as Largemouth Bass. The proposed dredging areas in between the terraces was evaluated and not anticipated to increase erosion of the adjacent marsh system. Furthermore, dredging in-situ material for building terraces is a widely accepted approach in Gulf Coast region marsh creation/terracing projects, as determined through conversations with project owners in Louisiana. Some terrace cap material will also be obtained from the Nimmo VII-A project. Through export of proven expertise from successful marsh terracing projects, this project would lay the foundation for future similar projects in the region through the development of detailed cost estimates, identification of best sources for local/regional materials, and establishment of partnerships with permitting officials at various levels of government.

Goals and Objectives

The overarching goal of this project is to construct the City's first nature-based adaptation project in the Southern Rivers Watershed and one of the CRMP's exemplary nature-based projects. This project aims to stabilize two critically eroding marsh islands from further degradation, decrease turbidity to promote the growth of aquatic vegetation, and provide flood risk reduction benefits through increased friction and wave attenuation. Table 1 below provides a high-level overview of the specific objectives established to solve the problem/need identified – specifically habitat degradation and wind tide flooding along with measure(s) of success. A more detailed description of these objectives is provided in the Supporting Documentation section.

Table 1: Overview of Project Objectives.

Objectives	Description	Measure(s) of Success	Timing of Measures
Objective 1	Create a Construction Access and Staging Area	a. Secured permits for construction. b. Contractor Selection. c. Construction of Staging Area.	a. December 2023 b. April-May 2023 c. June 2023 -February 2024
Objective 2	Restore Marsh and Aquatic Vegetation	a. Secured permits for construction. b. Restoration of 46.5 acres of habitat.	a. December 2023 b. March - October 2025 and March – October 2026
Objective 3	Engage Stakeholders and Disseminate Effective Practices	Number of people meaningfully engaged in the process of the project within the agreement period.	Continuous through period of performance.

Work Plan

Current Status and Ongoing Activities

The marsh terrace project design is progressing and will be ready for construction in the CFPF grant timeline. Table 2 summarizes ongoing tasks related to the project and an anticipated schedule for completion.

Table 2: Completed, ongoing, and anticipated activities leading up to construction.

Activity	Description	Schedule
Stakeholder Scoping Workshop	In November 2020, the City hosted a virtual workshop to receive initial input from project stakeholders.	Completed (Fall 2020)
Site Characterization and Vegetation Survey	In fall 2020, a site characterization and vegetation survey within Bonney Cove was conducted under a USFWS Special Use Permit (SUP). The purpose of the survey was to document existing emergent marsh and submerged aquatic vegetation (SAV) species composition and percent coverage within the proposed project area. MAP Environmental, Inc. conducted a literature review of marsh terracing projects in the Gulf Coast region to identify effective practices for project planning and design.	Completed (Fall 2020)
Bathymetric Survey	An updated bathymetric survey of Bonney Cove, also covered under a USFWS SUP, was completed in March 2021. This data serves as an input to identify appropriate design elevations to determine quantities of materials necessary to build the proposed marsh terraces and for numerical modeling of project alternatives.	Completed (Spring 2021)
Geotechnical Investigation	A geotechnical investigation of Bonney Cove was conducted in the spring of 2021. The permitted survey, (Virginia Marine Resources Commission (VMRC) Permit No. 2020-2286, U.S. Army Corps of Engineers (USACE) Permit No. 2020-02439, and USFWS SUP) included the collection of 10 soil borings in locations that avoided aquatic vegetation habitat. The soil samples were retrieved by drilling with a specialized airboat-mounted drill rig which was essential for drilling in shallow areas as it avoids disruption to bottom habitat. The soil samples were analyzed to determine the suitability and physical characteristics of the soils within the project area. Additional soil analysis was conducted to determine the suitability of Back Bay sediments for building components of the marsh terraces.	Completed (Spring 2021)

Activity	Description	Schedule
Water Quality and Hydrodynamic Survey	ODU conducted a water quality and hydrodynamic survey of Bonney Cove in the spring of 2021. The USFWS permitted survey collected water samples and deployment/retrieval of hydrodynamic sensors (pressure sensors, acoustic Doppler current profilers, and optical backscatter sensors) at three sampling points in Bonney Cove. Sensor equipment was deployed for two one-month periods (3/10/2021 – 4/12/2021 and 5/19/2021 – 6/8/2021). The water level, wave, and current data served as an input to the numerical model calibration. The water quality parameters (including pH, salinity, temperature, dissolved oxygen, chlorophyll, and turbidity) will serve as a reference to compare pre-and post-construction water quality conditions.	Completed (Summer 2021)
30% Design	Dewberry leveraged the field-collected data to establish design criteria for the project to ensure that it will be resilient in the face of changing future conditions during wind-tide events. Artistic design renderings were developed to enable stakeholders to visualize the implemented project.	Completed (Fall 2021)
Public Engagement – 30% Design	The City held a public information meeting on October 14, 2021, at Creeds Elementary School. The project team delivered a 10-minute presentation of the proposed project followed by an open-format discussion where participants reviewed the preliminary (30%) designs and artistic renderings and submitted comments regarding environmental and community impacts.	Completed (Fall 2021)
Numerical Modeling	Numerical modeling has been completed to evaluate the proposed project's impact on water levels, wave heights, and flow velocities within and surrounding the project area. Potential water quality impacts were also evaluated. The numerical modeling effort involved the development of an XBeach model, which is a nearshore model that accounts for wave-vegetation interactions based on field-derived drag coefficients.	Completed (Winter 2021)
Environmental Assessment and Scoping	In coordination with the USFWS and with technical assistance from Dewberry, the City evaluated the potential environmental impacts of the project. The draft environmental assessment document was distributed to key stakeholders with jurisdictional authority or a vested interest in the project for review and comment.	Completed (Summer 2023)

Activity	Description	Schedule
60% Design	After numerical modeling and stakeholder review of the 30% design, the engineering design plans were advanced from 30% to 60%.	Completed (Spring 2023)
95% Design and Public Engagement	The engineering design team prepared 95% engineering design plans to address comments on the 60% plan set. The City held a second public information meeting from 6:00 – 7:30 p.m. on July 13, 2023, at the Senior Resource Center in Virginia Beach where the project team delivered a 10-minute presentation of the proposed project followed by an open-format discussion where participants reviewed the 95% designs, updated artistic renderings, and submitted comments.	Completed (Fall 2023)
Construction Permit Applications Submitted	The City submitted the Joint Permit Applications for the proposed project, including the initial post-construction monitoring plan, to VMRC and the USACE in August 2023.	Completed (Summer 2023)
Modeling of Potential Adverse Impacts	In response to public concerns, the City performed additional numerical modeling of both northerly and southerly wind events and reviewed water level responses at locations in Back Bay for any potential adverse impacts. No adverse impacts were found for either type of event.	Completed (Fall 2023)
Publication of Frequently Asked Questions	The City will be publishing findings for the potential adverse impacts modeling, along with other responses to public concerns raised at the question in a Frequently Asked Questions webpage in November 2023.	In Progress (Fall 2023)
100% Design	The engineering design team prepared and submitted the 100% engineering design plans to the City for review. The plans will be finalized on receipt of any comments from the permitting process, anticipated to occur by end of 2023.	In Progress (Fall 2023)
Contractor Procurement	The engineering team will provide final plans, specifications, and construction estimates (PS&E). The City will prepare the bid Request for Proposal (RFP), provide Bid Packages, and review bids obtained, and select a construction contractor.	Planned (Winter 2023 - Spring 2024

What are the major activities and tasks?

The key activities and tasks to be competed under the agreement period are summarized in Table 3. Please refer to the Supporting Documentation section for a more detailed description of these activities and tasks.

Table 3: Overview of Activities and Tasks.

Activities	Description	Tasks
Activity 1	Construction Staging Area Preparation and Construction	1. Mobilize equipment 2. Stabilize road, establish construction staging area, abutments, install pre-engineered bridge, construct ramp to water and slurry basins. 3. Establish traffic flagging stations. 4. Install pipe and booster stations.
Activity 2	Marsh Terrace Construction	1. Construct 41 terraces (2-phased approach). 2. Demobilize equipment.
Activity 3	Stakeholder Engagement	1. Develop project marketing materials. 2. Attend and document engagement activities.

Who is responsible for completing the activities and tasks?

Responsibility for completing the project's activities and tasks lies with a collaborative effort led by the City's Department of Public Works. To ensure the successful execution of the project, the City has assembled a diverse team of consultants, advisors and subject matter experts. For a comprehensive understanding of the specific roles and responsibilities of each entity involved in carrying out the proposed scope of work, please refer to the *Supporting Documentation – Approach, Milestones, and Deliverables – Project Partner*s section of this report, which provides a detailed description of how each team member contributes to the project's overall success.

What is the timeframe for accomplishing activities and tasks?

An overview of the planned project timeline is shown in Figure 13. Grant activities will initiated in Summer 2024 with construction of the staging area and material acquisition. Please refer to the S*upporting Documentation – Approach, Milestones, and Deliverables –Milestone Schedule* section of this report for a detailed outline for each activity and associated deliverables.

Figure 13. Timeline overview for project implementation.

Identify the required partners to ensure success and where they are represented in the workplan.

A diverse team of consultants, advisors, and subject matter experts, led by the City's Department of Public Works, has been assembled to complete the project's activities and tasks. Please refer to the *Supporting Documentation – Approach, Milestones, and Deliverables – Project Partner*s section of this report for a detailed description of each team member's role, responsibilities, and contribution to the project's overall success.

Deliverables

An overview of the project deliverables is provided in Table 4. Please refer to the *Supporting Documentation – Approach, Milestones, and Deliverables* section of this report for more detail.

Table 4: Summary of Deliverables.

Activities	Deliverables
Activity 1: Construction Staging Area Preparation and Construction	1. Material acquisition. 2. Progression and completion of the construction staging area, with daily inspections to monitor progress. 3. Documented progress and completion through quarterly reports to DCR.
Activity 2: Marsh Terrace Construction	1. Progression and completion of the 2025 and 2026 construction phases, including plantings, with daily inspections to monitor progress. 2. Demobilization and removal of equipment from construction staging area. 3. Documented progress and completion through quarterly reports to DCR.
Activity 3: Stakeholder Engagement and Lessons-Learned Dissemination	1. Project marketing materials. 2. Records documenting number of stakeholders engaged during the outreach activities.

Maintenance plan tied to the identified viability of the project. Plan for sustaining the project after the agreement period (if applicable)

The City has developed a draft Annual Monitoring Plan and Post-Construction Monitoring Report that was submitted along with the Joint Permit Application for the project. See Attachment 5 for a copy of the draft report.

Project maintenance will be addressed by the City of Virginia Beach's Public Works Stormwater Operations Group. Any maintenance issues identified by the monitoring effort or other observers will be flagged to the Operations Group to address. The City intends to maintain the construction staging area to support future project maintenance needs. After completion of the monitoring program, the City will perform inspections every 2-5 years and make any repairs needed for the life of the project.

Evaluation

Indicators of Success

Indicators of success for this project have been identified during the development of the monitoring plan. Three (3) indicators of success were defined in relation to the primary objectives of the project (as defined elsewhere in this document), and include:

- The establishment of a sustainable coastal marsh island system.
- Stability of the marsh terrace structures.
- Establishment of a sustainable SAV community.

What data will be collected and how will it be used to measure success?

Data collection for the project has been detailed in the proposed monitoring plan and includes two sets of data: one set associated with as-built surveys to establish baseline reference conditions for subsequent monitoring efforts, and monitoring data to assess the success of the project in meeting the indicators defined above. Baseline and monitoring data will be compiled in an annual report and distributed to permitting agencies, and stakeholders as appropriate, to fulfill monitoring requirements and ensure success criteria are being met and maintenance needs are addressed.

Baseline data, which is proposed to be collected after the completion of each of two phases of terrace installation, will include the following data:

- Coordinates and diagrams of established transects, as well as site photographs from photo stations established along each sampling transect, as defined in the Methods section of the monitoring plan.
- Final location of all planted vegetation (upland plantings, high marsh plantings and low marsh plantings).
- Final location and extent of SAV plantings.
- Final grade topographic surveys (plan, profile, and cross sections).
- Discussion of the project design versus as-built conditions.

Monitoring data will be collected at the end of the full growing season during each monitoring year and include the following:

- Site photographs from photo stations defined in the Methods section of the monitoring report.
- Estimated percent cover and change in coverage from the as-built conditions to sampling year conditions for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- Estimated percent cover and change in coverage from planted conditions to sampling year conditions for SAV planting quadrants

- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

This monitoring data will be used to define success by tracking the establishment of the proposed vegetative communities on and between the proposed marsh terraces as well as the structural integrity of the marsh terrace structures themselves. Vegetation cover thresholds for each year will be defined to ensure planted communities are appropriately established on each marsh terrace. Acceptable measures of deviation will be defined for structural elements to ensure design requirements are met. Maintenance and mitigation measures defined in the monitoring plan will be implemented as required if success criteria are not met during any particular monitoring year.

How was cost effectiveness evaluated and measured against the expected outcomes?

Through a BCA approach using FEMA methods and ecosystem service valuations, a BCR of 1.17 was calculated for the project. This BCR is greater than 1, indicating the project can be considered cost-effective. The project also provides an additional $9.2M in value over the current estimated project costs.

A description of the BCA analysis and methods is provided in the following Benefit Cost Analysis Section.

What products, services, meetings, outreach efforts etc. will be conducted and how will success be measured?

The City is firmly dedicated to fostering meaningful engagement with project partners and external stakeholders throughout the project, with the goal of raising awareness about the project's approach and its benefits and enhancing the likelihood of its successful adoption in other areas within the region and the state.

Activity 4, titled "Stakeholder Engagement and Lessons-Learned Dissemination," provides a comprehensive outline of the City's outreach strategy, encompassing proposed deliverables and outreach endeavors. This strategic plan entails the development of project marketing materials, along with the facilitation of presentations and meetings with local and regional stakeholders, as well as participation in state and national-level conferences.

To gauge the effectiveness of our efforts, the City will employ metrics to track and document the number of individuals engaged throughout the project. This information will be regularly communicated to DCR to serve as a key performance indicator for project success.

For a more detailed breakdown of the tasks and deliverables associated with Activity 4, please refer to the Supporting Documentation section of this application.

Project Progress Monitoring Plan

The City's Project Progress Monitoring Plan is designed to guarantee the seamless and effective execution of the project. We have established a robust internal system to oversee the entire project lifecycle, ensuring that all key stakeholders are aligned with the project's objectives, activities, deliverables, and schedule.

The process commences with a kickoff meeting involving all project partners, where we collectively set the stage for the project. During this meeting, we thoroughly review the project's objectives and scope, ensuring that everyone is on the same page. This initial step is instrumental in fostering a shared understanding of the project's vision and goals among all involved parties.

In addition to the kickoff meeting, we place a strong emphasis on quality assurance and control. We meticulously assess each contractor's quality management system to ensure that well-defined procedures are in place to maintain the highest standards of quality throughout the project. This dedication to quality is paramount to delivering a successful project that meets the City's standards and the expectations of our stakeholders.

The City is committed to ongoing and transparent communication with our design and construction contractors, as well as our advisory stakeholders. Regular meetings will be held to monitor progress, address any potential challenges, and ensure the project adheres to the proposed milestone schedule and deliverables as outlined in this grant application. This proactive approach to project monitoring allows us to stay on track, identify and address issues promptly, and uphold our commitment to the successful completion of the project.

2023 Virginia Community Flood Preparedness Fund

Marsh Restoration in Back Bay, Virginia Beach

CITY OF VIRGINIA BEACH

Table of Contents

Appendix A – Application Form

Applicants must have prior approval from the Department to submit <u>applications, forms, and supporting documents by mail in lieu of the WebGrants portal.</u>

Appendix A: Application Form for Grant and Loan Requests for All Categories

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Virginia Department of Conservation and Recreation
Virginia Community Flood Preparedness Fund Grant Program

Name of Local Government:

Category Being Applied for (check one):

☐ **Capacity Building/Planning**

☑ **Project**

☐ **Study**

NFIP/DCR Community Identification Number (CID) 515531

Name of Authorized Official and Title: Toni Utterback, Stormwater Engineering Center Administrator

Signature of Authorized Official: Katie E Shannon for Toni Utterback

Mailing Address (1): 2875 Sabre Street, Suite 250

Mailing Address (2): ____________________

City: Virginia Beach **State:** Virginia **Zip:** 23452

Telephone Number: (757) 385-8746 **Cell Phone Number:** (____) ____________

Email Address: TPUtterback@vbgov.com

Contact and Title (If different from authorized official): C.J. Bodnar, Technical Services Program Manager

Type text here

Mailing Address (1): 2875 Sabre Street, Suite 250

Mailing Address (2): ______________________________

City: Virginia Beach **State:** Virginia **Zip:** 23452

Telephone Number: (757) 385-8430 **Cell Phone Number:** (____) ________________

Email Address: CBodnar@vbgov.com

Is the proposal in this application intended to benefit a low-income geographic area as defined in the Part 1 Definitions? Yes ____ No ✓

<u>Categories (select applicable activities that will be included in the project and used for scoring criterion):</u>

Capacity Building and Planning Grants

☐ Floodplain Staff Capacity.

☐ Resilience Plan Development

- ☐ Revisions to existing resilience plans and modifications to existing comprehensive and hazard mitigation plans.
- ☐ Resource assessments, planning, strategies, and development.
  - Policy management and/or development.
  - Stakeholder engagement and strategies.

☐ Other: ______________________________

Study Grants (Check All that Apply)

☐ Studies to aid in updating floodplain ordinances to maintain compliance with the NFIP, or to incorporate higher standards that may reduce the risk of flood damage. This must include establishing processes for implementing the ordinance, including but not limited to, permitting, record retention, violations, and variances. This may include revising a floodplain ordinance when the community is getting new Flood Insurance Rate Maps (FIRMs), updating a floodplain ordinance to include floodplain setbacks, freeboard, or other

higher standards, RiskMAP public noticing requirements, or correcting issues identified in a Corrective Action Plan.

- ☐ Revising other land use ordinances to incorporate flood protection and mitigation goals, standards, and practices.
- ☐ Conducting hydrologic and hydraulic (H&H) studies of floodplains. *Changes to the base flood, as demonstrated by the H&H must be submitted to FEMA within 6 months of the data becoming available.*
- ☐ Studies and Data Collection of Statewide and Regional Significance.
- ☐ Revisions to existing resilience plans and modifications to existing comprehensive and hazard.
- ☐ Other relevant flood prevention and protection project or study.

Project Grants and Loans (Check All that Apply – Hybrid Solutions will include items from both the "Nature-Based" and "Other" categories)

Nature-based solutions

- ☐ Acquisition of property (or interests therein) and/or structures for purposes of allowing floodwater inundation, strategic retreat of existing land uses from areas vulnerable to flooding; the conservation or enhancement of natural flood resilience resources; or acquisition of structures, provided the acquired property will be protected in perpetuity from further development, <u>and where the flood mitigation benefits will be achieved as a part of the same project as the property acquisition.</u>
- ☑ Wetland restoration.
- ☐ Floodplain restoration.
- ☐ Construction of swales and settling ponds.
- ☑ Living shorelines and vegetated buffers.
- ☐ Permanent conservation of undeveloped lands identified as having flood resilience value by *ConserveVirginia* Floodplain and Flooding Resilience layer or a similar data driven analytic tool, or the acquisition of developed land for future conservation.
- ☐ Dam removal.
- ☐ Stream bank restoration or stabilization.
- ☐ Restoration of floodplains to natural and beneficial function.

Other Projects

- ☐ Structural floodwalls, levees, berms, flood gates, structural conveyances.
- ☐ Storm water system upgrades.
- ☐ Medium and large-scale Low Impact Development (LID) in urban areas.

☐ Developing flood warning and response systems, which may include gauge installation, to notify residents of potential emergency flooding events.

☐ Dam restoration.

☐ Beneficial reuse of dredge materials for flood mitigation purposes

☐ Removal or relocation of structures from flood-prone areas where the land will not be returned to open space.

☐ Acquisition of property (or interests therein) and/or structures for purposes of allowing floodwater inundation, strategic retreat of existing land uses from areas vulnerable to flooding; the conservation or enhancement of natural flood resilience resources; or acquisition of structures, provided the acquired property will be protected in perpetuity from further development, <u>and where the flood mitigation benefits will **not be** achieved as a part of the same project as the property acquisition.</u>

☐ Other project identified in a DCR-approved Resilience Plan.

Location of Project or Activity (Include Maps): Bonney Cove in Back Bay, Virginia Beach

NFIP Community Identification Number (CID#) : 515531

Is Project Located in an NFIP Participating Community? ☑ Yes ☐ No

Is Project Located in a Special Flood Hazard Area? ☑ Yes ☐ No

Flood Zone(s) (If Applicable): Zone VE (EL 5 Feet), Zone AE (EL 4 Feet), Zone Open Water

Flood Insurance Rate Map Number(s) (If Applicable): 5155310215G and 5155310220G

Total Cost of Project: $53,378,490

Total Amount Requested $5,000,000

Amount Requested as Grant $5,000,000

Amount Requested as Project Loan (not including short-term loans for up-front costs) ____________________

Amount Requested as Short-Term loan for Up-Front Costs (not to exceed 20% of amount requested as Grant) ___________________________

For projects, planning, capacity building, and studies in low-income geographic areas: Are you requesting that match be waived? □ Yes □ No

<u>Additional Information for Loan Requests</u>
Requested Loan Security: _______________________________

(General Obligation, Lease, Revenue, Special Fund Revenue, and/or Moral obligation from other government entity)

Desired loan term: ___________________________________

Since the date of your latest financial statements, did the applicant issue any new debt? ______
(If yes, provide details)

Is there any pending or potential litigation by or against the applicant? _______________

Attach five years of current audited financial statements (FY18-22) or refer to website if posted
(Not necessary for existing VRA borrowers)

Attach FY2024 adopted budget or refer to website

Attach current Capital Improvement Plan

Attach adopted Financial Policies

Attach a list of the ten largest employers in the Applicant's jurisdiction.

Attach a list of the ten largest taxpayers in the Applicant's jurisdiction

Appendix B: Budget Form

Appendix B: Budget Narrative Template

Applicant Name: Community Flood Preparedness Fund & Resilient Virginia Revolving Loan Fund Detailed Budget Narrative Period of Performance: June 2024 through June 2027 Submission Date: November 12, 2023									
								Grand Total State Funding Request	$ 5,000,000
								Grand Total Local Share of Project	$ 38,356,966
			National Fish and Wildlife Foundation Grants					Federal Funding (if applicable)	$ 10,021,524
								Project Grand Total	$ 53,378,490
								Locality Cost Match	% 71.85
Breakout By Cost Type	Personnel	Fringe	Travel	Equipment	Supplies	Contracts	Indirect Costs	Other Costs	Total
Federal Share (if applicable)								10,021,524	10,021,524
Local Share								37,330,166	37,330,166
State Share								5,000,000	5,000,000
Pre-Award/Startup								276,800	276,800
Maintenance								750,000	750,000
Total	$	$	$	$	$	$	$	$53,378,490	$ 53,378,490

1. Federal Share represents National Fish and Wildlife Foundation (NFWF) Grants. NFWF is not a federal agency.
2. Local Share represents the total project cost less design and implementation (monitoring and initial maintenance) costs.
3. State Share represents the CFPF grant request.
4. Pre-Award costs represent project design costs.
5. Maintenance costs represent implementation (monitoring and initial maintenance costs).

Scope of Work Narrative

Introduction

The City of Virginia Beach ("City") is pleased to submit the Marsh Restoration in Back Bay project for consideration under the Flood Prevention and Protection Projects category in the 2023 Virginia Community Flood Preparedness Fund. The City has made significant investments in the study of historical flooding data, current and future hydrology, and the projected increase in flood frequency due to changing rainfall patterns and sea level rise. These studies culminated in Virginia Beach's Resilience Plan, socialized as "Sea Level Wise,"[1] which includes a conceptual suite of projects focused on flood control and resilience. The Virginia Beach Resilience Plan leverages four overarching adaptation strategies to identify actionable projects for each of the City's four unique major watersheds. This project represents the first adaptation project to advance to construction to implement the City's Resilience Plan.

The adaptation strategy for the Southern Rivers Watershed, which includes Back Bay, is presented in Figure 1. The strategy focuses on employing natural mitigation methods, an integrated system of defense structures, and complementary measures, such as land-use strategies. Collectively these approaches are designed to strategically reduce flow into and within Back Bay and improve flood storage and overall coastal resiliency. Marsh restoration was identified as a key resilience-building strategy as part of an extensive evaluation of structural and non-structural alternatives. Marsh restoration provides multiple benefits of flood risk reduction, enhanced habitat, and improved water quality.

As part of the Virginia Coastal Resilience Master Planning Framework, a precursor to the first phase of the Virginia Coastal Resilience Master Plan (CRMP), the Commonwealth of Virginia identified guiding principles for a statewide resilience strategy. One of these guiding principles is recognizing the importance of protecting and enhancing natural infrastructure and prioritizing nature-based infrastructure.[2] The City's marsh restoration project aligns with this principle and was highlighted as an exemplary nature-based project in the CRMP (refer to pages 178-179).[3]

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[1] City of Virginia Beach (2020). Virginia Beach Sea Level Wise Adaptation Strategy (Website).

[2] Office of Governor Ralph S. Northam Commonwealth of Virginia. (2020). Virginia Coastal Resilience Master Planning Framework (PDF).

[3] Office of Governor Ralph S. Northam Commonwealth of Virginia. (2021). Virginia Coastal Resilience Master Plan Phase 1 (PDF).

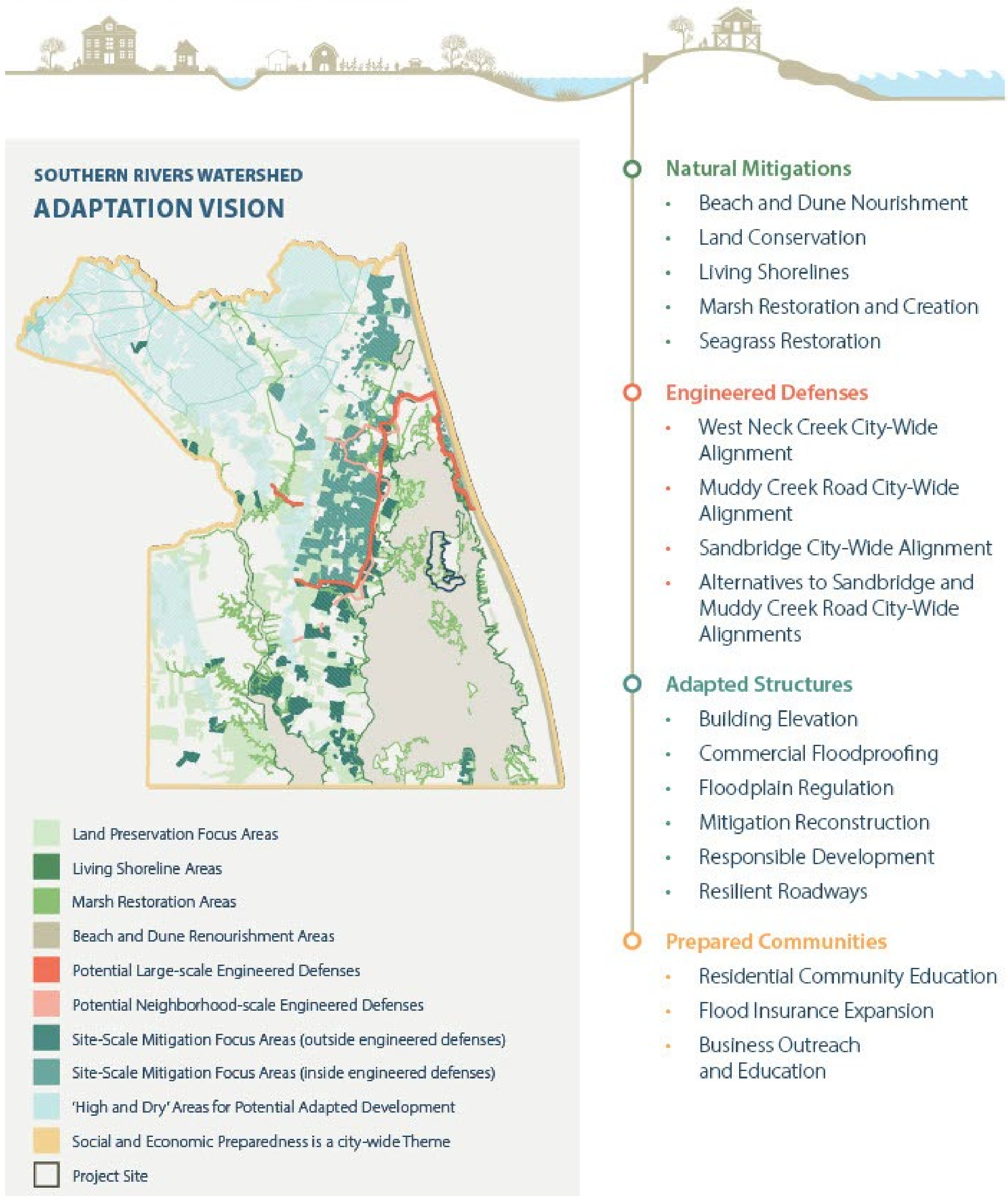

Figure 1: Adaptation Vision for the Southern Rivers Watershed.

Hydraulic modeling analysis identified Bonney Cove as a location where marsh restoration has the potential to reduce the propagation of floodwater through key pathways within Back Bay (Figure 2). The City prioritized this project as the first to advance to construction due to its significant benefits to community and habitat resilience.

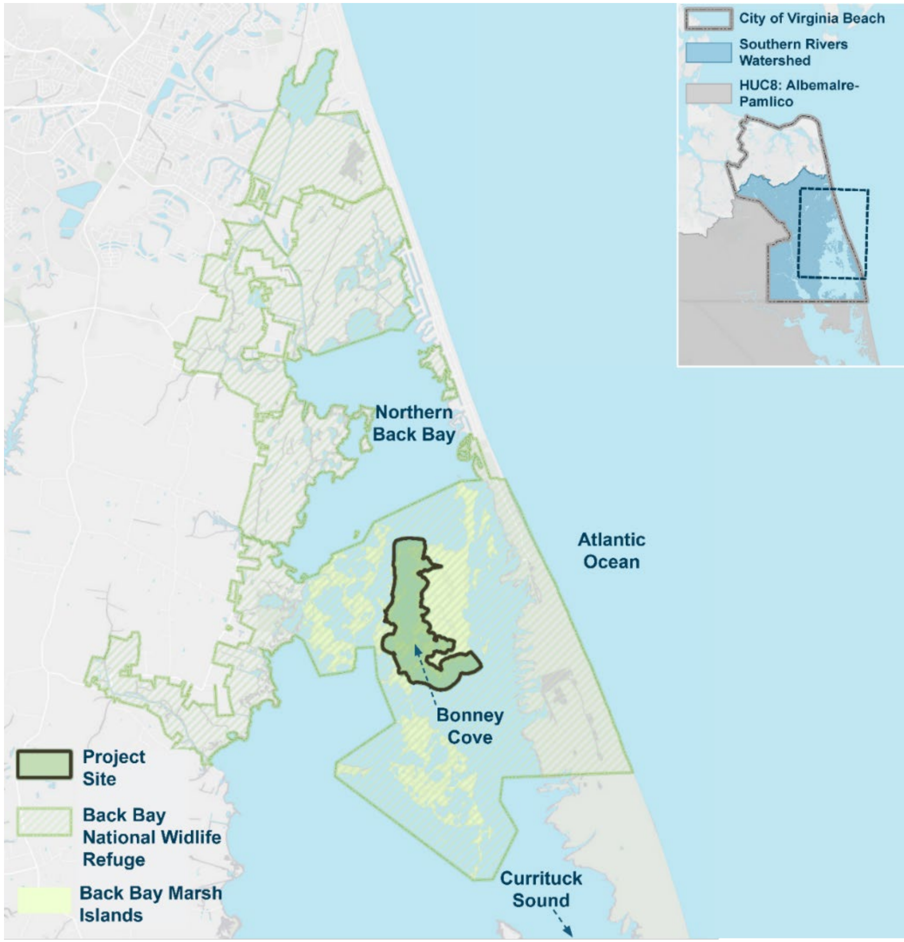

Figure 2: Project site location map.

This project represents a collaborative effort between the City's Department of Public Works alongside other City departments, public constituents, local nonprofits, and state and federal agencies. In selecting the project location and developing the design approach, the City has coordinated closely with the Back Bay National Wildlife Refuge (BBNWR), part of the U.S. Fish and Wildlife Service (USFWS), and the Virginia Department of Wildlife Resources (VDWR). Environmental organizations committed to stewardship of Back Bay have also contributed input throughout the design process, including the Back Bay Restoration Foundation (BBRF), Friends of Back Bay, the Back Bay National Wildlife Refuge Society, and the Albemarle-Pamlico National Estuary Partnership (APNEP). Project field investigations involved local support from Old Dominion University (ODU) and others, and outside expertise from Louisiana. The National Fish and Wildlife Foundation (NFWF) provided grant funding under the National Coastal Resilience Fund (NCRF) to support design, permitting, and environmental assessments. Broad support of the project is demonstrated by contributions from the organizations noted above along with other stakeholders engaged in the restoration effort.

Needs and Problems

Specific Problem Being Solved – Habitat Degradation and "Wind Tide" Flooding

Marshes are vital to the Southern Rivers Watershed for the ecological and flood reduction benefits they provide. The Southern Rivers Watershed contains 90% of the City's land area under an elevation of three feet, making this area particularly susceptible to flood impacts. As illustrated in Figure 3, sustained southerly winds push water up from the Albemarle-Pamlico Sound through the Currituck Sound and into Back Bay, creating a phenomenon referred to locally as "wind tide flooding". Marsh habitat loss has contributed to the opening of a secondary channel in Bonney Cove that has increased water flow during wind tide and other flood events to areas with high community exposure.

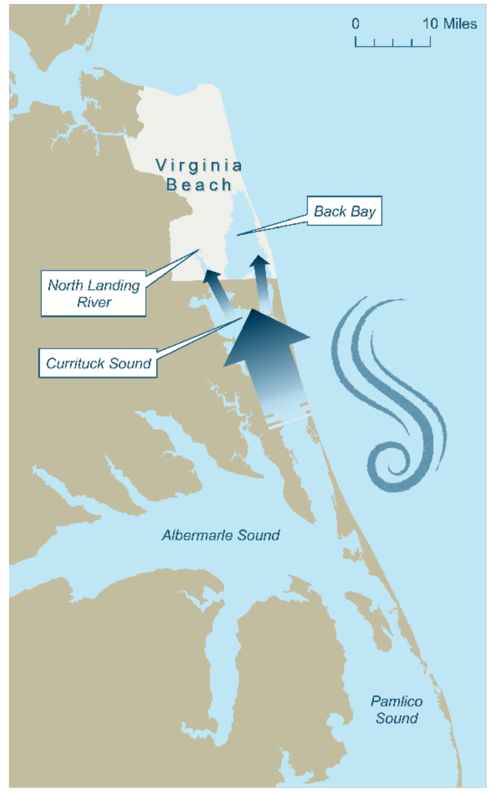

Figure 3: Flood pathways in the Southern Rivers Watershed.

Within today's marsh system, it takes between two to five days of sustained southerly winds to cause flooding, depending on the wind speed and direction. Over the last four years, more than five wind tide flooding events have occurred in this area. The increasing frequency of flooding events is primarily attributed to a foot of relative sea level rise in the last 50 years and degradation of marsh and seagrass habitat.

This marsh restoration project aims to address the challenges of habitat degradation and "wind tide" flooding by stabilizing two critically eroding marsh islands, decreasing turbidity to promote the growth of aquatic vegetation, and providing flood risk reduction benefits through increased friction and wave attenuation.

Factors Contributing to the Identified Problem

This growing flood risk in the Southern Rivers Watershed can be attributed mainly to the reduced friction in the water column from the increased water depth and eroded vegetation, which allows water to move more quickly through key hydraulic pathways. Another term for this is "fetch", which is defined as the open water distance over which a given wind can blow and generate higher waves without obstruction. Unmitigated, the continued loss of these marsh island systems and aquatic vegetation is expected to result in more frequent and intense wind tide flooding events.

Emergent Marsh Degradation

Approximately 50% of former marshland at the site (260 acres) has eroded into open water leading to the opening of a wide secondary channel ("Bonney Cove") that is about two miles

long and half a mile wide (Figure 4). The southern exposed edge of the adjacent marsh islands is exposed to approximately 1.5 miles of fetch in the predominant wind direction.

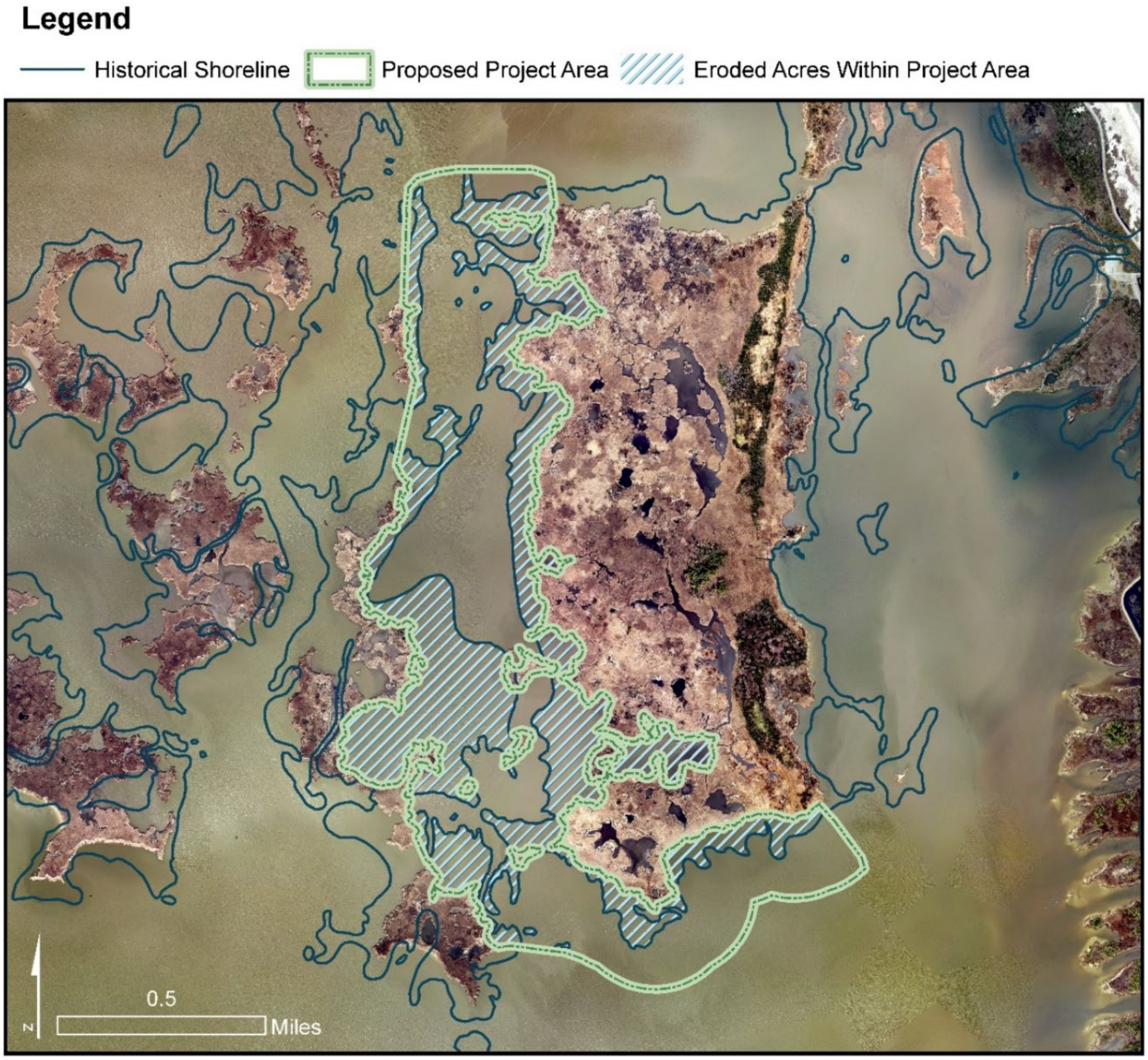

Figure 4: Historical marsh erosion within the project area.

Submerged Aquatic Vegetation (SAV) Loss

SAV used to be abundant at the site (around 45% coverage, overall) but is now extremely sparse, ranging from 0% to 10% coverage across the site, on average. Field studies conducted by the VDWR show that wind-driven waves and high flow velocities are the primary drivers of this loss, particularly in the last 5 years as shown in Figure 5.

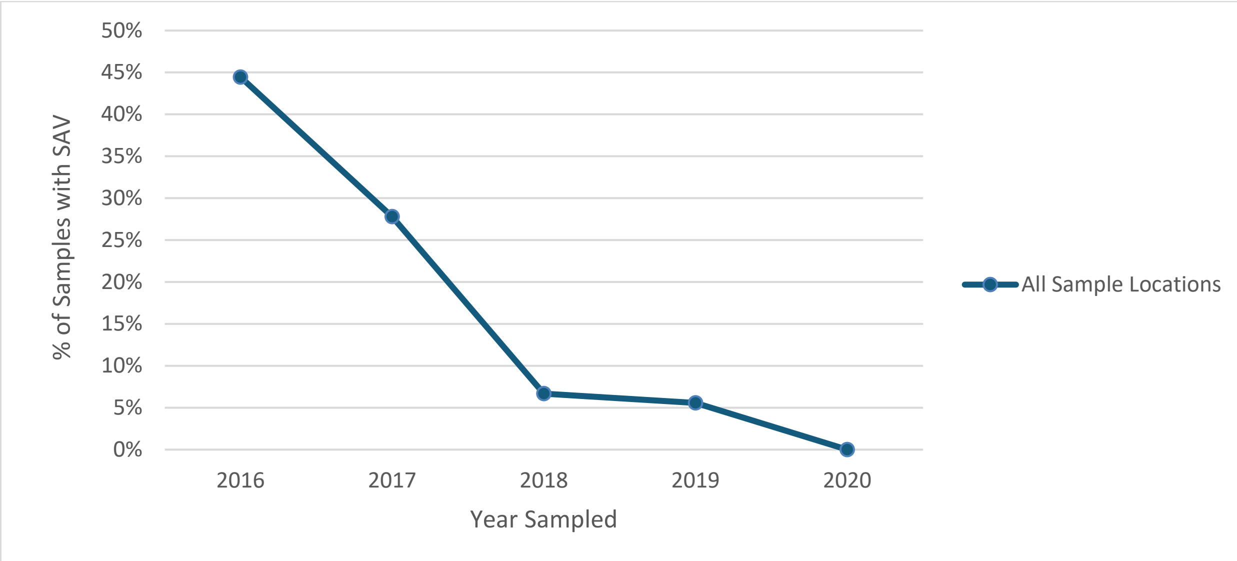

Figure 5: SAV sampling data from VDWR within the project vicinity.

Why is the Project Needed Locally/Regionally?

Pilot Project

The City's design concept for the marsh restoration project leverages "marsh terracing," an innovative coastal engineering technique widely used in Texas and Louisiana to convert shallow subtidal bottom to marsh. This technique has not yet been implemented along the U.S. East Coast and has not yet been implemented in the Mid-Atlantic region. Through the export of proven expertise from successful marsh terraces, this project would lay the foundation for future projects in the region, Virginia, and other states along the East Coast. The project would document detailed cost estimates, demonstrate effective construction practices for large-scale marsh creation projects, identify best sources for local/regional materials, and establish partnerships with permitting officials at various levels of government. The City has outlined a preliminary sequencing plan for marsh island restoration projects in Back Bay to strategically close hydraulic pathways and address priority restoration areas as shown in Figure 6. Some of these projects would require coordination with the State of North Carolina to realize its broader resilience efforts.

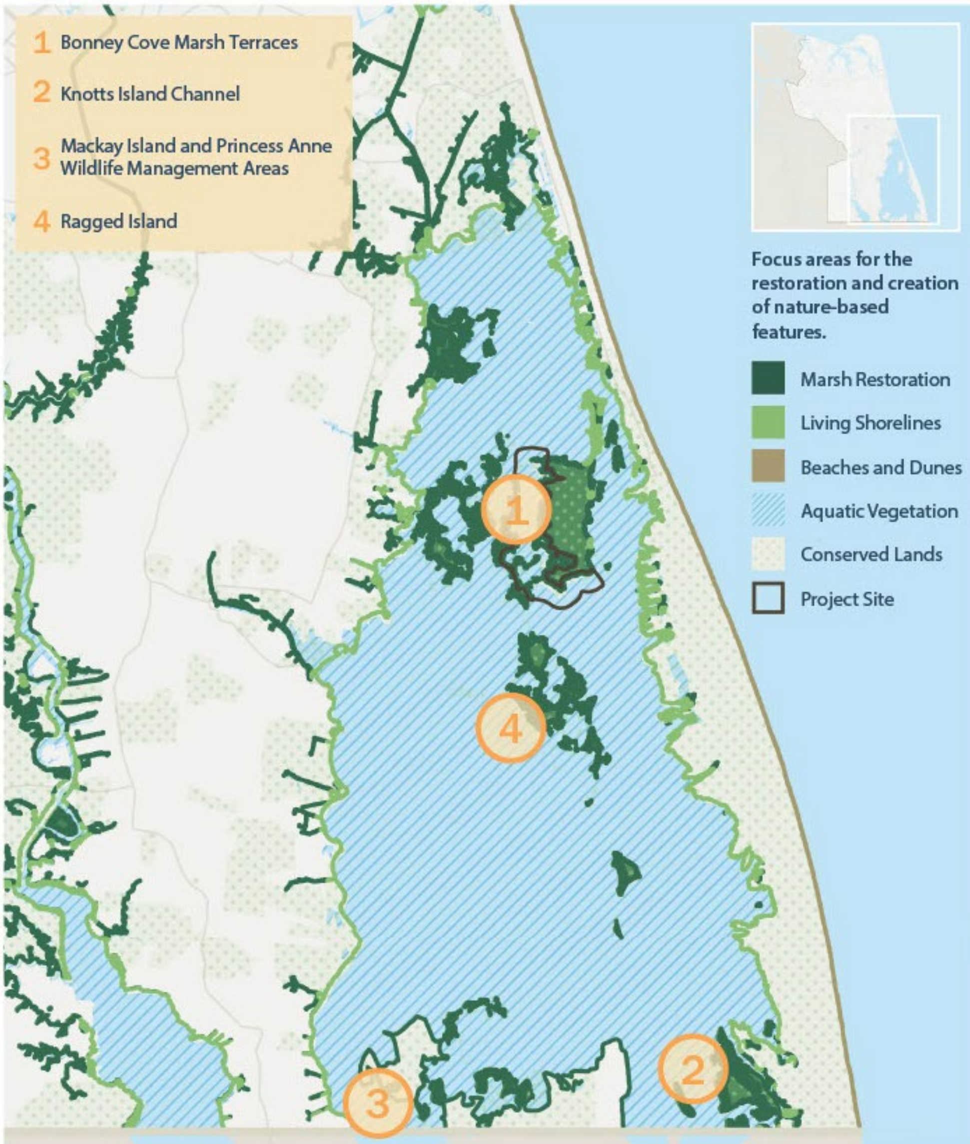

Figure 6: Preliminary Sequencing Restoration Plan.

Virginia Coastal Resilience Master Plan Exemplary Project

The CRMP impact assessment shows a high vulnerability of nature-based features to coastal flood hazards that is consistent with the City's analysis. In the Hampton Roads region, the CRMP impact assessment estimates a decrease from 40,600 acres to 2,940 acres of tidal wetlands by 2080, representing a 93% decline in tidal wetlands.[4] Back Bay was identified as a hotspot for tidal wetland loss, emphasizing the critical location of the City's marsh restoration effort. Specifically, the Virginia CRMP impact assessment shows that portions of tidal wetlands within the project area have "High" and "Very High" impact levels, which indicates areas of tidal marsh

[4] Office of Governor Ralph S. Northam Commonwealth of Virginia and Virginia Department of Conservation and Recreation (2021). Virginia Coastal Resilience Master Plan Phase 1 (PDF).

that are anticipated to be lost through inundation causing conversion to open water (Figure 7).

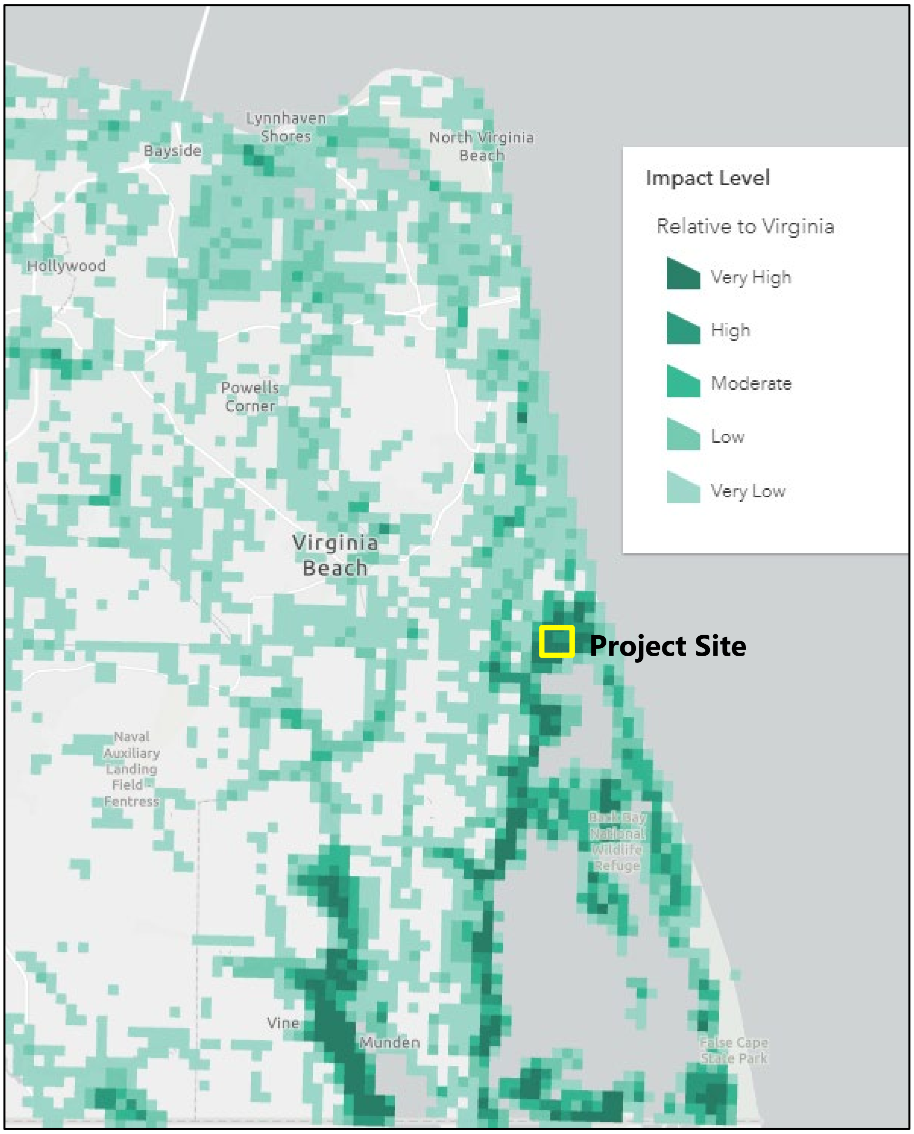

Figure 7: Virginia CRMP Impact Assessment for Tidal Wetlands.

Currituck Sound Coalition High Priority Area

In coordination with Audubon North Carolina, the Currituck Sounds Coalition designated the project site as a High Priority Area for restoring and enhancing vulnerable and degraded marshes with "high flood risk reduction benefits and habitat value" as shown in Figure 8[5].

[5] Audubon North Carolina. (2021). Currituck Sound Coalition Marsh Conservation Plan. (PDF)

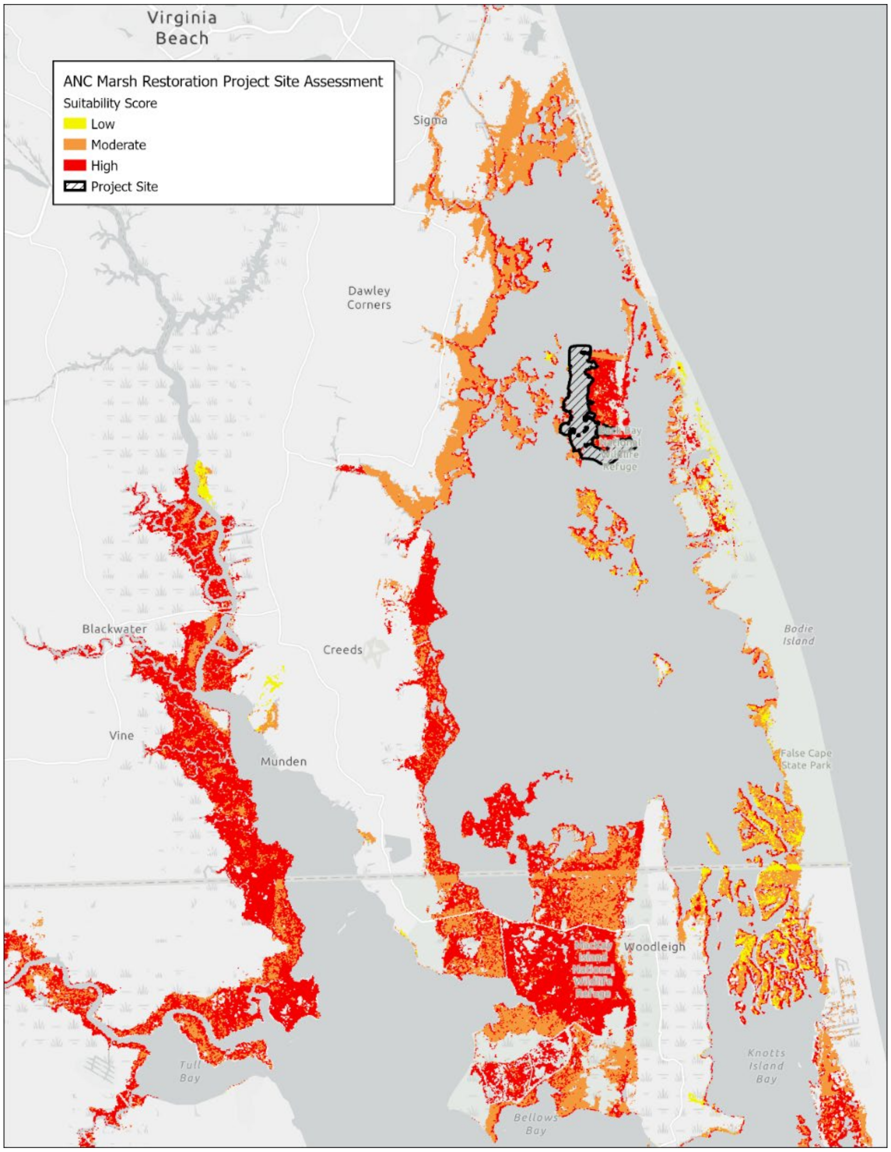

Figure 8: Audubon North Carolina Marsh Restoration Project Site Assessment

Ecological Core for Flood Resilience

The Virginia Department of Conservation and Recreation Natural Heritage Data Explorer provides data from ConserveVirginia v3.0 and other data to support conservation planning. The following map in Figure 9 displays Ecological Cores and the Floodplains and Flooding Resilience Category layer (blue polygon) from ConserveVirginia. The project area contains "High" (C3) and "General" (C5) Ecological Cores and is within the boundaries of the Floodplain and Flooding Resilience area.

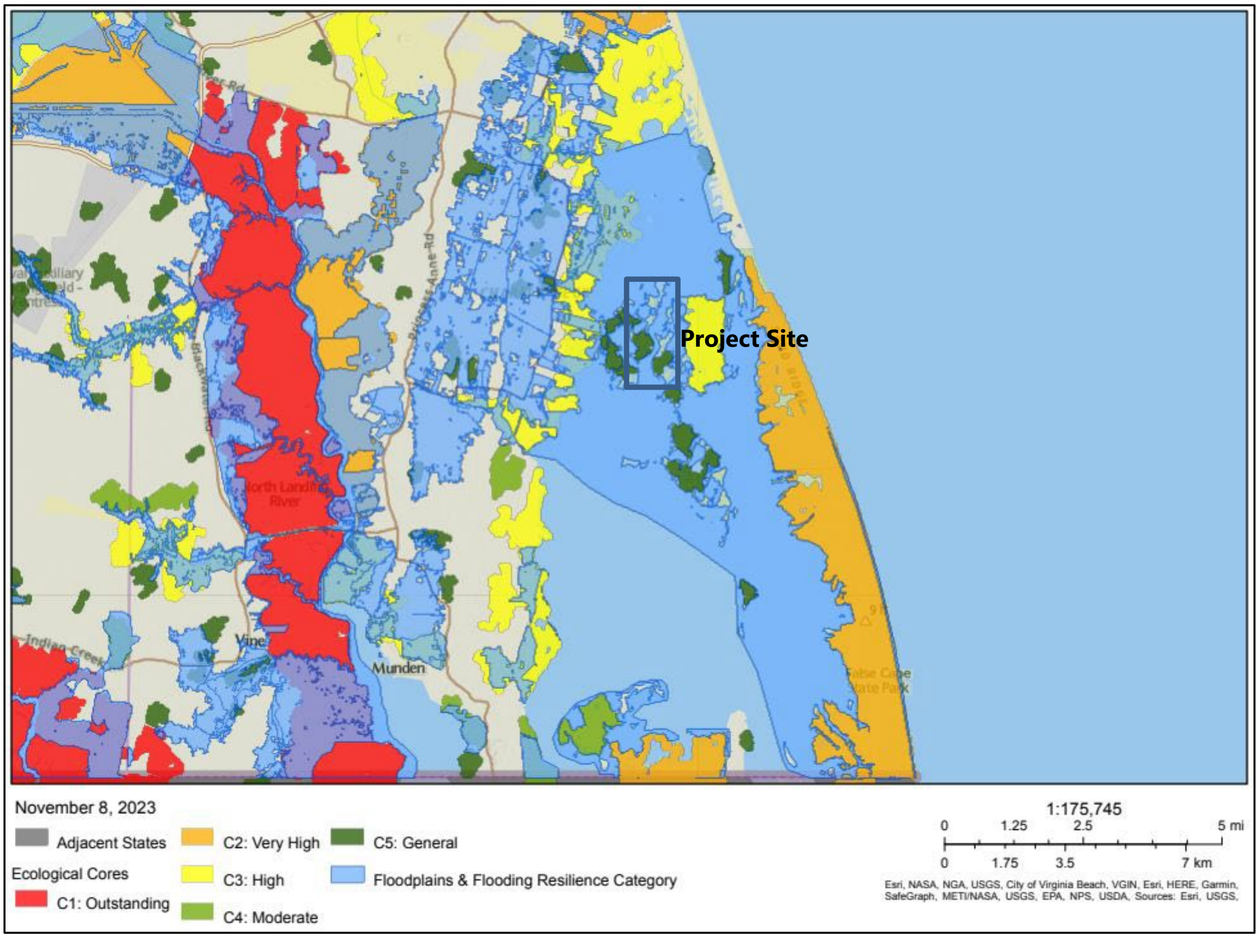

Figure 9: Virginia Natural Heritage Data Explorer Ecological Cores and ConserveVirginia Data.

The safety threats, or environmental concerns related to flood risk.

The City's risk assessment forecasts that approximately 70% of the remaining marsh (730 acres) surrounding the project site will convert to open water with three feet of sea level rise if unmitigated. Fragmentation of this adjacent marsh would result in about eight miles of fetch acting on the southern extent of the site in the predominant wind direction. Without these central marsh islands, the northern shorelines of Back Bay would be exposed to 12 miles of fetch from the Knotts Island Channel at the Virginia-North Carolina boundary. This condition would leave the fringing marshes highly vulnerable to accelerated erosion.

How does the project decrease the risk to public safety through flood risk reduction?

Construction of the forty-one individual marsh terraces, totaling 27,000 linear feet (a 51-acre footprint), across Bonney Cove offers a nature-based technique that will stabilize and protect the marsh island in the center of the bay and reduce erosion of the fringing marsh systems to the north. Numerical modeling was leveraged to quantify specific erosion reduction benefits of the project for wave heights and flow velocities:

- **Wave Height Reduction**: The marsh terraces are expected to reduce wave heights within the project site by approximately 45%. This reduction is consistent with other field studies, which have found that average wave heights within two terraced sites were 37% to 48% lower than those observed at the reference site (Brasher 2015). Wave energy reduction is anticipated to increase the potential for sediment deposition on the terraces' leeward side, leading to the growth of new emergent marsh and reducing erosion of adjacent marsh. Approximately five miles of marsh island shoreline around Bonney Cove will benefit directly from the erosion reduction associated with the computed wave attenuation.
- **Flow Velocity Reduction**: The marsh terraces reduce flow velocity within the project area. This reduction in velocity will reduce bottom shear stress, decrease turbidity, increase light penetration into the water column and promote the growth of SAV. Reducing bottom shear stress will make conditions more suitable for SAV growth between the terraces. Field studies of marsh terraces in Texas and Louisiana document an approximately 45% to 56% reduction in turbidity and the emergence of SAV in the years following terrace construction (Brasher 2015).
- **Wind Shear Stress Reduction**: Although not included as a parameter within the numerical modeling effort, the bald cypress trees planted on the terraces within the middle of the site are expected to reduce wind speed within the project site. This will further reduce wind-generated waves within the project site on the terraces' leeward and windward sides. Research shows that trees that grow to at least 30 feet at maturity result in lower wind speeds of up to 60 to 150 ft on the windward side and up to 900 ft on the leeward side (USDA).

How does the project protect or conserve natural resources?

The proposed project aims to restore marsh island communities in Bonney Cove that have historically provided environmental and flood reduction benefits to the communities in northern Back Bay. As illustrated in Figure 10, when an intact marsh begins to fragment and convert to open water, fetch increases and enables greater wave energy, increasing marsh erosion rates, and ultimately accelerating conversion to an ever-expanding body of open water. Strategic marsh restoration and creation in Bonney Cove would help mitigate the cycle of marsh island erosion and loss of SAV currently occurring in Back Bay, thereby protecting the remaining marsh islands and reducing fetch and wave energy.

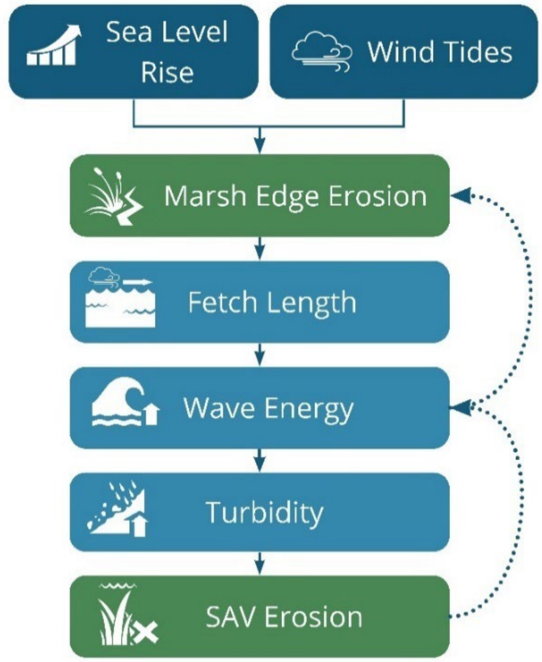

Figure 10: Cycle of marsh erosion, SAV loss, and increased wind-driven flooding.

The primary objective of this project is to create a sustainable coastal marsh island system in Back Bay through reclamation of historically lost marsh habitat and protection of existing marsh complexes from erosion. This restoration effort aims to provide multiple benefits of reduced flood impacts, enhanced fish and wildlife habitat, and improved water quality. The project is designed to achieve the following outcomes:

- Decrease turbidity to create conditions that promote the growth of emergent vegetation and aquatic grasses;
- Maximize habitat value for ecologically important fish and wildlife populations (e.g. Largemouth Bass, Bluegill, Yellow Perch, Striped Bass, Blueback Herring, Alewife, American Eel, etc.); and,
- Reduce fetch, wave heights, and flow velocities to mitigate erosion of fringing marsh systems that provide a buffer for the low-lying neighborhoods and roads that experience frequent flooding in northern Back Bay.

The City selected marsh terracing as the preferred restoration approach because the design is compatible with Back Bay's shallow bottom and the historical loss of habitat. Marsh terraces are narrow, man-made islands placed in shallow open water to restore previous marsh environments. Typically arranged in a chevron pattern, the overall field of marsh terraces dissipates waves, decreases turbidity, and slows down the moving water. The resulting calmer water conditions allow more sunlight to penetrate to the shallow bottom, promoting the establishment and growth of marsh seagrass and ultimately improving habitat quality for fish and wildlife. Further, as opposed to one continuous marsh platform, marsh terraces maximize habitat for a variety of fish and wildlife species, as illustrated in Figure 11.

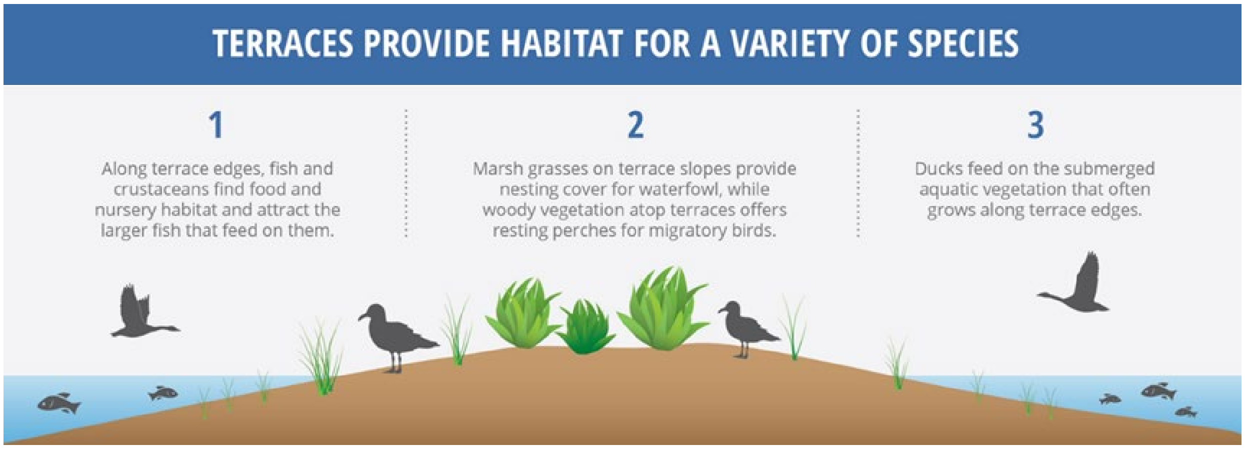

Figure 11: Conceptual diagram of marsh terraces.

Groups to be targeted who might directly benefit from this flood risk reduction effort.

The northern Back Bay communities adjacent to the project area and interested stakeholders have been engaged in the planning effort through public meetings. These meetings provided an opportunity for the community to provide feedback on the 30% and 95% designs and artistic renderings. We anticipate the project to benefit properties and infrastructure assets in northern Back Bay, including the following:

- **Reduce erosion rates along approximately 8 miles of shoreline by reducing wind and wave energy north of the project site.** Most of the properties along this reach of shoreline are not protected by traditional erosion risk reduction measures, such as bulkheads. Maintaining a naturalized shoreline while protecting fringe marsh is a priority of the City and its project partners. This approach will ensure that these marsh systems can migrate landward in response to sea level rise.
- **Reduce flood risk to commercial and residential properties north of the project site.** There are approximately 70 commercial and 2,350 residential structures within the two census block groups surrounding the project site. Around 635 of those structures are vulnerable to flooding during a 50-year event today. With three feet of sea level rise, approximately 2,060 structures are expected to be vulnerable to flooding during a 50-year return period event, representing about 85% of the residential structures within the project vicinity. These numbers underscore the importance of implementing the proposed project alongside complimentary flood risk reduction projects.
- **Reduce the magnitude and duration of flooding along critical access roads and critical facilities.** In addition to Muddy Creek Road, two other critical access roads are anticipated to benefit from delayed flooding. This includes Shipps Cabin Road (intersecting with Muddy Creek Road) and Sandpiper Road, which runs parallel to the eastern bank of Back Bay and provides ingress/egress out of the Sandbridge community (Figure 12).

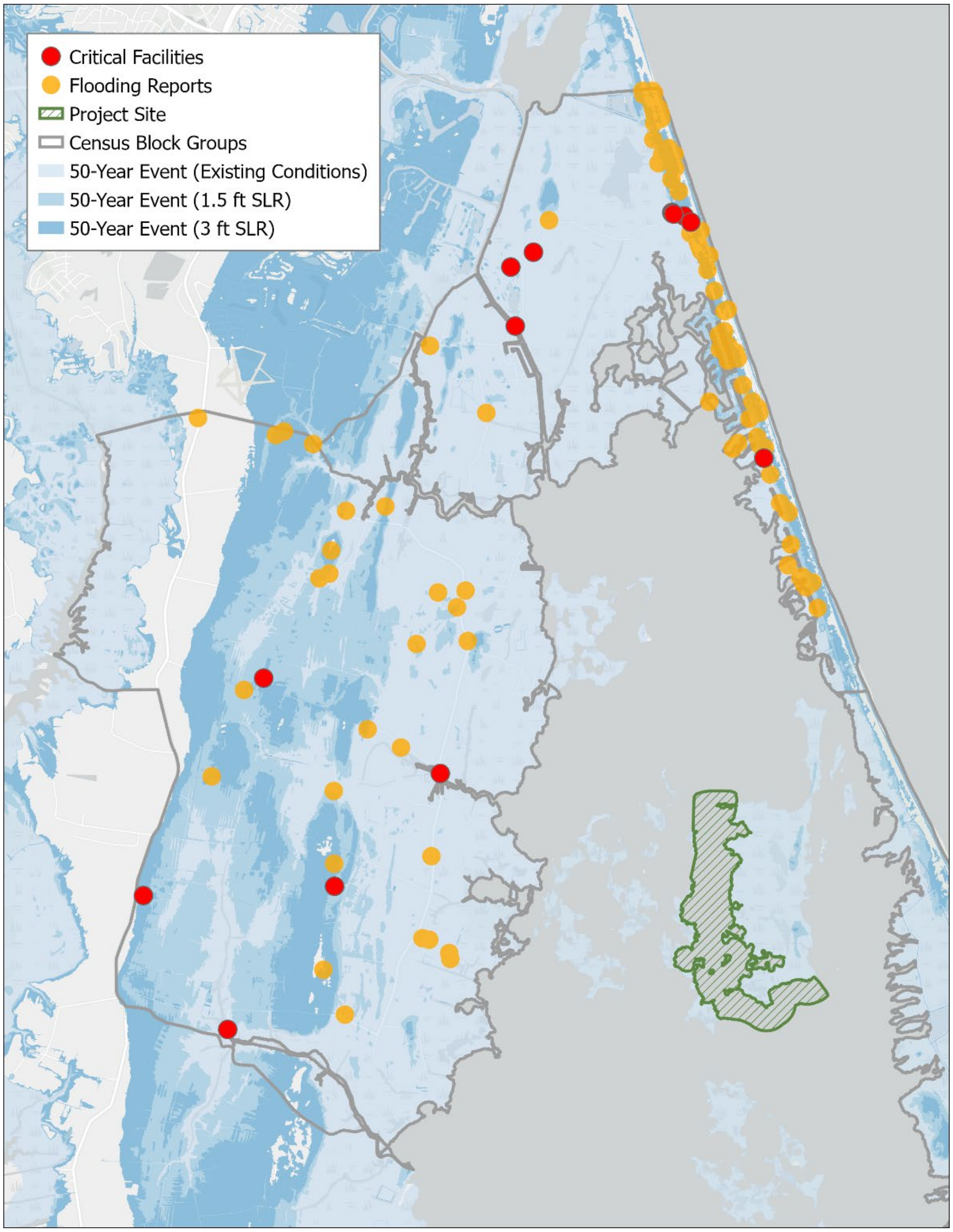

Figure 12: Critical facilities and flooding reports within project vicinity.

What would happen (or not happen) if the applicant does not receive funding?

If this project does not advance from design to construction, erosion of the adjacent marsh would continue to occur, resulting in fragmented habitat lacking the capacity to reduce wave action and slow water velocities. It is anticipated that wind-driven flooding events will continue to increase in frequency, resulting in increasing flooding of the low-lying properties and roadways surrounding northern Back Bay.

Alternatives Analysis

The proposed project offers the best approach for addressing the needs and problem statement outlined in this Scope of Work narrative. The project would result in the creation of 46.5 acres of marsh terraces, which would produce a net gain of approximately 16 acres of low/high marsh habitat by the end of the project construction compared to the No Action Alternative. The integrated system of marsh terrace ridges and perimeter rock armoring would stabilize the two critically eroding marsh islands (Long Island to the east, and a series of smaller unnamed islands to the west) from continued degradation. The tall terrace design improves the functionality and resiliency of the marsh system while also providing diversified habitat for fish and wildlife in the form of increased marsh edge as sea level rises. Numerical modeling of the preferred alternative demonstrated that the project would decrease wave heights and decrease the overall flow velocity of water moving through the project site, reducing water exchange in Back Bay during flooding events, encouraging sediment deposition, mitigating wave effects and consequent erosion, and result in localized water quality benefits. The proposed terraces would not only create a platform for vegetation growth within the marsh, but also reduce wave fetch in these large open water areas. The reduction in wave energy would lead to improved water clarity to promote the growth of SAV in the area between the terraces (approximately 310 acres).

Dredging in between the terraces to obtain sediment for the terrace cap would ensure no invasive vegetation is introduced into Back Bay, which is a high priority of the USFWS and VRMC. The dredging areas would also create valuable fish habitat to attract signature Back Bay fish and wildlife populations such as Largemouth Bass. The proposed dredging areas in between the terraces was evaluated and not anticipated to increase erosion of the adjacent marsh system. Furthermore, dredging in-situ material for building terraces is a widely accepted approach in Gulf Coast region marsh creation/terracing projects, as determined through conversations with project owners in Louisiana. Some terrace cap material will also be obtained from the Nimmo VII-A project. Through export of proven expertise from successful marsh terracing projects, this project would lay the foundation for future similar projects in the region through the development of detailed cost estimates, identification of best sources for local/regional materials, and establishment of partnerships with permitting officials at various levels of government.

Goals and Objectives

The overarching goal of this project is to construct the City's first nature-based adaptation project in the Southern Rivers Watershed and one of the CRMP's exemplary nature-based projects. This project aims to stabilize two critically eroding marsh islands from further degradation, decrease turbidity to promote the growth of aquatic vegetation, and provide flood risk reduction benefits through increased friction and wave attenuation. Table 1 below provides a high-level overview of the specific objectives established to solve the problem/need identified – specifically habitat degradation and wind tide flooding along with measure(s) of success. A more detailed description of these objectives is provided in the Supporting Documentation section.

Table 1: Overview of Project Objectives.

Objectives	Description	Measure(s) of Success	Timing of Measures
Objective 1	Create a Construction Access and Staging Area	a. Secured permits for construction. b. Contractor Selection. c. Construction of Staging Area.	a. December 2023 b. April-May 2023 c. June 2023 -February 2024
Objective 2	Restore Marsh and Aquatic Vegetation	a. Secured permits for construction. b. Restoration of 46.5 acres of habitat.	a. December 2023 b. March - October 2025 and March – October 2026
Objective 3	Engage Stakeholders and Disseminate Effective Practices	Number of people meaningfully engaged in the process of the project within the agreement period.	Continuous through period of performance.

Work Plan

Current Status and Ongoing Activities

The marsh terrace project design is progressing and will be ready for construction in the CFPF grant timeline. Table 2 summarizes ongoing tasks related to the project and an anticipated schedule for completion.

Table 2: Completed, ongoing, and anticipated activities leading up to construction.

Activity	Description	Schedule
Stakeholder Scoping Workshop	In November 2020, the City hosted a virtual workshop to receive initial input from project stakeholders.	Completed (Fall 2020)
Site Characterization and Vegetation Survey	In fall 2020, a site characterization and vegetation survey within Bonney Cove was conducted under a USFWS Special Use Permit (SUP). The purpose of the survey was to document existing emergent marsh and submerged aquatic vegetation (SAV) species composition and percent coverage within the proposed project area. MAP Environmental, Inc. conducted a literature review of marsh terracing projects in the Gulf Coast region to identify effective practices for project planning and design.	Completed (Fall 2020)
Bathymetric Survey	An updated bathymetric survey of Bonney Cove, also covered under a USFWS SUP, was completed in March 2021. This data serves as an input to identify appropriate design elevations to determine quantities of materials necessary to build the proposed marsh terraces and for numerical modeling of project alternatives.	Completed (Spring 2021)
Geotechnical Investigation	A geotechnical investigation of Bonney Cove was conducted in the spring of 2021. The permitted survey, (Virginia Marine Resources Commission (VMRC) Permit No. 2020-2286, U.S. Army Corps of Engineers (USACE) Permit No. 2020-02439, and USFWS SUP) included the collection of 10 soil borings in locations that avoided aquatic vegetation habitat. The soil samples were retrieved by drilling with a specialized airboat-mounted drill rig which was essential for drilling in shallow areas as it avoids disruption to bottom habitat. The soil samples were analyzed to determine the suitability and physical characteristics of the soils within the project area. Additional soil analysis was conducted to determine the suitability of Back Bay sediments for building components of the marsh terraces.	Completed (Spring 2021)

Activity	Description	Schedule
Water Quality and Hydrodynamic Survey	ODU conducted a water quality and hydrodynamic survey of Bonney Cove in the spring of 2021. The USFWS permitted survey collected water samples and deployment/retrieval of hydrodynamic sensors (pressure sensors, acoustic Doppler current profilers, and optical backscatter sensors) at three sampling points in Bonney Cove. Sensor equipment was deployed for two one-month periods (3/10/2021 – 4/12/2021 and 5/19/2021 – 6/8/2021). The water level, wave, and current data served as an input to the numerical model calibration. The water quality parameters (including pH, salinity, temperature, dissolved oxygen, chlorophyll, and turbidity) will serve as a reference to compare pre-and post-construction water quality conditions.	Completed (Summer 2021)
30% Design	Dewberry leveraged the field-collected data to establish design criteria for the project to ensure that it will be resilient in the face of changing future conditions during wind-tide events. Artistic design renderings were developed to enable stakeholders to visualize the implemented project.	Completed (Fall 2021)
Public Engagement – 30% Design	The City held a public information meeting on October 14, 2021, at Creeds Elementary School. The project team delivered a 10-minute presentation of the proposed project followed by an open-format discussion where participants reviewed the preliminary (30%) designs and artistic renderings and submitted comments regarding environmental and community impacts.	Completed (Fall 2021)
Numerical Modeling	Numerical modeling has been completed to evaluate the proposed project's impact on water levels, wave heights, and flow velocities within and surrounding the project area. Potential water quality impacts were also evaluated. The numerical modeling effort involved the development of an XBeach model, which is a nearshore model that accounts for wave-vegetation interactions based on field-derived drag coefficients.	Completed (Winter 2021)
Environmental Assessment and Scoping	In coordination with the USFWS and with technical assistance from Dewberry, the City evaluated the potential environmental impacts of the project. The draft environmental assessment document was distributed to key stakeholders with jurisdictional authority or a vested interest in the project for review and comment.	Completed (Summer 2023)

Activity	Description	Schedule
60% Design	After numerical modeling and stakeholder review of the 30% design, the engineering design plans were advanced from 30% to 60%.	Completed (Spring 2023)
95% Design and Public Engagement	The engineering design team prepared 95% engineering design plans to address comments on the 60% plan set. The City held a second public information meeting from 6:00 – 7:30 p.m. on July 13, 2023, at the Senior Resource Center in Virginia Beach where the project team delivered a 10-minute presentation of the proposed project followed by an open-format discussion where participants reviewed the 95% designs, updated artistic renderings, and submitted comments.	Completed (Fall 2023)
Construction Permit Applications Submitted	The City submitted the Joint Permit Applications for the proposed project, including the initial post-construction monitoring plan, to VMRC and the USACE in August 2023.	Completed (Summer 2023)
Modeling of Potential Adverse Impacts	In response to public concerns, the City performed additional numerical modeling of both northerly and southerly wind events and reviewed water level responses at locations in Back Bay for any potential adverse impacts. No adverse impacts were found for either type of event.	Completed (Fall 2023)
Publication of Frequently Asked Questions	The City will be publishing findings for the potential adverse impacts modeling, along with other responses to public concerns raised at the question in a Frequently Asked Questions webpage in November 2023.	In Progress (Fall 2023)
100% Design	The engineering design team prepared and submitted the 100% engineering design plans to the City for review. The plans will be finalized on receipt of any comments from the permitting process, anticipated to occur by end of 2023.	In Progress (Fall 2023)
Contractor Procurement	The engineering team will provide final plans, specifications, and construction estimates (PS&E). The City will prepare the bid Request for Proposal (RFP), provide Bid Packages, and review bids obtained, and select a construction contractor.	Planned (Winter 2023 - Spring 2024

What are the major activities and tasks?

The key activities and tasks to be competed under the agreement period are summarized in Table 3. Please refer to the Supporting Documentation section for a more detailed description of these activities and tasks.

Table 3: Overview of Activities and Tasks.

Activities	Description	Tasks
Activity 1	Construction Staging Area Preparation and Construction	1. Mobilize equipment 2. Stabilize road, establish construction staging area, abutments, install pre-engineered bridge, construct ramp to water and slurry basins. 3. Establish traffic flagging stations. 4. Install pipe and booster stations.
Activity 2	Marsh Terrace Construction	1. Construct 41 terraces (2-phased approach). 2. Demobilize equipment.
Activity 3	Stakeholder Engagement	1. Develop project marketing materials. 2. Attend and document engagement activities.

Who is responsible for completing the activities and tasks?

Responsibility for completing the project's activities and tasks lies with a collaborative effort led by the City's Department of Public Works. To ensure the successful execution of the project, the City has assembled a diverse team of consultants, advisors and subject matter experts. For a comprehensive understanding of the specific roles and responsibilities of each entity involved in carrying out the proposed scope of work, please refer to the *Supporting Documentation – Approach, Milestones, and Deliverables – Project Partner*s section of this report, which provides a detailed description of how each team member contributes to the project's overall success.

What is the timeframe for accomplishing activities and tasks?

An overview of the planned project timeline is shown in Figure 13. Grant activities will initiated in Summer 2024 with construction of the staging area and material acquisition. Please refer to the *Supporting Documentation – Approach, Milestones, and Deliverables –Milestone Schedule* section of this report for a detailed outline for each activity and associated deliverables.

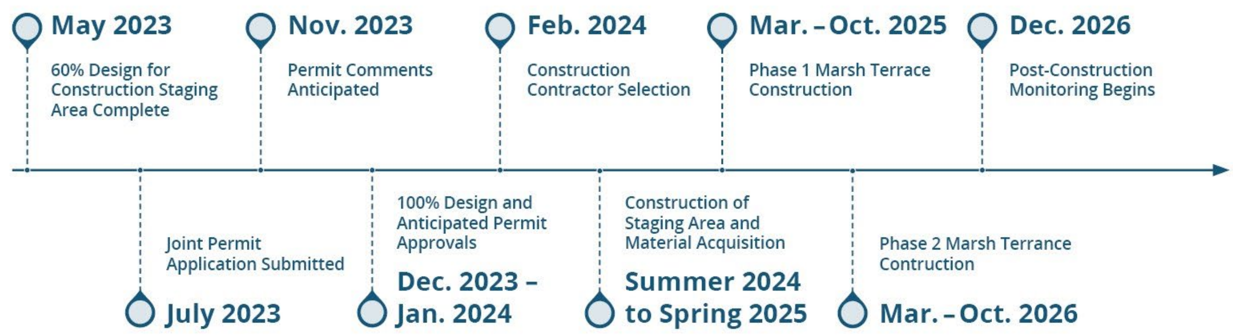

Figure 13. Timeline overview for project implementation.

Identify the required partners to ensure success and where they are represented in the workplan.

A diverse team of consultants, advisors, and subject matter experts, led by the City's Department of Public Works, has been assembled to complete the project's activities and tasks. Please refer to the *Supporting Documentation – Approach, Milestones, and Deliverables – Project Partner*s section of this report for a detailed description of each team member's role, responsibilities, and contribution to the project's overall success.

Deliverables

An overview of the project deliverables is provided in Table 4. Please refer to the *Supporting Documentation – Approach, Milestones, and Deliverables* section of this report for more detail.

Table 4: Summary of Deliverables.

Activities	Deliverables
Activity 1: Construction Staging Area Preparation and Construction	1. Material acquisition. 2. Progression and completion of the construction staging area, with daily inspections to monitor progress. 3. Documented progress and completion through quarterly reports to DCR.
Activity 2: Marsh Terrace Construction	1. Progression and completion of the 2025 and 2026 construction phases, including plantings, with daily inspections to monitor progress. 2. Demobilization and removal of equipment from construction staging area. 3. Documented progress and completion through quarterly reports to DCR.
Activity 3: Stakeholder Engagement and Lessons-Learned Dissemination	1. Project marketing materials. 2. Records documenting number of stakeholders engaged during the outreach activities.

Maintenance plan tied to the identified viability of the project. Plan for sustaining the project after the agreement period (if applicable)

The City has developed a draft Annual Monitoring Plan and Post-Construction Monitoring Report that was submitted along with the Joint Permit Application for the project. See Attachment 5 for a copy of the draft report.

Project maintenance will be addressed by the City of Virginia Beach's Public Works Stormwater Operations Group. Any maintenance issues identified by the monitoring effort or other observers will be flagged to the Operations Group to address. The City intends to maintain the construction staging area to support future project maintenance needs. After completion of the monitoring program, the City will perform inspections every 2-5 years and make any repairs needed for the life of the project.

Evaluation

Indicators of Success

Indicators of success for this project have been identified during the development of the monitoring plan. Three (3) indicators of success were defined in relation to the primary objectives of the project (as defined elsewhere in this document), and include:

- The establishment of a sustainable coastal marsh island system.
- Stability of the marsh terrace structures.
- Establishment of a sustainable SAV community.

What data will be collected and how will it be used to measure success?

Data collection for the project has been detailed in the proposed monitoring plan and includes two sets of data: one set associated with as-built surveys to establish baseline reference conditions for subsequent monitoring efforts, and monitoring data to assess the success of the project in meeting the indicators defined above. Baseline and monitoring data will be compiled in an annual report and distributed to permitting agencies, and stakeholders as appropriate, to fulfill monitoring requirements and ensure success criteria are being met and maintenance needs are addressed.

Baseline data, which is proposed to be collected after the completion of each of two phases of terrace installation, will include the following data:

- Coordinates and diagrams of established transects, as well as site photographs from photo stations established along each sampling transect, as defined in the Methods section of the monitoring plan.
- Final location of all planted vegetation (upland plantings, high marsh plantings and low marsh plantings).
- Final location and extent of SAV plantings.
- Final grade topographic surveys (plan, profile, and cross sections).
- Discussion of the project design versus as-built conditions.

Monitoring data will be collected at the end of the full growing season during each monitoring year and include the following:

- Site photographs from photo stations defined in the Methods section of the monitoring report.
- Estimated percent cover and change in coverage from the as-built conditions to sampling year conditions for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- Estimated percent cover and change in coverage from planted conditions to sampling year conditions for SAV planting quadrants

- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

This monitoring data will be used to define success by tracking the establishment of the proposed vegetative communities on and between the proposed marsh terraces as well as the structural integrity of the marsh terrace structures themselves. Vegetation cover thresholds for each year will be defined to ensure planted communities are appropriately established on each marsh terrace. Acceptable measures of deviation will be defined for structural elements to ensure design requirements are met. Maintenance and mitigation measures defined in the monitoring plan will be implemented as required if success criteria are not met during any particular monitoring year.

How was cost effectiveness evaluated and measured against the expected outcomes?

Through a BCA approach using FEMA methods and ecosystem service valuations, a BCR of 1.17 was calculated for the project. This BCR is greater than 1, indicating the project can be considered cost-effective. The project also provides an additional $9.2M in value over the current estimated project costs.

A description of the BCA analysis and methods is provided in the following Benefit Cost Analysis Section.

What products, services, meetings, outreach efforts etc. will be conducted and how will success be measured?

The City is firmly dedicated to fostering meaningful engagement with project partners and external stakeholders throughout the project, with the goal of raising awareness about the project's approach and its benefits and enhancing the likelihood of its successful adoption in other areas within the region and the state.

Activity 4, titled "Stakeholder Engagement and Lessons-Learned Dissemination," provides a comprehensive outline of the City's outreach strategy, encompassing proposed deliverables and outreach endeavors. This strategic plan entails the development of project marketing materials, along with the facilitation of presentations and meetings with local and regional stakeholders, as well as participation in state and national-level conferences.

To gauge the effectiveness of our efforts, the City will employ metrics to track and document the number of individuals engaged throughout the project. This information will be regularly communicated to DCR to serve as a key performance indicator for project success.

For a more detailed breakdown of the tasks and deliverables associated with Activity 4, please refer to the Supporting Documentation section of this application.

Project Progress Monitoring Plan

The City's Project Progress Monitoring Plan is designed to guarantee the seamless and effective execution of the project. We have established a robust internal system to oversee the entire project lifecycle, ensuring that all key stakeholders are aligned with the project's objectives, activities, deliverables, and schedule.

The process commences with a kickoff meeting involving all project partners, where we collectively set the stage for the project. During this meeting, we thoroughly review the project's objectives and scope, ensuring that everyone is on the same page. This initial step is instrumental in fostering a shared understanding of the project's vision and goals among all involved parties.

In addition to the kickoff meeting, we place a strong emphasis on quality assurance and control. We meticulously assess each contractor's quality management system to ensure that well-defined procedures are in place to maintain the highest standards of quality throughout the project. This dedication to quality is paramount to delivering a successful project that meets the City's standards and the expectations of our stakeholders.

The City is committed to ongoing and transparent communication with our design and construction contractors, as well as our advisory stakeholders. Regular meetings will be held to monitor progress, address any potential challenges, and ensure the project adheres to the proposed milestone schedule and deliverables as outlined in this grant application. This proactive approach to project monitoring allows us to stay on track, identify and address issues promptly, and uphold our commitment to the successful completion of the project.

Supporting Documentation

Project Information

The following sections provide details regarding the project site and highlight the impacted population, residential and commercial structures, and critical facilities. This section also provides an overview of the historical, existing, and projected flood conditions in and around the project site.

Population

As shown in Figure 14, two census block groups (518100454.121 and 518100464.001) adjacent to Back Bay are within the extent of the anticipated project benefits. The total population of these two block groups is 3,531.[6] The residential population has grown approximately 1.8% in the past two decades. The median household income in 2021 dollars is $99,078. There are approximately 2,500 residential housing units, of which 43.1% are owner-occupied, 11.4% are renter-occupied, and 45.5% are vacant. The high percentage of vacant housing units can likely be attributed to seasonal rentals within the Sandbridge Resort Area. The race and ethnicity demographics of the community are 94.4% White, 1.4% Black, 3.4% Hispanic, and less than 1% Asian and American Indian.

[6] Population, household income, housing units, and demographic data obtained from Esri ArcGIS Community Analyst (2022). Esri forecasts for 2021 based on U.S. Census Bureau 2010 data.

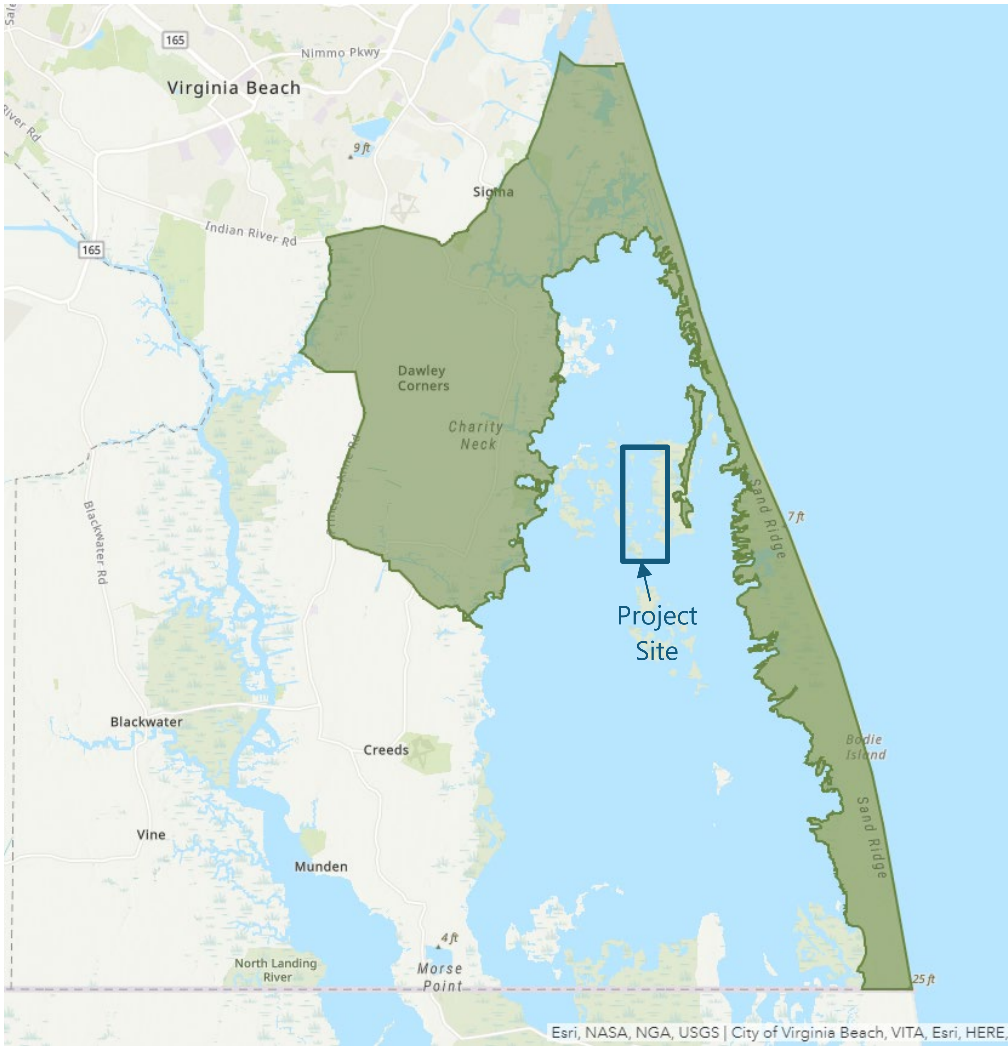

Figure 14: Census block groups selected for population estimates.

Historic Flooding Data and Hydrologic Studies Projecting Flood Frequency

Historical and Existing Flood Data

The project is located within a Federal Emergency Management Agency (FEMA) mapped Special Flood Hazard Area (SFHA), as shown in Figure 15 and Figure 16. Based on the City's current flood maps (effective January 16, 2015), the project site's flood zones are VE, AE, and Open Water. Portions of the site are within Otherwise Protected areas.

The following maps provide an overview of the existing flood hazards for the project area, including the northern boundary (Figure 15) and southern boundary (Figure 16). Based on the City's current flood maps (effective January 16, 2015), the project site contains VE and AE flood zones and Open Water.

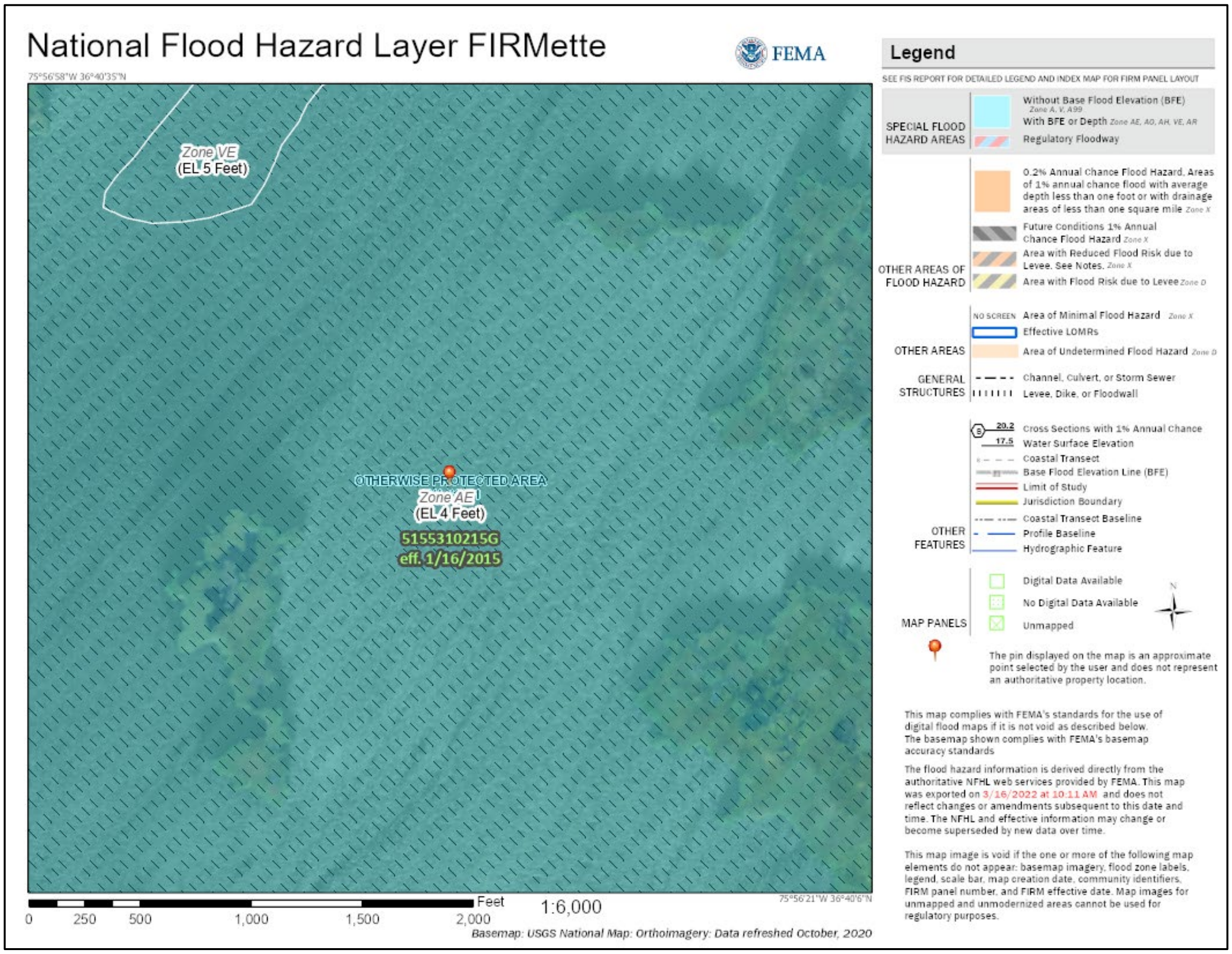

Figure 15: FIRMette for the project area (northern boundary).

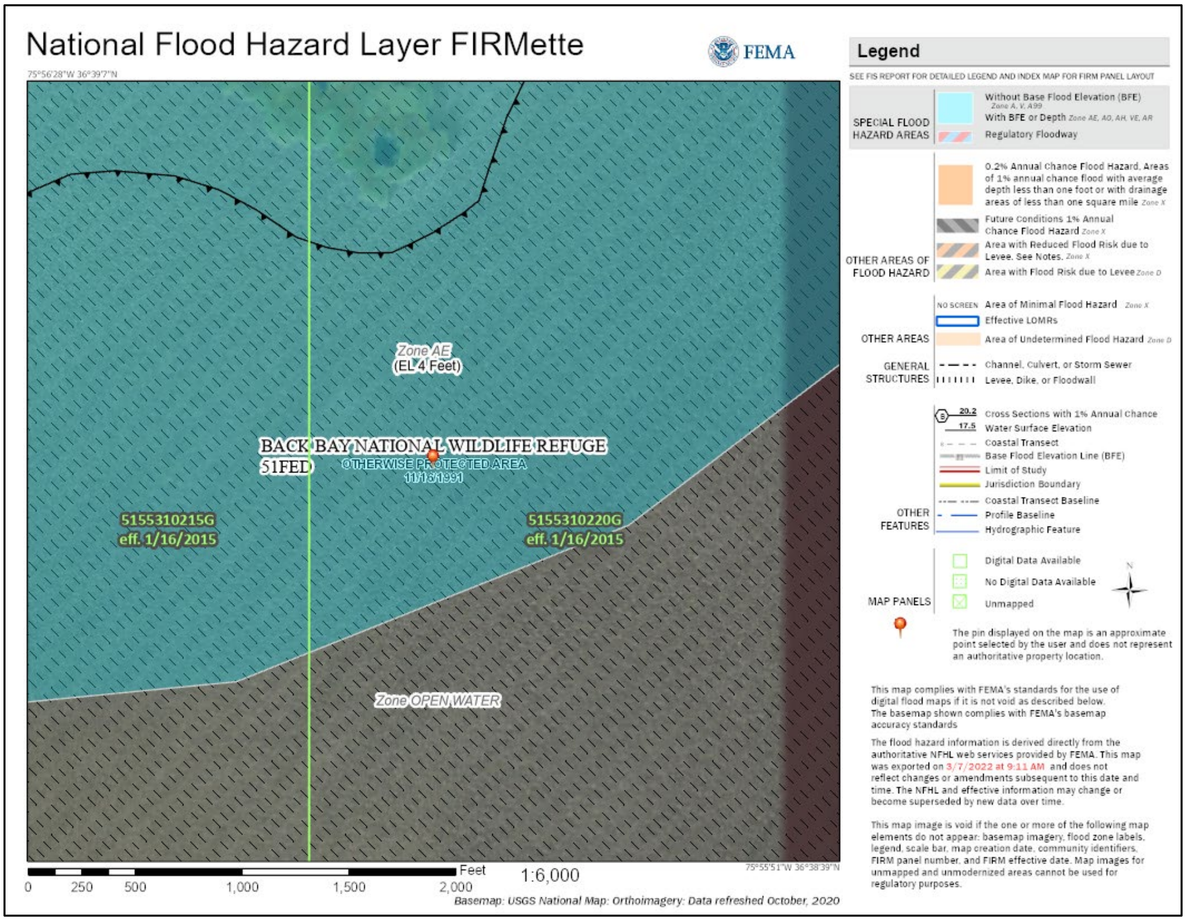

Figure 16: FIRMette for the project area (southern boundary).

The City maintains records of where residents report flood issues and what type of flooding is causing the issue. Residents regularly report flood issues through a hotline, which are then recorded in a flood event database. The census block groups adjacent to the project area reported 111 flood issues associated with heavy rain or high tide between 2001 and 2019. Critical facilities and flood incidences are relatively concentrated in the Sandbridge Resort Area.

Projected Flood Frequency

The USFWS, the City, and other stakeholders have made significant investments in detailed assessments, sophisticated computer models, and water level gauges to better understand historical and future wind tide flooding. Figure 17 displays the projected flood pathways under the 10-year and 100-year storm event under a 3 feet sea level rise scenario surrounding the project site.

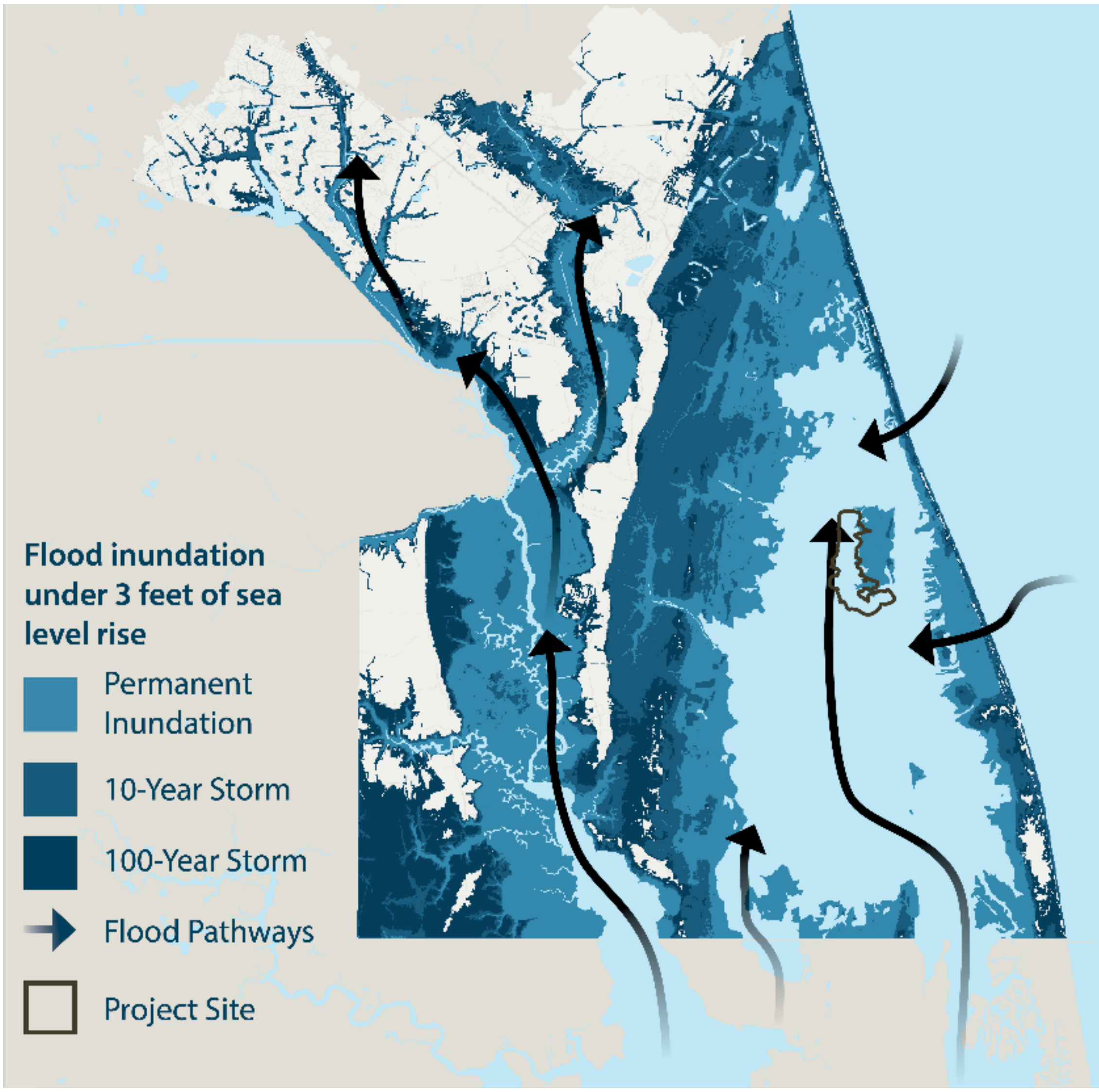

Figure 17: Flood pathways into the Southern Rivers Watershed with 3 feet of sea level rise.

Numerical modeling also shows that as sea levels continue to rise, a shorter duration wind event will produce more wind-induced flooding in less time. The three lines in Figure 18 represent the water level response to a sustained 15-mph wind for each sea level rise scenario. With the existing marsh system today (blue line), it takes approximately five days of sustained southerly wind to cause flooding. With 1.5 feet (yellow line) and 3 feet (red line) of sea level rise, the peak water level could be reached two to three days sooner, respectively. Model simulations showed that marsh island creation across Back Bay would help delay the onset of flooding by several days, which would allow the City and residents more preparation time[7].

[7] City of Virginia Beach. (2018). Analysis of Marsh Response to Sea Level Rise (PDF).

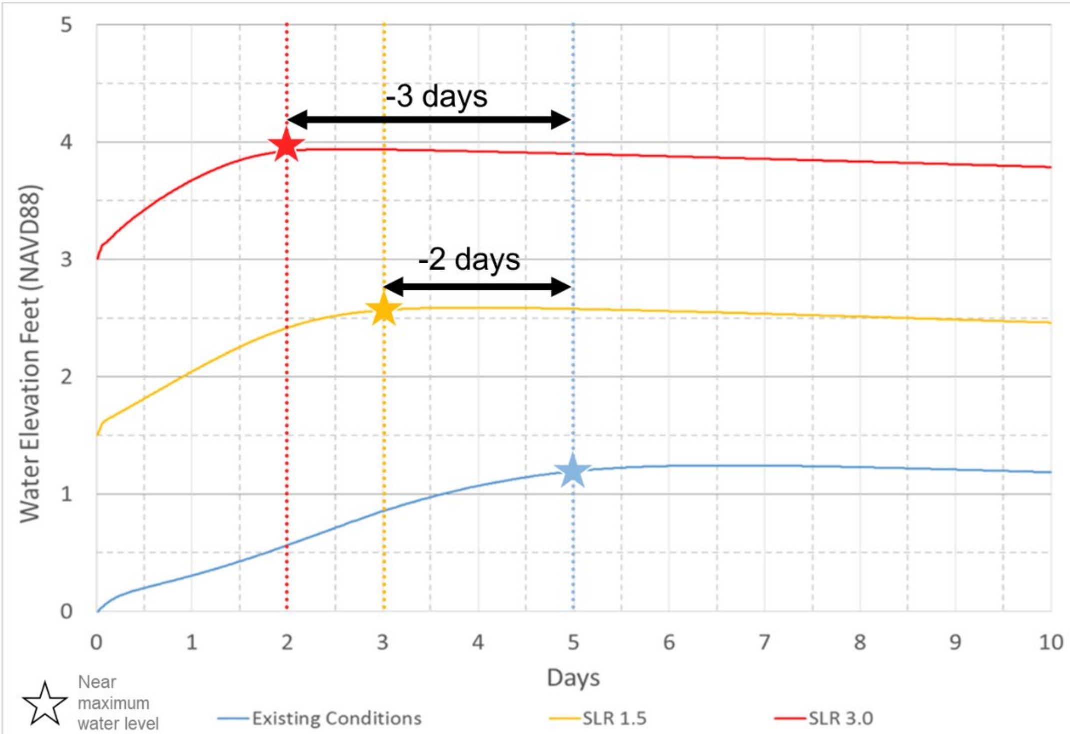

Figure 18: Water-level response under sustained 15-mph southerly wind.

The City analyzed future marsh conditions using the Sea Level Affecting Marshes Model (SLAMM).[7] Figure 19 illustrates areas likely to experience accelerated degradation of marsh in Back Bay due to rising water levels. If no action is taken, substantial marsh loss is projected in Bonney Cove under 3 feet of sea level rise. Within a 1-mile radius of Bonney Cove, the City's SLAMM model predicts that approximately 730 additional acres could be eroded into open water in response to sea level rise. This represents more than a 70% reduction as compared to the existing marsh system surrounding Bonney Cove today. It is also presumed that open water areas would continue to experience high levels of turbidity, which will continue to negatively affect SAV communities in Back Bay.

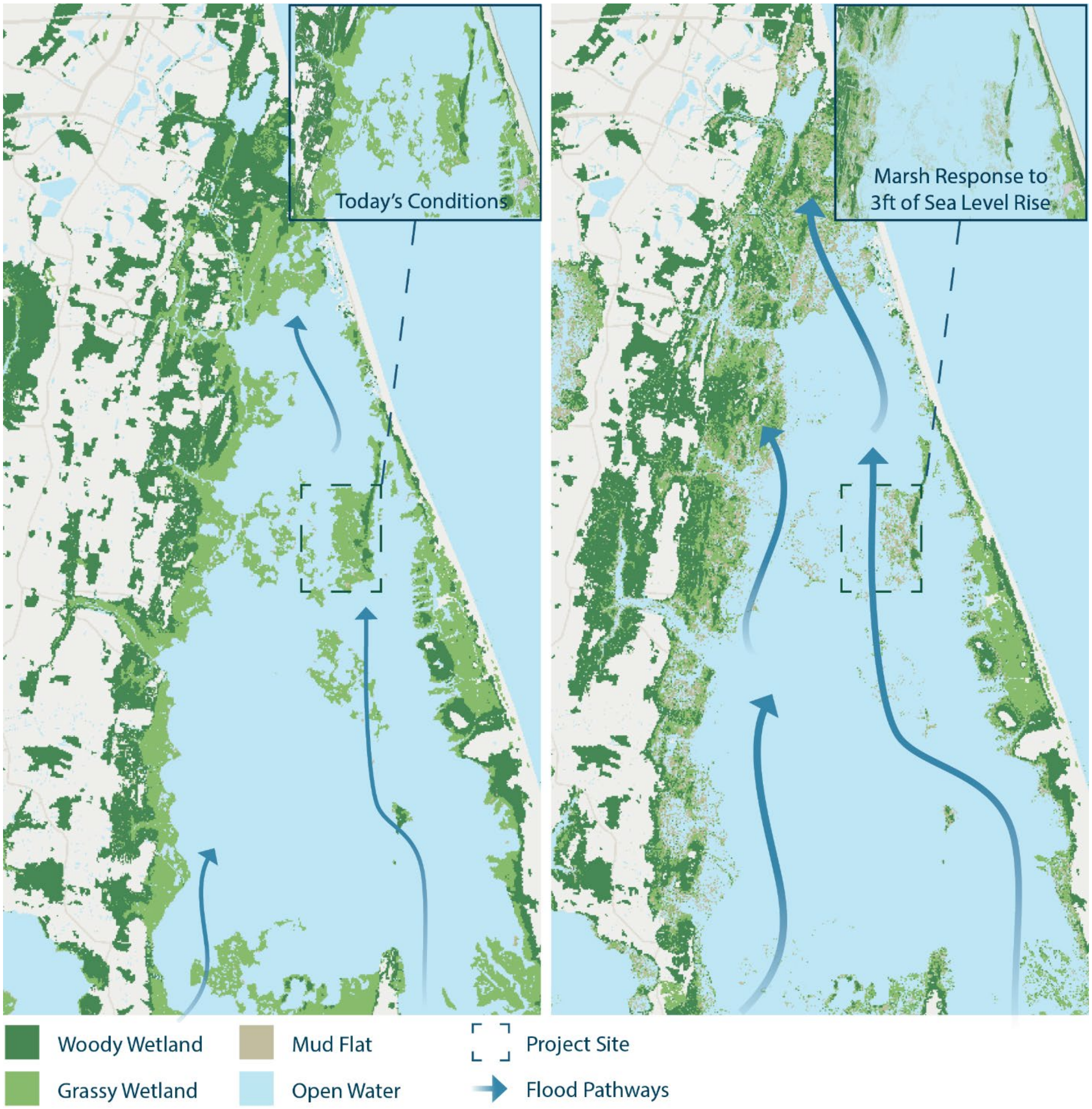

Figure 19: Comparison of current marsh conditions to future marsh conditions with 3 feet of sea level rise.

The proposed project site in Bonney Cove has a predominant south-southwest wind direction, which contributes to significant wave generation in the large unobstructed open-water areas and provides a continuous source of scouring and erosion in those areas. Marsh loss is likely to continue in the project area, creating a negative feedback cycle as continued fragmentation of the marsh would further deteriorate the remaining stands of healthy marsh and increase fetch. Today, the site faces low to medium fetch exposure, but in the future, the site could experience high to very high fetch exposure, as defined by the Virginia Institute of Marine Science (VIMS)

Shoreline Design Guidelines for Shore Protection in Virginia's Estuarine Environments.[8] Projections of increasing fetch at the site, along with the transects used for the wind fetch analysis, are summarized in Figure 20.

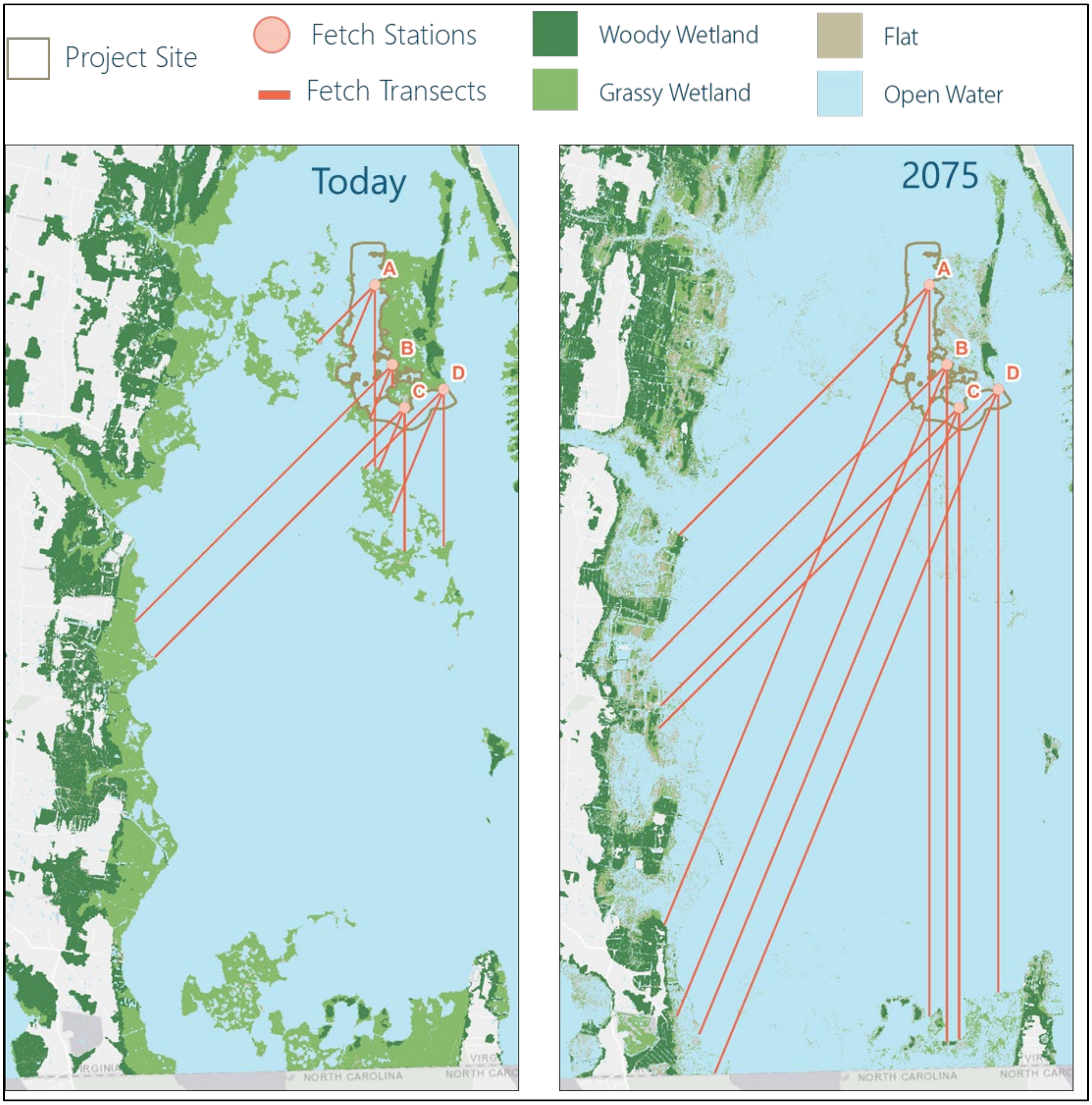

Figure 20: Wind fetch analysis of project area.

The following table displays specific values of fetch distances and classifications that correspond with the transects displayed in Figure 20 above.

[8] Virginia Institute of Marine Science. (2010). Living Shoreline Design Guidelines for Shore Protection in Virginia's Estuarine Environments; Version 1.2 (PDF).

Table 5: Measurements of fetch transects referenced in Figure 20.

Fetch Transect	Length, Miles (Today)	Classification	Length, Miles (3 feet SLR)	Classification
A-SW	0.9	Low	3.7	High
A-SSW	0.7	Low	7.3	Very High
A-S	1.9	Medium	7.7	Very High
B-SW	3.8	Medium	4.4	High
B-SSW	0.6	Low	7.4	Very High
B-S	0.2	Very Low	7.2	Very High
C-SW	3.7	Medium	4.4	High
C-SSW	0.7	Low	7.2	Very High
C-S	1.5	Medium	6.7	Very High
D-SW	1.2	Medium	5.1	Very High
D-SSW	1.4	Medium	7.8	Very High
D-S	1.7	Medium	6.4	Very High

No Adverse Impact

The City conducted additional hydraulic numerical modeling to identify any potential adverse impacts in response to concerns raised during a public meeting in July 2023. The City utilized a Danish Hydraulic Institute MIKE FLOOD model developed for stormwater master planning activities in Lower Southern Rivers Watershed of Virginia Beach. This model encompasses the entirety of Back Bay and extends into North Carolina's Currituck Sound. Model performance has been validated against observations from multiple flood events.

The effort looked at water level and velocities in response to a historical southerly wind tide flood in May 2017 and a northerly wind event associated with Tropical Storm Ophelia in September 2022. These events were ran with model grids depicting with- and without project conditions, considering the 100% project design specifications. The northerly wind event was

included to address concerns from residents of Knott's Island, at the southern end of Back Bay. Both the terrace field and the construction staging area were included in the with-project condition. The modeling found that there were no increases in water levels to areas within Back Bay or to Knotts Island. Negligible changes in water velocity (0.2 ft/s or less) were observed in the channel to the west of the terrace field. No increases in water levels were observed in the area of the construction staging area.

Local Government to Provide its Share of the Cost

The City of Virginia Beach is fully prepared to cover the cost share of the proposed project, as highlighted in the attached budget narrative, "Amount of Cash Funds Available." The funding for the grant match is contained within the City budget.

Benefit-Cost Analysis

FEMA recognizes the economic value of restoration projects and has provided ecosystem service economic valuations for benefit cost considerations. The approach and values used here are consistent with FEMA Benefit-Cost-Assessment (BCA) toolkit approaches and ecosystem service valuations published in "FEMA Ecosystem Service Value Updates, June 2022[9]." The 2022 FEMA guidance provides methods and values for various nature-based projects, including coastal wetlands. The valuations recognize ecosystem services for coastal wetlands including aesthetic value, climate regulation (carbon sequestration), flood and storm hazard reduction, habitat, recreation/tourism, water filtration and supply benefits of coastal wetland features.

Feasibility and Effectives Criteria

The project meets FEMA's Feasibility and Effectives Criteria for a Coastal Wetland as defined in the 2022 guidance, including:

- Land cover associated with the project is a "Estuarine and Marine Wetland" as classified for NWI for remaining marsh within and adjacent to the study area. The area of the project is also a historical marsh.
- The project demonstrates "ecosystem restoration" by using the terrace approach to recover degraded, damaged, and destroyed wetlands and submerged aquatic vegetation in the Back Bay ecosystem.
- The project meetings EPA concepts of restoration through direct creation of marshes (the terraces themselves) and enhancement of the ecosystem (reduction of water turbidity to enhance growth of submerged aquatic vegetation).
- The project will result in notable increased health and function of the local ecosystem in the "after mitigation" scenario through reduction of wave heights, water flow, and significantly decreased turbidity within the project area, as well as reduction of wave heights to adjacent areas.

[9] FEMA Ecosystem Service Value Updates, June 2022 (PDF).

- The project approach was aligned with established principles and techniques on wetland restoration, as outlined in the Coastal Wetlands and Tidal Flats section of the International Guidelines on Natural and Nature-base Features for Flood Risk Management10.

Design Life

As mentioned, the project useful life is 30-years. The FEMA 2022 guidance allows 50-years a typical lifespan; however, as stated in the project description, the elevation of the terraces was set based on a 30-year design life and estimated settlement.

Ecosystem Services Valuation

- The 2022 guidance values ecosystem services for coastal wetlands at $8,955 in 2021 U.S. dollars (USD), per acre, per year.
- The project will restore 46.5 acres of intertidal and upland marsh through direct creation of the marsh terraces. The project will also promote the growth of SAV in between the terraces, an area estimated at 310 acres. This provide for a total project benefit area of (46.5 + 310) = 356.5 acres.
- Project benefits occur over a period of time into the future; while most of the project costs are incurred up front and in the present. FEMA conducts its BCAs on a net present value basis, meaning the present value of the benefits gained from the project over the life of the project are compared to the total project cost to establish the BCR. Because project benefits accumulate over time, project benefits are calculated on an average annual basis ("annualized") and then multiplied by a Present Value Coefficient (PVC) to determine the present value of the annualized benefits.
- The present value coefficient is calculate as follows:

$$PVC = \left[\frac{1-(1-r)^{-T}}{r}\right]$$

  where *r* is the discount rate and *T* is the useful life of the project. The CFPF 2023 Grant Manual does not specify a discount rate for the benefits calculation; therefore, the latest FEMA program grant guidance was reviewed. For the 2023 FEMA Building Resilient Infrastructure and Communities (BRIC) and Floodplain Mitigation Assistance Grant Program (FMA) cycles FEMA has established a set discount rate of 3%[11]. The 3% discount rate provides for a PVC of 19.60 for a 30-year lifecycle for the project.
- Project benefits were calculated by:

$$Benefits = PVC \times Project\ Area \times Coastal\ Wetland\ Benefits$$

- The benefit cost ratio (BCR) was calculated as:

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[10] International Guidelines on Natural and Nature-Based Features for Flood Risk Management - Engineering With Nature (dren.mil)

[11] FEMA Fact Sheet. Notice of Funding Opportunity for Fiscal Year 2023 Building Resilient Infrastructure and Communities Program (PDF).

$$BCR = \frac{Benefits}{Costs}.$$

A summary of the calculated values is provided in the below table:

Table 6. Summary of BCA parameters and results.

Project Area	Benefits (acre / year, 2021 USD)	Project Lifespan	Benefits, 3% discount rate	Project Cost	BCR, 3% discount rate
356.5	8,954	30	$62,566,588	$53,378,490	1.17

The calculated BCR for the project was 1.17, based on the FEMA ecosystem services valuation approach. This BCR is greater than 1, indicating the project can be considered cost-effective. The project also provides an additional $9.19M in value over the project cost.

Local Floodplain Management Regulations

The City recognizes the vital importance of floodplains in the natural movement of water through the community. Appendix K of the Virginia Beach Code of Ordinances regulates development in the community's floodplains. The City requires that a permit is obtained for any construction or development in the Special Flood Hazard Area. For more information and details regarding the City's floodplain management and ordinances, please refer to the following:

- Link to current floodplain ordinance: Virginia Beach Floodplain Ordinance.

In addition, a copy of the current floodplain ordinance has been included in *Part IV, Section E5*. For further information regarding the City's hazard mitigation and comprehensive planning, please refer to the following:

- Link to current hazard mitigation plan: Regional Hazard Mitigation Planning.
- Link to current comprehensive plan: Virginia Beach Comprehensive Planning.

Other Necessary Information to Establish Project Priority

Repetitive Loss and/or Severe Repetitive Loss Properties

The repetitive loss database shows 113 repetitive loss and severe repetitive loss properties within the two census block groups (518100454.121 and 518100464.001) associated with the project area.

Residential and/or Commercial Structures

A detailed economic flood loss assessment presented in the City's Resilience Plan showed that approximately 45% of the entire future risk exposure in the City is concentrated in the Southern Rivers watershed. Of that risk, 65% is concentrated in three communities north of Back Bay

(Figure 21).[12] Under a "no action" scenario, average annualized flood losses would increase from $974 thousand, representing present day conditions, to $6 million with 1.5 feet of sea level rise as anticipated by 2050. This figure equals an increase of six times present day conditions. With 3 feet of sea level rise as anticipated by 2080, annualized losses are expected to drastically increase to $80 million, more than 80 times today's conditions.

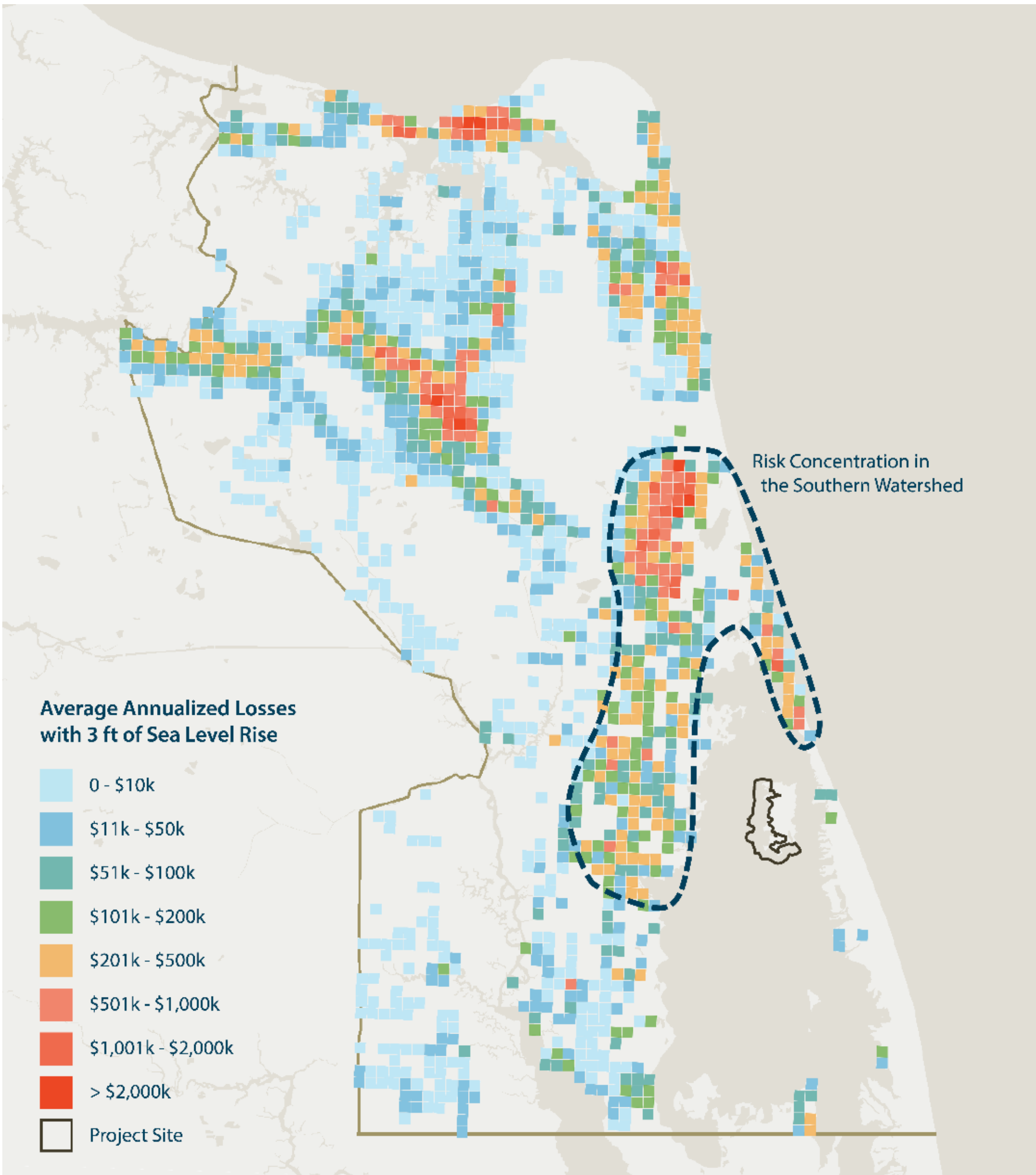

Figure 21: Concentration of average annualized losses estimated with 3 feet of sea level rise under a "no action" scenario presented in the City's Resilience Plan.

[12] City of Virginia Beach. (2020). Coastal Flooding and Economic Loss Analysis (PDF).

Within the two census block groups adjacent to Back Bay near the project area, there are approximately 70 commercial structures and 2,350 residential structures. Of those structures, approximately 635 structures are vulnerable to flooding during a 50-year event today. With 3 feet of sea level rise, approximately 2,060 structures are expected to be vulnerable during a 50-year event, representing approximately 85% of the residential structures within the project vicinity. These numbers underscore the importance of implementing the proposed project alongside complimentary flood risk reduction projects.

Critical Facilities

The two census block groups near the project site include 10 critical facilities. Table 7 summarizes critical facilities by type, total number, and the number of facilities exposed to the 50-year storm scenario under current and future "no action" scenarios. Under current 50-year storm conditions, 2 communication facilities and 1 electric power station would be exposed to flooding. With 3 feet of sea level rise, the number of critical facilities exposed to flooding increases to 9 total facilities.

Table 7: Summary of critical facilities located in the selected census block groups and flood hazard exposure to the 50-year storm event under current conditions and with 1.5 feet and 3 feet of sea level rise.

Type of Facility	Number of Facilities	Current 50-year storm	50-year storm with 1.5 feet sea level rise	50-year storm with 3 feet sea level rise
Communication	3	2 (66%)	2 (66%)	3 (100%)
Electric Power	1	1 (100%)	1 (100%)	1 (100%)
Fire Station	1	0	0	0
Potable Water	2	0	2 (100%)	2 (100%)
School	1	0	0	1 (100%)
Wastewater Treatment	2	0	0	2 (100%)

Need for Assistance

The City of Virginia Beach has invested significant time, money, and staff resources in understanding, communicating, and planning for the threats of sea level rise and recurrent flooding to the community. The City is ready to begin the implementation of adaptation measures, and the marsh terrace project is the first project to advance to construction from the City's Resilience Plan. The project represents the first step in restoring Back Bay and the larger Albemarle-Pamlico estuary, and serves as a pilot for additional restoration projects. Virginia Beach understands that flood mitigation costs are substantial and is seeking funds to support project implementation alongside dedicated resources procured by the City. The City's

Department of Public Works Stormwater Engineering Center has closely coordinated with the City's Department of Planning & Community Development throughout the design and permitting process. The Department of Public Works will oversee the construction of the marsh terrace project, including providing construction inspectors to monitor that the project is built to the City's design standards and technical specifications. Additionally, the City has access to necessary software, including AutoCAD and ArcGIS Desktop, and support from consultants to augment the City's technical capabilities.

Examples of City staff who will support the project include the following:

- Program Manager for the Technical Services Division of the Stormwater Engineering Center.
- Project Manager for Green Infrastructure Projects for the Technical Services Division of the Stormwater Engineering Center.
- Environmental Planner / Certified Floodplain Manager from the Wetlands & Shoreline Construction Team of the Planning Administration Division of the Department of Planning & Community Development.
- Planning Evaluation Coordinator from the Chesapeake Bay Preservation Area & Southern Rivers Watershed Team of the Planning Administration Division of the Department of Planning & Community Development.
- Full-time Construction Inspector assigned exclusively to this project from the City's Construction Bureau or under contract with the City Public Works Engineering Division.
- Grant Coordinator from the City's Public Works Engineering Division.

Additional staffing will be provided as needed to ensure project success.

This project benefits communities in northern Back Bay with a high concentration of flood losses (as shown in Figure 21). These communities contribute significantly to Virginia Beach's rural economy, including agriculture, forestry, fishing, hunting, and eco-tourism. In Hampton Roads, these industries contribute a combined $100 million in gross domestic product.[13] Protection of vulnerable natural infrastructure, such as the marshes in Back Bay, is critical to ensuring these industries can continue to thrive within the region.

Alternatives

Several other alternatives were considered but not advanced due to technical and environmental limitations. These alternatives are briefly summarized below.

[13] Office of Governor Ralph S. Northam Commonwealth of Virginia and Virginia Department of Conservation and Recreation. (2021). Virginia Coastal Resilience Master Plan Phase 1 (PDF); data referenced sourced from the US Bureau of Economic Analysis. (2019).

Alternative 1 - No Action Alternative

Under this alternative, no action would be taken to restore marsh habitat in the shallow open water channel of Bonney Cove. Erosion of the adjacent marsh would continue to occur, resulting in fragmented habitat lacking the capacity to reduce wave action and slow water velocities. It is anticipated that wind-driven flooding events will continue to increase in frequency, resulting in increasing flooding of the low-lying properties and roadways surrounding northern Back Bay.

Alternative 2 - Alternative Terrace Configuration Design(s)

Several configuration alternatives for the terraces were considered during the design process. These included four alternative layouts with different spacing and terrace top widths:

- **Alternative 2a** (Figure 22): Terraces would be spaced at approximately 300-foot intervals and have a top width of 15 feet. Between the base of the terraces, there would be approximately 220 feet for potential establishment of SAV habitat.
- **Alternative 2b** (Figure 23): Terraces would be spaced at approximately 300-foot intervals and have a top width of 30 feet. Between the base of the terraces, there would be approximately 200 feet for potential establishment of SAV habitat.
- **Alternative 2c** (Figure 24): Terraces would be spaced at approximately 600-foot intervals and have a top width of 15 feet. Between the base of the terraces, there would be approximately 520 feet for potential establishment of SAV habitat.
- **Alternative 2d** (Figure 25): Terraces would be spaced at approximately 600-foot intervals and have a top width of 30 feet. Between the base of the terraces, there would be approximately 500 feet for potential establishment of SAV habitat.

A common feature across all of these design alternatives was a breakwater that spanned the entire length of the southern extent of Long Island and a northern breakwater that spanned the northern exposed section of the project site.
Alternative 2a and 2b were eliminated due to constructability concerns regarding the quantity of sediment that would be required and due to the limited amount of room for SAV establishment in between the terraces (approximately 220- and 200- feet of potential SAV habitat between terraces for Alternative 2a and 2b, respectively).

Alternatives 2c and 2d were discussed extensively amongst the project team; however, it was ultimately determined that they did not maximize the opportunity for species diversity (by including both smaller and larger terraces). These alternatives were combined to form the preferred alternative presented in this document. Additional refinements that were made to these alternatives include the removal of the perimeter breakwater, as the proposed design elevation evaluated in the geotechnical analysis revealed stability issues with these large features.

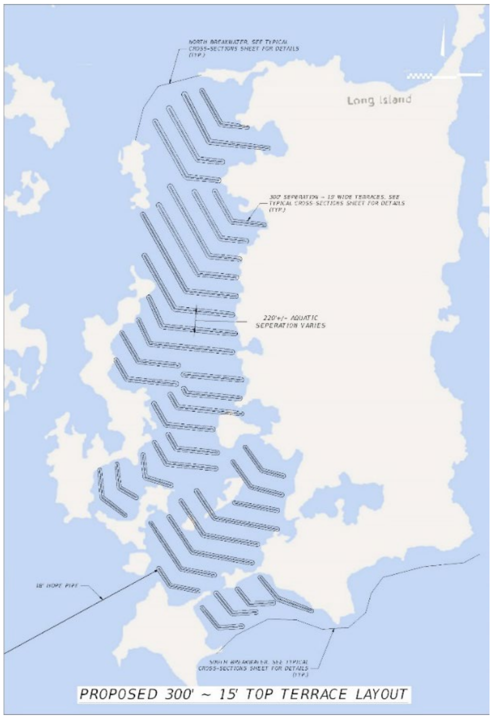

Figure 22: Alternative 2a.

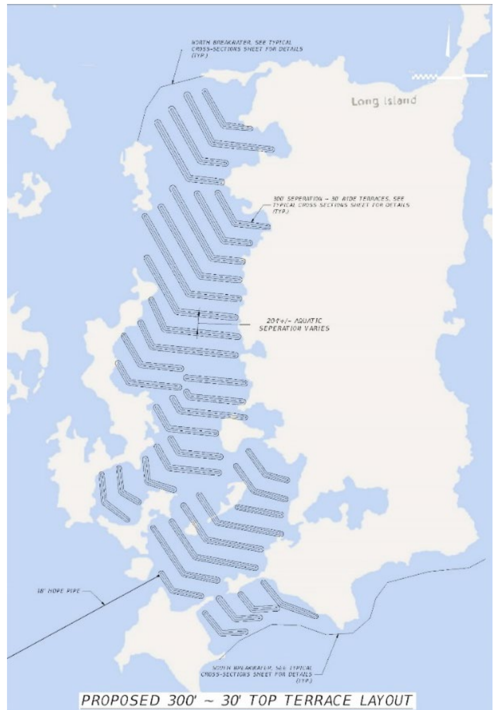

Figure 23: Alternative 2b.

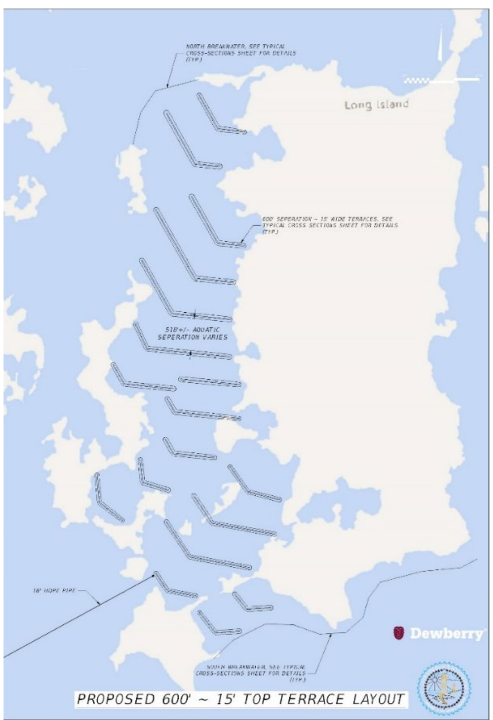

Figure 24: Alternative 2c.

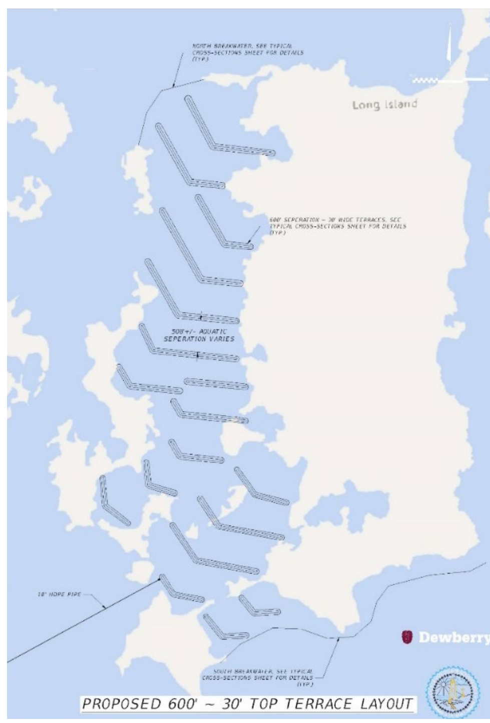

Figure 25: Alternative 2d.

Alternative Terrace Core Material Sources and Transportation – Alternative 3

In the proposed alternative with sand cores, a no-dredging alternative was considered. However, in order to successfully complete the project and establish the vegetation desired, material would need to be sourced, blended, transported, and placed. The City helped identify two potential borrow sources of material: Bow Creek Golf Course (Figure 26) and the Whitehurst Dredged Material Management Area (DMMA) (Figure 27).

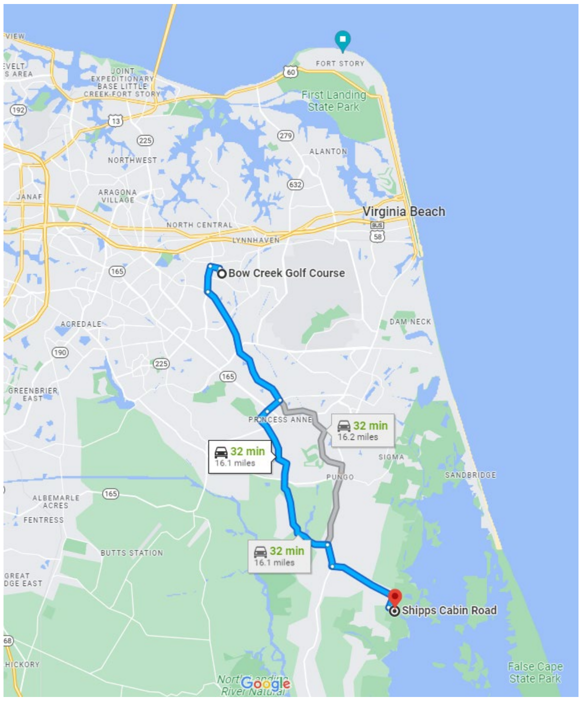

Figure 26: Distance from Bow Creek Golf Course to the proposed Shipps Cabin staging area.

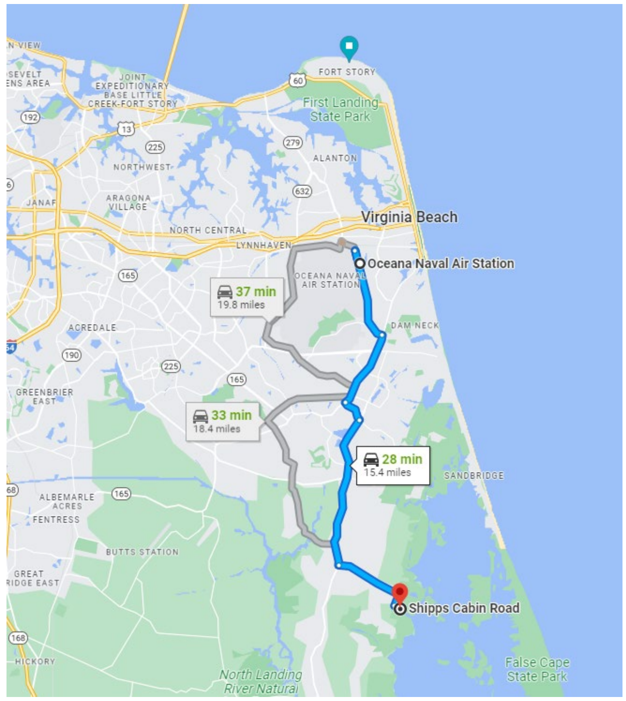

Figure 27: Distance from Whitehurst DMMA to the proposed Shipps Cabin staging area.

Bow Creek Golf Course: Bow Creek Golf Course is located approximately 16 miles from the proposed Shipps Cabin staging area. In the next few years, The Bow Creek Golf Course is scheduled to be converted into a Stormwater Park as one of 21 projects funded by the City's Stormwater Flood Protection Program. Large quantities of materials will be removed from the site for use within the City. The material from Bow Creek would need to be excavated, screened, and tested for foreign seeds and contaminants. Most likely, this material would have to be processed before it could be loaded again on dump trucks and hauled approximately 16 miles to a potential staging area where it would be loaded again on shallow draft barges.

Whitehurst DMMA: The Whitehurst DMMA is a similar distance to the proposed Shipps Cabin Road Construction Staging Area. The material at Whitehurst may not have to be processed as much; however, it would need to be tested for foreign seeds and contaminants. Because of the organic components in this soil and the need for the material to establish vegetation on the terraces, this material is not able to be hydraulically blended and pumped to the site. Therefore, this material would need to be loaded on shallow draft barges and then

placed by mechanical means. Further, the amount of material needed to cap the proposed terraces is approximately 110,000 cubic yards which equates to roughly 5,500 quad-axle dump trucks traveling city streets and damaging other infrastructure.

Barging of all materials was considered. Dewberry conducted meetings, site investigations, and talked with both industry leaders in maritime construction and locals who know the water in Back Bay. A typical 35-foot by 95-foot construction barge drafts approximately 7 feet. This type of barge is not able to be trucked to the landing site, nor is it able to be brought into Back Bay. There are truckable barges, but again the drafts of those barges can be in the 4 to 5 feet range when loaded and would require dredging a channel for access. Shallow draft barges can be used in Back Bay that only draft 1 to 3 feet, and they would need to be off-loaded from a staging site. To bring any materials such as stone, sandy fill, or terrace cap material by barge around Knotts Island is not feasible. The actual channel into the southern point of Back Bay has a height restriction due to the causeway serving Knotts Island.

Continuous Marsh Platform – Alternative 4

A continuous marsh platform to fill in the areas of historical marsh would help to restore this eroded habitat but would not provide conditions suitable for SAV establishment or optimize the wave/flow velocity attenuation through the project area. Furthermore, for a single marsh platform across Bonney Cove, the amount of material required would be more than 3 or 4 million cubic yards of material. To achieve that volume of material by dredging, significant areas of existing SAV present in Back Bay would need to be impacted. As the geotechnical report indicated, the existing material of the project site and surrounding areas is not capable of supporting itself in a constructed arrangement and would slough off back into the water. Further, providing this amount of material without dredging would require bringing external sediment sources into Back Bay, which could introduce invasive species. Finally, while the platform will reclaim marshland, it is not anticipated to establish extensive areas appropriate for SAV reestablishment and would eliminate deeper water areas preferred by some endemic wildlife species.

Goals and Objectives

The overarching goal of this project is to construct the City's first nature-based adaptation project in the Southern Rivers Watershed and one of the CRMP's exemplary nature-based projects. This project aims to stabilize two critically eroding marsh islands from further degradation, decrease turbidity to promote the growth of aquatic vegetation and provide flood risk reduction benefits through increased friction and wave attenuation. The following section summarizes the objectives through which this goal will be realized.

Objective 1 – Create a Construction Access and Staging Area

The project's first objective is to employ a construction approach that is compatible with the shallow nature of Back Bay and the large quantity of material required to build the marsh terraces. The engineering team performed a constructability review of suitable landing sites to

stage construction operations for the terraces. A property located at the end of Shipps Cabin Road (Figure 28) was identified as the preferred staging and construction access location for the following reasons:

- Shipps Cabin Road Construction Staging Area Proximity to site (2 miles).
- Shipps Cabin Road Construction Staging Area Proximity to sand borrow sources.
- Shipps Cabin Road between Muddy Creek Road and the Construction Staging Area is in disrepair and was identified as an opportunity to improve the condition of the road as part of the construction activities.

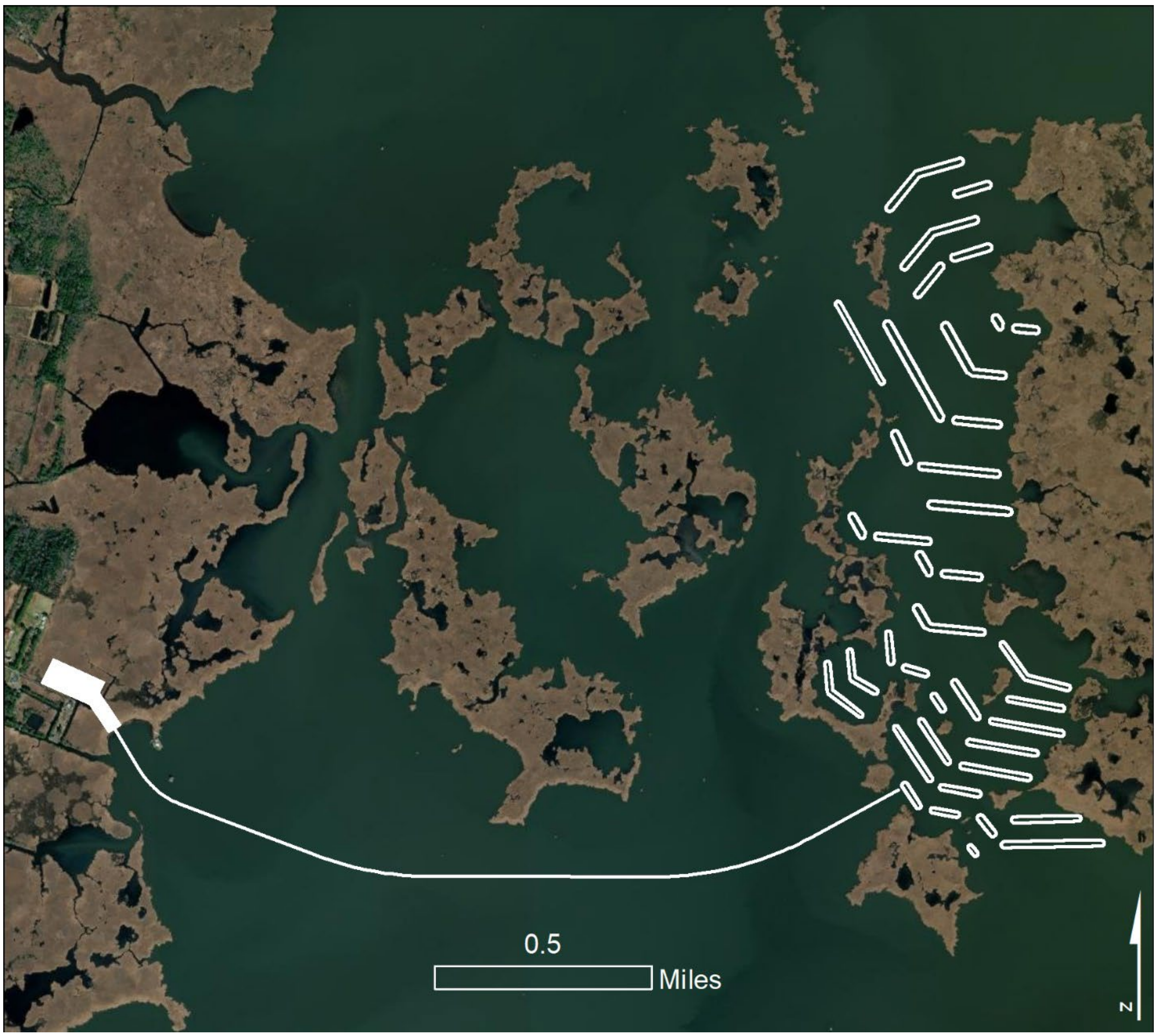

Figure 28: Proposed Construction Access.

On completion of the project, the City plans to retain the staging area for future monitoring and maintenance needs for the project. This future use is consistent with the sentiments of local stakeholders, as communicated during public engagement meetings for the study.

Expected Benefits:

- Enables constructability of the marsh terraces.
- Enable access to the project for post-construction monitoring and future marsh restoration projects.

Objective 2 – Restore Marsh and Aquatic Vegetation

The second objective of the project is to restore marsh and aquatic vegetation for habitat and flood resilience. Specifically, the City's construction of the marsh terraces will result in the restoration of approximately 46 acres of habitat within Back Bay, consisting of:

- 10 acres of low marsh habitat; low marsh plantings would include Big Cordgrass (*Spartina cynosuroides*) and Saltmarsh Cordgrass (*Spartina alterniflora*).
- 6 acres of high marsh habitat; high marsh plantings would include Black Needlerush (*Juncus roemerianus*) and Salt Meadow Hay (*Spartina patens*).
- 14 acres of upland vegetated habitat; upland vegetation would include Arrow-leaf Tearthumb (*Persicaria sagittate*), Groundsel Tree (*Baccharis halimifolia*), Wax Myrtle (*Myrica cerifera*), and Bald Cypress (*Taxodium distichum*).
- 16 acres of submerged terrace habitat anticipated to create suitable conditions for the emergence of SAV.

Additionally, approximately 310 acres of open water SAV habitat would remain between the proposed marsh terraces, and it is anticipated that construction of the terraces would create conditions within the project area favorable to the re-establishment of SAV populations.

Expected Benefits:

- Reduce wave heights, flow velocities, and wind sheer stress within the project area to protect marsh islands from continued erosion.
- Restore the natural buffer that helps protect low-lying neighborhoods and critical access roads from wind-driven flooding.
- Improved water quality by removing excess nutrients.
- Lowered transport of suspended sediment and prevention of resuspension of fine sediments in the water.
- Reduced flow velocity and absorbing wave/wind energy to reduce shoreline erosion.
- Creation of habitat (nursery and feeding areas) for fish (such as Largemouth Bass, Bluegill Yellow Perch, Striped, Blueback Herring, Alewife, and American Eel), migratory waterfowl (such as the Canvasback Duck [*Aythya vallisineria*]), and other aquatic animals.

Objective 3 – Engage Stakeholders and Disseminate Effective Practices

The City is committed to continued meaningful engagement with project partners and external stakeholders throughout the restoration and monitoring phases to ensure transferability to other sites in the region and state.

Expected Benefits:

- Ensure that the lessons from this project can be transferred and scaled to other sites in the state or region.

Approach, Milestones, and Deliverables

The following approach, milestones, and deliverables lay out a plan of action. The milestone schedule follows in *Section B: Milestone Schedule*.

Approach & Deliverables

Activity 1 – Construction Staging Area Preparation and Construction

Activity 1 involves preparing the Shipps Cabin Road property as a construction staging area. Construction activities will include stabilization of the road, laying geotextile to stabilize the ground under the construction staging area, filling with material for the construction staging area, adding fencing, creating bridge abutments and installing a temporary bridge and ramp for waterfront construction access, construction of slurry basins, and establishment of traffic flagging stations.

In the final step, the contractor will install pipe to pump the slurry material from the Shipps Cabin staging area to Bonney Cove. The pipe will be floated with subaqueous tie-downs at channels and certain points of access to maintain boat crossings. Those subaqueous locations will be marked by a buoy every 10 feet and temporary signage as reasonable. The contractor will install two booster stations along the alignment, one approximately half-way between the landing and Bonney Cove, and one at the edge of Bonney Cove. These booster stations will consist of a pontoon-mounted diesel engine pump capable of moving the sand slurry from the construction staging area to the site. It is estimated that 150 CY per hour of sand slurry would be pumped through the pipe in a 60:40 ratio. Additional booster stations may be required for manifolding and supplying slurry stations to individual terraces.

Relevant Objective(s): Objective 1

Deliverables:

- Conduct daily inspections to monitor construction progress of the Shipps Cabin Road Construction Staging Area preparation.

Assumptions:

- It is anticipated that the Shipps Cabin Road Construction Staging Area construction activities can occur simultaneously with material production in Year 1 (2024).

Activity 2 – Marsh Terrace Construction

Once the Shipps Cabin Construction Staging Area preparation is complete, marsh terrace construction activities can commence. The contractor will construct the terraces according to the 100% Final PS&E documents. The most recent engineering designs and design report are available upon request; they are not included as an attachment to this proposal due to file size. Figure 29 shows the overall layout of the terraces, and Figure 30 and Figure 31 show the project renderings. Terrace construction will begin in the northern extent of the project site at Terrace #100, noted in Figure 29, and the contractor will work south towards Terrace #140. The contractor will complete each terrace (including installation of plants) before moving onto the next.

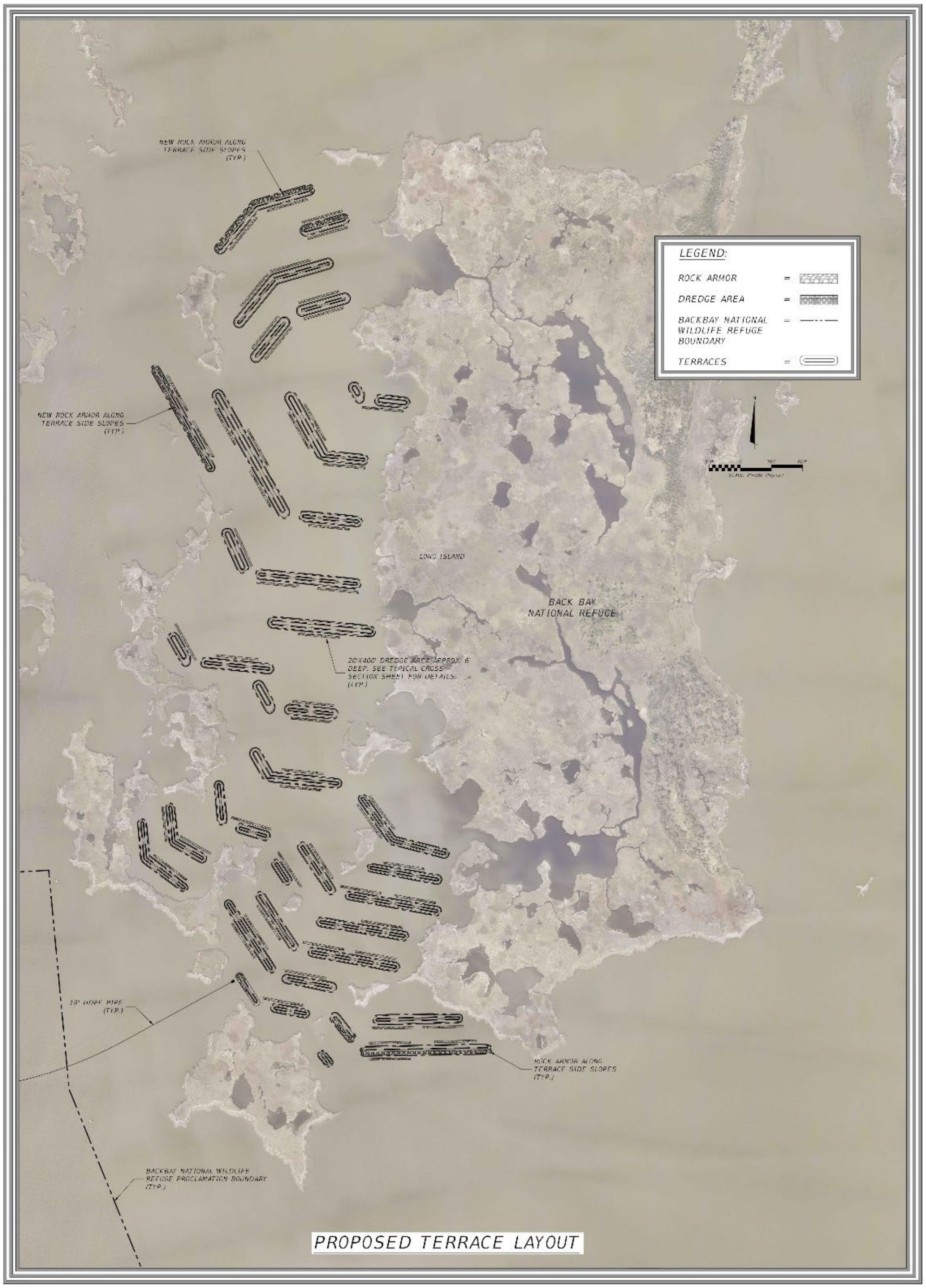

Figure 29: Marsh terrace layout across Bonney Cove.

Figure 30: Marsh terrace design rendering.

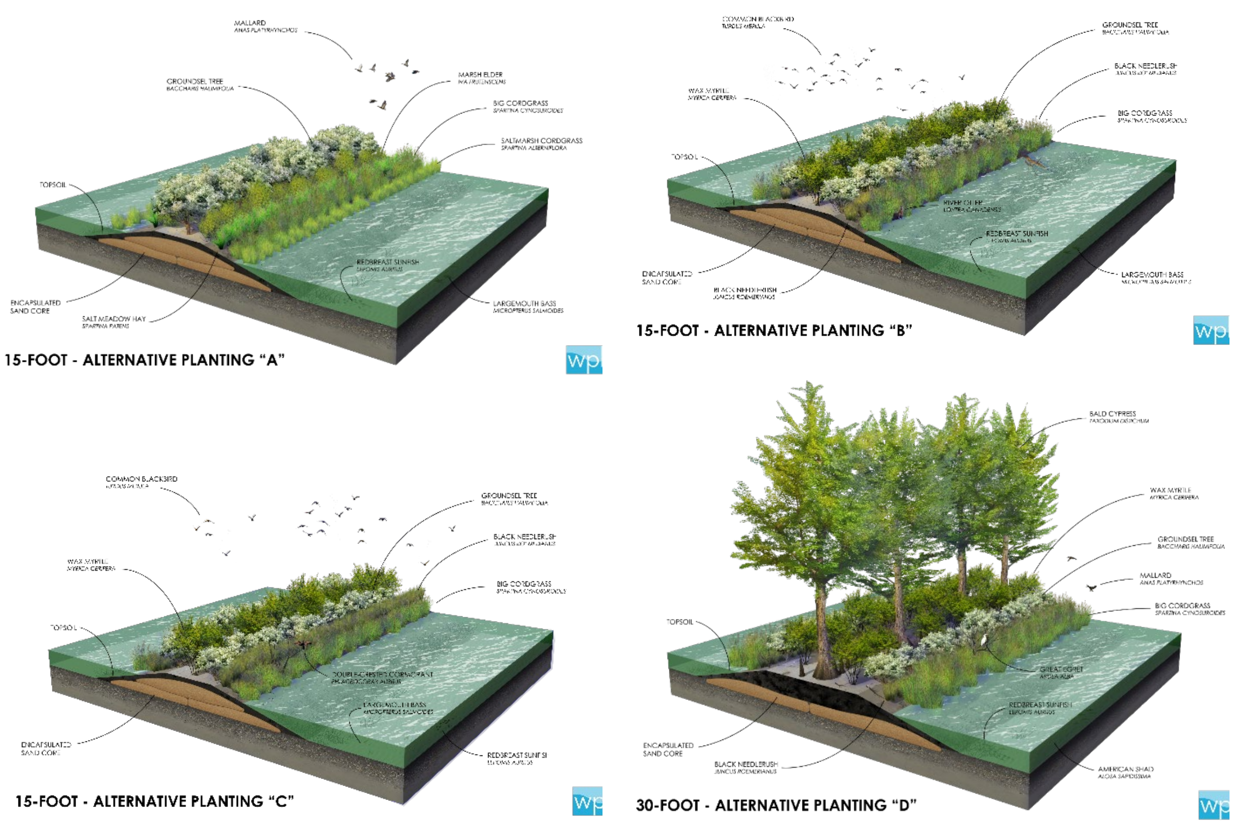

Figure 31: Marsh terrace cross-section design renderings.

The following section provides a high-level description of the proposed design and

construction approach.

Terrace Orientation:

The orientation of the terraces will be perpendicular to the predominant wind direction (south-southwest) to maximize wave energy reduction. The terraces in the northern extent of the project site will be angled perpendicular to a north-northwest wind direction. The terraces would be segmented in a chevron pattern (duck-wing pattern) to provide the most favorable fish and swimming crustacean (termed "nekton") habitat while also allowing adequate circulation to promote sedimentation and maintaining navigability throughout the project area. The terraces would not be connected to the adjacent marsh; this gap, or physical open water barrier, is intended to deter the invasion of Common Reed (*Phragmites australis*) stands from adjacent marshes.

Spacing:

The terraces would be spaced at approximately 300-foot intervals in the northern and southern quarters, and then 600-foot or greater intervals in the center. This arrangement aims to lessen the open water and subsequent wave action at the northern and southern ends of the site and allow adequate construction space for marine-based construction equipment.

Terrace Elevation and Width:

To achieve a sustainable marsh elevation throughout the project life, the marsh terraces would initially be built to a higher elevation during construction and allowed to settle to the desired target elevation over time. Taller terraces improve the functionality and resiliency of the system while also providing diversified habitat for fish and wildlife. The goal is that, by the end of the 30-year design life and with 1.5 feet of relative sea level rise, the terraces will be at or above the elevation of a moderate wind tide event (when Back Bay water levels are anticipated to reach +3.0 feet NAVD88 over the design water level). This threshold was determined to ensure the terraces would not be fully overtopped during a future wind tide event and maintain resiliency to anticipated sea level rise. The 1.5 feet sea level rise scenario is consistent with the near-term planning scenarios identified in the City's Resilience Plan to represent conditions from 2035 to 2050 and adopted by the Hampton Roads Planning District Commission (HRPDC) as part of resolution number 2018-01.

The terraces would have a top width of 15 or 30 feet and be built to an elevation of +4.5 to +5.0 feet NAVD88, depending on the width of the crest, underlying soils, and local bottom depth, with side slopes of 4 horizontal to 1 vertical (4H:1V). The +4.5- to +5.0-foot elevation is calculated based on a target elevation of +3.0 feet NAVD88 or higher at the end of the project's 30-year design life and an estimated settlement of approximately 1 to 2 feet, depending on where the terrace is located. The geotechnical investigation revealed that terraces in the site's southern portion are expected to experience greater settlement than those to the north.

Terrace Composition:

The terraces would consist of a sand-filled core that is encapsulated by a high-strength blend of woven and non-woven geotextile fabrics. The sand for this material will come from nearby offsite sources and be pumped through the 1-inch diameter pipe described in Activity 2. Once the cores are in place, long-reach excavators would travel along the tops of the terraces and begin to shape the cross slopes. Existing adjacent material devoid of SAV would be mechanically dredged and placed over the sand-filled cores. The marsh terraces would be covered with 1 to 3 feet of suitable fill, depending on crest widths, and then planted with native emergent and brackish plant species to stabilize the terraces and provide wind-driven flood reduction benefits.

Relevant Objective(s): Objective 2

Deliverables:

- Conduct daily inspections to monitor construction progress of the marsh terraces.

Assumptions:

- It is anticipated that construction of the terraces will occur in two phases over two years from 2025 through 2026, with the following assumptions:
    - Construction activities are not permitted within BBNWR from October 31 through February 28, annually, to limit disturbance to wintering waterfowl and migration during those months.

Activity 3 – Stakeholder Engagement and Lessons-Learned Dissemination

As the first large scale terracing project on the Atlantic coast, the City recognizes the importance of documenting lessons learned and effective practices during each of the proposed activities: contractor procurement, construction, and post-construction monitoring. The City plans to develop a set of project marketing materials (PowerPoint presentations, StoryMap, information flyers, etc.) to cover key topics, such as:

- Lessons learned during contractor procurement, construction, and post-construction monitoring.
- Effective practices for contractor procurement, bid development, and evaluation. This project is expected to require a highly specialized contractor given the complexity of the project, very shallow water depths, and distance of the site from available construction access and staging areas.
- Guidance for identifying the best sources for local and regional materials for building the terraces and developing a project construction schedule with enough lead time for producing the quantity of material needed for large-scale marsh creation projects.
- Effective practices for developing a post-construction monitoring plan for marsh terraces that a) aligns with permitting, grant, and other requirements and b) enables quantification of project benefits and areas for improvement.

- Effective practices for communicating project benefits based on a combination of field data collection, numerical modeling, and post-construction monitoring.

The City plans to leverage the materials to facilitate dissemination to key stakeholders to increase likelihood of transferability of the approach to other areas in the region and state. The City's plan for engagement is summarized in the following table. In addition to these efforts, the City is committed to collaborating with DCR to identify any additional opportunities to help socialize the project's innovative design and lessons learned.

Table 8: Summary of opportunities for City, regional, state, and national stakeholder engagement; expected benefits.

	Description of Proposed Outreach Activities
CITY	• Facilitate internal municipal awareness, coordination, and approval to gain budgetary approval for funding to expand the approach to other sites in Back Bay (such as "The Great Narrows", Mackay Island and Princess Anne Wildlife Management Areas, and Ragged Island) through presentations to the: o Virginia Beach City Council o City Manager Working Group for SLR and Recurrent Flooding, comprised of representatives from all City departments, to facilitate awareness, coordination, and action to advance the project to the restoration phase. • City of Virginia Beach Management Leadership Team (MLT), which includes the City Manager, Deputy City Managers, and Department heads from across the City.
REGION	• Collaborate with the National Audubon Society and Albemarle-Pamlico National Estuarine Partnership (APNEP) to: o Highlight the marsh terrace project as a success story in the next iteration of the Currituck Sound Coalition Marsh Conservation Plan. o Explore opportunities for marsh terrace projects in the Knotts Island Channel, a key flood pathway into Back Bay, as well as other locations in the Currituck and Albemarle-Pamlico Sound. • Share lessons learned to regional and state stakeholders, improving knowledge-based, awareness, and capacity for future efforts through presentations to: o Hampton Roads Adaptation Forum – a regional dialogue for academics, non-profits, consultants, and municipalities committed to resilience measures. o The Hampton Roads Planning District Commission (HRPDC) Coastal Resiliency Committee . o Regional conferences on green infrastructure, coastal resilience, and SLR adaptation. • Collaborate with Wetlands Watch, a regional non-profit organization committed to the protection of wetlands using nature-based solutions, to socialize the project and disseminate lessons learned.

	Description of Proposed Outreach Activities
STATE	• Continue to coordinate with the Virginia Department of Conservation and Recreation (DCR) to: o Promote the project as a success story for the State Coastal Master Plan (CRMP), which highlighted the project as an "exemplary" resilience project that aligns with the Commonwealth's objective to protect and enhance the state's natural infrastructure. o Incorporate project updates and lessons learned on the CRMP website is an excellent mechanism for dissemination to all coastal Planning District Commissions (PDCs)/Regional Commissions (RCs) across the state. • Continue to collaborate with The Nature Conservancy (TNC), a national player in guiding the implementation of nature-based strategies, to help disseminate lessons learned on project implementation. The City has engaged in early discussions with TNC about partnering to host a state-level workshop that would draw from the network of TNC's local and regional chapters • Presentations at state-level conferences on water resources, floodplain management, and resilience, such as hosted by Resilient Virginia and Virginia Lakes and Watersheds Association.
NATION	• Disseminate lessons learned/effective practices through presentations at 1-2 relevant national conferences such as Restore America's Estuaries, Association of State Floodplain Managers, or the American Shore and Beach Preservation Association, etc. • Leverage working relationships and existing contract work with the U.S. Army Corps of Engineers and partners to integrate lessons learned into the International Natural and Nature-Based Feature Design Guidelines to promote consideration of marsh terraces within similar Back Bay environments (for example, in North Carolina, Maryland, New Jersey, and New York).

Relevant Objective(s): Objective 3

Deliverables:

- Project marketing materials.
- Records documenting number of stakeholders engaged during outreach activities.

Activities Not Included Under this Grant

Submerged Aquatic Vegetation Transplant Plan: The City will evaluate opportunities for restoring native submerged aquatic vegetation populations in Back Bay, such as Wild Celery (*Vallisneria americana*), through consultations with subject matter experts. After terrace construction, the City will formulate a plan for planting submerged aquatic vegetation in between the terraces in coordination with identified partners and the construction contractor.

Post-Construction Monitoring: Post-construction monitoring and inspections will occur for a minimum of five (5) years following construction. Given the period of performance for the CFPF grant, post-construction monitoring activities have not been included in this application.

Milestone Schedule

The scope of work proposed in this grant application are scheduled to occur between June 2024 and June 2027. Work activities are anticipated to complete in December 2026; however, the proposed schedule extends through June 2027 for contingency. The project's expected progression is shown in the following milestone schedule, noting deliverables for each milestone:

2024 Activities

- *1st Quarter* ***(pre-grant period activities):***
  - 100% Final PS&E
  - Submit Bid Documents
- *2nd Quarter (pre-grant period activities):*
  - Final Bid Coordination/Acceptance
  - Construction NTP
- ***Begin Year 1 Grant Activities – 2nd Quarter 2024:***
  - Mobilization for Shipps Cabin Road Construction Staging Area
  - Initiation of Marsh Terrace Material Production
- *3rd Quarter:*
  - Construction NTP and Mobilization for Slurry Basin Installation
- *4th Quarter:*
  - Completion of Shipps Cabin Road Construction Staging Area and Slurry Basin Construction

2025

- *1st Quarter*
  - Completion of Marsh Terrace Material Production
  - Construction Mobilization for Marsh Terraces (beginning on March 1, 2025)
  - Oversight, Management, and Inspection Services of Slurry Basin Installation
- ***Begin Year 2 Grant Activities - 2nd Quarter 2025***
  - Construction of Marsh Terraces #100 – 105
- *3rd Quarter*
  - Construction of Marsh Terraces #106 – 114
- *4th Quarter*
  - Construction of Marsh Terraces #115 – 119
  - Marsh Terrace Construction Demobilization (to accommodate break in construction period from October 31, 2025 – February 28, 2026)

2026

- *1st Quarter*
  - Construction Re-Mobilization for Marsh Terraces (beginning on March 1, 2026)
- ***Begin Year 3 Grant Activities - 2nd Quarter 2026***

- Construction of Marsh Terraces #120 – 134
- *3rd Quarter*
  - Construction of Marsh Terraces #135 – 140
- *4th Quarter*
  - Shipps Cabin Road Construction Staging Area Final Improvements & Demobilization

2027

- *1st and 2nd Quarter*
  - *Contingency for any delays experienced through end of 2026*

End Year 3 Grant Activities

Project Partners

The following table highlights the specific project partners, their roles, and their capabilities concerning the proposed project.

Table 9: Potential Project Partners.

Entity	Role	Description
U.S. Fish and Wildlife Service, Back Bay National Wildlife Refuge	Project Partner / Advisor / Adjacent Land Owner	BBNWR owns the land adjacent to the project footprint and monitors migratory bird hunting within Presidential Proclamation boundaries. BBNWR has coordinated with the City on project design and will continue to be involved during project construction as a stakeholder and advisor.
Virginia Department of Wildlife Resources	Project Advisory / Stakeholder	The City has coordinated closely with VDWR on project design. Furthermore, VDWR has been monitoring SAV distribution in Back Bay for decades and will be a critical partner for identifying native seagrass species and techniques for restoration based on extensive experience from previous SAV restoration projects in Back Bay.
Virginia Beach Department of Planning & Community Development	Permit Compliance	The City's Department of Public Works has been in close coordination with the City's Department of Planning & Community Development throughout the design and permitting process. Continued involvement and coordination during construction and post-construction monitoring is anticipated.
Dewberry	Engineering Contractor	Engineering consultant to support the City with contractor procurement and construction administration.
To be Determined	Construction Contractors	Construction contractor for the Shipps Cabin Road Construction Staging Area and marsh terrace construction activities.

Entity	Role	Description
Friends of Back Bay	Project Advisory / Stakeholder	Friends of Back Bay was formed in the 1980s to lead efforts to expand and conserve BBNWR, including securing millions in funding to support the Refuge's expansion. The City has coordinated with the BBNWR Society throughout the design and permitting process and will continue this coordination through construction and post-construction monitoring.
Back Bay National Wildlife Refuge Society	Project Advisory / Stakeholder	The Back Bay National Wildlife Refuge Society (BBNWR Society) is an independent, 501(c)(3) non-profit group dedicated to supporting the mission of the USFWS National Wildlife Refuge System and specifically promoting awareness of the BBNWR through education and participation. The City has coordinated with BBNWR Society throughout the design and permitting process and will continue this coordination through construction and post-construction monitoring.
Back Bay Restoration Foundation	Project Advisory / Stakeholder	Back Bay Restoration Foundation (BBRF) is an independent, 501(c)(3) non-profit group focusing on growing concerns about issues such as recurrent flooding, sea level rise, and development in the Southern Rivers Watershed. The group aims to serve as an advocate for the Bay and surrounding residents. The City has coordinated with BBRF throughout the design and permitting process and will continue this coordination through construction and post-construction monitoring.

Relationship to Other Projects

This project represents the first nature-based project in the Southern Rivers Watershed to advance to design and construction to implement the City's Wise Resilience Plan. The project is also an aspect of the Stormwater Green Infrastructure aspect of the City's Flood Protection Plan. The City has received a $3M award from the CFPF to support another project in the Stormwater Green Infrastructure element of the Flood Protection Program – the Elizabeth River Wetland and Floodplain Restoration Project (Round 1 CFPF Grant Awards).

The City has also received two NFWF NRCF grants from the Marsh Restoration in Back Bay project. Approximately $135,000 in NFWF NRCF funding was awarded in 2020 for the previous phase (design and permitting) for the project. The City continues to meet the obligations and period of performance of this NFWF grant. In 2022, the NFWF NRCF awarded $9,886,400 to support construction activities.

In its Resilience Plan, Virginia Beach identifies an adaptation approach for the Southern Rivers Watershed that emphasizes natural mitigation methods and integrated systems of defenses. As a natural mitigation strategy, the marsh terrace project aims to serve as a first line of defense during flood events, reducing wind-driven fetch, wave energy, and flow velocities to protect the important marsh buffer surrounding the shorelines of Back Bay. Other projects are also needed to provide multi-layered flood protection to northern Back Bay communities (Figure 32). Several

of these projects are highlighted below. It should be noted that the projects described below are either not yet funded or will be funded in the future through the City's Capital Improvement Program.

Figure 32: Southern Rivers Watershed Adaptation Vision.

Marsh island restoration serves as a critical first line of defense of the multi-layered protection system in the Southern Rivers Watershed. The following map (Figure 33) shows the structural adaptation projects proposed for the Southern Rivers Watershed, including the Muddy Creek Road and Sandbridge flood defense systems. The City's numerical modeling shows that, if implemented, there is potential for small increases in flooding outside of these structural protection systems.[14] This emphasizes the need for complimentary measures, including the marsh terrace project, land acquisition, and conservation efforts, to mitigate this residual risk.

[14] City of Virginia Beach (2020). City-wide Structural Alternatives for Coastal Flood Protection (PDF).

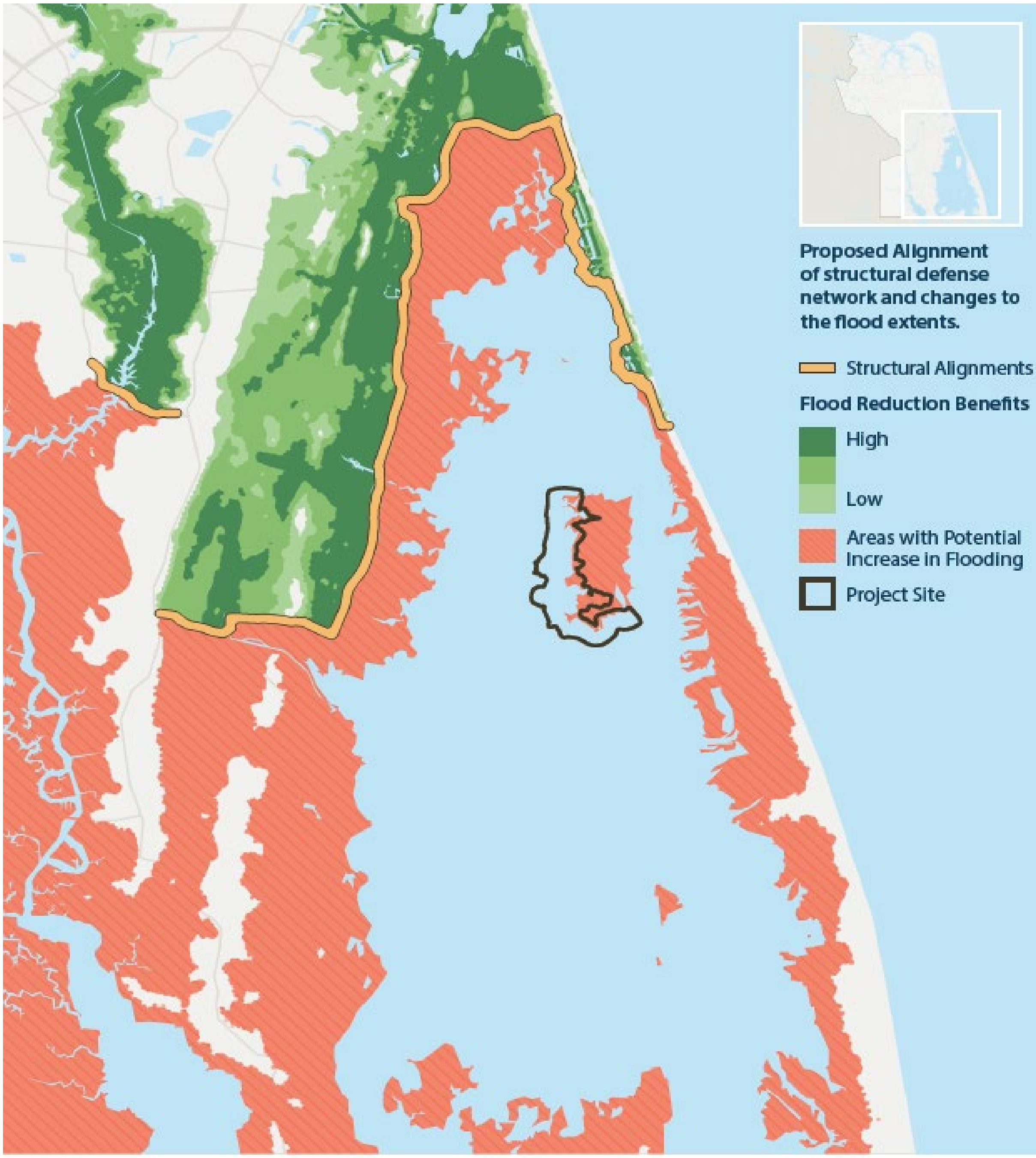

Figure 33: Structural adaptation projects proposed for the Southern Rivers Watershed, including the Muddy Creek Road and Sandridge flood defense systems.

Backside of Sandbridge Flood Defense System

Protection of the Sandbridge resort community from increasing coastal flood hazards would require a complex and expensive structural protection system because of the manufactured land configuration on the backside of Sandbridge. The proposed protection system includes elevating Sandbridge Road and constructing a network of seawalls, levees, and gates along the Back Bay shoreline of Sandbridge. This project does not have designated funding at this time.

Hell Point Creek Flood Defense System

As part of the integrated Sandbridge City-Wide flood defense network, a storm surge barrier across Hell Point Creek could block flood waters originating from Back Bay. Sandbridge Road would also need to be raised to ensure floodwaters could not flank the system. This project does not have designated funding at this time.

Sandbridge/New Bridge Intersection Improvements

Road and shoulder improvements are planned to increase safety at the New Bridge Road/Sandbridge Road intersection and reduce the need for road closures due to flooding from the adjacent Ashville Creek.

Muddy Creek Road Flood Defense System

Muddy Creek Road provides access to important rural and agricultural communities and Back Bay and the Wildlife Refuge. Muddy Creek Road is one of the lowest-lying roadways in all of Virginia Beach and frequently floods. This City-Wide Structural Alternative Flood Protection analysis identified this roadway as a critical location to provide flood protection. The proposed system, known as the Muddy Creek Road Alignment, would transform much of Muddy Creek Road into a levee, with the road on the top. The City's numerical modeling effort shows that the Muddy Creek Road Flood Defense System could potentially increase flood risk to the east of Muddy Creek Road, as shown in Figure 33. Therefore, the implementation of nature-based strategies suitable to the low-lying shorelines of Back Bay is essential to mitigate these impacts. This project does not have designated funding at this time.

Voluntary Acquisition Program

Virginia Beach City Council has recently funded a $2.0 million City-wide voluntary acquisition program to encourage flood-prone property owners to apply for a buyout. Parcels acquired by the City, in the Southern Rivers Watershed, would then be converted to open space to serve as flood storage and a marsh migration buffer.

Stormwater Master Plan

The City Council initiated an update of the City's Stormwater Master Plan in 2014. This effort is interchanging information with aspects of the City's Resilience Plan to account for the impact of sea level rise on the stormwater system's performance. Specific stormwater drainage improvement projects are included within the Lower Southern Rivers Watershed Drainage Basin.

Virginia Coastal Resilience Master Plan

The CRMP highlighted the marsh terrace project as an exemplary nature-based resilience project. The CRMP emphasizes Virginia Beach's strategic use of multiple funding streams to implement a large-scale nature-based project. DCR’s contribution to the project’s construction could be highlighted as a success story for implementation of the CRMP.

Audubon North Carolina Currituck Sound Coalition Marsh Conservation Plan

In coordination with Audubon North Carolina, the Currituck Sounds Coalition identified marsh restoration priorities based on criteria for siting restoration projects, including vulnerability to sea level rise, historic increase in surface water, and distance to hardened shorelines. This assessment identified Virginia Beach's marsh terrace project site as a high-priority area for restoration. There is an opportunity to highlight this project as a success story in the next iteration of the Audubon's Marsh Conservation Plan, which is slated to be updated every three years.

Maintenance Plan

Standard maintenance measures have been defined as part of the draft Annual Monitoring Plan and Post-Construction Monitoring Report developed for this project. See Attachment 5 for a copy of the draft report.

Subsequent to the monitoring period, project maintenance will be addressed by the City's Public Works Stormwater Operations Group, who will also respond to any maintenance issues identified by the monitoring effort or other observers. The City intends to maintain the construction staging area to support future project maintenance needs. The City will perform inspections every 2-5 years and make any repairs needed for the life of the project after completion of the initial monitoring program.

As described by the draft Annual Monitoring Plan and Post-Construction Monitoring Report, maintenance measures include the replacement of plantings (including upland, marsh and SAV plantings), the removal of debris from the terraces, the removal of invasive vegetation identified in the planting areas, the addition of sediment to eroding areas of the terraces, and the replacement of waterfowl barriers as necessary. In addition, structural maintenance measures that might be identified and prescribed during monitoring efforts include replacement of dislodged stones, addition of stone to address structure settlement, and general repair of sand cores or other structural elements. As proposed, these measures would become conditions of the wetland permits required for this project, in addition to standard commitments and requirements defined by the permitting agencies.

In addition to the commitments made in the monitoring plan, and those anticipated to be defined during the permitting process, it is the assumption that the placement of the proposed marsh terrace structures in state waters (subaqueous bottoms) will require the City to maintain the marsh terraces in perpetuity. As previously defined through coordination with VMRC, the City would obtain a compensable interest in the property that has been filled on top of state-owned subaqueous bottomlands (i.e. the terraces). As such, the City would be responsible for maintaining the proposed marsh terraces structures to ensure they fulfill their intended functions, as defined in the objectives and indicators of success previously defined in this proposal.

Criteria

The project receives a total score of **65 Points**. An explanation of how the project meets each

of the applicable scoring criteria contained in Appendix D is provided below.

Eligible Project (Type)

Category/Points: Wetland/floodplain restoration, Living shorelines and vegetated buffers (25 Points)

Explanation: Marsh terraces are considered a type of wetland restoration or a component of a living shoreline project:

- Wetland Restoration: Wetland restoration aims to reestablish or enhance natural wetland ecosystems. Marsh terraces can be constructed in areas where wetlands have been degraded or lost, and they help to recreation or support wetland functions. They provide habitat for various species, improve water quality, and can contribute to the overall health and resilience of a wetland ecosystem.
- Living Shoreline Project: Living shorelines are designed to protect shorelines from erosion while also promoting ecological and environmental benefits. Marsh terraces are often used as a component of living shoreline projects. They can serve as a buffer against wave action, stabilize shorelines, and create suitable habitat for marsh and aquatic species.

Social Vulnerability Index Score

Category/Points: Low Social Vulnerability (0 Points)

Explanation: Based on the Virginia Flood Risk Information System (VFRIS) Social Vulnerability Index Layer, the Social Vulnerability Index scores of the communities located in the two census block groups adjacent to Back Bay near the project site are -1.07 and -0.43 (an average of -0.75), which falls into the Low Social Vulnerability category.

Community Scale Benefits

Category/Points: More than one census block group (30 Points)

Explanation: As documented in the *Supporting Documentation - Project Information – Population* section of this document, the project is anticipated to benefit two census block groups (518100454.121 and 518100464.001).

Expected Lifespan of Project

Category/Points: Over 20 Years (10 Points)

Explanation: As documented in the *Supporting Documentation – Approach, Milestones, and Deliverables – Activity 3 (Marsh Terrace Construction)* section, the marsh terraces have a 30-year design life.

Budget Narrative

The following budget narrative details the proposed project expenditures. See Appendix B for completed budget spreadsheet.

Estimated Total Project Cost

The current estimated total project cost is **$53,378,490.** This estimate includes design, site acquisition for the construction staging area, construction, inspections and support, implementation, and contingencies, as shown in the below table. The design engineer's opinion of probable cost for construction is provided

Project Activity	Capital Improvement Program Estimate
Design	$276,800
Site Acquisition	$50,000
Construction	$41,839,900
Inspections and Support	$5,609,200
Implementation	$750,000
Contingencies	$4,852,590
Total:	$53,378,490

Funds Requested from the Fund

The City is requesting a total of **$5,000,000.00** in funding from the CFPF Round 4. These funds will support contractual services of the engineering consultant and construction contractor to execute Activity 2 (Construction Staging Area Preparation and Construction) and Activity 3 (Marsh Terrace Construction). No support is requested for City personnel.

These funds will be used to support ongoing construction activities through 2024-2026. Example activities include contractor construction services, mobilization/demobilization, construction staging area construction, slurry pipe installation, portions of the terrace materials, and waterfowl barriers. Construction costs are based on a detailed estimate from the design engineer that includes detailed breakdown of estimated quantities and costs from the 95% design package using industry standards for the anticipated aspects of the project construction. The City has withheld the detailed estimate as it provides information that would affect bidding on the construction.

Amount of Funds Available

The City as prime recipient is providing a cash match of $38,356,966 from funds fully programmed and available from the City's Flood Protection Program Capital Improvement Program to support the project. The Flood Protection Program is supported by a related bond referendum that provided $567.5M to fund more than 40 projects identified for Phase 1 of the Program. The program is tightly managed by the City, an independent contractor, and has a resident oversight board. The City is fully confident these funds will be available for constructing this project.

The City's dedicated funds will provide cash match to cover contractual services to support Activity 1 (Construction Staging Area Preparation and Construction), Activity 2 (Marsh Terrace Construction), Activity 3 (Stakeholder Engagement and Dissemination), and all related City support and direct overhead costs related for the project.

The National Fish and Wildlife Foundation is also supporting the project through two grant awards from the National Coastal Resilience Fund. This includes an initial award of $135,124 in 2020 for design and a second award of $9,886,400 in 2022 to support construction. The 2022 grant funds are dedicated to purchasing the native vegetation and a portion of the materials needed to build the marsh terraces.

A summary of project costs, funds available, and funds requested is provided below:

Item	Amount
Project Cost:	$53,378,490.00
Funding Sources Available	
NFWF Grant:	$10,021,524.00
CFPF Grant Request:	$5,000,000
City Funds Available:	$38,356,96600
Total Project Funding:	**$53,378,490.00**

Authorization to Request for Funding

Please refer to *attachment* for the documentation authorizing the funding request.

Attachment 1: Virginia Beach Resilience Plan DCR Approval

Matthew J. Strickler
Secretary of Natural Resources

Clyde E. Cristman
Director

COMMONWEALTH *of* VIRGINIA
DEPARTMENT OF CONSERVATION AND RECREATION

Rochelle Altholz
Deputy Director of Administration and Finance

Russell W. Baxter
Deputy Director of Dam Safety & Floodplain Management and Soil & Water Conservation

Nathan Burrell
Deputy Director of Government and Community Relations

Thomas L. Smith
Deputy Director of Operations

July 20, 2021

Toni Utterback, P.E.
Department of Public Works
2875 Sabre Street, Suite 250
Virginia Beach, VA 23452

RE: Virginia Beach Resilience Plan Second Submission - CFPF

Dear Ms. Utterback:

Thank you for the resubmission of the Sea Level Wise Adaptation Plan for City of Virginia Beach. After careful review and consideration, the Virginia Department of Conservation and Recreation has deemed the Plan complete and meets all the criteria outlined in the June 2021 Community Flood Preparedness Grant Manual. This approval will remain in effect for a period of three years, ending on July 31, 2024.

The following elements were evaluated as part of this review:

1. **Element 1: It is project-based with projects focused on flood control and resilience. DCR RESPONSE**
    a. Project-based: Four watersheds—each with a defined geographic area, analysis of community social and environmental characteristics, types of flooding, and a tailored flood resilience strategy with <u>discrete projects identified</u>.

Projects focused on flood control and resilience include:

Neighborhood	Flood Control Project
Elizabeth River	City-wide alignment, living shoreline, marsh restoration, land conservation
Lynnhaven	Chesapeake Bay alignment, Lesner Bridge Neighborhood alignment (East & West), beach & dune nourishment, ecological revetments, shellfish reef restoration, seagrass restoration
Oceanfront	Atlantic Oceanfront alignment, Rudee Heights alignment
Southern Rivers	West Neck Creek city-wide alignment, Muddy Creek Road city-wide alignment, Sandbridge city-wide alignment

**additional projects listed within the Sea Level Wise Adaptation Strategy.*

2. **Element 2: It incorporates nature-based infrastructure to the maximum extent possible. DCR RESPONSE**

    a. Nature-based infrastructure: Flood mitigation projects throughout the city incorporate nature-based solutions and were identified for maximum use within specific watersheds.

3. **Element 3: It includes considerations of all parts of a locality regardless of socioeconomics or race. DCR RESPONSE**
    a. All parts of a locality: Locality divided into four watersheds, covering the entirety of the jurisdictional boundary.
    b. Social vulnerability: Social implications of flood hazards and analysis of populations at-risk documented.
    c. Demographic Analysis: Demographic and Population Vulnerability Analysis conducted by Dewberry and incorporated into the Plan.

4. **Element 4: It includes coordination with other local and inter-jurisdictional projects, plans, and activities and has a clearly articulated timeline or phasing for plan implementation. DCR RESPONSE**
    a. Coordination with other projects, plans, and activities: Contains the planning processes and frameworks which outline local and regional plans used by the City and address resilience; and how they have been integrated for flood adaptation planning.
    b. Clearly articulated timeline or phasing for plan implementation: Program phases clearly articulated and described in detail—Impact assessment, Adaptation research, Strategy development, and Long-term implementation.

5. **Element 5: Is based on the best available science, and incorporates climate change, sea level rise, storm surge (where appropriate), and current flood maps.**
    a. Technically backed water-resources analysis, sea level rise projections, storm surge, and climate change incorporated into strategic approach.

VA DCR looks forward to working with you as you work to make Virginia Beach a more resilient community. If you have questions or need additional assistance, please contact us at cfpf@dcr.virginia.gov. Again, thank you for your interest in the Community Flood Preparedness Fund.

Sincerely,

Wendy Howard Cooper, Director
Dam Safety and Floodplain Management

cc: Darryl Glover, DCR

Attachment 2: Authorization to request funding from the Fund from governing body or chief executive of the local government

City of Virginia Beach

DEPARTMENT OF BUDGET AND MANAGEMENT SERVICES
(757) 385-8234
(757) 385-1857 FAX

VBgov.com
MUNICIPAL CENTER
BUILDING 1, 3RD FLOOR
2401 COURTHOUSE DRIVE
VIRGINIA BEACH, VA 23456-9001

INTER-OFFICE MEMORANDUM

DATE: November 1, 2023

TO: Patrick A. Duhaney, City Manager

FROM: Stuart McCrery, Budget and Policy Analyst KJ for SM

SUBJECT: Application for Virginia Community Flood Preparedness Fund Grant

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The Department of Public Works is requesting permission to apply for the Virginia Community Flood Preparedness Fund Grant from the Virginia Department of Conservation and Recreation. The Virginia Community Flood Preparedness Fund was established in the 2020 session of the General Assembly. Money in this fund comes from the auction of carbon allowances through the Regional Greenhouse Gas Initiative. It was established to provide support to localities across Virginia to reduce the impacts of flooding, including flooding driven by climate change.

Public Works is requesting a total of $5,000,000 to construct marsh terraces in Back Bay to promote wetland restoration and mitigate frequent flooding. The City has already made significant investments into this project through CIP project 100551 "Stormwater Green Infrastructure."

This grant also requires a local match of 30% for projects that implement nature-based solutions; however, the City has more than met this requirement through its current appropriations to CIP project 1000551 "Stormwater Green Infrastructure" which currently total over $49 million from the Referendum and other grant awards.

Budget & Management Services recommends this grant application for approval. Please indicate approval or disapproval below. Applications are due by November 12, 2023.

11/1/2023

Approve (Date) Disapprove (Date)

Attachment 3: Virginia Beach Floodplain Administrator Support Letter

City of Virginia Beach

VBgov.com

DEPARTMENT OF PLANNING & COMMUNITY DEVELOPMENT
PHONE (757) 385-4621
FAX (757) 385-5667
VA Relay Number TTY: 711

2875 SABRE STREET, SUITE 500
VIRGINIA BEACH, VA 23452-7385

November 7, 2023

Division of Dam Safety and Floodplain Management
600 East Main Street, 24th Floor
Richmond, Virginia 23219

RE: Community Flood Preparedness Fund – Marsh Terrace Creation, Back Bay

The proposed project is located in both open water and a Federal Emergency Management Agency (FEMA) mapped Special Flood Hazard Area (SFHA). Hydraulic modeling analysis identified Bonney Cove as a location where marsh restoration has the potential to reduce the propagation of floodwater through key pathways within Back Bay. This project aims to stabilize two critically eroding marsh islands that serve as a key flood pathway into northern Back Bay, promote the growth of aquatic vegetation, and provide flood risk reduction benefits to communities in the surrounding area. Within the two census block groups that would benefit from this project, there are 113 repetitive loss and severe repetitive loss properties.

If I can provide any further information or assistance, please call me at 757-385-4621, or e-mail me at wmcnamar@vbgov.com.

Sincerely,

Whitney McNamara

Whitney McNamara, CFM
Floodplain Administrator and CRS Coordinator

Attachment 4: Letters of Support

Back Bay Restoration Foundation

PO Box 57041 • Virginia Beach, Virginia • 23457• 757-818-4829

November 6, 2023

Department of Conservation and Recreation
Dam Safety and Floodplain Management
600 E. Main St., 24th Floor
Richmond, VA 23219

Re: Virginia Community Flood Preparedness Fund Grant

Grantors:

The Back Bay Restoration Foundation (BBRF), is a 35 year-old non-profit watershed organization, founded in 1986 by a group of local citizens concerned about deterioration of the Back Bay watershed visible then through decreases in Submerged Aquatic Vegetation (SAV), fish, and waterfowl. BBRF is the only voice solely dedicated to conserving and improving Virginia Beach's two Southern Watersheds; namely, the Back Bay and North Landing River watersheds. Our efforts focus on education, stewardship and outreach to conserve the largest watersheds in Virginia Beach. We team with other non-profits, and city, state and federal agencies to work toward best solutions for the future of the Back Bay and North Landing River watersheds. BBRF strives to raise awareness, addressing issues that negatively affect these watersheds such as sea level rise, land subsidence and land use changes.

Back Bay is a historical, nationally significant, watershed. With the Back Bay National Wildlife Refuge (NWR) and significant State conservation lands at its core, the watershed was recognized as an Aquatic Resource of National Importance (ARNI) in 2008 by both the US Fish and Wildlife Service and the US Army Corps of Engineers. Back Bay is a wind-tidal oligohaline estuary and is located at the northern tip of the Albemarle/Pamlico estuarine system, the second largest estuarine complex in the United States. The Albemarle/Pamlico estuarine system was designated as an Estuary of National Significance in 1987 and selected to be studied as part of the Environmental Protection Agency's National Estuary Program. Back Bay is a shallow-water aquatic ecosystem with an average depth of four feet. Winds can influence the water depth by as much as three feet.

BBRF supports the City of Virginia Beach's application for Round 4 of VADCR's Community Flood Preparedness Fund. We were strong advocates of the City's successful applications to the National Fish and Wildlife Foundation (NFWF), and have seen what they accomplished with the initial NFWF funding they received. With the combined funding of NFWF, the City of Virginia Beach, and this application for DCR funding, their project of creating a Marsh Terrace Network to Achieve Restoration and Flood Resilience has overachieved by any measure. From community engagement and the NEPA process to conceptual and preliminary designs as described in the recent Army Corps Public Notice, the City has been productive and completely transparent.

As noted above, the City's community engagement and partnerships with organizations like ours has been transparent and resulted in broad support. Although the current project is localized in its first application, we expect the results will significantly mitigate SLR, land subsidence and wind tides in Back Bay. Similarly, this restoration will provide the biotic building blocks to maintain the watershed's national importance for wildlife. The innovative designs proposed will inform future projects at the landscape level. Although innovative, we believe the project is technically sound based on BBRF's 35 years of experience in habitat restoration.

Please feel free to contact us for further information.

Jared Brandwein

Executive Director
Back Bay Restoration Foundation

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Back Bay National Wildlife Refuge
1324 Sandpiper Road
Virginia Beach, VA 23456

October 30, 2023

Wendy Howard Cooper
Division of Dam Safety and Floodplain Management
600 East Main Street, 24th Floor
Richmond, Virginia 23219

Dear Ms. Cooper,

The City of Virginia Beach is proposing to install marsh terraces in the waters of Back Bay adjacent to Back Bay National Wildlife Refuge. This project is expected to reduce wave energy and thus decrease the speed of erosion of remaining islands in the project area, many of which are managed by the U.S. Fish and Wildlife Service and provide habitat for migratory birds and other species. Additionally, the addition of multiple vegetative structures added to the bay will supplement habitat and provide nesting grounds for multiple species.

The mission of the U.S. Fish and Wildlife Service is *working with others to conserve, protect, and enhance fish, wildlife, plants, and their habitats for the continuing benefit of the American people*. Although much work is conducted on federal property to achieve this mission, the Service equally coordinates with external partners to further mutual goals. The proposed marsh terrace project is an excellent example of local and federal government coordination, and we support the City of Virginia Beach's proposed project.

Megan Reed

Megan Reed
Refuge Manager

Albemarle - Pamlico
National Estuary Partnership

Our mission is to identify, protect, and restore
the significant resources of the Albemarle-Pamlico estuarine system.

October 26, 2023

Wendy Howard Cooper
Virginia Dept. of Conservation and Recreation
Division of Dam Safety and Floodplain Management
600 E. Main St., 24th Floor
Richmond, VA 23219

Dear Wendy,

The Albemarle-Pamlico National Estuary Partnership (APNEP) strongly endorses the City of Virginia Beach and partners' application to Round 4 of The Virginia Community Flood Preparedness Fund (CFPF). The proposal is to support construction of the Back Bay Marsh Terrace Restoration Project.

APNEP relies on regional partnerships and collaboration to implement our 2012-2022 Comprehensive Conservation & Management Plan (CCMP) within the waterways of our congressionally designated "estuary of national significance." The proposed partnership between the City of Virginia Beach and the U.S. Fish and Wildlife Service will also advance our 2020 Memorandum of Understanding between Virginia and North Carolina to protect the ecosystem resources in the shared waterways between our two states. The project also addresses a "high priority" area for restoring and enhancing vulnerable marshes with high flood risk reduction benefits and habitat value, as identified by Audubon's Currituck Sound Coalition Marsh Conservation Plan released in 2021.

The marsh terrace project employs the use of natural features to build resilience to flooding in the Back Bay watershed. The project offers coastal resilience and habitat protection and conservation co-benefits including preserving marsh islands, restoring Submerged Aquatic Vegetation, migratory bird and fish habitat, reducing flow that could exacerbate wind tide flooding in local communities, and filling a gap in prior applied research on predominantly fresh water coastal lagoons. These features support the following CCMP actions:

- A2.3: Support research on adapting to impacts associated with climate change and sea level rise.
- C3.2: Develop and implement a coordinated wetland restoration strategy.
- C3.3: Develop and implement a submerged aquatic vegetation (SAV) restoration strategy.
- D3.3: Provide assistance to state, regional, and local governments to incorporate climate change and sea level rise considerations into their planning processes.

In closing, we strongly support the full funding of the City of Virginia Beach's proposal to Round 4 of The Virginia Community Flood Preparedness Fund (CFPF). Please contact Steve Anderson, Partnership Coordinator, at (919) 707-8743 with questions.

Sincerely,

W. Crowell

William L. Crowell, Jr., Ph.D., AICP, CEE
Director

Attachment 5: Copy of the Current Floodplain Ordinance

ORD-3685

AN ORDINANCE TO AMEND SECTIONS 1.1, 1.2, 1.3, 1.8, 2.1, 2.2, 2.3, 2.4, 2.8, 2.11, 3.1, 4.1, 4.2, 4.3, 4.4, 4.6, 4.8, 4.9, 4.10, 5.1, 6.1, AND 6.3 OF APPENDIX K, FLOODPLAIN ORDINANCE OF THE CITY CODE PERTAINING TO HOUSEKEEPING THE DELETION OF PUBLIC WORKS REQUIREMENTS AND THE ADDITION OF A COASTAL A ZONE AND A COASTAL HIGH HAZARD ZONE

Sections Amended: 1.1, 1.2, 1.3, 1.8, 2.1, 2.2, 2.3, 2.4, 2.8, 2.11, 3.1, 4.1, 4.2, 4.3, 4.4, 4.6, 4.8, 4.9, 4.10, 5.1, 6.1, and 6.3 of Appendix K, Floodplain Ordinance

WHEREAS, the public necessity, convenience, general welfare and good zoning practice so require;

BE IT ORDAINED BY THE CITY COUNCIL OF THE CITY OF VIRGINIA BEACH, VIRGINIA:

That Sections 1.1, 1.2, 1.3, 1.8, 2.1, 2.2, 2.3, 2.4, 2.8, 2.11, 3.1, 4.1, 4.2, 4.3, 4.4, 4.6, 4.8, 4.9, 4.10, 5.1, 6.1, and 6.3 of Appendix K, Floodplain Ordinance is hereby amended and reordained to read as follows:

APPENDIX K FLOODPLAIN ORDINANCE

ARTICLE I. GENERAL PROVISIONS

Sec. 1.1. Statutory authorization and purpose.

A. This ordinance is adopted pursuant to the authority granted to localities by Code of Virginia § ~~10.1-600 et seq~~ 15.2-984.

B. The city council finds the purpose of these provisions is to prevent the loss of life and property, the creation of health and safety hazards, the disruption of commerce and governmental services, the extraordinary and unnecessary expenditure of public funds for flood protection and relief, and the impairment of the tax base by:

1. Regulating uses, activities, and development that, alone or in combination with other existing or future uses, activities, and development, will cause unacceptable increases in flood heights, velocities, and frequencies;

2. Restricting or prohibiting certain uses, activities, and development from locating within districts subject to flooding;
3. Requiring all uses, activities, and developments that do occur in flood-prone districts be protected or flood-proofed against flooding and flood damage;

4. Protecting individuals from buying land and structures that are unsuited for intended purposes because of flood hazards; and

5. Acknowledging that the tide data over the last one hundred (100) years shows that Virginia Beach is facing an increased danger of flooding caused by both sea level rise and subsidence and has adopted the Sea Level Wise Adaptation Report as part of the Comprehensive Plan.

Sec. 1.2. Applicability.

These provisions shall apply to all privately and publicly owned lands within the jurisdiction of the City of Virginia Beach and identified as areas ~~of special flood hazard~~ at risk of flooding by the City of Virginia Beach or shown ~~according to~~ on the Flood Insurance Rate Map (FIRM) or included on the flood insurance study (FIS) that ~~is~~ are provided to the City of Virginia Beach by the Federal Emergency Management Agency (FEMA) and dated January 16, 2015 ~~or identified as floodplains subject to special restrictions in section 4.10 of this ordinance~~.

Sec. 1.3. Definitions.

. . . .

City manager. The City Manager of the City of Virginia Beach, or his designees.

Design Flood Elevation (regulatory flood protection elevation). The base flood elevation plus the freeboard required by this ordinance.

. . . .

Recreational vehicle. A vehicle that is:

1. Built on a single chassis;
2. Four hundred (400) square feet or less when measured at the largest horizontal projection;
3. Designed to be self-propelled or permanently towable by a light duty truck; and
4. Designed primarily not for use as a permanent dwelling but as temporary living quarters for recreational camping, travel, or seasonal use.

~~*Regulatory flood protection elevation (design flood elevation)*. The base flood elevation plus the freeboard required by this ordinance.~~

. . . .

Sec. 1.8. Penalty for violations.

Any person who fails to comply with any of the requirements or provisions of this ordinance or directions of the ~~d~~Directors of ~~p~~Planning ~~or public works~~ or any authorized employee of the City of Virginia Beach shall be guilty of the appropriate violation and subject to the penalties therefore. Any violation of the provision of this ordinance shall be punishable by a fine of not more than one hundred dollars ($100.00). Each person shall be deemed guilty of a separate offense for each and every day or portion thereof during which any violation of any of the provisions of this ordinance is committed.

The Virginia Uniform Statewide Building Code (VA USBC) addresses building code violations and the associated penalties in ~~section 104 and section 115~~ VA USBC § 104 and § 115. Violations and associated penalties of the Zoning Ordinance for the City of Virginia Beach are addressed in § 104 of the Zoning Ordinance.

In addition to the above penalties, all other actions are hereby reserved, including an action in equity for the proper enforcement of this ordinance. The imposition of a fine or penalty for any violation of, or noncompliance with, this ordinance shall not excuse the violation or noncompliance or permit it to continue, and all such persons shall be required to correct or remedy such violations within a reasonable time. Any structure constructed, reconstructed, enlarged, altered, or relocated in noncompliance with this ordinance may be declared by the City of Virginia Beach to be a public nuisance and abatable as such. Flood insurance may be withheld from structures constructed in violation of this ordinance.

ARTICLE II. ADMINISTRATION

Sec. 2.1. Designation of the floodplain administrator.

The City Manager of the City of Virginia Beach is hereby appointed the floodplain administrator to administer and implement this ordinance. The floodplain administrator has delegated the duties and responsibilities set forth in this ordinance to the ~~departments of public works and planning, as specified below~~ Department of Planning and Community Development.

Sec. 2.2. Duties and responsibilities of the ~~department of public works~~ floodplain administrator or his designee.

The duties and responsibilities of the ~~department of public works~~ floodplain administrator of his designee shall include but are not limited to:

A. Interpreting floodplain boundaries and providing available base flood elevation and flood hazard information;

B. Verifying that applicants proposing an alteration of a watercourse have notified adjacent communities, the department of conservation and recreation (division of dam safety and floodplain management), and other appropriate agencies (Virginia Department of Environmental Quality (VADEQ), United States Army Corps of Engineers (USACE), etc.) and have submitted copies of such notifications to FEMA;

C. Advising applicants for new construction or substantial improvement of structures that are located within an area of the coastal barrier resources system established by the Coastal Barrier Resources Act that Federal flood insurance is not available on such structures; areas subject to this limitation are shown on FIRMs as coastal barrier resource system areas or otherwise protected areas;

D. Submitting to FEMA, or requiring applicants to submit to FEMA, data and information necessary to maintain FIRMs, including hydrologic and hydraulic engineering analyses prepared by or for the city, within six (6) months after such data and information becomes available if the analyses indicate changes in base flood elevations;

E. Maintaining and permanently keeping <u>records that are necessary for the administration of these regulations, including:</u>

<u>1.</u> ~~flood~~ <u>Flood</u> insurance studies, FIRMs (including historic studies and maps and current effective studies and maps) and letters of map change; <u>and</u>

<u>2. Documentation supporting issuance and denial of permits, Elevation Certificates, documentation of the elevation (in relation to the datum on the FIRM) to which structures have been floodproofed, inspection records, other required design certifications, variances, and records of enforcement actions taken to correct violations of these regulations.</u>

F. Notifying FEMA when the corporate boundaries of the City of Virginia Beach have been modified and:

1. Providing a map that clearly delineates the new corporate boundaries or the new area for which the authority to regulate pursuant to this ordinance has either been assumed or relinquished through annexation; and

2. If the FIRM for any annexed area includes SFHAs that have flood zones with regulatory requirements that are not set forth in this

ordinance, prepare amendments to this ordinance to adopt the FIRM and appropriate requirements, and submit the amendments to the city council for adoption; such adoption shall take place at the same time as or prior to the date of annexation and a copy of the amended ordinance shall be provided to the department of conservation and recreation (division of dam safety and floodplain management) and FEMA.

G. Upon the request of FEMA, completing and submitting a report concerning participation in the NFIP, which may request information regarding the number of buildings in the SFHA, the number of permits issued for development in the SFHA, and the number of variances issued for development in the SFHA.

H. Reviewing applications for permits to determine whether proposed activities will be located in the SFHA;

I. Reviewing applications to determine whether proposed activities will be reasonably safe from flooding and requiring new construction and substantial improvements to meet the requirements of this ordinance;

J. Reviewing applications to determine whether all necessary permits have been obtained from the federal, state, or local agencies from which prior or concurrent approval is required; in particular, permits from state agencies for any construction, reconstruction, repair, or alteration of a dam, reservoir, or waterway obstruction (including bridges, culverts, structures), any alteration of a watercourse, or any change of the course, current, or cross section of a stream or body of water, including any change to the SFHAs of free-flowing non-tidal waters of the state;

K. Approving applications and issuing permits to develop in flood hazard areas if the provisions of this ordinance have been met, or disapproving applications if the provisions of this ordinance have not been met;

L. Granting administrative variances pursuant to section 6.1 of this ordinance;

M. Inspecting, or causing to be inspected, buildings, structures, and other development for which permits have been issued to determine compliance with this ordinance or to determine if non-compliance has occurred or violations have been committed;

N. Reviewing elevation certificates and requiring incomplete or deficient certificates to be corrected;

O. Maintaining and permanently keeping documentation supporting the issuance and denial of permits, elevation certificates, documentation of the elevation (in relation to the datum on the FIRM) to which structures have been flood proofed, and other required design certifications, variances, and records of enforcement actions taken to correct violations of this ordinance;

P. Enforcing the provisions of this ordinance, investigating violations, issuing notices of violations or stop work orders, and requiring permit holders to take corrective action;

Q. Advising the city council regarding the intent of this ordinance and, for each application for a variance, preparing a staff report and recommendation; and

R. Administering the requirements related to proposed work on existing buildings:

1. Making determinations as to whether buildings and structures that are located in flood hazard areas and that are damaged by any cause have been substantially damaged; and

2. Making reasonable efforts to notify owners of substantially damaged structures of the need to obtain a permit to repair, rehabilitate, or reconstruct, and prohibit the non-compliant repair of substantially damaged buildings except for temporary emergency protective measures necessary to secure a property or stabilize a building or structure to prevent additional damage.

S. Undertaking, as determined appropriate by the floodplain administrator due to the circumstances, other actions that may include but are not limited to: issuing press releases, public service announcements, and other public information materials related to permit requests and repair of damaged structures; coordinating with other federal, state, and local agencies to assist with substantial damage determinations; providing owners of damaged structures information related to the proper repair of damaged structures in SFHAs; and assisting property owners with documentation necessary to file claims for increased cost of compliance coverage under National Flood Insurance Program (NFIP) flood insurance policies; and

T. It is the duty of the city floodplain administrator to take into account flood, mudslide, and flood-related erosion hazards, to the extent that they are known, in all official actions relating to land management and use throughout the entire jurisdictional area of the city, whether or not those

hazards have been specifically delineated geographically (e.g., via mapping or surveying).

~~Sec. 2.3. Duties and responsibilities of the department of planning.~~ Reserved.

~~The duties and responsibilities of the department of planning shall include but are not limited to:~~

~~A.~~ ~~Reviewing applications for permits to determine whether proposed activities will be located in the SFHA;~~

~~B.~~ ~~Reviewing applications to determine whether proposed activities will be reasonably safe from flooding and requiring new construction and substantial improvements to meet the requirements of this ordinance;~~

~~C.~~ ~~Reviewing applications to determine whether all necessary permits have been obtained from the federal, state, or local agencies from which prior or concurrent approval is required; in particular, permits from state agencies for any construction, reconstruction, repair, or alteration of a dam, reservoir, or waterway obstruction (including bridges, culverts, structures), any alteration of a watercourse, or any change of the course, current, or cross section of a stream or body of water, including any change to the SFHAs of free-flowing non-tidal waters of the state;~~

~~D.~~ ~~Approving applications and issuing permits to develop in flood hazard areas if the provisions of this ordinance have been met, or disapproving applications if the provisions of this ordinance have not been met;~~

~~E.~~ ~~Granting administrative variances pursuant to section 6.1 of this ordinance;~~

~~F.~~ ~~Inspecting, or causing to be inspected, buildings, structures, and other development for which permits have been issued to determine compliance with this ordinance or to determine if non-compliance has occurred or violations have been committed;~~

~~G.~~ ~~Reviewing elevation certificates and requiring incomplete or deficient certificates to be corrected;~~

~~H.~~ ~~Maintaining and permanently keeping documentation supporting the issuance and denial of permits, elevation certificates, documentation of the elevation (in relation to the datum on the FIRM) to which structures have been flood proofed, and other required design certifications, variances, and records of enforcement actions taken to correct violations of this ordinance;~~

~~I. Enforcing the provisions of this ordinance, investigating violations, issuing notices of violations or stop work orders, and requiring permit holders to take corrective action;~~

~~J. Advising the city council regarding the intent of this ordinance and, for each application for a variance, preparing a staff report and recommendation; and~~

~~K. Administering the requirements related to proposed work on existing buildings:~~

~~1. Making determinations as to whether buildings and structures that are located in flood hazard areas and that are damaged by any cause have been substantially damaged; and~~

~~2. Making reasonable efforts to notify owners of substantially damaged structures of the need to obtain a permit to repair, rehabilitate, or reconstruct, and prohibit the non-compliant repair of substantially damaged buildings except for temporary emergency protective measures necessary to secure a property or stabilize a building or structure to prevent additional damage.~~

~~Sec. 2.4. Shared duties and responsibilities.~~ <u>Reserved.</u>

~~The duties and responsibilities shared by the departments of public works and Planning shall include but are not limited to:~~

~~A. Undertaking, as determined appropriate by the floodplain administrator due to the circumstances, other actions that may include but are not limited to: issuing press releases, public service announcements, and other public information materials related to permit requests and repair of damaged structures; coordinating with other federal, state, and local agencies to assist with substantial damage determinations; providing owners of damaged structures information related to the proper repair of damaged structures in SFHAs; and assisting property owners with documentation necessary to file claims for increased cost of compliance coverage under National Flood Insurance Program (NFIP) flood insurance policies; and~~

~~B. It is the duty of the city floodplain administrator to take into account flood, mudslide, and flood-related erosion hazards, to the extent that they are known, in all official actions relating to land management and use throughout the entire jurisdictional area of the city, whether or not those hazards have been specifically delineated geographically (e.g., via mapping or surveying).~~

. . . .

Sec. 2.8. Interpretation of district boundaries.

Initial interpretations of the boundaries of the floodplain districts shall be made by the floodplain administrator. Should a dispute arise concerning the boundaries of any of the districts~~, the city council shall make the necessary determination. The person questioning or contesting the location of the district boundary shall be given a reasonable opportunity to present his case to the city council and to submit his own technical evidence if he so desires~~ a surveyor shall provide either an elevation certificate or recent survey showing topographic elevations and delineating the Special Flood Hazard Area.

. . . .

Sec. 2.11. Appeals to decisions made by the floodplain administrator.

It is further provided that any decision of the floodplain administrator or his designee may be modified, reversed, or affirmed by the city council upon appeal by any aggrieved party to such decision, if such appeal is filed with the floodplain administrator within thirty (30) days of such decision through the application for a Floodplain Variance outlined in Section VI of this ordinance.

ARTICLE III. ESTABLISHMENT OF FLOODPLAIN DISTRICTS

Sec. 3.1. Description of floodplain districts.

A. Special flood hazard areas (SFHA). The SFHAs shall include land in the floodplain subject to a one (1) percent or greater chance of being flooded in any given year. The basis for the delineation of these districts shall be the FIS and the FIRM for the City of Virginia Beach prepared by FEMA, Federal Insurance Administration, dated January 16, 2015, and any subsequent revisions or amendments thereto.

The boundaries of the SFHAs are established as shown on the FIRM, which is declared to be a part of this ordinance and shall be kept on file at the City of Virginia Beach Department of ~~Public Works~~ Planning and Community Development, and include the following districts:

1. The Floodway District is in an AE Zone and is delineated, for the purposes of this ordinance, using the criterion that certain areas within the floodplain must be capable of carrying the waters of the one (1) percent annual chance flood without increasing the water surface elevation of that flood more than one (1) foot at any point. The areas included in this district are specifically defined in Table 7 of the above-referenced FIS and shown on the accompanying FIRM.

2. The AE or AH Zones on the FIRM accompanying the FIS shall be those areas for which one (1) percent annual chance flood elevations have been provided and the floodway has not been delineated.

3. The A Zone on the FIRM accompanying the FIS shall be those areas for which no detailed flood profiles or elevations are provided, but the one (1) percent annual chance floodplain boundary has been approximated.

4. The AO Zone on the FIRM accompanying the FIS shall be those areas of shallow flooding identified as AO on the FIRM.

5. ~~Reserved.~~ The Coastal A Zone on the FIRM accompanying the FIS shall be those areas labeled as AE and are located seaward of the limit of moderate wave action (LiMWA) line.

6. The VE or V Zones on FIRMs accompanying the FIS shall be those areas that are known as coastal high hazard areas, extending from offshore to the inland limit of a primary frontal dune along an open coast and any other area subject to high velocity wave action from storm or seismic sources.

B. ~~Floodplain subject to special restrictions~~ *Local Flood Hazard Areas*. The City of Virginia Beach may identify and regulate local flood hazard or ponding areas that are not delineated on the FIRM. These areas are ~~identified in section 4.10 and may be delineated on a map using best available topographic data and locally derived information such as flood of record, historic high water marks, or approximate study methodologies~~ identified as follows:~~.~~

a. *Other areas of flood risk*. The X and the X(Shaded) Zone on the FIRM where the City of Virginia Beach Stormwater Master Plan has identified areas, outside SFHAs delineated on the FIRM, that area susceptible to flooding. The most recent updated version of the modeling shall be used to identify areas that are likely to experience flooding.

b. *Floodplain Subject to Special Restrictions*. The Floodplain Subject to Special Restrictions is identified in section 4.10 and includes areas in the southern part of the city which are characterized by wind tides, low topography, and poorly draining soils.

ARTICLE IV. FLOODPLAIN DISTRICT PROVISIONS

Sec. 4.1. Permit and application requirements.

. . . .

B. Site plans and permit applications. All applications for development within any floodplain district and all building permits issued within ~~the~~ any floodplain district shall incorporate the following information:

1. For any addition, conversion of any non-habitable space to habitable space, or the construction or installation of a new accessory structure that requires a building permit.

   a. A physical survey, performed after the effective date of the FIRM that:

      i. accurately depicts current improvements on the property;
      ii. provides a flood zone determination and BFE or flood depth at the stie; and
      iii. delineates the location of the flood zones on the property.

   b. For structures located in the SFHA delineated on the FIRM, a current elevation certificate sealed by a licensed design professional.

2. For new construction and any substantial improvement of the principal structure:

   a. a proposed site plan sealed by a registered design professional that provides:

      ~~1~~i. The elevation of the base flood at the site;

      ~~2~~ii. The elevation of the lowest floor (including basement) or, in V Zones, the lowest horizontal structural member;

      ~~3~~iii. For structures to be flood-proofed (non-residential only), the elevation to which the structure will be flood-proofed; and

      4iv. Topographic information showing existing and proposed ground elevations.

Sec. 4.2. General standards.

. . . .

5. Electrical, heating, ventilation, plumbing, air conditioning equipment, and other service facilities, including duct work, shall be designed and/or ~~located so as to prevent water from entering or accumulating within the components during conditions of flooding~~ or above the design flood elevation.

6. New and replacement water supply systems shall be designed to minimize or eliminate infiltration of flood waters into the system.

7. New and replacement sanitary sewage systems shall be designed to minimize or eliminate infiltration of flood waters into the systems and discharges from the systems into flood waters.

8. On-site waste disposal systems shall be located and constructed to avoid impairment to them or contamination from them during flooding.

9. No use shall be permitted if such use will increase the amounts of potentially damaging materials, including those likely to be injurious to health, that might be transported in floods.

10. For properties located in SFHAs delineated on the FIRM, an elevation certificate and, if applicable, a flood-proofing certificate shall be provided to the Floodplain Administrator prior to any foundation inspection, final inspections, and the issuance of any certificates of occupancy, in order to assure compliance with these floodplain regulations.

11. Prior to any proposed alteration or relocation of any channels or of any watercourse or stream within the city, a permit shall be obtained from the USACE, VADEQ, the Virginia Marine Resources Commission, and the Wetlands Board through the joint permit application process. Furthermore, notification of the proposal shall be given by the applicant to all affected adjacent jurisdictions, the department of conservation and recreation (division of dam safety and floodplain management), other required agencies, and FEMA.

12. The flood carrying capacity within an altered or relocated portion of any watercourse shall be maintained.

~~B. In all SFHAs, the following additional provisions shall apply:~~

~~1. Prior to any proposed alteration or relocation of any channels or of any watercourse or stream, within the city a permit shall be obtained from the USACE, VADEQ, the Virginia Marine Resources Commission, and the Wetlands Board through the joint permit application process. Furthermore, notification of the proposal shall be given by the applicant to all affected adjacent jurisdictions, the department of conservation and recreation (division of dam safety and floodplain management), other required agencies, and FEMA.~~

~~2. The flood carrying capacity within an altered or relocated portion of any watercourse shall be maintained.~~

~~3. Sand dunes, barrier beaches, and other natural protective barriers shall remain intact to provide protection against wind, waves, and erosion drainage. Any person who desires to use or alter any coastal primary sand dune, other than for the purpose of conducting the activities specified in section 1602 of the Zoning Ordinance of the City of Virginia Beach, shall first obtain a permit from the USACE, VADEQ, the Virginia Marine Resources Commission, and the Wetlands Board through the joint permit application process.~~

Sec. 4.3. Elevation and construction requirements.

In all ~~SFHAs where base flood elevations have been provided in the FIS or generated by a licensed professional in accordance with section 4.6 of this ordinance~~ floodplain districts, with the exception of Coastal A and Coastal High Hazard (VE) zones, the following provisions shall apply:

A. Residential construction requirements. ~~New construction or substantial improvement of any residential structure or manufactured home in Zones AE, AH, and A with detailed base flood elevations shall have the lowest floor, including basement, elevated to a minimum of two (2) feet above the base flood level.~~ The lowest flood, including basement, shall be set to the higher of the following:

i. A minimum of two (2) feet above the base flood elevation established on the most recent FIRM or by the most recent FIS or,

ii. A minimum of one (1) foot above the 100-year HGL elevation measured at the nearest existing or proposed public drainage structure or BMP, in the City Stormwater Master Plan.

B. Non-residential construction requirements. New construction or substantial improvement of any commercial, industrial, or non-residential building or manufactured home shall have the lowest floor, including basement, elevated as ~~minimum of two (2) feet above the base flood level~~ established in Section 4.3 A of this ordinance. Buildings ~~located in AE or AH Zones~~ may be flood-proofed in lieu of being elevated provided that all areas of the building components below the ~~elevation corresponding to the base flood elevation plus a minimum of two (2) feet freeboard~~ design flood elevation are watertight with walls substantially impermeable to the passage of water, and use structural components having the capability of resisting hydrostatic and hydrodynamic loads and the effect of buoyancy. A professional engineer or architect licensed by the Commonwealth of Virginia shall certify that the standards of this subsection are satisfied. Such certification, including the specific elevation (in relation to NAVD88) to which such structures are flood proofed, shall be maintained by the building official.

C. ~~Space below the lowest floor requirements. In Zones A, AE, AH, and AO, f~~<u>F</u>ully enclosed areas of new construction or substantially improved existing structures that are below the ~~regulatory~~ <u>design</u> flood protection elevation shall:

1. Not be designed or used for human habitation, but shall only be used for parking of vehicles, building access, or limited storage of maintenance equipment used in connection with the premises. Access to the enclosed area shall be the minimum necessary to allow for parking of vehicles (garage door), limited storage of maintenance equipment (standard exterior door), or entry to the living area (stairway or elevator).

2. Be constructed entirely of flood resistant materials below the ~~regulatory~~ <u>design</u> flood ~~protection~~ elevation.

3. <u>Space below the lowest floor of SFHAs delineated on the FIRM shall</u> ~~I~~<u>i</u>nclude measures to automatically equalize hydrostatic flood forces on walls by allowing for the entry and exit of floodwaters. To meet this requirement, the openings shall either be certified by a professional engineer or architect licensed by the Commonwealth of Virginia or meet or exceed the following minimum design criteria:

. . . .

Sec. 4.4. Floodway requirements.

. . . .

B. The placement of new or replacement manufactured homes (mobile homes) is prohibited.

~~C.~~ ~~The following uses and structures may be permitted in the floodway district, subject to the requirements of articles III, IV, V, and VI of this ordinance:~~

~~1.~~ ~~Public and private outdoor recreational facilities;~~

~~2.~~ ~~Agricultural uses, including farming, grazing, and the raising of poultry or livestock; provided, that poultry or livestock shall not be housed within five hundred (500) feet of any residential, apartment, or hotel district;~~

~~3.~~ ~~Open uses, such as public and private roadways, off street parking, or loading and unloading areas related to uses in adjoining districts;~~

4. ~~Commercial mining, soil removal, and sand pits subject to regulations applicable to extractive industries as set forth in the conditional use provisions of the Zoning Ordinance of the City of Virginia Beach;~~

5. ~~Public improvements, such as dams, levees and channel improvements, and utilities installations and substations, including temporary storage of materials, except flammable, toxic or noxious materials, and temporary location of maintenance installations; and~~

6. ~~Uses and structures customarily accessory and clearly incidental and subordinate to uses listed above, including in connection with agricultural uses; roadside stands for the sale of agricultural products produced on the premises; provided that:~~

   a. ~~Only one (1) such stand shall be permitted per lot;~~

   b. ~~No such stand shall exceed five hundred (500) square feet in floor area; and~~

   c. ~~No such stand on the street frontage shall be erected within twenty (20) feet of the property line.~~

. . . .

Sec. 4.6. A Zone requirements.

. . . .

B. The floodplain administrator reserves the right to require a hydrologic and hydraulic analysis for any development and to determine the base flood elevation. When such base flood elevation data is utilized, the lowest floor shall be elevated to minimum of two (2) feet above the base flood level. During the permitting process, the floodplain administrator shall obtain:

   1. The elevation of the lowest floor (including the basement) of all new and substantially improved structures; and

   2. If the structure has been flood-proofed in accordance with the requirements of this ordinance, the elevation (in relation to NAVD88) to which the structure has been flood-proofed.

~~C. When the data is not available from any source, the lowest floor of the structure shall be elevated to not less than two (2) feet above the highest adjacent grade.~~

Sec. 4.8. ~~Reserved~~ X and X(Shaded) Zone requirements. (Other Areas of Flood Risk).

A. *Residential construction requirements*. The lowest floor, including basements, shall be set to a minimum of one (1) foot above the 100-year HGL elevation measured at the nearest existing or proposed public drainage structure or BMP, in the City Stormwater Master Plan.

B. *Non-residential construction requirements*. New construction or substantial improvement of any commercial, industrial, or non-residential building or manufactured home shall have the lowest floor, including basement, elevated as established in Section 4.8 A of this ordinance above. Buildings may be flood-proofed in lieu of being elevated provided that all areas of the building components below the design flood elevation are watertight with walls substantially impermeable to the passage of water, and use structural components having the capability of resisting hydrostatic and hydrodynamic loads and the effect of buoyancy. A professional engineer or architect licensed by the Commonwealth of Virginia shall certify that the standards of this subsection area satisfied. Such certification, including the specific elevation (in relation to NAVD88) to which such structures are flood proofed, shall be maintained by the building official.

Sec. 4.9. – Coastal High Hazard (~~V and~~ VE Zone) requirements.

The following provisions shall apply within ~~V and VE Zones~~ Coastal A Zones and Coastal High Hazard Areas:

A. All new construction and substantial improvements, including to manufactured homes, shall be elevated on pilings or columns so that:

1. The bottom of the lowest horizontal structural member of the lowest floor (excluding the pilings or columns) is elevated to a minimum of ~~two~~ three (~~2~~3) feet above the base flood ~~level~~ elevation; and

2. The pile or column foundation and structure attached thereto is anchored to resist flotation, collapse, and lateral movement due to the effects of wind and water loads acting simultaneously on all building components. Wind and water loading values shall each have a one (1) percent chance of being equaled or exceeded in any given year.

B. A professional engineer or architect licensed by the Commonwealth of Virginia shall develop or review the structural design, specifications, and plans for the construction and shall certify that the design and methods of construction to be used are in accordance with accepted standards of practice for meeting the provisions of article IV, section 4.6 A. A V Zone

Design Certificate shall be submitted to Permits and Inspections with plans for a building permit.

. . . .

I. ~~The man-made alteration of sand dunes, which would increase potential flood damage, is prohibited.~~ Sand dunes, barrier beaches, and other natural protective barriers shall remain intact to provide protection against wind, waves, and erosion drainage. Any person who desires to use or alter any coastal primary sand dune or beaches, other than for the purpose of conducting the activities specified in Article 1600, Section 1602 of the Zoning Ordinance of the City of Virginia Beach, shall first obtain a permit, or authorization, from the USACE, VADEQ, the Virginia Marine Resources Commission, and the Wetlands Board through the joint permit application process.

J. Manufactured homes are prohibited.

Sec. 4.10. Floodplain subject to special restrictions.

A. All ~~FIRM delineated~~ SFHAs that ultimately drain to Back Bay or the Currituck Sound ~~located in the following areas~~ shall be identified as a floodplain subject to special restrictions~~:~~.

~~1. North Landing River and its tributaries south of Lynnhaven Parkway;~~

~~2. West Neck Creek and its tributaries south of Shipps Corner Road, London Bridge Road, and the portion of Dam Neck Road east of its intersection with London Bridge Road; and~~

~~3. Bays, creeks, lakes, guts, coves, wetlands, marshes and swamps and their tributaries comprising the Back Bay and Small Coastal South watersheds south of South Birdneck Road and east of Princess Anne Road and General Booth Boulevard.~~

B. The following provisions shall apply within the floodplain subject to special restrictions:

1. Notwithstanding any provision of this ordinance to the contrary, no filling shall be permitted, including filling with material excavated from the same floodplain except for:

a. The purpose of public roadway or other similar public works construction undertaken by the Department of Public Works or Virginia Department of Transportation, or their agent for

construction. This construction includes flood protection and flood mitigation projects;

b. The maintenance, alteration, or relocation of bona fide agricultural ditches, swales, or agricultural pathways or those ditches required for proper lot drainage;

c. For shoreline stabilization or maintenance projects, such as riprap revetment, bulkheads, or other treatment used to stabilize and protect the banks of waterways, the city manager or his designee may approve the placement of fill provided the following criteria are met:

i. A joint permit application is submitted;

ii. The alignment of the stabilization structure is along the escarpment or in line with adjacent stabilization structures; ~~and~~

iii. If there is an existing shoreline stabilization structure, any proposed replacement structure shall be no more than six (6) inches higher than the existing structure; and

~~iii~~iv. Fill must be the minimum necessary to support the stabilization project.

2. The city manager, or his designee, may approve the placement of fill provided that the following criteria are met:

a. Proposed fill within the floodplain:

i. Shall be mitigated to result in no decrease in flood storage volume on the site;

ii. Shall be mitigated entirely on the same site that will incur the fill;

iii. Shall be contiguous to the existing floodplain that is being filled; and

iv. Shall be limited to the smallest amount of area and volume possible to correct irregularities within the boundary of the project.

b. The combined areas of fill and mitigation shall not exceed five (5) percent of the total area within the floodplain located on the site that will incur the fill.

3. Residential dwelling structures shall not be located within the floodplains subject to special restrictions on lots created after October 23, 2001. Residential dwelling structures located in ~~local flood hazard areas as of~~ a SFHA and constructed prior to October 23, 2001 may be expanded with attached additions to a total footprint of less than one thousand (1,000) square feet; such additions shall also comply with the requirements set forth in article V of this ordinance.

. . . .

ARTICLE V. EXISTING STRUCTURES IN FLOODPLAIN AREAS

Sec. 5.1. Existing structures.

A structure or use of a structure or premises that lawfully existed prior to the adoption of this ordinance, but which is not in conformity with this ordinance, may be continued subject to the following conditions:

A. Any existing structures in the floodway area shall not be expanded or enlarged unless it has been demonstrated through hydrologic and hydraulic analyses performed in accordance with standard engineering practices that the proposed expansion or enlargement would not result in any increase in the base flood elevation.

B. Any modification, alteration, repair, reconstruction, or improvement of any kind to a structure and/or use located in any floodplain ~~areas~~ district to an extent or amount of less than fifty (50) percent of its market value shall conform to the VA USBC and meet the freeboard height in effect at the start of construction for the original structure.

C. Any modification, alteration, repair, reconstruction, or improvement of any kind to a structure and/or use, in any floodplain ~~area~~ district to an extent or amount of fifty (50) percent or more of its market value shall be undertaken only in full compliance with this ordinance and shall require the entire structure to conform to the VA USBC.

ARTICLE VI. VARIANCES AND APPEALS

Sec. 6.1. Administrative variances.

The floodplain administrator shall approve or deny an application requesting an administrative variance after receipt of a complete application. Administrative variances may only be granted for the following uses, development, or redevelopment:

A. As defined in section 4.10, floodplains subject to special restrictions, for filling only.

B. Any structure or use sustaining damage not caused by flood to an extent or amount of fifty (50) percent or more of its market value to allow the structure to be rebuilt to the freeboard height in effect at the start of construction for the original structure. If the structure is a pre-FIRM structure, full compliance with the current VAUSBC freeboard above the base flood elevation is required. Structures that are utilizing an approved land management plan for their on-site waste disposal may be allowed to continue the use of the land management plan as long as it is approved by the city and the health department, even for damage or destruction resulting from flood.

C. As defined in section 4.8 B, X and X(Shaded) Zone requirements. (Other Areas of Flood Risk), and 4.3 A(ii) when the required finished floor is higher than the BFE plus two feet of freeboard, where the floodplain administrator, in consultation with the Development Services Center, has determined that the proposed stormwater engineering design will approximately mitigate any impacts to the finished floor of the nonresidential development.

Sec. 6.3. Application process.

A. Applications for variances from the requirements of this ordinance shall be made to the city council and filed with the director of planning. The fee for such applications shall be ~~six hundred fifty dollars~~ seven hundred eighty ($~~650~~780.00). Such fee shall include all costs of notifications and advertising. Except in cases in which such fee is waived, the director shall not accept any application not accompanied by payment of the required fee. The procedure for the advertising, hearing and determination of applications for floodplain variances shall be in accordance with the requirements pertaining to applications for subdivision variances, as set forth in section 9.4 of the subdivision ordinance. In cases in which a variance application is filed by reason of a natural disaster that is the subject of a federal declaration of emergency, application and associated advertising fees shall be waived and such application shall be given expedited processing to the maximum practical extent.

B. All applications shall be accompanied by the following:

1. A separate map, on a 1″ = 100′ or greater scale, identifying all proposed land disturbance, including fill and mitigation areas, and the limits of the existing and proposed SFHAs, tidal and non-tidal wetlands, Southern Rivers Watershed Management Area Buffer, and CBPA Resource Protection Area Buffer; and

2. A preliminary floodplain study addressing the physical and environmental characteristics of the floodplain located on adjoining properties and in the general area. Such study shall be sufficient to show that the variance, if granted, will meet the standards defined in section 6.~~3~~4 and in addition thereto, shall:

    a. Contain supporting data and calculations required for a Preliminary Stormwater Engineering Analysis as appropriate~~, given the preliminary nature of the floodplain study~~;

    b. Comply with the Public Works Design Standards Manual; and

    c. Be certified by a professional engineer, architect, surveyor, landscape architect or practitioner of a related field having a valid license issued by the Commonwealth of Virginia or who is exempt from licensure pursuant to applicable provisions of the Virginia Code.

Adopted by the Council of the City of Virginia Beach, Virginia, on the 1st day of February, 2022.

Attachment 6: Copy of Monitoring/Maintenance Plan

Dewberry

[DRAFT] Annual Monitoring Plan and Post-Construction Monitoring Report

Marsh Restoration in Back Bay, Virginia Beach, VA

Prepared by: Dewberry Engineers, Inc.

[July 6, 2023]

[REPORT VERSION [DRAFT]]

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INTRODUCTION

This project is intended to implement one of the nature-based projects proposed in Virginia Beach's "Sea Level Wise" (SLW) Adaptation Strategy[1] adopted by the Virginia Beach City Council in June 2020. The SLW Adaptation Strategy presents a holistic framework for addressing flood risks across the City, consisting of four general strategies – natural mitigations, engineered defenses, adapted structures, and prepared communities. These strategies were applied to each major watershed in the City and tailored to their unique characteristics and risk profiles. The adaptation vision for the Lower Southern Rivers Drainage Basin, where the proposed project is located, focuses on employing natural mitigation methodologies to strategically reduce flow into and within Back Bay, along with an integrated system of defense structures and complementary adaptation measures, such as land-use strategies, to improve flood storage and overall coastal resiliency. The Bonney Cove area of Back Bay, where the project site is proposed, is particularly suitable for the use of nature-based strategies given the low elevations of marshlands and documented historic degradation of habitat. Participants at the 'near-neighbor' public engagement meetings held during the SLW Adaptation Strategy development were supportive of these types of strategies.

The City has several dedicated Capital Improvement Program (CIP) initiatives for the Lower Southern Rivers Drainage Basin for implementation of these strategies. The City's Stormwater Green Infrastructure CIP has obligated approximately $421,700 in contracts to support field investigations, environmental assessments, and engineering designs of the project – a true indication of the City's commitment to nature-based approaches and the critical first step in a broader effort. During the General Election on November 2, 2021, Virginia Beach residents voted to authorize $567.5 million dollars in debt to fund the design and construction of 21 Phase 1 projects in the citywide Flood Protection Program. [2] The Back Bay Marsh Terrace project is included under the Stormwater Green Infrastructure Master Project.[3] Other Southern Watershed projects that received funding under the Flood Protection Program include the West Neck Creek Bridge City-Wide Sea Level Rise Strategy, the Pungo Ferry Road Improvements, and the Sandbridge/New Bridge Intersection Improvements projects.

Outside of this project, the Virginia Beach City Council has recently funded a $5.2 million dollar voluntary acquisition program to encourage flood-prone properties to apply for a buyout to enable the City to convert parcels to open space to serve as flood storage and a marsh migration buffer. The City's

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[1] City of Virginia Beach Sea Level Wise Adaptation Strategy webpage: https://www.vbgov.com/government/departments/public-works/comp-sea-level-rise/Pages/default.aspx

[2] City of Virginia Beach Flood Protection Program webpage: https://www.vbgov.com/government/departments/public-works/flood-protection-program/Pages/Flood-Protection-Program.aspx.

[3] Stormwater Green Infrastructure Page: https://www.vbgov.com/government/departments/public-works/flood-protection-program/Pages/Stormwater-Green-Infrastructure-.aspx

Stormwater Green Infrastructure CIP is also supporting the implementation of other natural and nature-based projects across the City, including a wetland and floodplain restoration project along the Eastern Branch of the Elizabeth River.

An assessment of restoration opportunities in the City's Lower Southern Rivers Drainage Basin with dual flood reduction and habitat restoration benefits identified the Bonney Cove area as a potential project site for several reasons. The Bonney Cove site has experienced significant historical ecological degradation. Historical shoreline data from 1869 indicates approximately 50% of present-day open water in Bonney Cove (260 acres) was previously marsh (Figure 1). Loss of the marsh island habitat within Bonney Cove has resulted in the opening of a secondary channel allowing increased flow exchange between the upper and lower bays. In comparison to shore-adjacent restoration, off-shore marsh restoration leveraging hydraulic modeling identified Bonney Cove as a location where marsh restoration has the potential to reduce the propagation of floodwaters through key pathways within Back Bay. The United States Fish and Wildlife Service (USFWS) and the Virginia Department of Wildlife Resources (VDWR) also identified Bonney Cove as a restoration priority as this area serves as an ideal location for Submerged Aquatic Vegetation (SAV) reestablishment and vital habitat for migratory birds and fish.

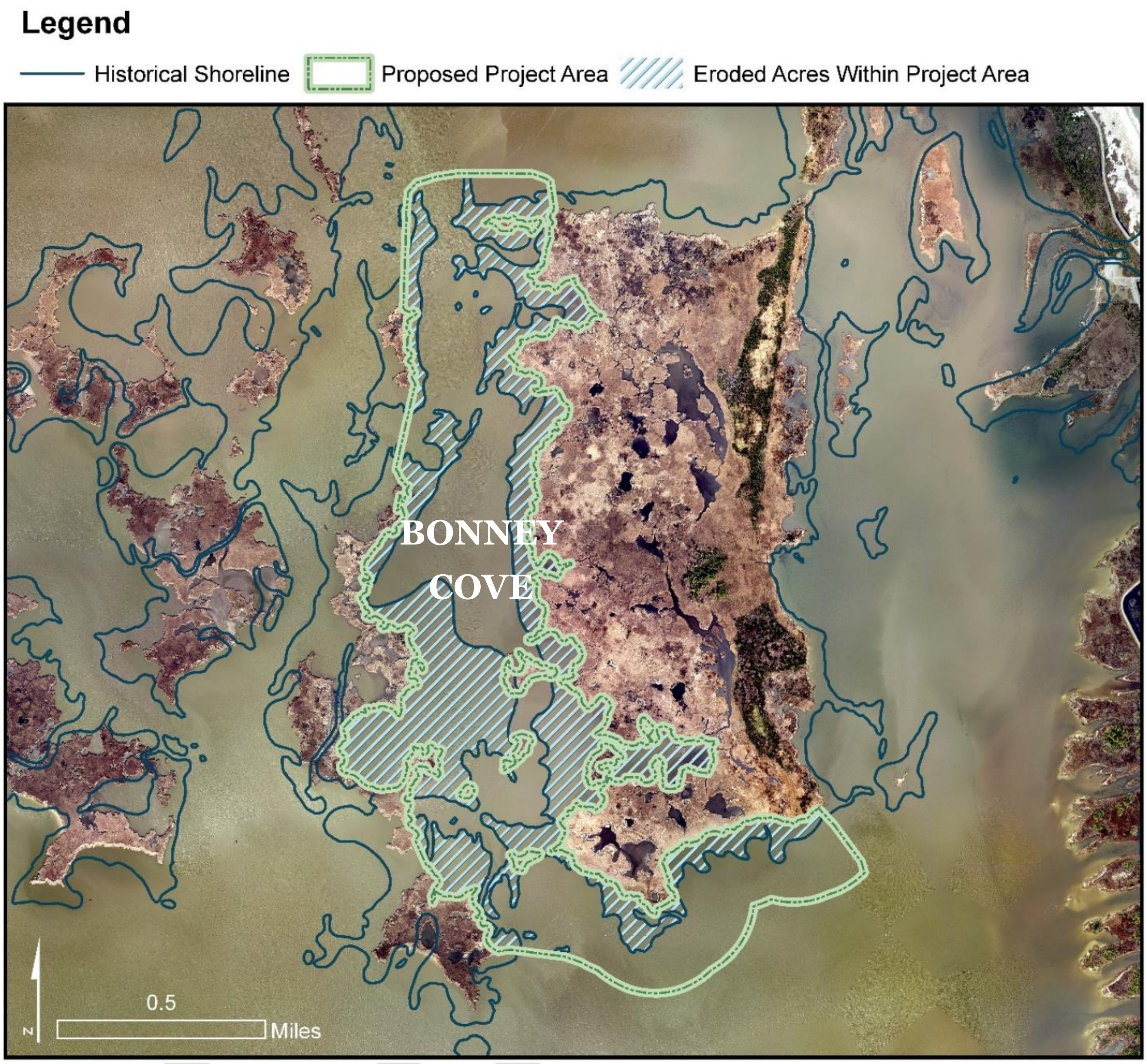

Figure 1: Historical marsh erosion within the project area.

The project is situated within the Bonney Cove area of Back Bay, spanning the western and southern lengths of Long Island, as shown in Figure 1.

Project Background

Marsh island restoration through terracing was identified as a particularly viable solution given Back Bay's shallow bottom and the historical loss of habitat. The marsh terraces are narrow man-made islands that will be arranged across areas that were historically marsh but are now shallow open water. A series of these islands, or terraces, are typically arranged in a chevron pattern. The overall field of terraces dissipates waves and slows down water moving through the area. In turn, the calmer water allows more sunlight to penetrate to the shallow bottom, promoting establishment and growth of marsh

and SAV habitats. Further, as opposed to one continuous marsh platform, marsh terraces maximize habitat for a variety of fish and wildlife species.

The Preferred Alternative includes the creation of 41 individual marsh terraces totaling approximately 25,000 linear feet (or an approximately 47-acre footprint) across Bonney Cove. These 47 acres of terraces are comprised of approximately 13 acres of emergent (low and high marsh) vegetated habitat, 14 acres of upland vegetated habitat, and 16 acres of submerged terrace habitat. Approximately 310 acres of suitable SAV habitat will remain in between the terraces.

Terrace Construction and Orientation

Terrace construction will begin in the northern extent of the project site, and the contractor will work towards the southern extent of the site. The contractor will complete each terrace, including installing plants, before moving to the next. Marsh terrace construction will occur over two years (2025 to 2026) and will pause annually between October 31st and March 1st to limit disturbance to wintering waterfowl and migration, in accommodation of BBNWR's requirement. Approximately 20 terraces will be constructed in 2025 ("Phase 1"), and 21 terraces will be constructed in 2026 ("Phase 2"). The following sections summarize the proposed design and construction approach.

Terraces will be generally oriented perpendicular to the predominant wind direction (south-southwest) to maximize wave energy reduction. The terraces will be segmented in a chevron (duck-wing) pattern to create the most favorable fish and swimming crustacean (termed "nekton") habitat, facilitate adequate circulation, and maintain navigability throughout the project area. The terraces will not be connected to the adjacent marsh to maintain a physical open water barrier to deter the invasion of Common Reed (*Phragmites australis*) stands.

The terraces will be spaced at approximately 300-foot intervals in the northern and southern quarters and span 15 feet in width, and at least 600-foot intervals in the center and span 30 feet in width. This arrangement will lessen the amount of open water and subsequent wave action at the northern and southern ends of the site and provide space for marine-based construction equipment. The design team reviewed the final spacing layout of the terraces to ensure navigability of a watercraft through the project site which will be required for post-construction monitoring, any needed maintenance, as well as community recreational access.

The terraces would consist of a sand filled core encapsulated by a high-strength blend of woven and non-woven geotextile fabrics ("geobags"). The sand for this material would need to come from offsite sources. Back Bay is too shallow to accommodate conventional barges for material placement. To avoid extensive impacts to the bottom of the bay, the slurry basin will pump sand for the project from the proposed Shipps Cabin Road staging area to Bonney Cove. The slurry pipeline will consist of approximately 10,424 linear feet of 12" diameter HDPE fused/welded pipeline that will be assembled on land and floated into its proposed alignment within Back Bay. The pipe would be marked by floats

every 5 feet and temporary signage as reasonable. It is anticipated the pipeline will be submerged to the bottom of the bay at channel crossings and adjacent to a duck hunting cabin adjacent to the alignment. By establishing a floating pipeline, it will limit disturbances to the subaqueous bottomlands along the alignment and allow for the retraction of the pipeline during the winter inactive periods and inclement weather events. Booster stations would be placed approximately every mile. These booster stations would consist of a pontoon mounted diesel engine pump capable of moving the sand slurry from the laydown area to the site. Given the distance to the site, four or five of these booster stations are anticipated to be necessary to create the sand cores of the terrace. It is estimated that 450 Gallons Per Minute (GPM) of sand slurry would be pumped through the pipe.

Once the cores are in place, long reach excavators would travel along the tops of the terraces and begin to shape the cross slopes. Appropriate materials for establishing vegetation atop the terraces will be primarily sourced from materials dredged during the Sandbridge Road Nimmo Parkway Phase VII-A project located immediately north of Back Bay (VMRC 15-1564, USACE IP NAO-2015-00151). Materials will be tested and screened to remove organics prior to application to the terraces. As needed, dredging sites adjacent to the proposed terrace locations that are confirmed to be devoid of SAV will be utilized to provide supplemental soil materials to top the proposed terraces[4]. It was determined that the in-situ bay sediment would be suitable for vegetation growth. The marsh terraces would be covered with 1 to 3 feet of suitable fill, depending on crest widths. Jute netting will cover the topsoil to control erosion and promote vegetation establishment. Coir logs will be places along the terrace slope controls to further promote vegetation establishment along the slope.

SAV Plantings

The City has partnered with Virginia Polytechnic Institute and State University ("Virginia Tech") to evaluate opportunities for restoring populations of native Wild Celery (*Vallisneria americana*) in Back Bay. The Virginia Tech research team has developed an innovative technique to grow Wild Celery in an aquaculture center that results in larger, mature plants that can better withstand Back Bay's turbidity. Once transplanted, plants are surrounded by cages to prevent predation. These founder colonies can be used for propagation throughout Back Bay. After terrace construction, the City will transplant Wild Celery in an area adjacent to the site. This founder colony will be used to strategically transplant Wild Celery in between the terraces for 5 years after construction (2026 – 2029) with the ultimate goal of establishing 10 acres of SAV vegetation in between the marsh terraces.

[4] The 60% preliminary design showed preliminary siting of these dredge areas based on avoidance of existing SAV habitat; however, pre-construction surveys of SAV would be required to re-delineate these dredging areas.

Terrace Plantings – Upland and Marsh Vegetation

The terraces' intertidal perimeter will be planted with appropriate emergent estuarine plant species (e.g., Saltmarsh Cordgrass [*Spartina alterniflora*] and Salt Meadow Hay [*Spartina patens*]) and brackish plant species (e.g., Big Cordgrass [*Spartina cynosuroides*]). These plants will be installed as soon as possible after construction to stabilize planting areas and protect the terrace from erosion. In addition to emergent grass, woody growth (i.e., shrubs and trees) within the terrace crest will be incorporated to protect the terraces' surfaces from rain and wind erosion and hold the landform together through substantial root systems.

Appropriate native species were identified based on the review of the reference marshes surrounding the project site and a review of water levels in Back Bay. Since the Bay's water levels are not affected by lunar tides and instead by wind-driven fluctuations, the project team evaluated average water elevations at the U.S. Geological Survey (USGS) Beggars Bridge Creek Gauge (Gauge ID 0204300267) from 2016 – 2021 to determine ranges of inundation to achieve functional marsh elevations throughout the project life, defined as:

- *Mean Low Water (MLW)*: the average low water at the site (10th Percentile: -0.62 ft NAVD88)
- *Mean High Water (MHW)*: the average high water at the site (95th Percentile: 1.22 ft NAVD88)
- *Mean Tide Level (MTL)*: halfway between MLW and MHW (0.3 ft NAVD88)
- *Upper Limit of Wetlands (ULW)*: approximately 1.5 times the mean tide range at the site (2.76 ft NAVD88)

These elevations were correlated to suitability for low marsh, high marsh, and upland species, as shown in Table 1.

Table 1: Proposed planting elevation zones.

Planting Zone	Definition	Elevation Range	Elevation (feet NAVD88)	Percentage of record where water reaches these elevations
Low Marsh	Marsh that is flooded frequently but exposed sometimes	MTL - MHW	0.3 – 1.2 ft	48%
High Marsh	Marsh that is generally only flooded during higher-than average water conditions	MHW – ULW	1.2 to 2.8 ft	7%
Upland Habitat	Habitat that is rarely flooded, only during extreme conditions	> ULW	> 2.8 ft	0%

Five planting schemas were identified to provide the highest possible environmental benefit in terms of erosion control, habitat diversity, and fetch reduction. The wider (30-foot) terraces will be planted with Bald Cypress (*Taxodium districhum*) trees capable of withstanding rising water levels. The full list of species and quantities is provided in the 95% design plan set.

The final engineered design component is the strategic placement of rock on the exposed perimeter terraces on the project site's north, west, and southern extents. The need for the rock armor was determined through analysis of wind data both from NOAA and ASCE-7-10 50-year return period anticipated 3-second gust values. These values were used to calculate fetch-generated waves at the project site. The calculations performed confirmed that armored protection would be required to protect the proposed terraces from the forces created by wave action. The stone sizes required for these features (Class II rip rap) were calculated following the procedures laid out in the USACE Coastal Engineering Manual (CEM) and Virginia Institute of Marine Science (VIMS) Living Shoreline Design Guidelines for Shore Protection in Virginia's Estuarine Environments. Two calculation methods, Hudson (1974) and Van Der Meer (1988), from the CEM were utilized to evaluate the range of acceptable rock armor for the exposed perimeter. These two methods calculate the armor stone size based on several design inputs including initial wave height, allowable damage level, revetment slope, and breaking versus non-breaking waves. The two methods often result in corresponding values that are used by the engineer to make an experienced determination on the final rock armor sizing. The rock armor will serve as a nature-based design element by acting as a substrate for the Wild Celery grass that has proven to be successful for SAV establishment in Back Bay (see Figure 2).

Figure 2: Example Back Bay SAV experiment; photo courtesy of Virginia Tech.

Monitoring Goals and Objectives

Annual post-construction monitoring of the site is required by the Virginia Marine Resource Commission (VMRC) (TBD) Permit (VMRC #XXXX-XXXX) and the U.S. Army Corps of Engineers (USACE) Individual Permit (NOA-20XX-XXXXX). [Insert details of the relevant permits and permit conditions]. The following goals, objectives, and metrics were established to enable consistent tracking of the primary living shoreline project components across each monitoring year.

1. **Monitoring Goal 1**: Establishment of a Sustainable Coastal Marsh Island System
   a. Objective 1a: Establish Emergent Marsh Habitat
      - Metric: For each monitoring year, the project area should maintain or increase the overall coverage of emergent marsh vegetation. There should be no significant signs of herbivory or invasive species establishment.

   b. Objective 1b: Establish Upland Habitat
      - Metric: For each monitoring year, the project area should maintain or increase the overall coverage of upland vegetation. There should be no significant signs of herbivory or invasive species establishment.
2. **Monitoring Goal 2**: Stability of Marsh Terraces
   a. Objective 2: Marsh Terrace Structures
      - Metric: For each monitoring year, the terrace structures should show no significant signs of damage, deterioration or extreme settlement.
3. **Monitoring Goal 3**: Establishment of a Sustainable SAV Community
   a. Objective 3: Establish SAV Communities

- Metric: For each monitoring year, the SAV planting areas should maintain or increase the overall coverage of SAV vegetation. There should be no significant signs of herbivory or invasive species establishment.

MONITORING PLAN

The monitoring plan includes stakeholders, a schedule for the annual monitoring inspections, the monitoring strategy/sampling plan, and approach for addressing any needs for maintenance.

Monitoring Stakeholders

An Environmental Scientist from Dewberry Engineers Inc. will perform the annual monitoring inspections and provide a copy of the monitoring report to the City of Virginia Beach, USACE, VDEQ, VMRC, and the City of Virginia Beach Wetlands Board as necessary. As owners of the project, the City of Virginia Beach will review monitoring recommendations and perform corrective actions as necessary.

Annual Inspection Schedule

Monitoring inspections should be conducted annually, during the peak growing season, which is defined by VMRC as between June and August. To enable consistent tracking of project performance from year to year, annual monitoring inspections will be conducted prior to the end of the growing season in September of each year, with annual reports to be submitted to regulatory stakeholders prior to November 30th [or an annual date defined in the permit conditions] of each year. The following outlines the monitoring inspection schedule and deliverables.

Phase 1 Post-Construction As-Built Report (Date: Prior to December 31st, 2025)

To serve as a baseline for the post-construction annual monitoring, an as-built report for the Phase 1 terraces will be completed following the construction of each phase of terraces and submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following.

- Coordinates and diagrams of established transects, as well as site photographs from photo stations 1-40 as defined in the Methods section.
- Final location of all planted vegetation (upland plantings, high marsh plantings and low marsh plantings).
- Final grade topographic surveys (plan, profile, and cross sections).
- Discussion of the project design versus as-built conditions.

Phase 2 Post-Construction As-Built Report (Date: Prior to December 31st, 2026)

To serve as a baseline for the post-construction annual monitoring, an as-built report for the Phase 2 terraces will be completed following the construction of each phase of terraces and submitted to the

City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following.

- Coordinates and diagrams of established transects, as well as site photographs from photo stations 41-80 as defined in the Methods section.
- Final location of all planted vegetation (upland plantings, high marsh plantings and low marsh plantings).
- Final location and extent of SAV plantings.
- Final grade topographic surveys (plan, profile, and cross sections).
- Discussion of the project design versus as-built conditions.

Year 1a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2026)

At the end of the first full growing season following planting of the Phase 1 terraces, a Year 1a monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 40 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 1 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion; it is anticipated that the wetland planting contractor will provide a one-year post construction maintenance and guarantee period for the wetland plantings.

Year 1b/2a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2027)

At the end of the first full growing season following planting of the Phase 2 terraces following planting, and the second full growing season of the Phase 1 terraces, a Year 1b/2a monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 1 conditions (for Phase 2 terraces) and to Year 2 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).

- Estimated percent cover and change in coverage from planted conditions to Year 1 conditions for SAV planting quadrants
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion; it is anticipated that the wetland planting contractor will provide a one-year post construction maintenance and guarantee period for the wetland plantings.

Year 2b/3a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2028)

At the end of the second full growing season of the Phase 2 terraces following planting, and the third full growing season of the Phase 1 terraces, a Year 2b/3a monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 2 conditions (for Phase 2 terraces) and to Year 3 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- Estimated percent cover and change in coverage from planted conditions to Year 2 conditions for SAV planting quadrants
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

Year 3b/4a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2029)

At the end of the third full growing season of the Phase 2 terraces following planting, and the fourth full growing season of the Phase 1 terraces, a Year 3b/4a monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 3 conditions (for Phase 2 terraces) and to Year 4 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).

- Estimated percent cover and change in coverage from planted conditions to Year 3 conditions for SAV planting quadrants
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

Year 4b/5a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2030)

At the end of the fourth full growing season of the Phase 2 terraces following planting, and the fifth full growing season of the Phase 1 terraces, a Year 4b/Final (Year 5a) monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 4 conditions (for Phase 2 terraces) and to Year 5 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- Estimated percent cover and change in coverage from planted conditions to Year 4 conditions for SAV planting quadrants
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

Year 5b Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2031)

At the end of the fifth full growing season of the Phase 2 terraces following planting, a Final (Year 5b) monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 41 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 5 conditions (for Phase 2 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- Estimated percent cover and change in coverage from planted conditions to Year 5 conditions for SAV planting quadrants

- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

Monitoring Strategy

The monitoring strategy consists of established transects with photo stations and quadrants that cover the area between transects. This approach enables monitoring of the four primary features of the living shoreline: uplands, low-marsh plantings, high-marsh plantings, and SAV*.

*Note: The planting scheme for SAV has not yet been established but it is anticipated that some SAV will be planted along the submerged portions of the marsh terraces. If more suitable planting locations are determined to be between terraces, separate transects will be established and sampled to track SAV survival apart from the proposed terrace transects.

Transects/Photo Points

A total of eighty (80) transects will be established across the project site, with 10 transects located along each of 8 terraces. Transects will span perpendicular to the length of each terrace from the ridge to the edge of the planted/vegetated area. See Figures 3 and 4 for graphic depictions of the proposed transect locations and layouts. Terraces were selected using a random stratified method to ensure representative terraces in each location within the project area (North Interior, North Exterior, South Interior, South Exterior), and of each planting scheme, were represented in the proposed monitoring plan. The selected terraces are as follows:

- North Interior: T-110, T-113
- North Exterior: T-100, T-106
- South Interior: T-124, T-131
- South Exterior: T-123, T-140

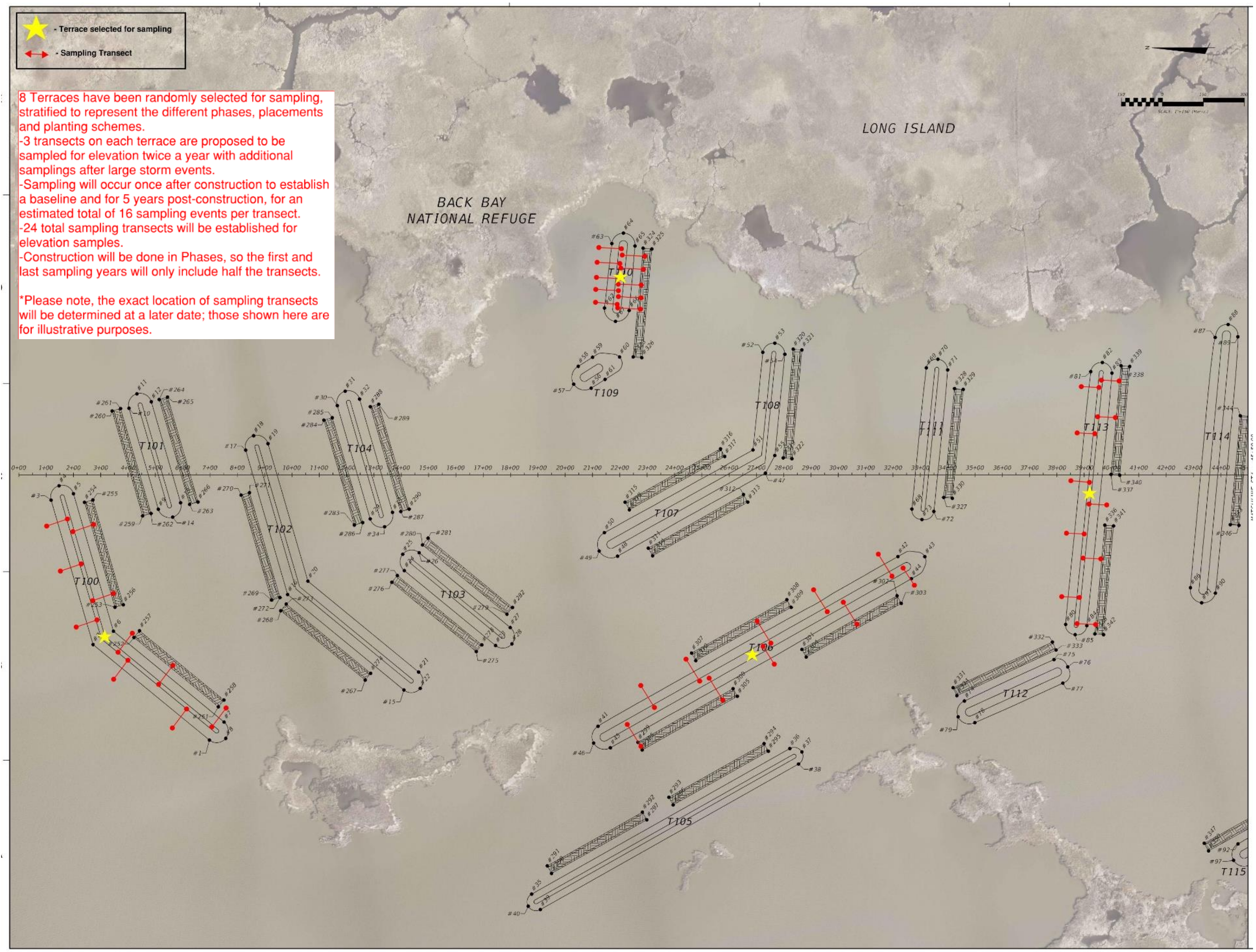

Figure 3: Monitoring design site plan – North Terraces

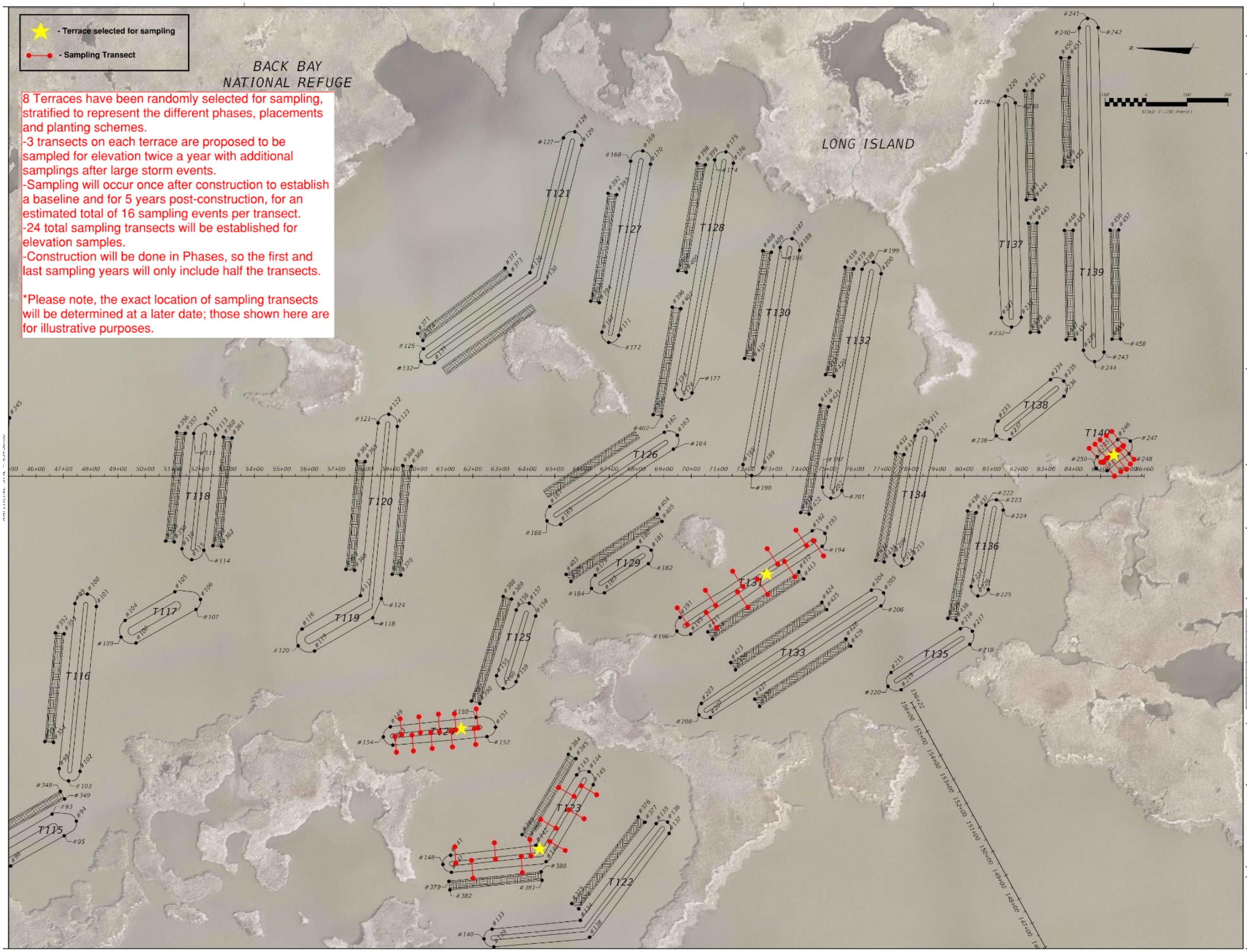

Figure 4: Monitoring design site plan – South Terraces

Permanent photo stations will be established at each quadrant along each transect to capture the design features/established habitats and vegetation. Figure 5 shows the general proposed locations (indicated by the red arrows/labels) for each quadrant and photograph station along each transect. Photos were shot from each photo location on [DATE]. These photos will be collected annually and compiled in Appendix B.

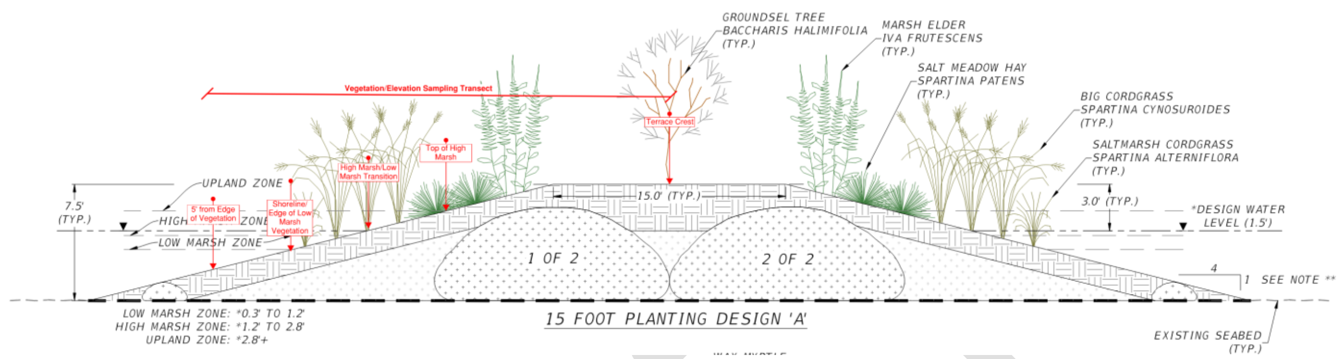

Figure 5: Photo station layout example

Quadrants

To estimate percent cover of vegetation, four (4) quadrants along each of ten (10) transects will be established on the eight selected terraces to allow for estimates of habitat coverage and planting survival. Estimates of coverage and survival were compared to post-construction conditions to evaluate changes.

Further, the following guiding questions were established to monitor overall project performance, presence of invasive species, and identify any needs for maintenance:

1. Are there specific problem areas where plants are dying or appear unhealthy?
2. Were any signs of herbivory observed?
3. Are there any undesirable plant species present?
4. Condition of the terrace structures: Is there any observed settlement, dislodged stone, significant debris etc.?
5. If an updated survey was conducted, are there any significant changes in the profile of the marsh terraces?
6. Does the upland portion of each terrace show any significant signs of erosion or loss of vegetation?

MONITORING RESULTS

Table 2: Low Marsh Vegetation Percent Cover Monitoring Results (Example Table – Terrace 1).

		Estimated Percent Coverage						Percent Change in Coverage (from Baseline)				
Terrace/ Transect	Photo Station Reference	Baseline (2024)	Year 1 (2025)	Year 2 (2026)	Year 3 (2027)	Year 4 (2028)	Year 5 (2029)	Baseline to Year 1	Baseline to Year 2	Baseline to Year 3	Baseline to Year 4	Baseline to Year 5
1 - 1	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 2	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 3	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 4	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 5	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 6	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 7	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 8	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 9	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 10	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
Overall		**Choose an item.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**

Table 3: High Marsh Vegetation Percent Cover Monitoring Results (Example Table – Terrace 1).

		Estimated Percent Coverage						Percent Change in Coverage (from Baseline)				
Terrace/ Transect	Photo Station Reference	Baseline (2024)	Year 1 (2025)	Year 2 (2026)	Year 3 (2027)	Year 4 (2028)	Year 5 (2029)	Baseline to Year 1	Baseline to Year 2	Baseline to Year 3	Baseline to Year 4	Baseline to Year 5
1 - 1	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 2	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 3	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 4	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 5	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 6	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 7	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 8	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 9	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 10	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
Overall		**Choose an item.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**

Table 4: General Observations for Wetland Planting Areas on the Marsh Terraces (Example Table – Terrace 1)

Monitoring Questions	Terrace/Transect									
	1 - 1	1 - 2	1 - 3	1 - 4	1 - 5	1 - 6	1 - 7	1 - 8	1 - 9	1 - 10
Are there specific problem areas where plants are dying or appear unhealthy?	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☒ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.
Were any herbivory issues observed?	YES ☐ NO ☒ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☒ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.
Are there any undesirable plant species present?	YES ☐ NO ☒ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☒ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.
If updated survey was conducted, are there any significant changes in the profile of the living shoreline system?	YES ☐ NO ☒ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☒ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.

Table 5: General Observations for the Unplanted Structural Components of the Marsh Terraces (Example Table – Terrace 1)

Monitoring Questions	Terrace/Transect 1 - 1	1 - 2	1 - 3	1 - 4	1 - 5	1 - 6	1 - 7	1 - 8	1 - 9	1 - 10
Are there any structural issues with the planted terrace structures (e.g. observed settlement, loss of topsoil, etc.)?	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.
Is there any observed growth in SAV on or adjacent to the marsh terraces?	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.

Are there any structural issues with the rock armoring on the terraces (e.g. observed settlement, dislodged stone, significant debris, etc.)?	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.

MAINTENANCE RECOMMENDATIONS

The following table outlines the recommendations for maintenance, including estimated quantities and specific guidance, based on the results of the [YEAR] monitoring results.

Table 6: Maintenance Recommendations Checklist

Design Feature/ Monitoring Objective	Maintenance Elements	Location & Estimated Quantity	Specific Guidance
Terrace Upland and Wetland Habitats and Wetland Soils – Monitoring Objectives 1a/1b	☐ Replace plants	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Add new plants	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Remove debris	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Remove invasive vegetation	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Add sand to eroding areas	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Replace waterfowl barrier	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.

Design Feature/ Monitoring Objective	Maintenance Elements	Location & Estimated Quantity	Specific Guidance
Terrace Structures & Stone Armoring, Monitoring Objective 2a/2b	☐ Re-place dislodged stones	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Add additional stone to address settlement	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Remove debris	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Repair sand cores or other structural elements	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
SAV Establishment, Monitoring Objective 3	☐ Replace plants	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Add new plants	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.

APPENDIX A: AS-BUILT PLANS

[Page left intentionally blank; as-built plans will be included in the Year 1 monitoring report]

APPENDIX B: MONITORING PHOTOGRAPHS

Table 7: Terrace 1 Transect 1 Photographs

Photograph from Photo Location 1A	Photograph from Photo Location 1B
Photograph from Photo Location 1C	Additional photos of any problem areas.

Table 8: Terrace 1 Transect 2 Photographs

Photograph from Photo Location 2A	Photograph from Photo Location 2B
Photograph from Photo Location 2C	Additional photos of any problem areas.

Table 9: Terrace 1 Transect 3 Photographs

Photograph from Photo Location 3A	Photograph from Photo Location 3B
Photograph from Photo Location 3C	Additional photos of any problem areas.

Table 10: Terrace 1 Transect 4 Photographs

Photograph from Photo Location 4A	Photograph from Photo Location 4B
Photograph from Photo Location 4C	Additional photos of any problem areas.

Table 11: Terrace 1 Transect 5 Photographs

Photograph from Photo Location 5A	Photograph from Photo Location 5B
Photograph from Photo Location 5C	Additional photos of any problem areas.

Table 12: Terrace 1 Transect 6 Photographs

Photograph from Photo Location 6A	Photograph from Photo Location 6B
Photograph from Photo Location 6C	Additional photos of any problem areas.

Table 13: Terrace 1 Transect 7 Photographs

Photograph from Photo Location 7A	Photograph from Photo Location 7B
Photograph from Photo Location 7C	Additional photos of any problem areas.

Table 14: Terrace 1 Transect 7 Photographs

Photograph from Photo Location 7A	Photograph from Photo Location 7B
Photograph from Photo Location 7C	Additional photos of any problem areas.

Table 15: Terrace 1 Transect 8 Photographs

Photograph from Photo Location 8A	Photograph from Photo Location 8B
Photograph from Photo Location 8C	Additional photos of any problem areas.

Table 16: Terrace 1 Transect 9 Photographs

Photograph from Photo Location 9A	Photograph from Photo Location 9B
Photograph from Photo Location 9C	Additional photos of any problem areas.

Table 17: Terrace 1 Transect 10 Photographs

Photograph from Photo Location 9A	Photograph from Photo Location 9B
Photograph from Photo Location 9C	Additional photos of any problem areas.

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2023 Virginia Community Flood Preparedness Fund

Marsh Restoration in Back Bay, Virginia Beach

CITY OF VIRGINIA BEACH

Table of Contents

Appendix A – Application Form

Applicants must have prior approval from the Department to submit <u>applications, forms, and supporting documents by mail in lieu of the WebGrants portal.</u>

Appendix A: Application Form for Grant and Loan Requests for All Categories

---

Virginia Department of Conservation and Recreation
Virginia Community Flood Preparedness Fund Grant Program

Name of Local Government:

Category Being Applied for (check one):

☐ **Capacity Building/Planning**

☑ **Project**

☐ **Study**

NFIP/DCR Community Identification Number (CID) 515531

Name of Authorized Official and Title: Toni Utterback, Stormwater Engineering Center Administrator

Signature of Authorized Official: Katie E Shamm for Toni Utterback

Mailing Address (1): 2875 Sabre Street, Suite 250

Mailing Address (2): ______

City: Virginia Beach **State:** Virginia **Zip:** 23452

Telephone Number: (757) 385-8746 **Cell Phone Number:** (____) ______

Email Address: TPUtterback@vbgov.com

Contact and Title (If different from authorized official): C.J. Bodnar, Technical Services Program Manager

Type text here

Mailing Address (1): 2875 Sabre Street, Suite 250

Mailing Address (2): ______________________________

City: Virginia Beach **State:** Virginia **Zip:** 23452

Telephone Number: (757) 385-8430 **Cell Phone Number:** (____) ________________

Email Address: CBodnar@vbgov.com

Is the proposal in this application intended to benefit a low-income geographic area as defined in the Part 1 Definitions? Yes ____ No ✓

Categories (select applicable activities that will be included in the project and used for scoring criterion):

Capacity Building and Planning Grants

☐ Floodplain Staff Capacity.

☐ Resilience Plan Development

- ☐ Revisions to existing resilience plans and modifications to existing comprehensive and hazard mitigation plans.
- ☐ Resource assessments, planning, strategies, and development.
  - Policy management and/or development.
  - Stakeholder engagement and strategies.

☐ Other: ______________________________

Study Grants (Check All that Apply)

☐ Studies to aid in updating floodplain ordinances to maintain compliance with the NFIP, or to incorporate higher standards that may reduce the risk of flood damage. This must include establishing processes for implementing the ordinance, including but not limited to, permitting, record retention, violations, and variances. This may include revising a floodplain ordinance when the community is getting new Flood Insurance Rate Maps (FIRMs), updating a floodplain ordinance to include floodplain setbacks, freeboard, or other

higher standards, RiskMAP public noticing requirements, or correcting issues identified in a Corrective Action Plan.

- ☐ Revising other land use ordinances to incorporate flood protection and mitigation goals, standards, and practices.
- ☐ Conducting hydrologic and hydraulic (H&H) studies of floodplains. *Changes to the base flood, as demonstrated by the H&H must be submitted to FEMA within 6 months of the data becoming available.*
- ☐ Studies and Data Collection of Statewide and Regional Significance.
- ☐ Revisions to existing resilience plans and modifications to existing comprehensive and hazard.
- ☐ Other relevant flood prevention and protection project or study.

Project Grants and Loans (Check All that Apply – Hybrid Solutions will include items from both the "Nature-Based" and "Other" categories)

Nature-based solutions

- ☐ Acquisition of property (or interests therein) and/or structures for purposes of allowing floodwater inundation, strategic retreat of existing land uses from areas vulnerable to flooding; the conservation or enhancement of natural flood resilience resources; or acquisition of structures, provided the acquired property will be protected in perpetuity from further development, <u>and where the flood mitigation benefits will be achieved as a part of the same project as the property acquisition.</u>
- ☑ Wetland restoration.
- ☐ Floodplain restoration.
- ☐ Construction of swales and settling ponds.
- ☑ Living shorelines and vegetated buffers.
- ☐ Permanent conservation of undeveloped lands identified as having flood resilience value by *ConserveVirginia* Floodplain and Flooding Resilience layer or a similar data driven analytic tool, or the acquisition of developed land for future conservation.
- ☐ Dam removal.
- ☐ Stream bank restoration or stabilization.
- ☐ Restoration of floodplains to natural and beneficial function.

Other Projects

- ☐ Structural floodwalls, levees, berms, flood gates, structural conveyances.
- ☐ Storm water system upgrades.
- ☐ Medium and large-scale Low Impact Development (LID) in urban areas.

- ☐ Developing flood warning and response systems, which may include gauge installation, to notify residents of potential emergency flooding events.
- ☐ Dam restoration.
- ☐ Beneficial reuse of dredge materials for flood mitigation purposes
- ☐ Removal or relocation of structures from flood-prone areas where the land will not be returned to open space.
- ☐ Acquisition of property (or interests therein) and/or structures for purposes of allowing floodwater inundation, strategic retreat of existing land uses from areas vulnerable to flooding; the conservation or enhancement of natural flood resilience resources; or acquisition of structures, provided the acquired property will be protected in perpetuity from further development, <u>and where the flood mitigation benefits will **not be** achieved as a part of the same project as the property acquisition.</u>
- ☐ Other project identified in a DCR-approved Resilience Plan.

Location of Project or Activity (Include Maps): Bonney Cove in Back Bay, Virginia Beach

NFIP Community Identification Number (CID#) : 515531

Is Project Located in an NFIP Participating Community? ☑ Yes ☐ No

Is Project Located in a Special Flood Hazard Area? ☑ Yes ☐ No

Flood Zone(s) (If Applicable): Zone VE (EL 5 Feet), Zone AE (EL 4 Feet), Zone Open Water

Flood Insurance Rate Map Number(s) (If Applicable): 5155310215G and 5155310220G

Total Cost of Project: $53,378,490

Total Amount Requested $5,000,000

Amount Requested as Grant $5,000,000

Amount Requested as Project Loan (not including short-term loans for up-front costs) ___________________

Amount Requested as Short-Term loan for Up-Front Costs (not to exceed 20% of amount requested as Grant) _________________________

For projects, planning, capacity building, and studies in low-income geographic areas: Are you requesting that match be waived? □ Yes □ No

<u>Additional Information for Loan Requests</u>
Requested Loan Security: _____________________________

(General Obligation, Lease, Revenue, Special Fund Revenue, and/or Moral obligation from other government entity)

Desired loan term: _________________________________

Since the date of your latest financial statements, did the applicant issue any new debt? ______
(If yes, provide details)

Is there any pending or potential litigation by or against the applicant? ______________

Attach five years of current audited financial statements (FY18-22) or refer to website if posted
(Not necessary for existing VRA borrowers)

Attach FY2024 adopted budget or refer to website

Attach current Capital Improvement Plan

Attach adopted Financial Policies

Attach a list of the ten largest employers in the Applicant's jurisdiction.

Attach a list of the ten largest taxpayers in the Applicant's jurisdiction

Appendix B: Budget Form

Appendix B: Budget Narrative Template

Applicant Name:
Community Flood Preparedness Fund &
Resilient Virginia Revolving Loan Fund
Detailed Budget Narrative
Period of Performance: June 2024 through June 2027
Submission Date: November 12, 2023

	Grand Total State Funding Request	$ 5,000,000
	Grand Total Local Share of Project	$ 38,356,966
National Fish and Wildlife Foundation Grants	Federal Funding (if applicable)	$ 10,021,524
	Project Grand Total	$ 53,378,490
	Locality Cost Match	% 71.85

Breakout By Cost Type	Personnel	Fringe	Travel	Equipment	Supplies	Contracts	Indirect Costs	Other Costs	Total
Federal Share (if applicable)								10,021,524	10,021,524
Local Share								37,330,166	37,330,166
State Share								5,000,000	5,000,000
Pre-Award/Startup								276,800	276,800
Maintenance								750,000	750,000
Total	$	$	$	$	$	$	$	$53,378,490	$ 53,378,490

1. Federal Share represents National Fish and Wildlife Foundation (NFWF) Grants. NFWF is not a federal agency.
2. Local Share represents the total project cost less design and implementation (monitoring and initial maintenance) costs.
3. State Share represents the CFPF grant request.
4. Pre-Award costs represent project design costs.
5. Maintenance costs represent implementation (monitoring and initial maintenance costs).

Scope of Work Narrative

Introduction

The City of Virginia Beach ("City") is pleased to submit the Marsh Restoration in Back Bay project for consideration under the Flood Prevention and Protection Projects category in the 2023 Virginia Community Flood Preparedness Fund. The City has made significant investments in the study of historical flooding data, current and future hydrology, and the projected increase in flood frequency due to changing rainfall patterns and sea level rise. These studies culminated in Virginia Beach's Resilience Plan, socialized as "Sea Level Wise,"[1] which includes a conceptual suite of projects focused on flood control and resilience. The Virginia Beach Resilience Plan leverages four overarching adaptation strategies to identify actionable projects for each of the City's four unique major watersheds. This project represents the first adaptation project to advance to construction to implement the City's Resilience Plan.

The adaptation strategy for the Southern Rivers Watershed, which includes Back Bay, is presented in Figure 1. The strategy focuses on employing natural mitigation methods, an integrated system of defense structures, and complementary measures, such as land-use strategies. Collectively these approaches are designed to strategically reduce flow into and within Back Bay and improve flood storage and overall coastal resiliency. Marsh restoration was identified as a key resilience-building strategy as part of an extensive evaluation of structural and non-structural alternatives. Marsh restoration provides multiple benefits of flood risk reduction, enhanced habitat, and improved water quality.

As part of the Virginia Coastal Resilience Master Planning Framework, a precursor to the first phase of the Virginia Coastal Resilience Master Plan (CRMP), the Commonwealth of Virginia identified guiding principles for a statewide resilience strategy. One of these guiding principles is recognizing the importance of protecting and enhancing natural infrastructure and prioritizing nature-based infrastructure.[2] The City's marsh restoration project aligns with this principle and was highlighted as an exemplary nature-based project in the CRMP (refer to pages 178-179).[3]

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[1] City of Virginia Beach (2020). Virginia Beach Sea Level Wise Adaptation Strategy (Website).
[2] Office of Governor Ralph S. Northam Commonwealth of Virginia. (2020). Virginia Coastal Resilience Master Planning Framework (PDF).
[3] Office of Governor Ralph S. Northam Commonwealth of Virginia. (2021). Virginia Coastal Resilience Master Plan Phase 1 (PDF).

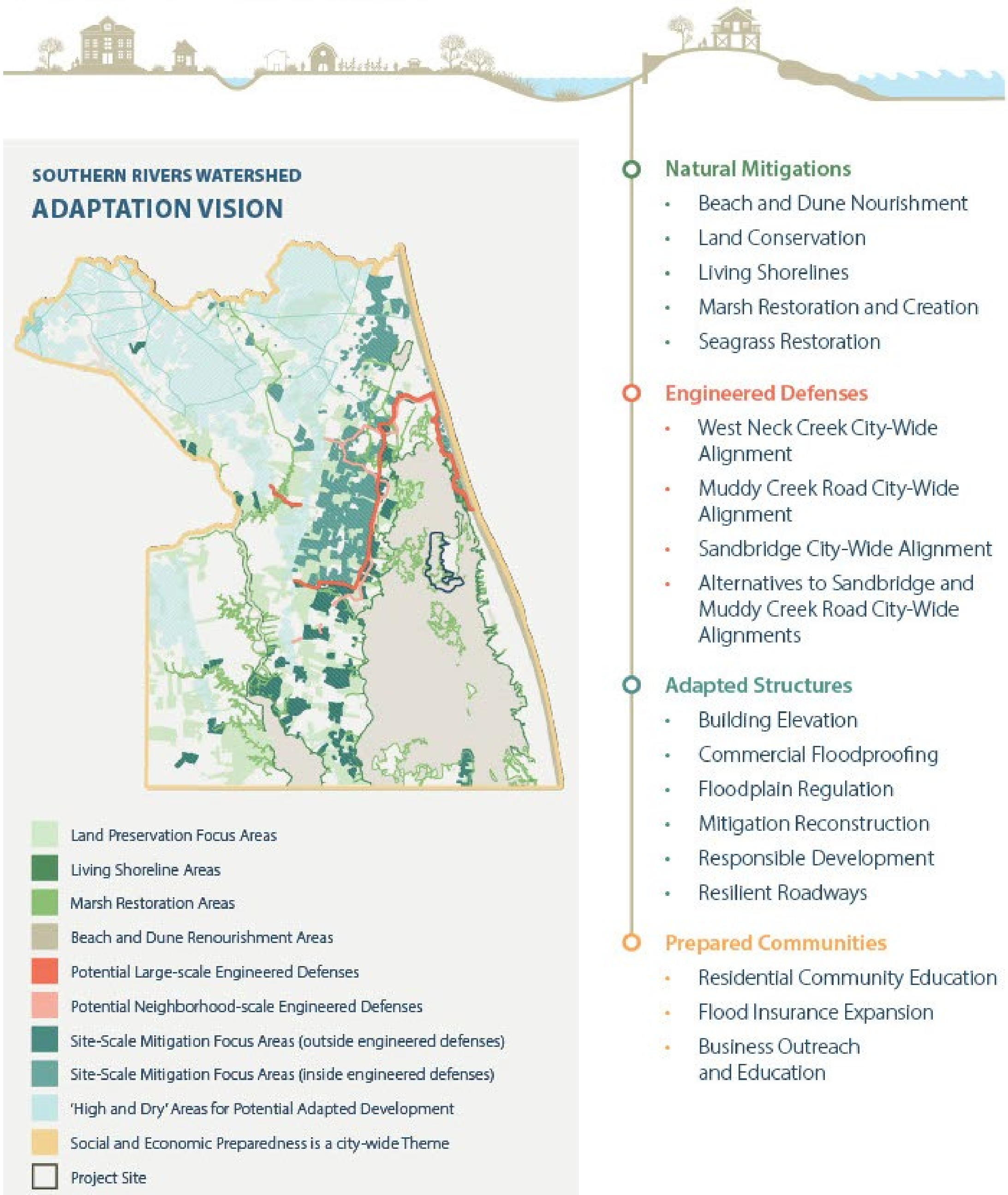

Figure 1: Adaptation Vision for the Southern Rivers Watershed.

Hydraulic modeling analysis identified Bonney Cove as a location where marsh restoration has the potential to reduce the propagation of floodwater through key pathways within Back Bay (Figure 2). The City prioritized this project as the first to advance to construction due to its significant benefits to community and habitat resilience.

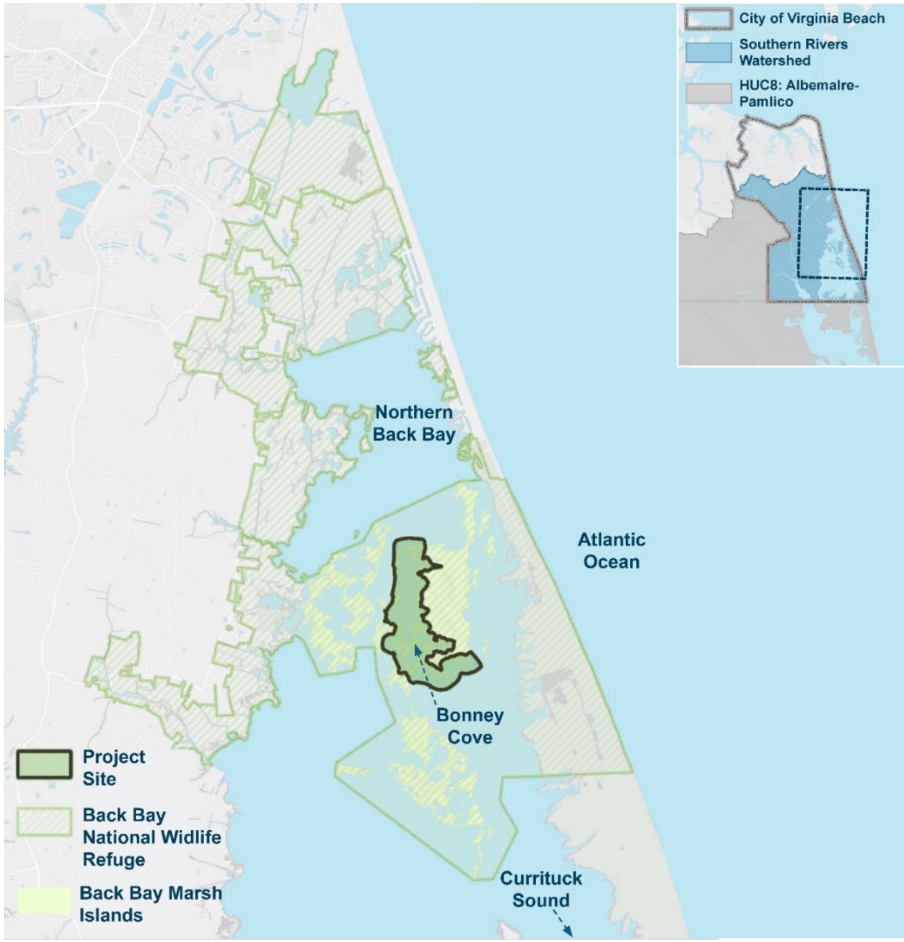

Figure 2: Project site location map.

This project represents a collaborative effort between the City's Department of Public Works alongside other City departments, public constituents, local nonprofits, and state and federal agencies. In selecting the project location and developing the design approach, the City has coordinated closely with the Back Bay National Wildlife Refuge (BBNWR), part of the U.S. Fish and Wildlife Service (USFWS), and the Virginia Department of Wildlife Resources (VDWR). Environmental organizations committed to stewardship of Back Bay have also contributed input throughout the design process, including the Back Bay Restoration Foundation (BBRF), Friends of Back Bay, the Back Bay National Wildlife Refuge Society, and the Albemarle-Pamlico National Estuary Partnership (APNEP). Project field investigations involved local support from Old Dominion University (ODU) and others, and outside expertise from Louisiana. The National Fish and Wildlife Foundation (NFWF) provided grant funding under the National Coastal Resilience Fund (NCRF) to support design, permitting, and environmental assessments. Broad support of the project is demonstrated by contributions from the organizations noted above along with other stakeholders engaged in the restoration effort.

Needs and Problems

Specific Problem Being Solved – Habitat Degradation and “Wind Tide” Flooding

Marshes are vital to the Southern Rivers Watershed for the ecological and flood reduction benefits they provide. The Southern Rivers Watershed contains 90% of the City's land area under an elevation of three feet, making this area particularly susceptible to flood impacts. As illustrated in Figure 3, sustained southerly winds push water up from the Albemarle-Pamlico Sound through the Currituck Sound and into Back Bay, creating a phenomenon referred to locally as "wind tide flooding". Marsh habitat loss has contributed to the opening of a secondary channel in Bonney Cove that has increased water flow during wind tide and other flood events to areas with high community exposure.

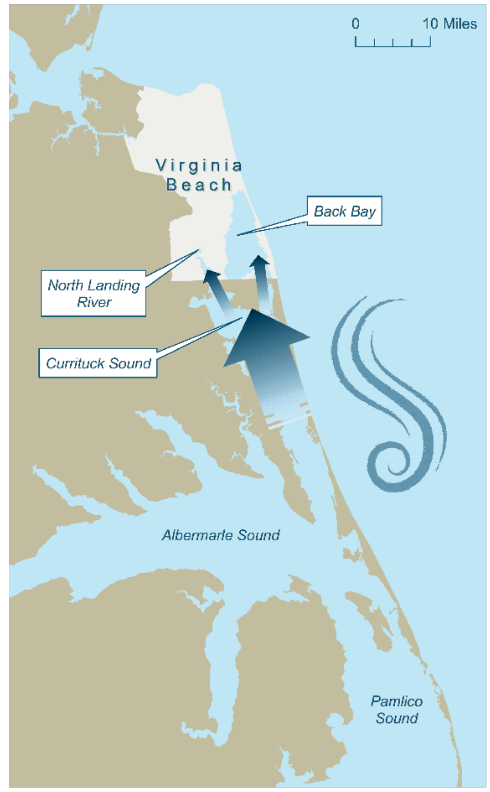

Figure 3: Flood pathways in the Southern Rivers Watershed.

Within today's marsh system, it takes between two to five days of sustained southerly winds to cause flooding, depending on the wind speed and direction. Over the last four years, more than five wind tide flooding events have occurred in this area. The increasing frequency of flooding events is primarily attributed to a foot of relative sea level rise in the last 50 years and degradation of marsh and seagrass habitat.

This marsh restoration project aims to address the challenges of habitat degradation and “wind tide” flooding by stabilizing two critically eroding marsh islands, decreasing turbidity to promote the growth of aquatic vegetation, and providing flood risk reduction benefits through increased friction and wave attenuation.

Factors Contributing to the Identified Problem

This growing flood risk in the Southern Rivers Watershed can be attributed mainly to the reduced friction in the water column from the increased water depth and eroded vegetation, which allows water to move more quickly through key hydraulic pathways. Another term for this is “fetch”, which is defined as the open water distance over which a given wind can blow and generate higher waves without obstruction. Unmitigated, the continued loss of these marsh island systems and aquatic vegetation is expected to result in more frequent and intense wind tide flooding events.

Emergent Marsh Degradation

Approximately 50% of former marshland at the site (260 acres) has eroded into open water leading to the opening of a wide secondary channel ("Bonney Cove") that is about two miles

long and half a mile wide (Figure 4). The southern exposed edge of the adjacent marsh islands is exposed to approximately 1.5 miles of fetch in the predominant wind direction.

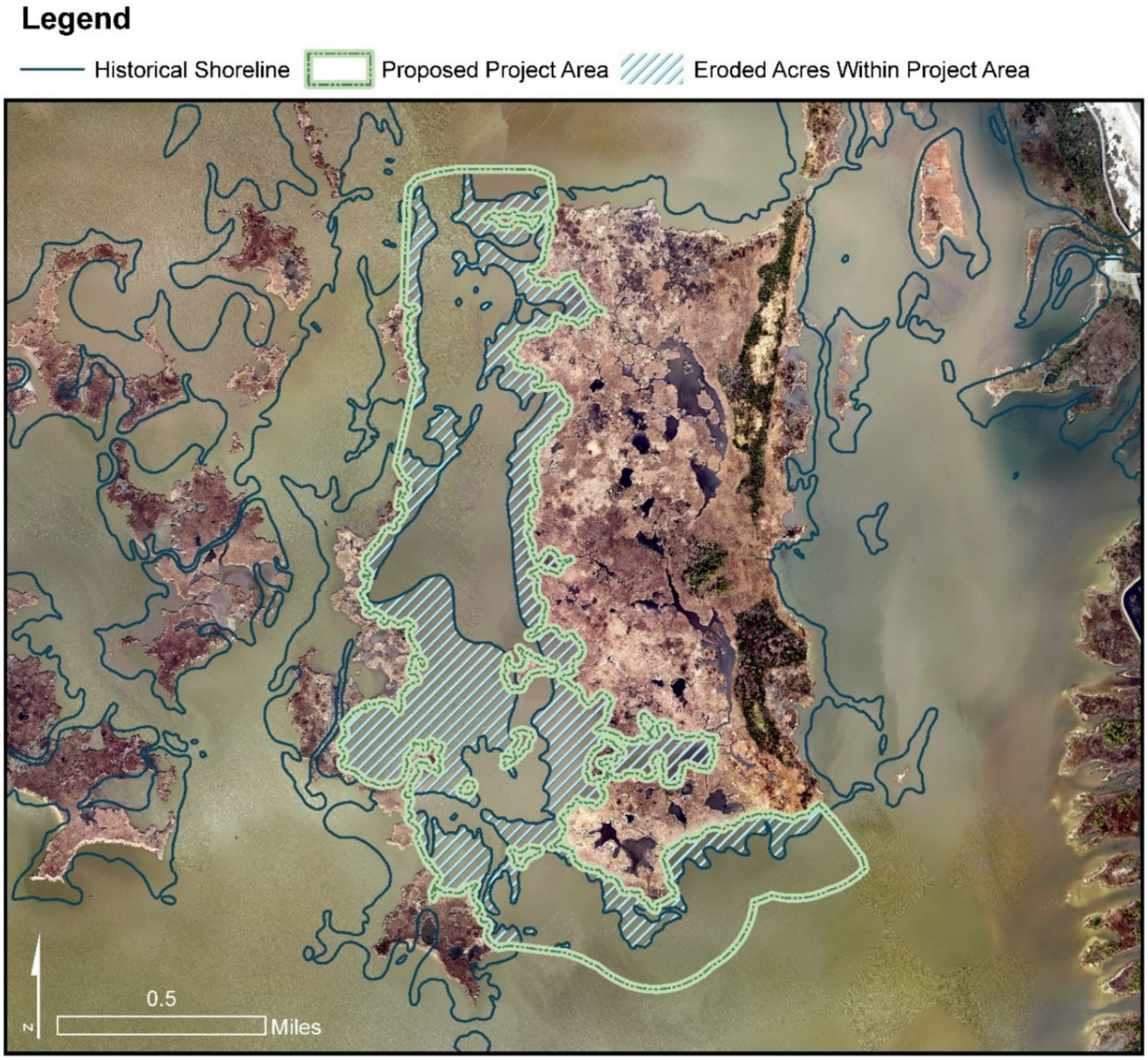

Figure 4: Historical marsh erosion within the project area.

Submerged Aquatic Vegetation (SAV) Loss

SAV used to be abundant at the site (around 45% coverage, overall) but is now extremely sparse, ranging from 0% to 10% coverage across the site, on average. Field studies conducted by the VDWR show that wind-driven waves and high flow velocities are the primary drivers of this loss, particularly in the last 5 years as shown in Figure 5.

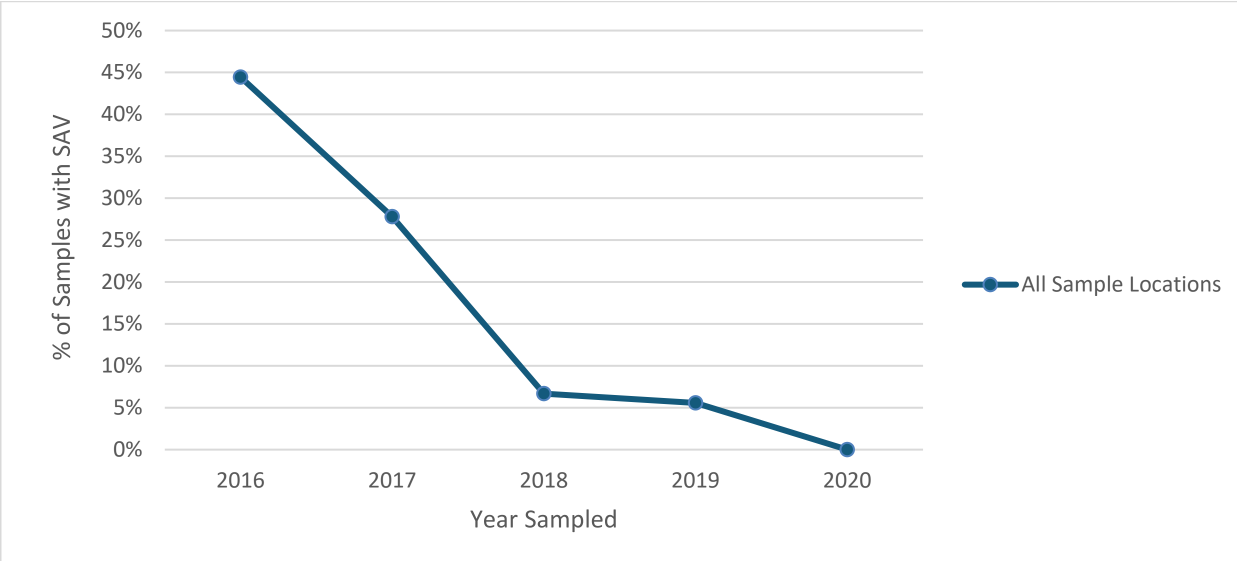

Figure 5: SAV sampling data from VDWR within the project vicinity.

Why is the Project Needed Locally/Regionally?

Pilot Project

The City's design concept for the marsh restoration project leverages "marsh terracing," an innovative coastal engineering technique widely used in Texas and Louisiana to convert shallow subtidal bottom to marsh. This technique has not yet been implemented along the U.S. East Coast and has not yet been implemented in the Mid-Atlantic region. Through the export of proven expertise from successful marsh terraces, this project would lay the foundation for future projects in the region, Virginia, and other states along the East Coast. The project would document detailed cost estimates, demonstrate effective construction practices for large-scale marsh creation projects, identify best sources for local/regional materials, and establish partnerships with permitting officials at various levels of government. The City has outlined a preliminary sequencing plan for marsh island restoration projects in Back Bay to strategically close hydraulic pathways and address priority restoration areas as shown in Figure 6. Some of these projects would require coordination with the State of North Carolina to realize its broader resilience efforts.

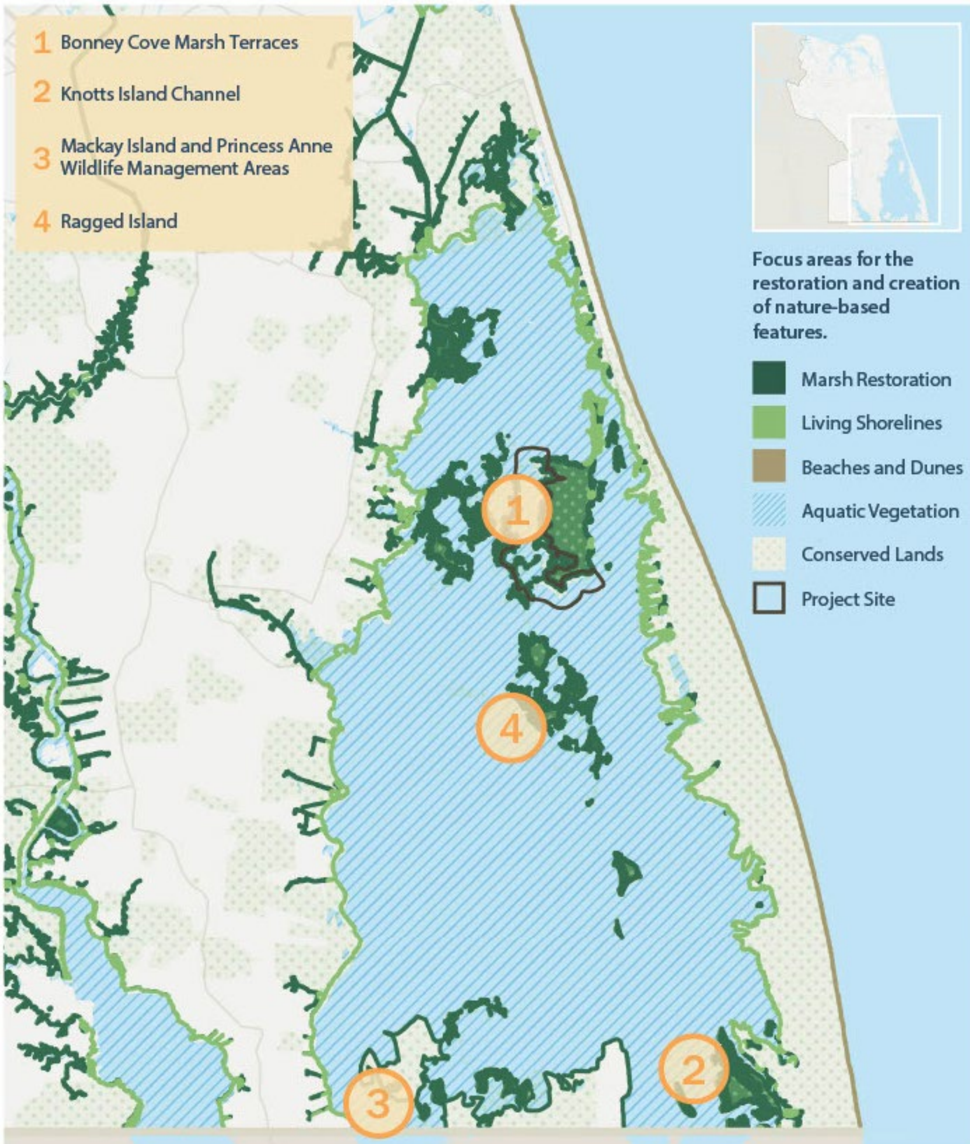

Figure 6: Preliminary Sequencing Restoration Plan.

Virginia Coastal Resilience Master Plan Exemplary Project

The CRMP impact assessment shows a high vulnerability of nature-based features to coastal flood hazards that is consistent with the City's analysis. In the Hampton Roads region, the CRMP impact assessment estimates a decrease from 40,600 acres to 2,940 acres of tidal wetlands by 2080, representing a 93% decline in tidal wetlands.[4] Back Bay was identified as a hotspot for tidal wetland loss, emphasizing the critical location of the City's marsh restoration effort. Specifically, the Virginia CRMP impact assessment shows that portions of tidal wetlands within the project area have “High” and “Very High” impact levels, which indicates areas of tidal marsh

[4] Office of Governor Ralph S. Northam Commonwealth of Virginia and Virginia Department of Conservation and Recreation (2021). Virginia Coastal Resilience Master Plan Phase 1 (PDF).

that are anticipated to be lost through inundation causing conversion to open water (Figure 7).

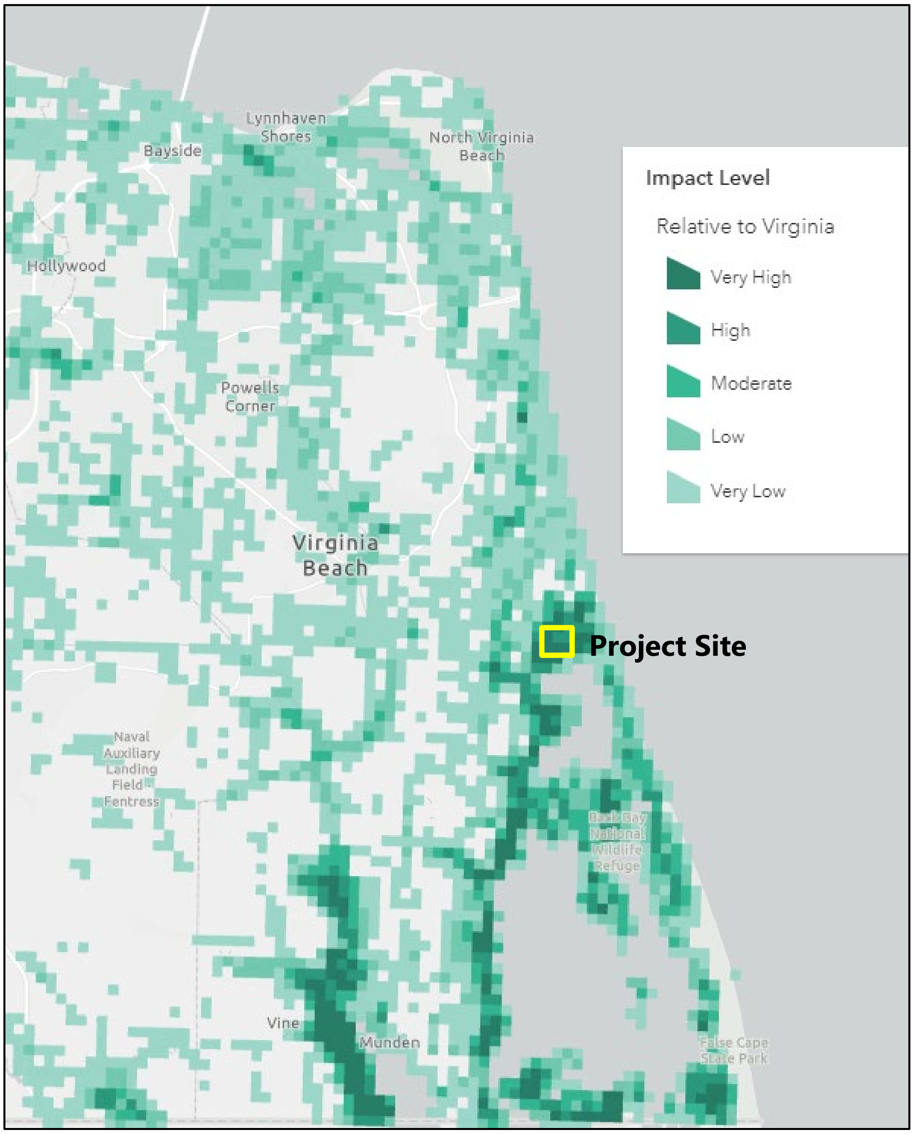

Figure 7: Virginia CRMP Impact Assessment for Tidal Wetlands.

Currituck Sound Coalition High Priority Area

In coordination with Audubon North Carolina, the Currituck Sounds Coalition designated the project site as a High Priority Area for restoring and enhancing vulnerable and degraded marshes with "high flood risk reduction benefits and habitat value" as shown in Figure 8[5].

[5] Audubon North Carolina. (2021). Currituck Sound Coalition Marsh Conservation Plan. (PDF)

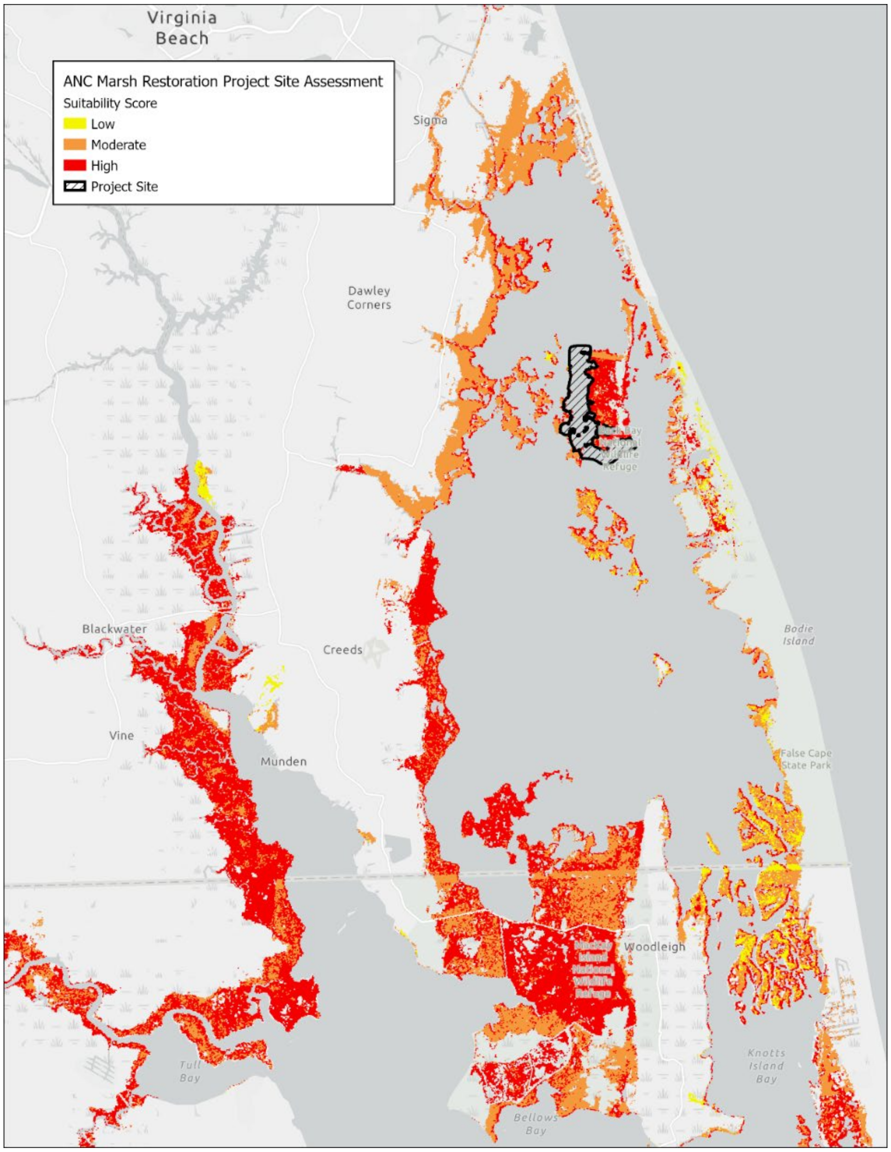

Figure 8: Audubon North Carolina Marsh Restoration Project Site Assessment

Ecological Core for Flood Resilience

The Virginia Department of Conservation and Recreation Natural Heritage Data Explorer provides data from ConserveVirginia v3.0 and other data to support conservation planning. The following map in Figure 9 displays Ecological Cores and the Floodplains and Flooding Resilience Category layer (blue polygon) from ConserveVirginia. The project area contains "High" (C3) and "General" (C5) Ecological Cores and is within the boundaries of the Floodplain and Flooding Resilience area.

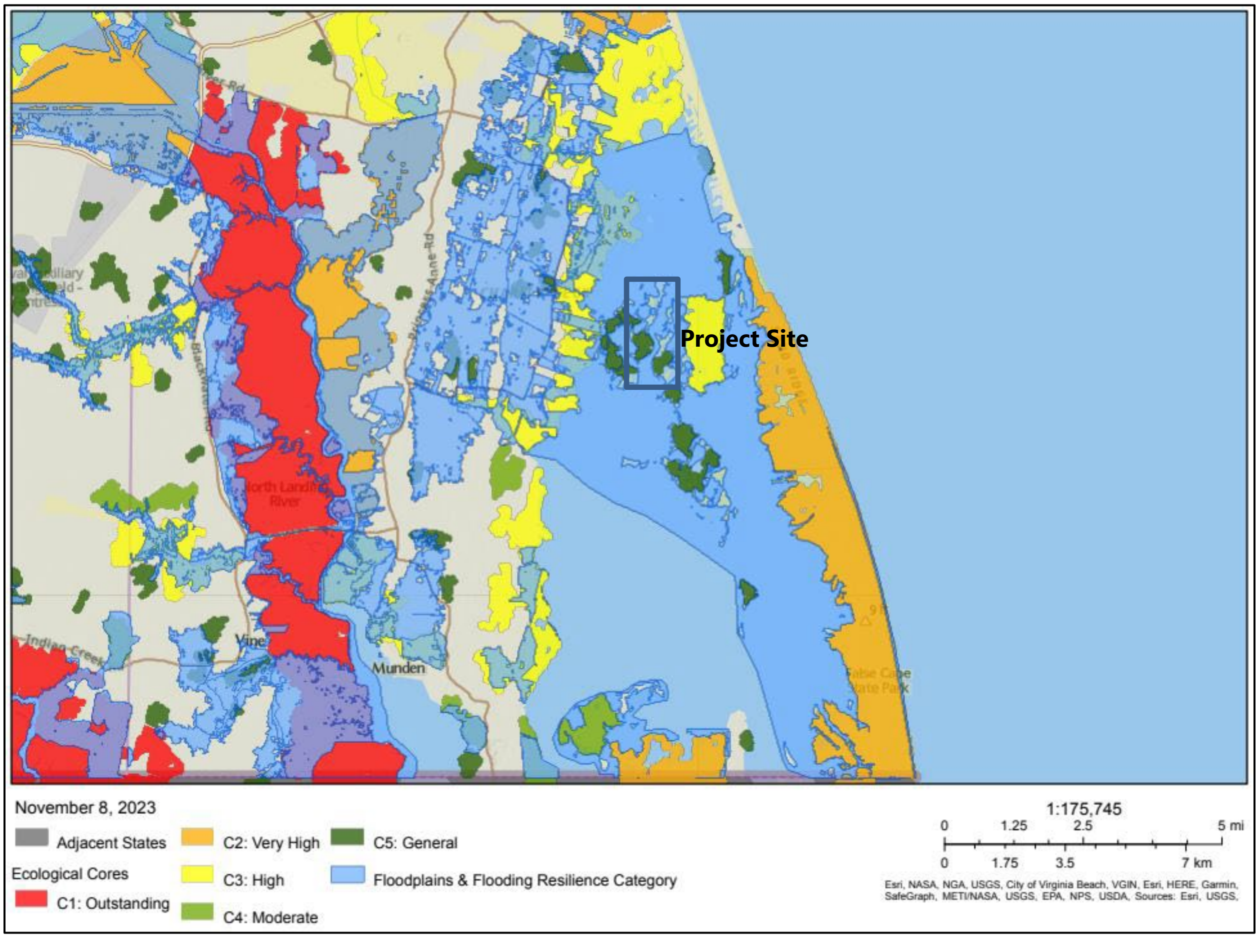

Figure 9: Virginia Natural Heritage Data Explorer Ecological Cores and ConserveVirginia Data.

The safety threats, or environmental concerns related to flood risk.

The City's risk assessment forecasts that approximately 70% of the remaining marsh (730 acres) surrounding the project site will convert to open water with three feet of sea level rise if unmitigated. Fragmentation of this adjacent marsh would result in about eight miles of fetch acting on the southern extent of the site in the predominant wind direction. Without these central marsh islands, the northern shorelines of Back Bay would be exposed to 12 miles of fetch from the Knotts Island Channel at the Virginia-North Carolina boundary. This condition would leave the fringing marshes highly vulnerable to accelerated erosion.

How does the project decrease the risk to public safety through flood risk reduction?

Construction of the forty-one individual marsh terraces, totaling 27,000 linear feet (a 51-acre footprint), across Bonney Cove offers a nature-based technique that will stabilize and protect the marsh island in the center of the bay and reduce erosion of the fringing marsh systems to the north. Numerical modeling was leveraged to quantify specific erosion reduction benefits of the project for wave heights and flow velocities:

- **Wave Height Reduction**: The marsh terraces are expected to reduce wave heights within the project site by approximately 45%. This reduction is consistent with other field studies, which have found that average wave heights within two terraced sites were 37% to 48% lower than those observed at the reference site (Brasher 2015). Wave energy reduction is anticipated to increase the potential for sediment deposition on the terraces' leeward side, leading to the growth of new emergent marsh and reducing erosion of adjacent marsh. Approximately five miles of marsh island shoreline around Bonney Cove will benefit directly from the erosion reduction associated with the computed wave attenuation.
- **Flow Velocity Reduction**: The marsh terraces reduce flow velocity within the project area. This reduction in velocity will reduce bottom shear stress, decrease turbidity, increase light penetration into the water column and promote the growth of SAV. Reducing bottom shear stress will make conditions more suitable for SAV growth between the terraces. Field studies of marsh terraces in Texas and Louisiana document an approximately 45% to 56% reduction in turbidity and the emergence of SAV in the years following terrace construction (Brasher 2015).
- **Wind Shear Stress Reduction**: Although not included as a parameter within the numerical modeling effort, the bald cypress trees planted on the terraces within the middle of the site are expected to reduce wind speed within the project site. This will further reduce wind-generated waves within the project site on the terraces' leeward and windward sides. Research shows that trees that grow to at least 30 feet at maturity result in lower wind speeds of up to 60 to 150 ft on the windward side and up to 900 ft on the leeward side (USDA).

How does the project protect or conserve natural resources?

The proposed project aims to restore marsh island communities in Bonney Cove that have historically provided environmental and flood reduction benefits to the communities in northern Back Bay. As illustrated in Figure 10, when an intact marsh begins to fragment and convert to open water, fetch increases and enables greater wave energy, increasing marsh erosion rates, and ultimately accelerating conversion to an ever-expanding body of open water. Strategic marsh restoration and creation in Bonney Cove would help mitigate the cycle of marsh island erosion and loss of SAV currently occurring in Back Bay, thereby protecting the remaining marsh islands and reducing fetch and wave energy.

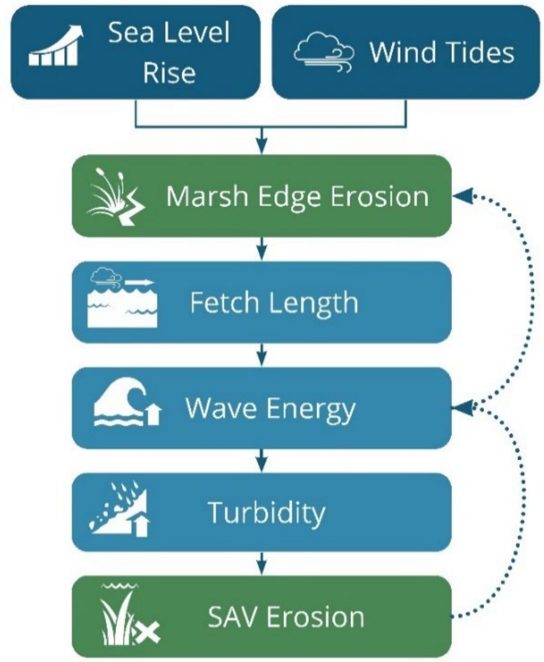

Figure 10: Cycle of marsh erosion, SAV loss, and increased wind-driven flooding.

The primary objective of this project is to create a sustainable coastal marsh island system in Back Bay through reclamation of historically lost marsh habitat and protection of existing marsh complexes from erosion. This restoration effort aims to provide multiple benefits of reduced flood impacts, enhanced fish and wildlife habitat, and improved water quality. The project is designed to achieve the following outcomes:

- Decrease turbidity to create conditions that promote the growth of emergent vegetation and aquatic grasses;
- Maximize habitat value for ecologically important fish and wildlife populations (e.g. Largemouth Bass, Bluegill, Yellow Perch, Striped Bass, Blueback Herring, Alewife, American Eel, etc.); and,
- Reduce fetch, wave heights, and flow velocities to mitigate erosion of fringing marsh systems that provide a buffer for the low-lying neighborhoods and roads that experience frequent flooding in northern Back Bay.

The City selected marsh terracing as the preferred restoration approach because the design is compatible with Back Bay's shallow bottom and the historical loss of habitat. Marsh terraces are narrow, man-made islands placed in shallow open water to restore previous marsh environments. Typically arranged in a chevron pattern, the overall field of marsh terraces dissipates waves, decreases turbidity, and slows down the moving water. The resulting calmer water conditions allow more sunlight to penetrate to the shallow bottom, promoting the establishment and growth of marsh seagrass and ultimately improving habitat quality for fish and wildlife. Further, as opposed to one continuous marsh platform, marsh terraces maximize habitat for a variety of fish and wildlife species, as illustrated in Figure 11.

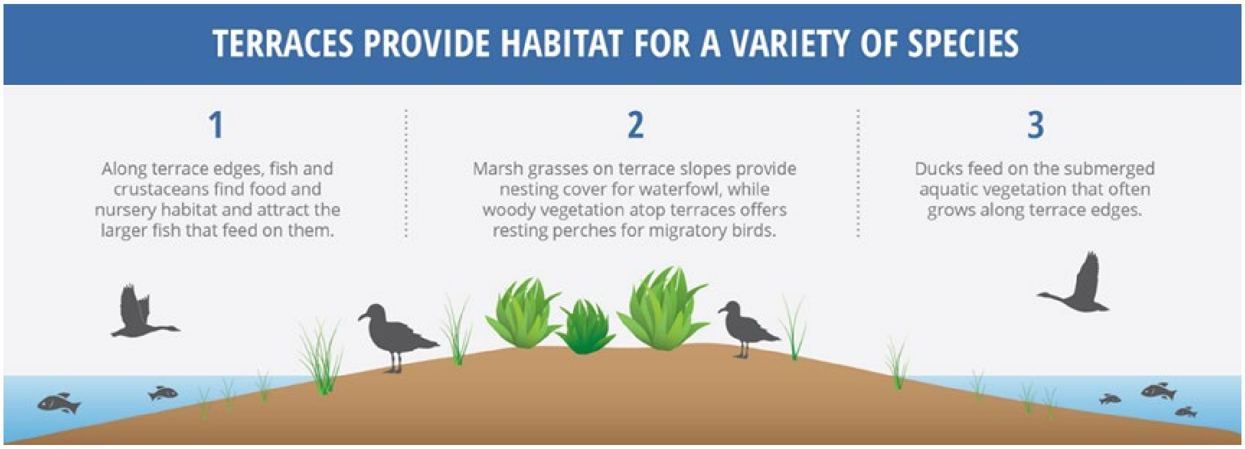

Figure 11: Conceptual diagram of marsh terraces.

Groups to be targeted who might directly benefit from this flood risk reduction effort.

The northern Back Bay communities adjacent to the project area and interested stakeholders have been engaged in the planning effort through public meetings. These meetings provided an opportunity for the community to provide feedback on the 30% and 95% designs and artistic renderings. We anticipate the project to benefit properties and infrastructure assets in northern Back Bay, including the following:

- **Reduce erosion rates along approximately 8 miles of shoreline by reducing wind and wave energy north of the project site.** Most of the properties along this reach of shoreline are not protected by traditional erosion risk reduction measures, such as bulkheads. Maintaining a naturalized shoreline while protecting fringe marsh is a priority of the City and its project partners. This approach will ensure that these marsh systems can migrate landward in response to sea level rise.
- **Reduce flood risk to commercial and residential properties north of the project site.** There are approximately 70 commercial and 2,350 residential structures within the two census block groups surrounding the project site. Around 635 of those structures are vulnerable to flooding during a 50-year event today. With three feet of sea level rise, approximately 2,060 structures are expected to be vulnerable to flooding during a 50-year return period event, representing about 85% of the residential structures within the project vicinity. These numbers underscore the importance of implementing the proposed project alongside complimentary flood risk reduction projects.
- **Reduce the magnitude and duration of flooding along critical access roads and critical facilities.** In addition to Muddy Creek Road, two other critical access roads are anticipated to benefit from delayed flooding. This includes Shipps Cabin Road (intersecting with Muddy Creek Road) and Sandpiper Road, which runs parallel to the eastern bank of Back Bay and provides ingress/egress out of the Sandbridge community (Figure 12).

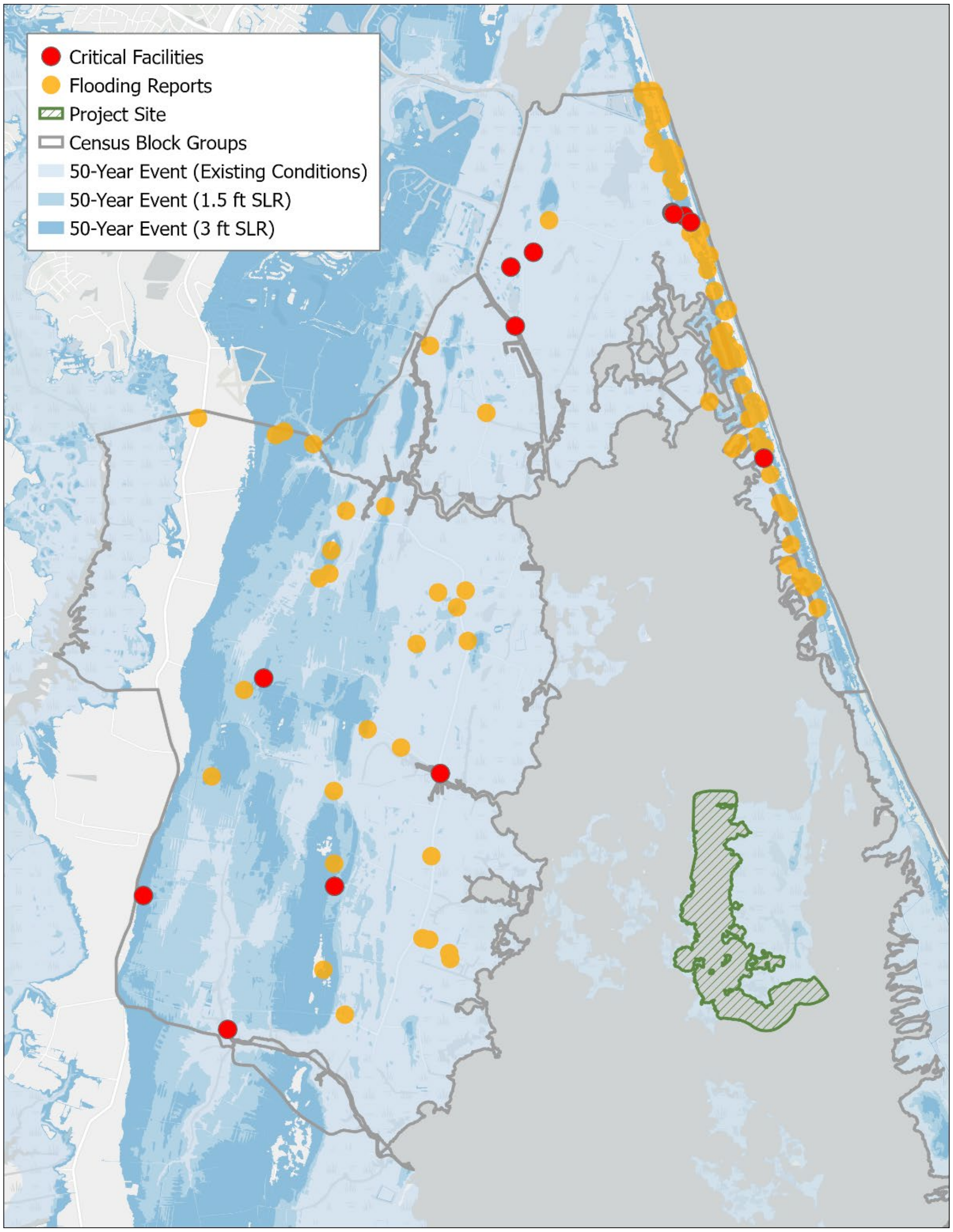

Figure 12: Critical facilities and flooding reports within project vicinity.

What would happen (or not happen) if the applicant does not receive funding?

If this project does not advance from design to construction, erosion of the adjacent marsh would continue to occur, resulting in fragmented habitat lacking the capacity to reduce wave action and slow water velocities. It is anticipated that wind-driven flooding events will continue to increase in frequency, resulting in increasing flooding of the low-lying properties and roadways surrounding northern Back Bay.

Alternatives Analysis

The proposed project offers the best approach for addressing the needs and problem statement outlined in this Scope of Work narrative. The project would result in the creation of 46.5 acres of marsh terraces, which would produce a net gain of approximately 16 acres of low/high marsh habitat by the end of the project construction compared to the No Action Alternative. The integrated system of marsh terrace ridges and perimeter rock armoring would stabilize the two critically eroding marsh islands (Long Island to the east, and a series of smaller unnamed islands to the west) from continued degradation. The tall terrace design improves the functionality and resiliency of the marsh system while also providing diversified habitat for fish and wildlife in the form of increased marsh edge as sea level rises. Numerical modeling of the preferred alternative demonstrated that the project would decrease wave heights and decrease the overall flow velocity of water moving through the project site, reducing water exchange in Back Bay during flooding events, encouraging sediment deposition, mitigating wave effects and consequent erosion, and result in localized water quality benefits. The proposed terraces would not only create a platform for vegetation growth within the marsh, but also reduce wave fetch in these large open water areas. The reduction in wave energy would lead to improved water clarity to promote the growth of SAV in the area between the terraces (approximately 310 acres).

Dredging in between the terraces to obtain sediment for the terrace cap would ensure no invasive vegetation is introduced into Back Bay, which is a high priority of the USFWS and VRMC. The dredging areas would also create valuable fish habitat to attract signature Back Bay fish and wildlife populations such as Largemouth Bass. The proposed dredging areas in between the terraces was evaluated and not anticipated to increase erosion of the adjacent marsh system. Furthermore, dredging in-situ material for building terraces is a widely accepted approach in Gulf Coast region marsh creation/terracing projects, as determined through conversations with project owners in Louisiana. Some terrace cap material will also be obtained from the Nimmo VII-A project. Through export of proven expertise from successful marsh terracing projects, this project would lay the foundation for future similar projects in the region through the development of detailed cost estimates, identification of best sources for local/regional materials, and establishment of partnerships with permitting officials at various levels of government.

Goals and Objectives

The overarching goal of this project is to construct the City's first nature-based adaptation project in the Southern Rivers Watershed and one of the CRMP's exemplary nature-based projects. This project aims to stabilize two critically eroding marsh islands from further degradation, decrease turbidity to promote the growth of aquatic vegetation, and provide flood risk reduction benefits through increased friction and wave attenuation. Table 1 below provides a high-level overview of the specific objectives established to solve the problem/need identified – specifically habitat degradation and wind tide flooding along with measure(s) of success. A more detailed description of these objectives is provided in the Supporting Documentation section.

Table 1: Overview of Project Objectives.

Objectives	Description	Measure(s) of Success	Timing of Measures
Objective 1	Create a Construction Access and Staging Area	a. Secured permits for construction. b. Contractor Selection. c. Construction of Staging Area.	a. December 2023 b. April-May 2023 c. June 2023 -February 2024
Objective 2	Restore Marsh and Aquatic Vegetation	a. Secured permits for construction. b. Restoration of 46.5 acres of habitat.	a. December 2023 b. March - October 2025 and March – October 2026
Objective 3	Engage Stakeholders and Disseminate Effective Practices	Number of people meaningfully engaged in the process of the project within the agreement period.	Continuous through period of performance.

Work Plan

Current Status and Ongoing Activities

The marsh terrace project design is progressing and will be ready for construction in the CFPF grant timeline. Table 2 summarizes ongoing tasks related to the project and an anticipated schedule for completion.

Table 2: Completed, ongoing, and anticipated activities leading up to construction.

Activity	Description	Schedule
Stakeholder Scoping Workshop	In November 2020, the City hosted a virtual workshop to receive initial input from project stakeholders.	Completed (Fall 2020)
Site Characterization and Vegetation Survey	In fall 2020, a site characterization and vegetation survey within Bonney Cove was conducted under a USFWS Special Use Permit (SUP). The purpose of the survey was to document existing emergent marsh and submerged aquatic vegetation (SAV) species composition and percent coverage within the proposed project area. MAP Environmental, Inc. conducted a literature review of marsh terracing projects in the Gulf Coast region to identify effective practices for project planning and design.	Completed (Fall 2020)
Bathymetric Survey	An updated bathymetric survey of Bonney Cove, also covered under a USFWS SUP, was completed in March 2021. This data serves as an input to identify appropriate design elevations to determine quantities of materials necessary to build the proposed marsh terraces and for numerical modeling of project alternatives.	Completed (Spring 2021)
Geotechnical Investigation	A geotechnical investigation of Bonney Cove was conducted in the spring of 2021. The permitted survey, (Virginia Marine Resources Commission (VMRC) Permit No. 2020-2286, U.S. Army Corps of Engineers (USACE) Permit No. 2020-02439, and USFWS SUP) included the collection of 10 soil borings in locations that avoided aquatic vegetation habitat. The soil samples were retrieved by drilling with a specialized airboat-mounted drill rig which was essential for drilling in shallow areas as it avoids disruption to bottom habitat. The soil samples were analyzed to determine the suitability and physical characteristics of the soils within the project area. Additional soil analysis was conducted to determine the suitability of Back Bay sediments for building components of the marsh terraces.	Completed (Spring 2021)

Activity	Description	Schedule
Water Quality and Hydrodynamic Survey	ODU conducted a water quality and hydrodynamic survey of Bonney Cove in the spring of 2021. The USFWS permitted survey collected water samples and deployment/retrieval of hydrodynamic sensors (pressure sensors, acoustic Doppler current profilers, and optical backscatter sensors) at three sampling points in Bonney Cove. Sensor equipment was deployed for two one-month periods (3/10/2021 – 4/12/2021 and 5/19/2021 – 6/8/2021). The water level, wave, and current data served as an input to the numerical model calibration. The water quality parameters (including pH, salinity, temperature, dissolved oxygen, chlorophyll, and turbidity) will serve as a reference to compare pre-and post-construction water quality conditions.	Completed (Summer 2021)
30% Design	Dewberry leveraged the field-collected data to establish design criteria for the project to ensure that it will be resilient in the face of changing future conditions during wind-tide events. Artistic design renderings were developed to enable stakeholders to visualize the implemented project.	Completed (Fall 2021)
Public Engagement – 30% Design	The City held a public information meeting on October 14, 2021, at Creeds Elementary School. The project team delivered a 10-minute presentation of the proposed project followed by an open-format discussion where participants reviewed the preliminary (30%) designs and artistic renderings and submitted comments regarding environmental and community impacts.	Completed (Fall 2021)
Numerical Modeling	Numerical modeling has been completed to evaluate the proposed project's impact on water levels, wave heights, and flow velocities within and surrounding the project area. Potential water quality impacts were also evaluated. The numerical modeling effort involved the development of an XBeach model, which is a nearshore model that accounts for wave-vegetation interactions based on field-derived drag coefficients.	Completed (Winter 2021)
Environmental Assessment and Scoping	In coordination with the USFWS and with technical assistance from Dewberry, the City evaluated the potential environmental impacts of the project. The draft environmental assessment document was distributed to key stakeholders with jurisdictional authority or a vested interest in the project for review and comment.	Completed (Summer 2023)

Activity	Description	Schedule
60% Design	After numerical modeling and stakeholder review of the 30% design, the engineering design plans were advanced from 30% to 60%.	Completed (Spring 2023)
95% Design and Public Engagement	The engineering design team prepared 95% engineering design plans to address comments on the 60% plan set. The City held a second public information meeting from 6:00 – 7:30 p.m. on July 13, 2023, at the Senior Resource Center in Virginia Beach where the project team delivered a 10-minute presentation of the proposed project followed by an open-format discussion where participants reviewed the 95% designs, updated artistic renderings, and submitted comments.	Completed (Fall 2023)
Construction Permit Applications Submitted	The City submitted the Joint Permit Applications for the proposed project, including the initial post-construction monitoring plan, to VMRC and the USACE in August 2023.	Completed (Summer 2023)
Modeling of Potential Adverse Impacts	In response to public concerns, the City performed additional numerical modeling of both northerly and southerly wind events and reviewed water level responses at locations in Back Bay for any potential adverse impacts. No adverse impacts were found for either type of event.	Completed (Fall 2023)
Publication of Frequently Asked Questions	The City will be publishing findings for the potential adverse impacts modeling, along with other responses to public concerns raised at the question in a Frequently Asked Questions webpage in November 2023.	In Progress (Fall 2023)
100% Design	The engineering design team prepared and submitted the 100% engineering design plans to the City for review. The plans will be finalized on receipt of any comments from the permitting process, anticipated to occur by end of 2023.	In Progress (Fall 2023)
Contractor Procurement	The engineering team will provide final plans, specifications, and construction estimates (PS&E). The City will prepare the bid Request for Proposal (RFP), provide Bid Packages, and review bids obtained, and select a construction contractor.	Planned (Winter 2023 - Spring 2024

What are the major activities and tasks?

The key activities and tasks to be competed under the agreement period are summarized in Table 3. Please refer to the Supporting Documentation section for a more detailed description of these activities and tasks.

Table 3: Overview of Activities and Tasks.

Activities	Description	Tasks
Activity 1	Construction Staging Area Preparation and Construction	1. Mobilize equipment 2. Stabilize road, establish construction staging area, abutments, install pre-engineered bridge, construct ramp to water and slurry basins. 3. Establish traffic flagging stations. 4. Install pipe and booster stations.
Activity 2	Marsh Terrace Construction	1. Construct 41 terraces (2-phased approach). 2. Demobilize equipment.
Activity 3	Stakeholder Engagement	1. Develop project marketing materials. 2. Attend and document engagement activities.

Who is responsible for completing the activities and tasks?

Responsibility for completing the project's activities and tasks lies with a collaborative effort led by the City's Department of Public Works. To ensure the successful execution of the project, the City has assembled a diverse team of consultants, advisors and subject matter experts. For a comprehensive understanding of the specific roles and responsibilities of each entity involved in carrying out the proposed scope of work, please refer to the *Supporting Documentation – Approach, Milestones, and Deliverables – Project Partner*s section of this report, which provides a detailed description of how each team member contributes to the project's overall success.

What is the timeframe for accomplishing activities and tasks?

An overview of the planned project timeline is shown in Figure 13. Grant activities will initiated in Summer 2024 with construction of the staging area and material acquisition. Please refer to the *Supporting Documentation – Approach, Milestones, and Deliverables –Milestone Schedule* section of this report for a detailed outline for each activity and associated deliverables.

Figure 13. Timeline overview for project implementation.

Identify the required partners to ensure success and where they are represented in the workplan.

A diverse team of consultants, advisors, and subject matter experts, led by the City's Department of Public Works, has been assembled to complete the project's activities and tasks. Please refer to the *Supporting Documentation – Approach, Milestones, and Deliverables – Project Partner*s section of this report for a detailed description of each team member's role, responsibilities, and contribution to the project's overall success.

Deliverables

An overview of the project deliverables is provided in Table 4. Please refer to the *Supporting Documentation – Approach, Milestones, and Deliverables* section of this report for more detail.

Table 4: Summary of Deliverables.

Activities	Deliverables
Activity 1: Construction Staging Area Preparation and Construction	1. Material acquisition. 2. Progression and completion of the construction staging area, with daily inspections to monitor progress. 3. Documented progress and completion through quarterly reports to DCR.
Activity 2: Marsh Terrace Construction	1. Progression and completion of the 2025 and 2026 construction phases, including plantings, with daily inspections to monitor progress. 2. Demobilization and removal of equipment from construction staging area. 3. Documented progress and completion through quarterly reports to DCR.
Activity 3: Stakeholder Engagement and Lessons-Learned Dissemination	1. Project marketing materials. 2. Records documenting number of stakeholders engaged during the outreach activities.

Maintenance plan tied to the identified viability of the project. Plan for sustaining the project after the agreement period (if applicable)

The City has developed a draft Annual Monitoring Plan and Post-Construction Monitoring Report that was submitted along with the Joint Permit Application for the project. See Attachment 5 for a copy of the draft report.

Project maintenance will be addressed by the City of Virginia Beach's Public Works Stormwater Operations Group. Any maintenance issues identified by the monitoring effort or other observers will be flagged to the Operations Group to address. The City intends to maintain the construction staging area to support future project maintenance needs. After completion of the monitoring program, the City will perform inspections every 2-5 years and make any repairs needed for the life of the project.

Evaluation

Indicators of Success

Indicators of success for this project have been identified during the development of the monitoring plan. Three (3) indicators of success were defined in relation to the primary objectives of the project (as defined elsewhere in this document), and include:

- The establishment of a sustainable coastal marsh island system.
- Stability of the marsh terrace structures.
- Establishment of a sustainable SAV community.

What data will be collected and how will it be used to measure success?

Data collection for the project has been detailed in the proposed monitoring plan and includes two sets of data: one set associated with as-built surveys to establish baseline reference conditions for subsequent monitoring efforts, and monitoring data to assess the success of the project in meeting the indicators defined above. Baseline and monitoring data will be compiled in an annual report and distributed to permitting agencies, and stakeholders as appropriate, to fulfill monitoring requirements and ensure success criteria are being met and maintenance needs are addressed.

Baseline data, which is proposed to be collected after the completion of each of two phases of terrace installation, will include the following data:

- Coordinates and diagrams of established transects, as well as site photographs from photo stations established along each sampling transect, as defined in the Methods section of the monitoring plan.
- Final location of all planted vegetation (upland plantings, high marsh plantings and low marsh plantings).
- Final location and extent of SAV plantings.
- Final grade topographic surveys (plan, profile, and cross sections).
- Discussion of the project design versus as-built conditions.

Monitoring data will be collected at the end of the full growing season during each monitoring year and include the following:

- Site photographs from photo stations defined in the Methods section of the monitoring report.
- Estimated percent cover and change in coverage from the as-built conditions to sampling year conditions for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- Estimated percent cover and change in coverage from planted conditions to sampling year conditions for SAV planting quadrants

- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

This monitoring data will be used to define success by tracking the establishment of the proposed vegetative communities on and between the proposed marsh terraces as well as the structural integrity of the marsh terrace structures themselves. Vegetation cover thresholds for each year will be defined to ensure planted communities are appropriately established on each marsh terrace. Acceptable measures of deviation will be defined for structural elements to ensure design requirements are met. Maintenance and mitigation measures defined in the monitoring plan will be implemented as required if success criteria are not met during any particular monitoring year.

How was cost effectiveness evaluated and measured against the expected outcomes?

Through a BCA approach using FEMA methods and ecosystem service valuations, a BCR of 1.17 was calculated for the project. This BCR is greater than 1, indicating the project can be considered cost-effective. The project also provides an additional $9.2M in value over the current estimated project costs.

A description of the BCA analysis and methods is provided in the following Benefit Cost Analysis Section.

What products, services, meetings, outreach efforts etc. will be conducted and how will success be measured?

The City is firmly dedicated to fostering meaningful engagement with project partners and external stakeholders throughout the project, with the goal of raising awareness about the project's approach and its benefits and enhancing the likelihood of its successful adoption in other areas within the region and the state.

Activity 4, titled "Stakeholder Engagement and Lessons-Learned Dissemination," provides a comprehensive outline of the City's outreach strategy, encompassing proposed deliverables and outreach endeavors. This strategic plan entails the development of project marketing materials, along with the facilitation of presentations and meetings with local and regional stakeholders, as well as participation in state and national-level conferences.

To gauge the effectiveness of our efforts, the City will employ metrics to track and document the number of individuals engaged throughout the project. This information will be regularly communicated to DCR to serve as a key performance indicator for project success.

For a more detailed breakdown of the tasks and deliverables associated with Activity 4, please refer to the Supporting Documentation section of this application.

Project Progress Monitoring Plan

The City's Project Progress Monitoring Plan is designed to guarantee the seamless and effective execution of the project. We have established a robust internal system to oversee the entire project lifecycle, ensuring that all key stakeholders are aligned with the project's objectives, activities, deliverables, and schedule.

The process commences with a kickoff meeting involving all project partners, where we collectively set the stage for the project. During this meeting, we thoroughly review the project's objectives and scope, ensuring that everyone is on the same page. This initial step is instrumental in fostering a shared understanding of the project's vision and goals among all involved parties.

In addition to the kickoff meeting, we place a strong emphasis on quality assurance and control. We meticulously assess each contractor's quality management system to ensure that well-defined procedures are in place to maintain the highest standards of quality throughout the project. This dedication to quality is paramount to delivering a successful project that meets the City's standards and the expectations of our stakeholders.

The City is committed to ongoing and transparent communication with our design and construction contractors, as well as our advisory stakeholders. Regular meetings will be held to monitor progress, address any potential challenges, and ensure the project adheres to the proposed milestone schedule and deliverables as outlined in this grant application. This proactive approach to project monitoring allows us to stay on track, identify and address issues promptly, and uphold our commitment to the successful completion of the project.

Supporting Documentation

Project Information

The following sections provide details regarding the project site and highlight the impacted population, residential and commercial structures, and critical facilities. This section also provides an overview of the historical, existing, and projected flood conditions in and around the project site.

Population

As shown in Figure 14, two census block groups (518100454.121 and 518100464.001) adjacent to Back Bay are within the extent of the anticipated project benefits. The total population of these two block groups is 3,531.[6] The residential population has grown approximately 1.8% in the past two decades. The median household income in 2021 dollars is $99,078. There are approximately 2,500 residential housing units, of which 43.1% are owner-occupied, 11.4% are renter-occupied, and 45.5% are vacant. The high percentage of vacant housing units can likely be attributed to seasonal rentals within the Sandbridge Resort Area. The race and ethnicity demographics of the community are 94.4% White, 1.4% Black, 3.4% Hispanic, and less than 1% Asian and American Indian.

[6] Population, household income, housing units, and demographic data obtained from Esri ArcGIS Community Analyst (2022). Esri forecasts for 2021 based on U.S. Census Bureau 2010 data.

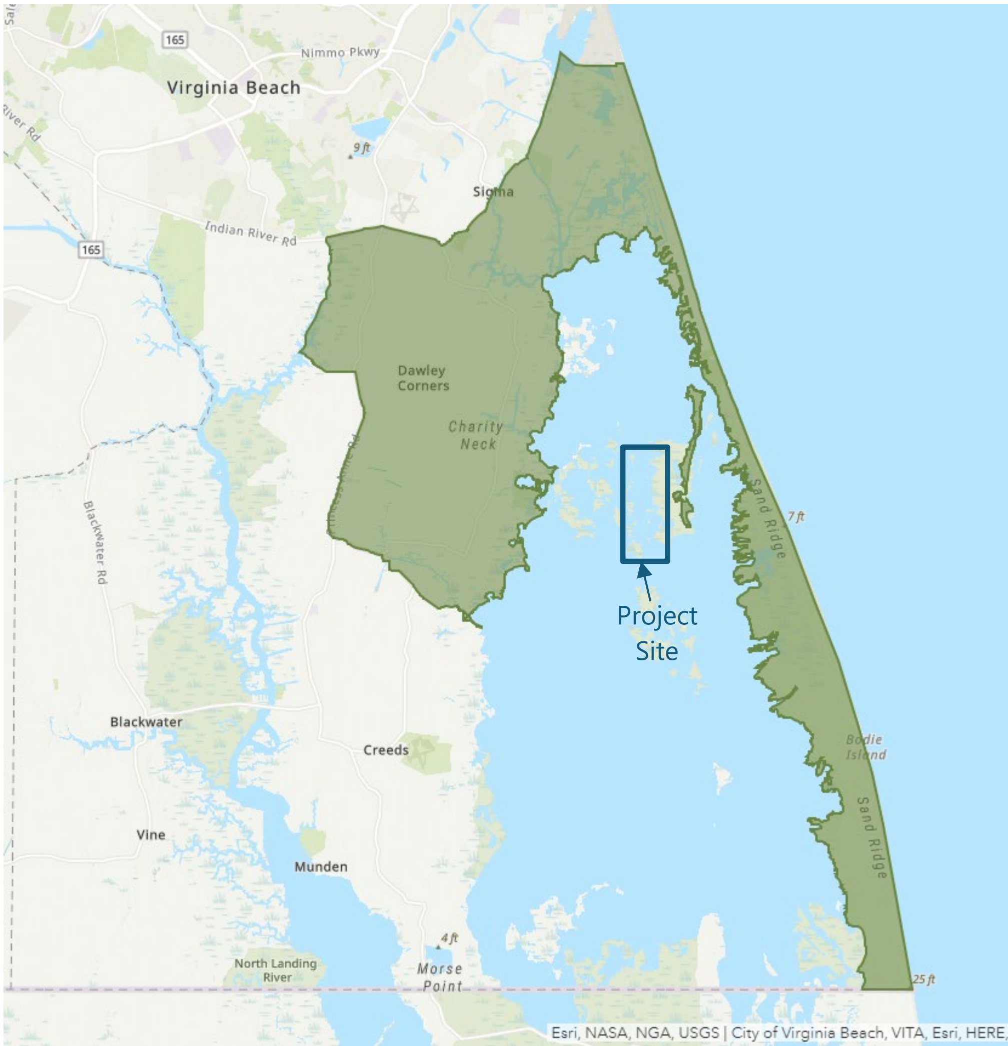

Figure 14: Census block groups selected for population estimates.

Historic Flooding Data and Hydrologic Studies Projecting Flood Frequency

Historical and Existing Flood Data

The project is located within a Federal Emergency Management Agency (FEMA) mapped Special Flood Hazard Area (SFHA), as shown in Figure 15 and Figure 16. Based on the City's current flood maps (effective January 16, 2015), the project site's flood zones are VE, AE, and Open Water. Portions of the site are within Otherwise Protected areas.

The following maps provide an overview of the existing flood hazards for the project area, including the northern boundary (Figure 15) and southern boundary (Figure 16). Based on the City's current flood maps (effective January 16, 2015), the project site contains VE and AE flood zones and Open Water.

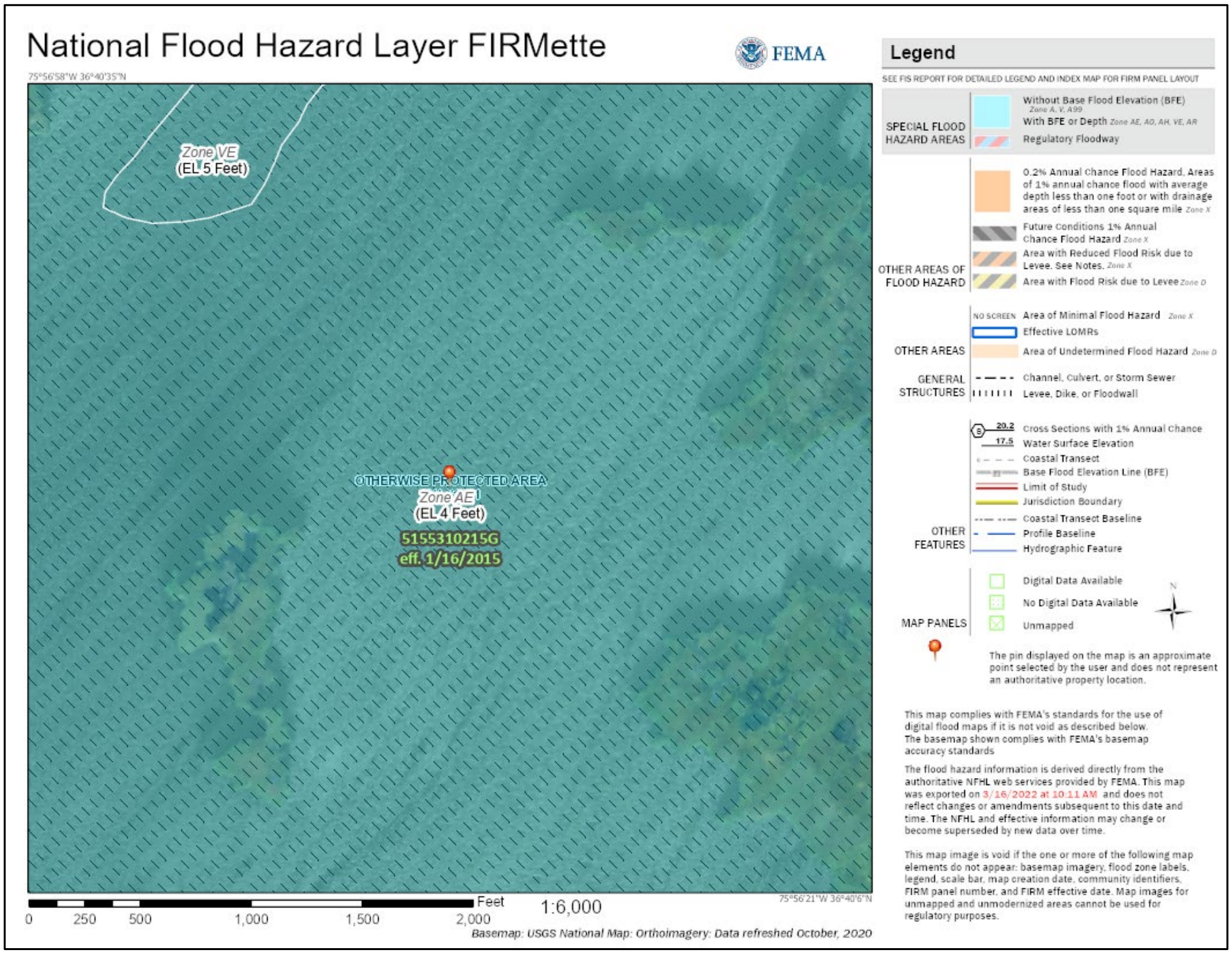

Figure 15: FIRMette for the project area (northern boundary).

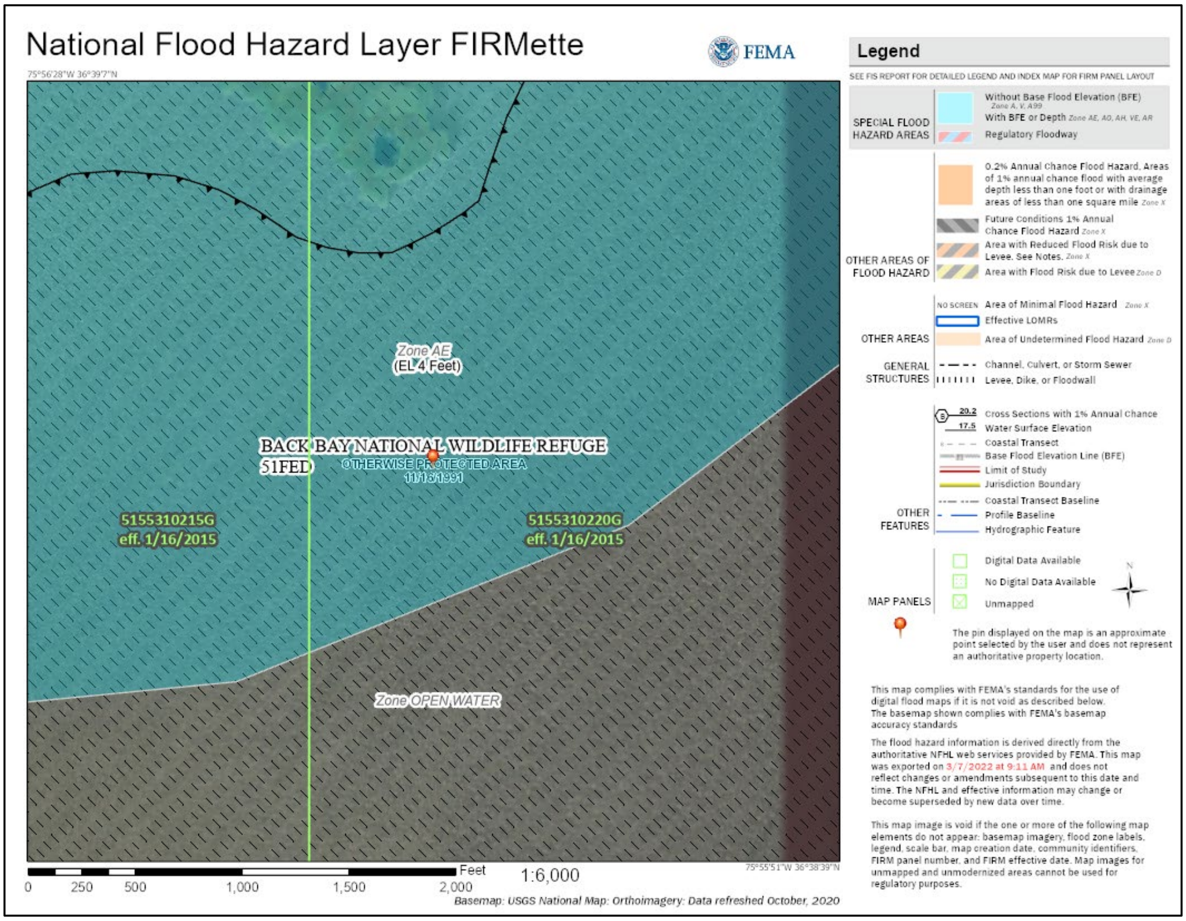

Figure 16: FIRMette for the project area (southern boundary).

The City maintains records of where residents report flood issues and what type of flooding is causing the issue. Residents regularly report flood issues through a hotline, which are then recorded in a flood event database. The census block groups adjacent to the project area reported 111 flood issues associated with heavy rain or high tide between 2001 and 2019. Critical facilities and flood incidences are relatively concentrated in the Sandbridge Resort Area.

Projected Flood Frequency

The USFWS, the City, and other stakeholders have made significant investments in detailed assessments, sophisticated computer models, and water level gauges to better understand historical and future wind tide flooding. Figure 17 displays the projected flood pathways under the 10-year and 100-year storm event under a 3 feet sea level rise scenario surrounding the project site.

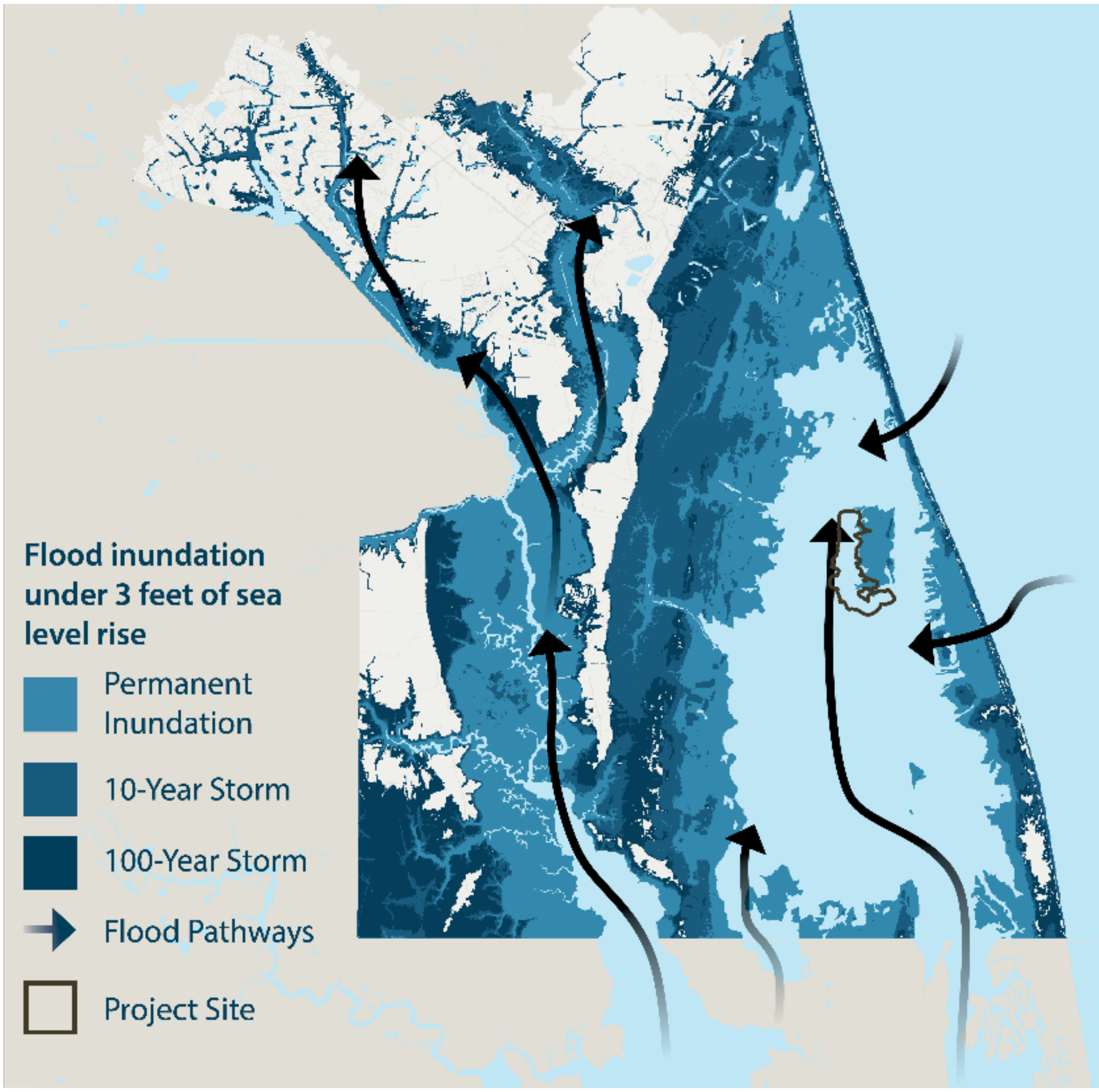

Figure 17: Flood pathways into the Southern Rivers Watershed with 3 feet of sea level rise.

Numerical modeling also shows that as sea levels continue to rise, a shorter duration wind event will produce more wind-induced flooding in less time. The three lines in Figure 18 represent the water level response to a sustained 15-mph wind for each sea level rise scenario. With the existing marsh system today (blue line), it takes approximately five days of sustained southerly wind to cause flooding. With 1.5 feet (yellow line) and 3 feet (red line) of sea level rise, the peak water level could be reached two to three days sooner, respectively. Model simulations showed that marsh island creation across Back Bay would help delay the onset of flooding by several days, which would allow the City and residents more preparation time[7].

[7] City of Virginia Beach. (2018). Analysis of Marsh Response to Sea Level Rise (PDF).

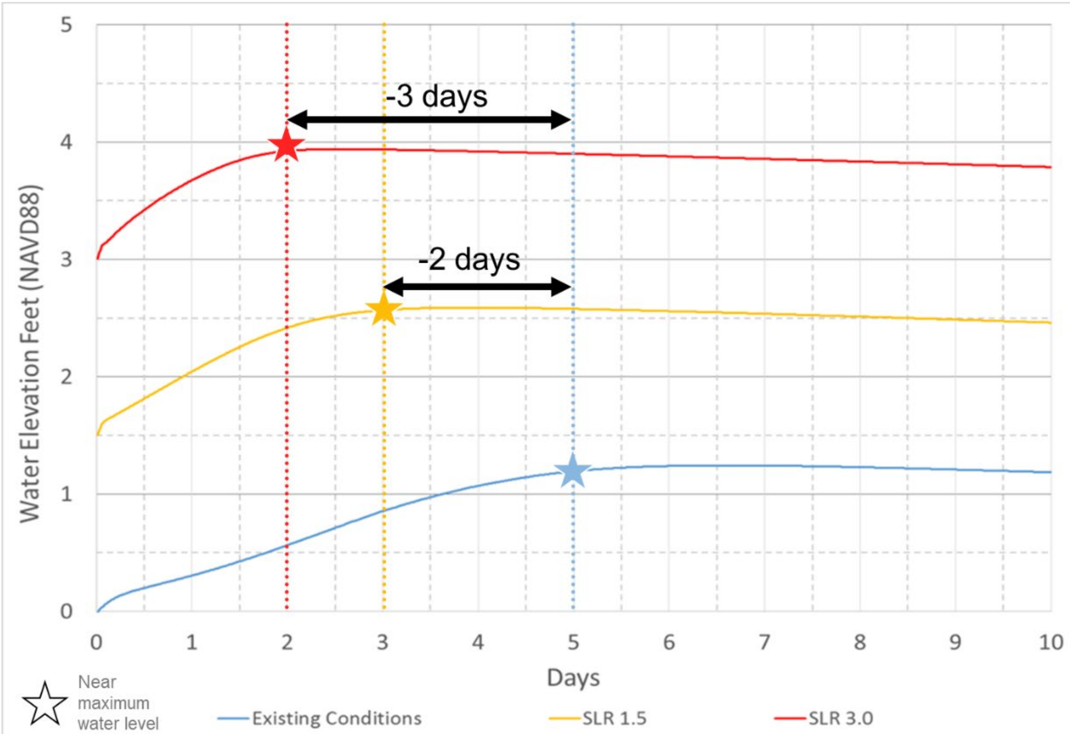

Figure 18: Water-level response under sustained 15-mph southerly wind.

The City analyzed future marsh conditions using the Sea Level Affecting Marshes Model (SLAMM).[7] Figure 19 illustrates areas likely to experience accelerated degradation of marsh in Back Bay due to rising water levels. If no action is taken, substantial marsh loss is projected in Bonney Cove under 3 feet of sea level rise. Within a 1-mile radius of Bonney Cove, the City's SLAMM model predicts that approximately 730 additional acres could be eroded into open water in response to sea level rise. This represents more than a 70% reduction as compared to the existing marsh system surrounding Bonney Cove today. It is also presumed that open water areas would continue to experience high levels of turbidity, which will continue to negatively affect SAV communities in Back Bay.

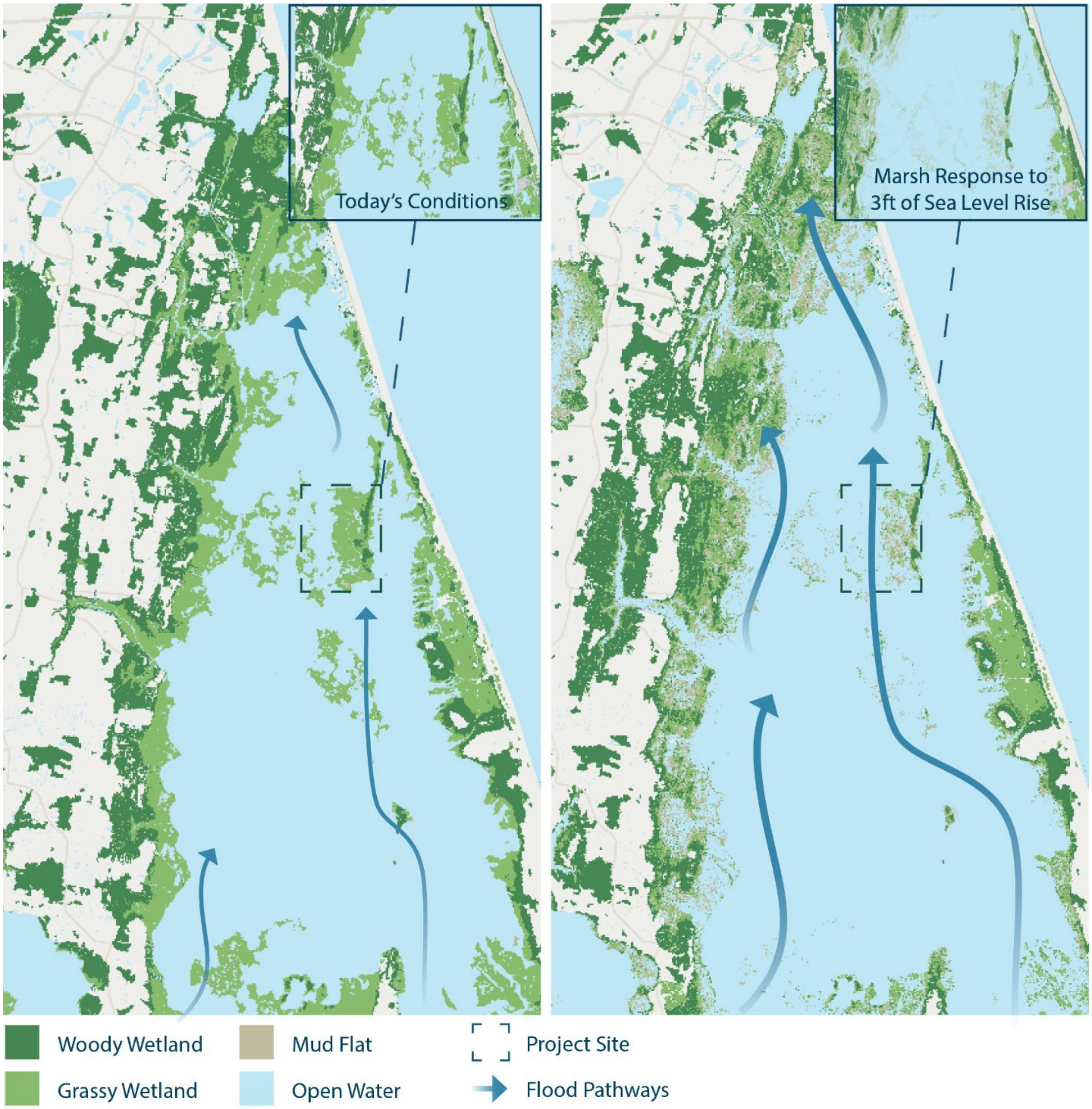

Figure 19: Comparison of current marsh conditions to future marsh conditions with 3 feet of sea level rise.

The proposed project site in Bonney Cove has a predominant south-southwest wind direction, which contributes to significant wave generation in the large unobstructed open-water areas and provides a continuous source of scouring and erosion in those areas. Marsh loss is likely to continue in the project area, creating a negative feedback cycle as continued fragmentation of the marsh would further deteriorate the remaining stands of healthy marsh and increase fetch. Today, the site faces low to medium fetch exposure, but in the future, the site could experience high to very high fetch exposure, as defined by the Virginia Institute of Marine Science (VIMS)

Shoreline Design Guidelines for Shore Protection in Virginia's Estuarine Environments.[8] Projections of increasing fetch at the site, along with the transects used for the wind fetch analysis, are summarized in Figure 20.

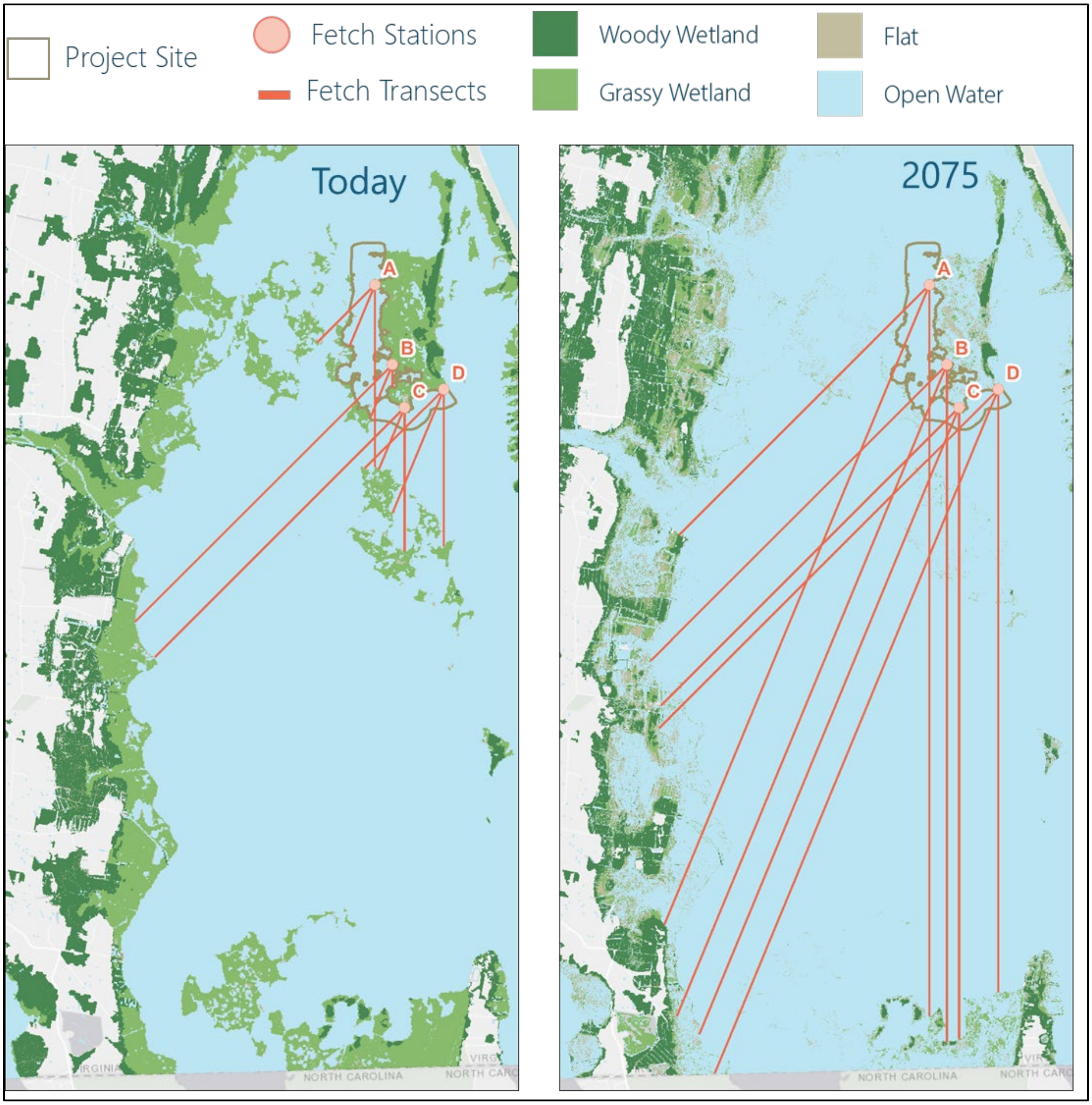

Figure 20: Wind fetch analysis of project area.

The following table displays specific values of fetch distances and classifications that correspond with the transects displayed in Figure 20 above.

[8] Virginia Institute of Marine Science. (2010). Living Shoreline Design Guidelines for Shore Protection in Virginia's Estuarine Environments; Version 1.2 (PDF).

Table 5: Measurements of fetch transects referenced in Figure 20.

Fetch Transect	Length, Miles (Today)	Classification	Length, Miles (3 feet SLR)	Classification
A-SW	0.9	Low	3.7	High
A-SSW	0.7	Low	7.3	Very High
A-S	1.9	Medium	7.7	Very High
B-SW	3.8	Medium	4.4	High
B-SSW	0.6	Low	7.4	Very High
B-S	0.2	Very Low	7.2	Very High
C-SW	3.7	Medium	4.4	High
C-SSW	0.7	Low	7.2	Very High
C-S	1.5	Medium	6.7	Very High
D-SW	1.2	Medium	5.1	Very High
D-SSW	1.4	Medium	7.8	Very High
D-S	1.7	Medium	6.4	Very High

No Adverse Impact

The City conducted additional hydraulic numerical modeling to identify any potential adverse impacts in response to concerns raised during a public meeting in July 2023. The City utilized a Danish Hydraulic Institute MIKE FLOOD model developed for stormwater master planning activities in Lower Southern Rivers Watershed of Virginia Beach. This model encompasses the entirety of Back Bay and extends into North Carolina's Currituck Sound. Model performance has been validated against observations from multiple flood events.

The effort looked at water level and velocities in response to a historical southerly wind tide flood in May 2017 and a northerly wind event associated with Tropical Storm Ophelia in September 2022. These events were ran with model grids depicting with- and without project conditions, considering the 100% project design specifications. The northerly wind event was

included to address concerns from residents of Knott's Island, at the southern end of Back Bay. Both the terrace field and the construction staging area were included in the with-project condition. The modeling found that there were no increases in water levels to areas within Back Bay or to Knotts Island. Negligible changes in water velocity (0.2 ft/s or less) were observed in the channel to the west of the terrace field. No increases in water levels were observed in the area of the construction staging area.

Local Government to Provide its Share of the Cost

The City of Virginia Beach is fully prepared to cover the cost share of the proposed project, as highlighted in the attached budget narrative, "Amount of Cash Funds Available." The funding for the grant match is contained within the City budget.

Benefit-Cost Analysis

FEMA recognizes the economic value of restoration projects and has provided ecosystem service economic valuations for benefit cost considerations. The approach and values used here are consistent with FEMA Benefit-Cost-Assessment (BCA) toolkit approaches and ecosystem service valuations published in "FEMA Ecosystem Service Value Updates, June 2022[9]." The 2022 FEMA guidance provides methods and values for various nature-based projects, including coastal wetlands. The valuations recognize ecosystem services for coastal wetlands including aesthetic value, climate regulation (carbon sequestration), flood and storm hazard reduction, habitat, recreation/tourism, water filtration and supply benefits of coastal wetland features.

Feasibility and Effectives Criteria

The project meets FEMA's Feasibility and Effectives Criteria for a Coastal Wetland as defined in the 2022 guidance, including:

- Land cover associated with the project is a "Estuarine and Marine Wetland" as classified for NWI for remaining marsh within and adjacent to the study area. The area of the project is also a historical marsh.
- The project demonstrates "ecosystem restoration" by using the terrace approach to recover degraded, damaged, and destroyed wetlands and submerged aquatic vegetation in the Back Bay ecosystem.
- The project meetings EPA concepts of restoration through direct creation of marshes (the terraces themselves) and enhancement of the ecosystem (reduction of water turbidity to enhance growth of submerged aquatic vegetation).
- The project will result in notable increased health and function of the local ecosystem in the "after mitigation" scenario through reduction of wave heights, water flow, and significantly decreased turbidity within the project area, as well as reduction of wave heights to adjacent areas.

[9] FEMA Ecosystem Service Value Updates, June 2022 (PDF).

- The project approach was aligned with established principles and techniques on wetland restoration, as outlined in the Coastal Wetlands and Tidal Flats section of the International Guidelines on Natural and Nature-base Features for Flood Risk Management10.

Design Life

As mentioned, the project useful life is 30-years. The FEMA 2022 guidance allows 50-years a typical lifespan; however, as stated in the project description, the elevation of the terraces was set based on a 30-year design life and estimated settlement.

Ecosystem Services Valuation

- The 2022 guidance values ecosystem services for coastal wetlands at $8,955 in 2021 U.S. dollars (USD), per acre, per year.
- The project will restore 46.5 acres of intertidal and upland marsh through direct creation of the marsh terraces. The project will also promote the growth of SAV in between the terraces, an area estimated at 310 acres. This provide for a total project benefit area of (46.5 + 310) = 356.5 acres.
- Project benefits occur over a period of time into the future; while most of the project costs are incurred up front and in the present. FEMA conducts its BCAs on a net present value basis, meaning the present value of the benefits gained from the project over the life of the project are compared to the total project cost to establish the BCR. Because project benefits accumulate over time, project benefits are calculated on an average annual basis ("annualized") and then multiplied by a Present Value Coefficient (PVC) to determine the present value of the annualized benefits.
- The present value coefficient is calculate as follows:

$$PVC = \left[\frac{1-(1-r)^{-T}}{r}\right]$$

where *r* is the discount rate and *T* is the useful life of the project. The CFPF 2023 Grant Manual does not specify a discount rate for the benefits calculation; therefore, the latest FEMA program grant guidance was reviewed. For the 2023 FEMA Building Resilient Infrastructure and Communities (BRIC) and Floodplain Mitigation Assistance Grant Program (FMA) cycles FEMA has established a set discount rate of 3%[11]. The 3% discount rate provides for a PVC of 19.60 for a 30-year lifecycle for the project.

- Project benefits were calculated by:

$$Benefits = PVC \times Project\ Area \times Coastal\ Wetland\ Benefits$$

- The benefit cost ratio (BCR) was calculated as:

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[10] International Guidelines on Natural and Nature-Based Features for Flood Risk Management - Engineering With Nature (dren.mil)

[11] FEMA Fact Sheet. Notice of Funding Opportunity for Fiscal Year 2023 Building Resilient Infrastructure and Communities Program (PDF).

$$BCR = \frac{Benefits}{Costs}.$$

A summary of the calculated values is provided in the below table:

Table 6. Summary of BCA parameters and results.

Project Area	Benefits (acre / year, 2021 USD)	Project Lifespan	Benefits, 3% discount rate	Project Cost	BCR, 3% discount rate
356.5	8,954	30	$62,566,588	$53,378,490	1.17

The calculated BCR for the project was 1.17, based on the FEMA ecosystem services valuation approach. This BCR is greater than 1, indicating the project can be considered cost-effective. The project also provides an additional $9.19M in value over the project cost.

Local Floodplain Management Regulations

The City recognizes the vital importance of floodplains in the natural movement of water through the community. Appendix K of the Virginia Beach Code of Ordinances regulates development in the community's floodplains. The City requires that a permit is obtained for any construction or development in the Special Flood Hazard Area. For more information and details regarding the City's floodplain management and ordinances, please refer to the following:

- Link to current floodplain ordinance: Virginia Beach Floodplain Ordinance.

In addition, a copy of the current floodplain ordinance has been included in *Part IV, Section E5*. For further information regarding the City's hazard mitigation and comprehensive planning, please refer to the following:

- Link to current hazard mitigation plan: Regional Hazard Mitigation Planning.
- Link to current comprehensive plan: Virginia Beach Comprehensive Planning.

Other Necessary Information to Establish Project Priority

Repetitive Loss and/or Severe Repetitive Loss Properties

The repetitive loss database shows 113 repetitive loss and severe repetitive loss properties within the two census block groups (518100454.121 and 518100464.001) associated with the project area.

Residential and/or Commercial Structures

A detailed economic flood loss assessment presented in the City's Resilience Plan showed that approximately 45% of the entire future risk exposure in the City is concentrated in the Southern Rivers watershed. Of that risk, 65% is concentrated in three communities north of Back Bay

(Figure 21).[12] Under a "no action" scenario, average annualized flood losses would increase from $974 thousand, representing present day conditions, to $6 million with 1.5 feet of sea level rise as anticipated by 2050. This figure equals an increase of six times present day conditions. With 3 feet of sea level rise as anticipated by 2080, annualized losses are expected to drastically increase to $80 million, more than 80 times today's conditions.

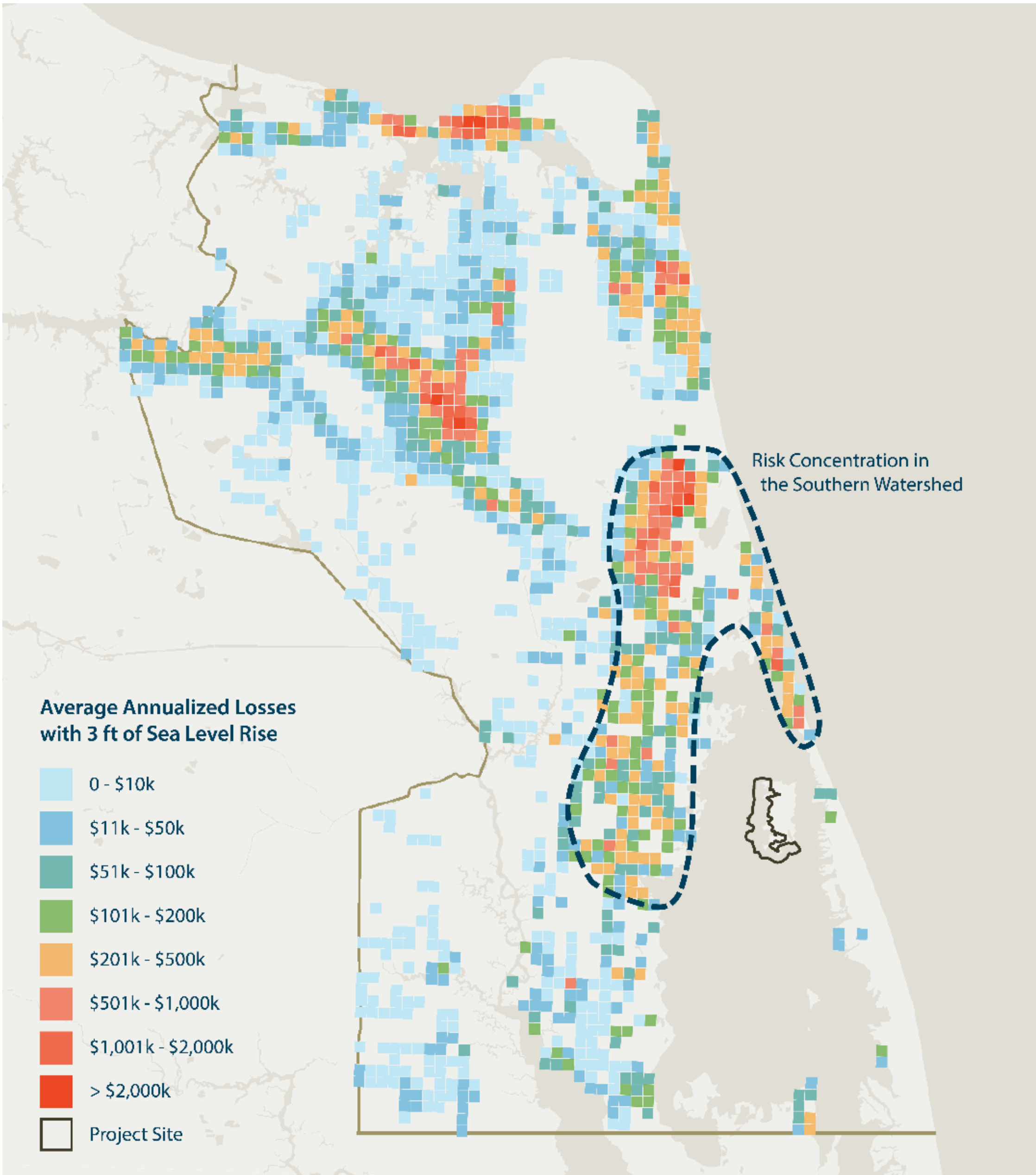

Figure 21: Concentration of average annualized losses estimated with 3 feet of sea level rise under a "no action" scenario presented in the City's Resilience Plan.

[12] City of Virginia Beach. (2020). Coastal Flooding and Economic Loss Analysis (PDF).

Within the two census block groups adjacent to Back Bay near the project area, there are approximately 70 commercial structures and 2,350 residential structures. Of those structures, approximately 635 structures are vulnerable to flooding during a 50-year event today. With 3 feet of sea level rise, approximately 2,060 structures are expected to be vulnerable during a 50-year event, representing approximately 85% of the residential structures within the project vicinity. These numbers underscore the importance of implementing the proposed project alongside complimentary flood risk reduction projects.

Critical Facilities

The two census block groups near the project site include 10 critical facilities. Table 7 summarizes critical facilities by type, total number, and the number of facilities exposed to the 50-year storm scenario under current and future "no action" scenarios. Under current 50-year storm conditions, 2 communication facilities and 1 electric power station would be exposed to flooding. With 3 feet of sea level rise, the number of critical facilities exposed to flooding increases to 9 total facilities.

Table 7: Summary of critical facilities located in the selected census block groups and flood hazard exposure to the 50-year storm event under current conditions and with 1.5 feet and 3 feet of sea level rise.

Type of Facility	Number of Facilities	Current 50-year storm	50-year storm with 1.5 feet sea level rise	50-year storm with 3 feet sea level rise
Communication	3	2 (66%)	2 (66%)	3 (100%)
Electric Power	1	1 (100%)	1 (100%)	1 (100%)
Fire Station	1	0	0	0
Potable Water	2	0	2 (100%)	2 (100%)
School	1	0	0	1 (100%)
Wastewater Treatment	2	0	0	2 (100%)

Need for Assistance

The City of Virginia Beach has invested significant time, money, and staff resources in understanding, communicating, and planning for the threats of sea level rise and recurrent flooding to the community. The City is ready to begin the implementation of adaptation measures, and the marsh terrace project is the first project to advance to construction from the City's Resilience Plan. The project represents the first step in restoring Back Bay and the larger Albemarle-Pamlico estuary, and serves as a pilot for additional restoration projects. Virginia Beach understands that flood mitigation costs are substantial and is seeking funds to support project implementation alongside dedicated resources procured by the City. The City's

Department of Public Works Stormwater Engineering Center has closely coordinated with the City's Department of Planning & Community Development throughout the design and permitting process. The Department of Public Works will oversee the construction of the marsh terrace project, including providing construction inspectors to monitor that the project is built to the City's design standards and technical specifications. Additionally, the City has access to necessary software, including AutoCAD and ArcGIS Desktop, and support from consultants to augment the City’s technical capabilities.

Examples of City staff who will support the project include the following:

- Program Manager for the Technical Services Division of the Stormwater Engineering Center.
- Project Manager for Green Infrastructure Projects for the Technical Services Division of the Stormwater Engineering Center.
- Environmental Planner / Certified Floodplain Manager from the Wetlands & Shoreline Construction Team of the Planning Administration Division of the Department of Planning & Community Development.
- Planning Evaluation Coordinator from the Chesapeake Bay Preservation Area & Southern Rivers Watershed Team of the Planning Administration Division of the Department of Planning & Community Development.
- Full-time Construction Inspector assigned exclusively to this project from the City’s Construction Bureau or under contract with the City Public Works Engineering Division.
- Grant Coordinator from the City’s Public Works Engineering Division.

Additional staffing will be provided as needed to ensure project success.

This project benefits communities in northern Back Bay with a high concentration of flood losses (as shown in Figure 21). These communities contribute significantly to Virginia Beach's rural economy, including agriculture, forestry, fishing, hunting, and eco-tourism. In Hampton Roads, these industries contribute a combined $100 million in gross domestic product.[13] Protection of vulnerable natural infrastructure, such as the marshes in Back Bay, is critical to ensuring these industries can continue to thrive within the region.

Alternatives

Several other alternatives were considered but not advanced due to technical and environmental limitations. These alternatives are briefly summarized below.

[13] Office of Governor Ralph S. Northam Commonwealth of Virginia and Virginia Department of Conservation and Recreation. (2021). Virginia Coastal Resilience Master Plan Phase 1 (PDF); data referenced sourced from the US Bureau of Economic Analysis. (2019).

Alternative 1 - No Action Alternative

Under this alternative, no action would be taken to restore marsh habitat in the shallow open water channel of Bonney Cove. Erosion of the adjacent marsh would continue to occur, resulting in fragmented habitat lacking the capacity to reduce wave action and slow water velocities. It is anticipated that wind-driven flooding events will continue to increase in frequency, resulting in increasing flooding of the low-lying properties and roadways surrounding northern Back Bay.

Alternative 2 - Alternative Terrace Configuration Design(s)

Several configuration alternatives for the terraces were considered during the design process. These included four alternative layouts with different spacing and terrace top widths:

- **Alternative 2a** (Figure 22): Terraces would be spaced at approximately 300-foot intervals and have a top width of 15 feet. Between the base of the terraces, there would be approximately 220 feet for potential establishment of SAV habitat.
- **Alternative 2b** (Figure 23): Terraces would be spaced at approximately 300-foot intervals and have a top width of 30 feet. Between the base of the terraces, there would be approximately 200 feet for potential establishment of SAV habitat.
- **Alternative 2c** (Figure 24): Terraces would be spaced at approximately 600-foot intervals and have a top width of 15 feet. Between the base of the terraces, there would be approximately 520 feet for potential establishment of SAV habitat.
- **Alternative 2d** (Figure 25): Terraces would be spaced at approximately 600-foot intervals and have a top width of 30 feet. Between the base of the terraces, there would be approximately 500 feet for potential establishment of SAV habitat.

A common feature across all of these design alternatives was a breakwater that spanned the entire length of the southern extent of Long Island and a northern breakwater that spanned the northern exposed section of the project site.
Alternative 2a and 2b were eliminated due to constructability concerns regarding the quantity of sediment that would be required and due to the limited amount of room for SAV establishment in between the terraces (approximately 220- and 200- feet of potential SAV habitat between terraces for Alternative 2a and 2b, respectively).

Alternatives 2c and 2d were discussed extensively amongst the project team; however, it was ultimately determined that they did not maximize the opportunity for species diversity (by including both smaller and larger terraces). These alternatives were combined to form the preferred alternative presented in this document. Additional refinements that were made to these alternatives include the removal of the perimeter breakwater, as the proposed design elevation evaluated in the geotechnical analysis revealed stability issues with these large features.

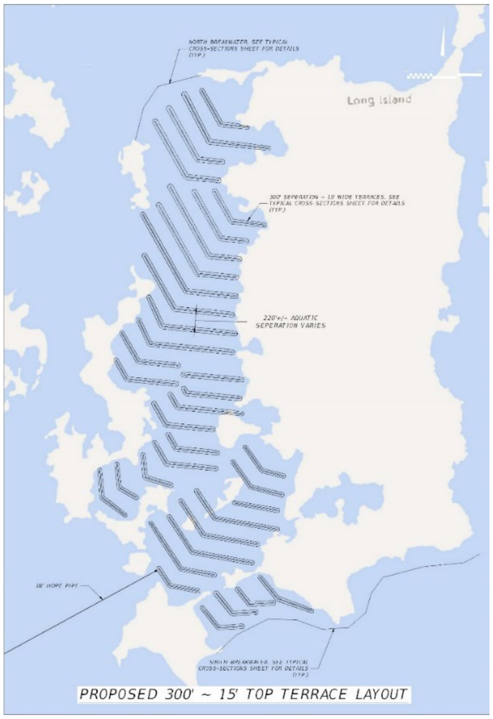

Figure 22: Alternative 2a.

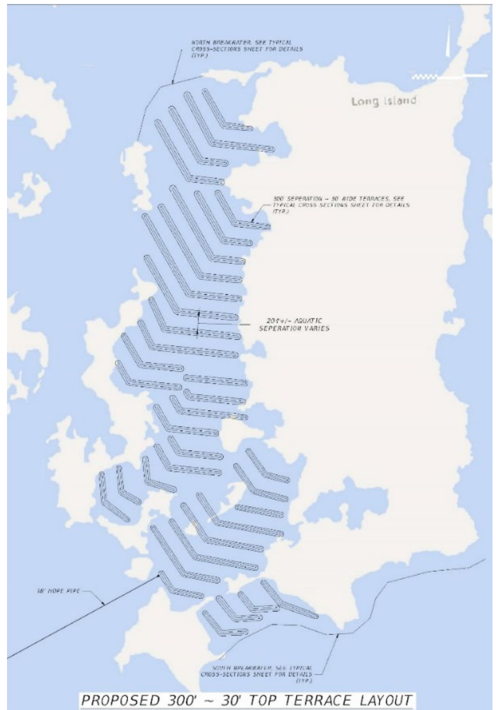

Figure 23: Alternative 2b.

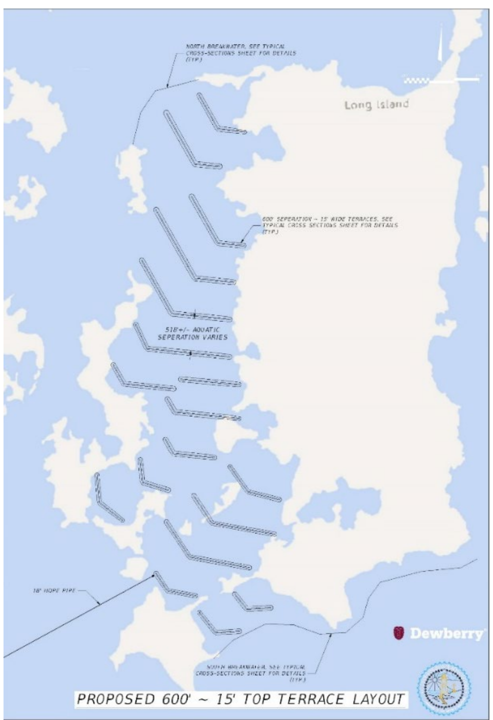

Figure 24: Alternative 2c.

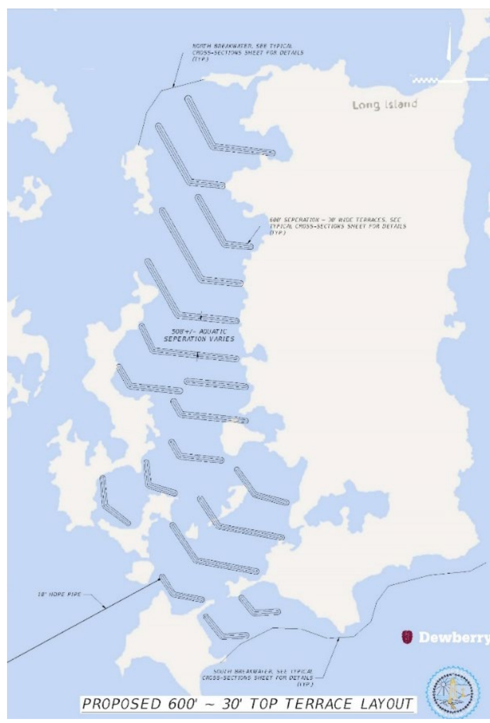

Figure 25: Alternative 2d.

Alternative Terrace Core Material Sources and Transportation – Alternative 3

In the proposed alternative with sand cores, a no-dredging alternative was considered. However, in order to successfully complete the project and establish the vegetation desired, material would need to be sourced, blended, transported, and placed. The City helped identify two potential borrow sources of material: Bow Creek Golf Course (Figure 26) and the Whitehurst Dredged Material Management Area (DMMA) (Figure 27).

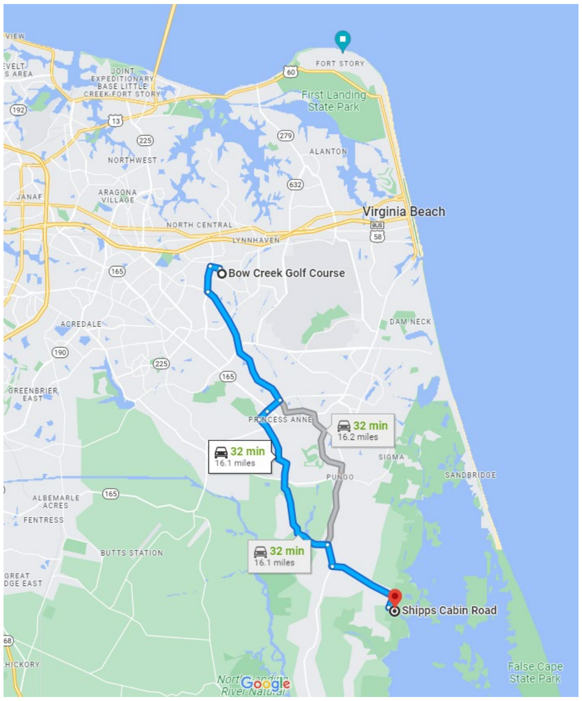

Figure 26: Distance from Bow Creek Golf Course to the proposed Shipps Cabin staging area.

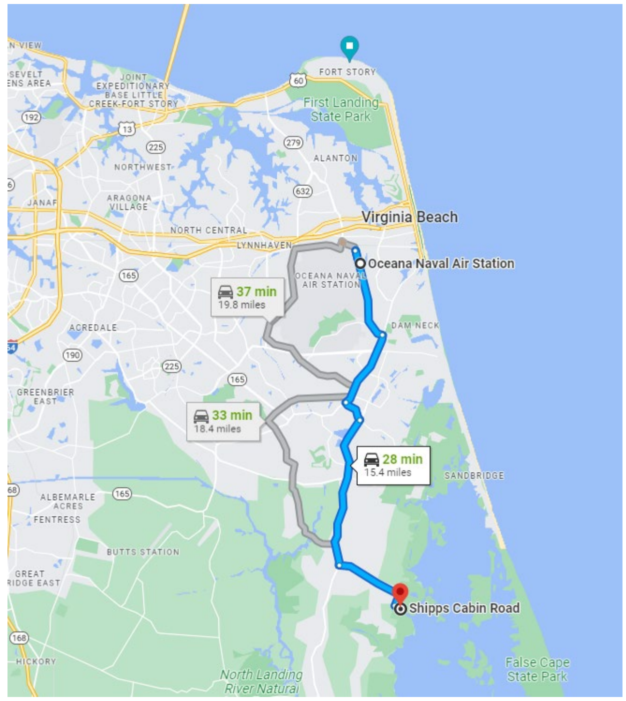

Figure 27: Distance from Whitehurst DMMA to the proposed Shipps Cabin staging area.

Bow Creek Golf Course: Bow Creek Golf Course is located approximately 16 miles from the proposed Shipps Cabin staging area. In the next few years, The Bow Creek Golf Course is scheduled to be converted into a Stormwater Park as one of 21 projects funded by the City's Stormwater Flood Protection Program. Large quantities of materials will be removed from the site for use within the City. The material from Bow Creek would need to be excavated, screened, and tested for foreign seeds and contaminants. Most likely, this material would have to be processed before it could be loaded again on dump trucks and hauled approximately 16 miles to a potential staging area where it would be loaded again on shallow draft barges.

Whitehurst DMMA: The Whitehurst DMMA is a similar distance to the proposed Shipps Cabin Road Construction Staging Area. The material at Whitehurst may not have to be processed as much; however, it would need to be tested for foreign seeds and contaminants. Because of the organic components in this soil and the need for the material to establish vegetation on the terraces, this material is not able to be hydraulically blended and pumped to the site. Therefore, this material would need to be loaded on shallow draft barges and then

placed by mechanical means. Further, the amount of material needed to cap the proposed terraces is approximately 110,000 cubic yards which equates to roughly 5,500 quad-axle dump trucks traveling city streets and damaging other infrastructure.

Barging of all materials was considered. Dewberry conducted meetings, site investigations, and talked with both industry leaders in maritime construction and locals who know the water in Back Bay.   A typical 35-foot by 95-foot construction barge drafts approximately 7 feet. This type of barge is not able to be trucked to the landing site, nor is it able to be brought into Back Bay. There are truckable barges, but again the drafts of those barges can be in the 4 to 5 feet range when loaded and would require dredging a channel for access. Shallow draft barges can be used in Back Bay that only draft 1 to 3 feet, and they would need to be off-loaded from a staging site. To bring any materials such as stone, sandy fill, or terrace cap material by barge around Knotts Island is not feasible. The actual channel into the southern point of Back Bay has a height restriction due to the causeway serving Knotts Island.

Continuous Marsh Platform – Alternative 4

A continuous marsh platform to fill in the areas of historical marsh would help to restore this eroded habitat but would not provide conditions suitable for SAV establishment or optimize the wave/flow velocity attenuation through the project area. Furthermore, for a single marsh platform across Bonney Cove, the amount of material required would be more than 3 or 4 million cubic yards of material. To achieve that volume of material by dredging, significant areas of existing SAV present in Back Bay would need to be impacted.   As the geotechnical report indicated, the existing material of the project site and surrounding areas is not capable of supporting itself in a constructed arrangement and would slough off back into the water. Further, providing this amount of material without dredging would require bringing external sediment sources into Back Bay, which could introduce invasive species. Finally, while the platform will reclaim marshland, it is not anticipated to establish extensive areas appropriate for SAV reestablishment and would eliminate deeper water areas preferred by some endemic wildlife species.

Goals and Objectives

The overarching goal of this project is to construct the City's first nature-based adaptation project in the Southern Rivers Watershed and one of the CRMP's exemplary nature-based projects. This project aims to stabilize two critically eroding marsh islands from further degradation, decrease turbidity to promote the growth of aquatic vegetation and provide flood risk reduction benefits through increased friction and wave attenuation. The following section summarizes the objectives through which this goal will be realized.

Objective 1 – Create a Construction Access and Staging Area

The project's first objective is to employ a construction approach that is compatible with the shallow nature of Back Bay and the large quantity of material required to build the marsh terraces. The engineering team performed a constructability review of suitable landing sites to

stage construction operations for the terraces. A property located at the end of Shipps Cabin Road (Figure 28) was identified as the preferred staging and construction access location for the following reasons:

- Shipps Cabin Road Construction Staging Area Proximity to site (2 miles).
- Shipps Cabin Road Construction Staging Area Proximity to sand borrow sources.
- Shipps Cabin Road between Muddy Creek Road and the Construction Staging Area is in disrepair and was identified as an opportunity to improve the condition of the road as part of the construction activities.

Figure 28: Proposed Construction Access.

On completion of the project, the City plans to retain the staging area for future monitoring and maintenance needs for the project. This future use is consistent with the sentiments of local stakeholders, as communicated during public engagement meetings for the study.

Expected Benefits:

- Enables constructability of the marsh terraces.
- Enable access to the project for post-construction monitoring and future marsh restoration projects.

Objective 2 – Restore Marsh and Aquatic Vegetation

The second objective of the project is to restore marsh and aquatic vegetation for habitat and flood resilience. Specifically, the City's construction of the marsh terraces will result in the restoration of approximately 46 acres of habitat within Back Bay, consisting of:

- 10 acres of low marsh habitat; low marsh plantings would include Big Cordgrass (*Spartina cynosuroides*) and Saltmarsh Cordgrass (*Spartina alterniflora*).
- 6 acres of high marsh habitat; high marsh plantings would include Black Needlerush (*Juncus roemerianus*) and Salt Meadow Hay (*Spartina patens*).
- 14 acres of upland vegetated habitat; upland vegetation would include Arrow-leaf Tearthumb (*Persicaria sagittate*), Groundsel Tree (*Baccharis halimifolia*), Wax Myrtle (*Myrica cerifera*), and Bald Cypress (*Taxodium distichum*).
- 16 acres of submerged terrace habitat anticipated to create suitable conditions for the emergence of SAV.

Additionally, approximately 310 acres of open water SAV habitat would remain between the proposed marsh terraces, and it is anticipated that construction of the terraces would create conditions within the project area favorable to the re-establishment of SAV populations.

Expected Benefits:

- Reduce wave heights, flow velocities, and wind sheer stress within the project area to protect marsh islands from continued erosion.
- Restore the natural buffer that helps protect low-lying neighborhoods and critical access roads from wind-driven flooding.
- Improved water quality by removing excess nutrients.
- Lowered transport of suspended sediment and prevention of resuspension of fine sediments in the water.
- Reduced flow velocity and absorbing wave/wind energy to reduce shoreline erosion.
- Creation of habitat (nursery and feeding areas) for fish (such as Largemouth Bass, Bluegill Yellow Perch, Striped, Blueback Herring, Alewife, and American Eel), migratory waterfowl (such as the Canvasback Duck [*Aythya vallisineria*]), and other aquatic animals.

Objective 3 – Engage Stakeholders and Disseminate Effective Practices

The City is committed to continued meaningful engagement with project partners and external stakeholders throughout the restoration and monitoring phases to ensure transferability to other sites in the region and state.

Expected Benefits:

- Ensure that the lessons from this project can be transferred and scaled to other sites in the state or region.

Approach, Milestones, and Deliverables

The following approach, milestones, and deliverables lay out a plan of action. The milestone schedule follows in *Section B: Milestone Schedule*.

Approach & Deliverables

Activity 1 – Construction Staging Area Preparation and Construction

Activity 1 involves preparing the Shipps Cabin Road property as a construction staging area. Construction activities will include stabilization of the road, laying geotextile to stabilize the ground under the construction staging area, filling with material for the construction staging area, adding fencing, creating bridge abutments and installing a temporary bridge and ramp for waterfront construction access, construction of slurry basins, and establishment of traffic flagging stations.

In the final step, the contractor will install pipe to pump the slurry material from the Shipps Cabin staging area to Bonney Cove. The pipe will be floated with subaqueous tie-downs at channels and certain points of access to maintain boat crossings. Those subaqueous locations will be marked by a buoy every 10 feet and temporary signage as reasonable. The contractor will install two booster stations along the alignment, one approximately half-way between the landing and Bonney Cove, and one at the edge of Bonney Cove. These booster stations will consist of a pontoon-mounted diesel engine pump capable of moving the sand slurry from the construction staging area to the site. It is estimated that 150 CY per hour of sand slurry would be pumped through the pipe in a 60:40 ratio. Additional booster stations may be required for manifolding and supplying slurry stations to individual terraces.

Relevant Objective(s): Objective 1

Deliverables:

- Conduct daily inspections to monitor construction progress of the Shipps Cabin Road Construction Staging Area preparation.

Assumptions:

- It is anticipated that the Shipps Cabin Road Construction Staging Area construction activities can occur simultaneously with material production in Year 1 (2024).

Activity 2 – Marsh Terrace Construction

Once the Shipps Cabin Construction Staging Area preparation is complete, marsh terrace construction activities can commence. The contractor will construct the terraces according to the 100% Final PS&E documents. The most recent engineering designs and design report are available upon request; they are not included as an attachment to this proposal due to file size. Figure 29 shows the overall layout of the terraces, and Figure 30 and Figure 31 show the project renderings. Terrace construction will begin in the northern extent of the project site at Terrace #100, noted in Figure 29, and the contractor will work south towards Terrace #140. The contractor will complete each terrace (including installation of plants) before moving onto the next.

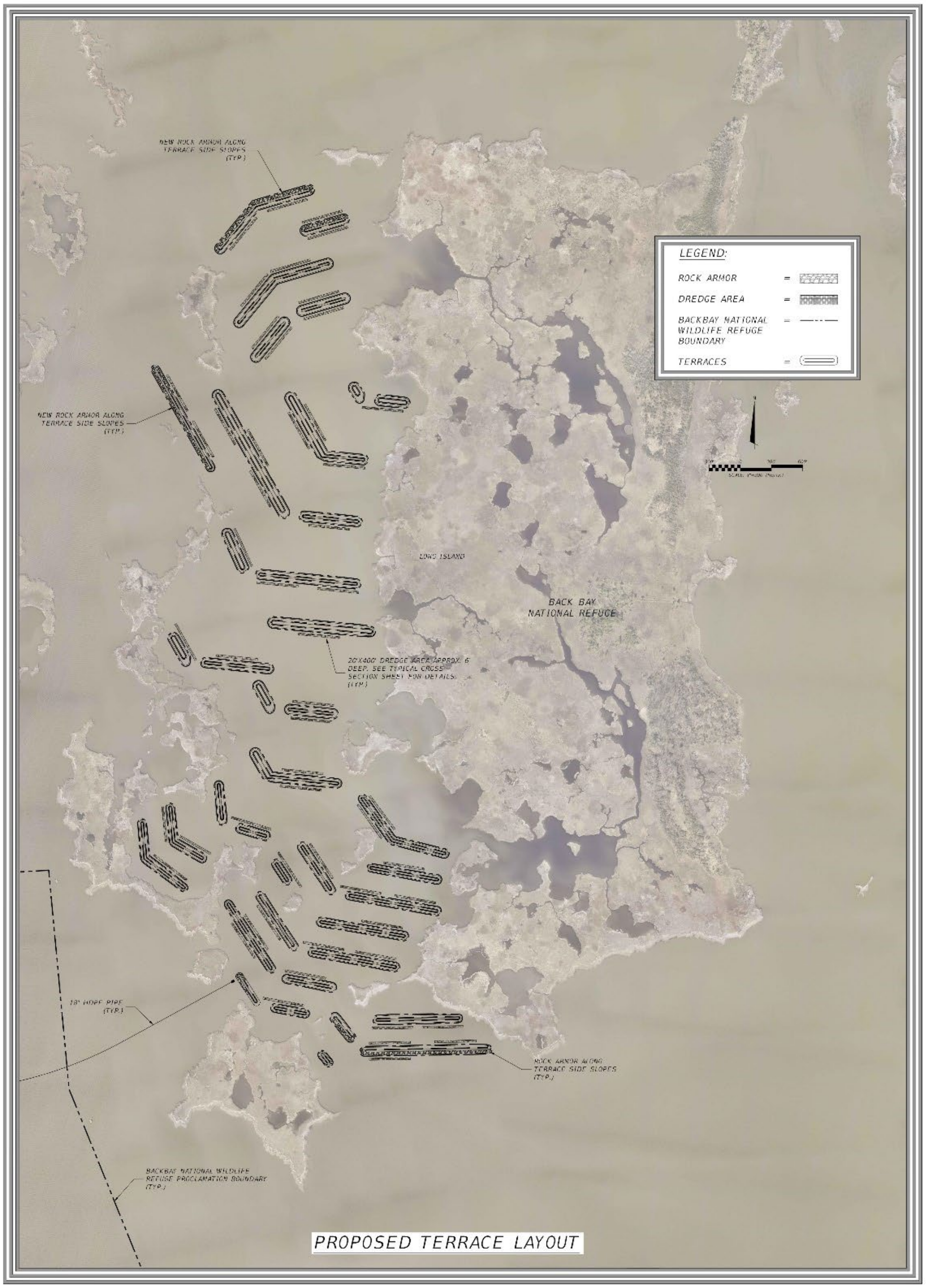

Figure 29: Marsh terrace layout across Bonney Cove.

Figure 30: Marsh terrace design rendering.

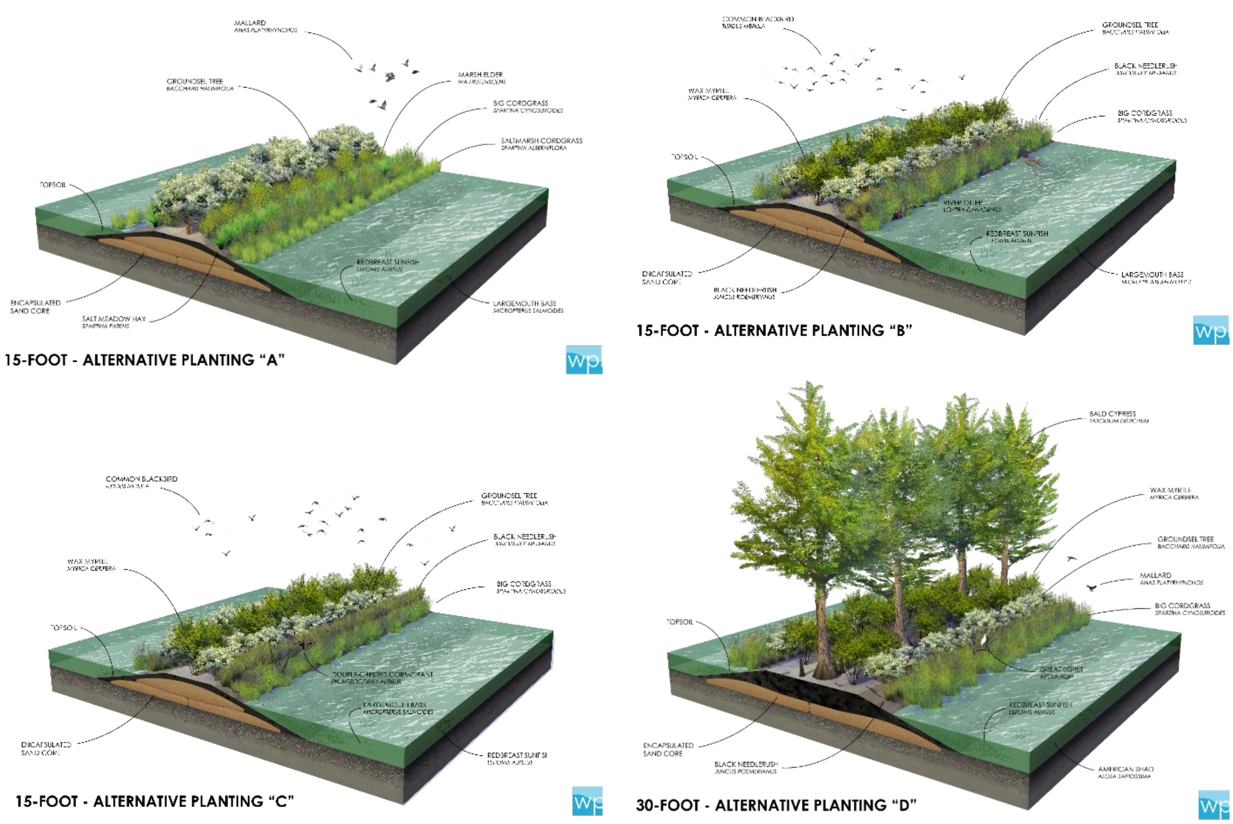

Figure 31: Marsh terrace cross-section design renderings.

The following section provides a high-level description of the proposed design and

construction approach.

Terrace Orientation:

The orientation of the terraces will be perpendicular to the predominant wind direction (south-southwest) to maximize wave energy reduction. The terraces in the northern extent of the project site will be angled perpendicular to a north-northwest wind direction. The terraces would be segmented in a chevron pattern (duck-wing pattern) to provide the most favorable fish and swimming crustacean (termed "nekton") habitat while also allowing adequate circulation to promote sedimentation and maintaining navigability throughout the project area. The terraces would not be connected to the adjacent marsh; this gap, or physical open water barrier, is intended to deter the invasion of Common Reed (*Phragmites australis*) stands from adjacent marshes.

Spacing:

The terraces would be spaced at approximately 300-foot intervals in the northern and southern quarters, and then 600-foot or greater intervals in the center. This arrangement aims to lessen the open water and subsequent wave action at the northern and southern ends of the site and allow adequate construction space for marine-based construction equipment.

Terrace Elevation and Width:

To achieve a sustainable marsh elevation throughout the project life, the marsh terraces would initially be built to a higher elevation during construction and allowed to settle to the desired target elevation over time. Taller terraces improve the functionality and resiliency of the system while also providing diversified habitat for fish and wildlife. The goal is that, by the end of the 30-year design life and with 1.5 feet of relative sea level rise, the terraces will be at or above the elevation of a moderate wind tide event (when Back Bay water levels are anticipated to reach +3.0 feet NAVD88 over the design water level). This threshold was determined to ensure the terraces would not be fully overtopped during a future wind tide event and maintain resiliency to anticipated sea level rise. The 1.5 feet sea level rise scenario is consistent with the near-term planning scenarios identified in the City's Resilience Plan to represent conditions from 2035 to 2050 and adopted by the Hampton Roads Planning District Commission (HRPDC) as part of resolution number 2018-01.

The terraces would have a top width of 15 or 30 feet and be built to an elevation of +4.5 to +5.0 feet NAVD88, depending on the width of the crest, underlying soils, and local bottom depth, with side slopes of 4 horizontal to 1 vertical (4H:1V). The +4.5- to +5.0-foot elevation is calculated based on a target elevation of +3.0 feet NAVD88 or higher at the end of the project's 30-year design life and an estimated settlement of approximately 1 to 2 feet, depending on where the terrace is located. The geotechnical investigation revealed that terraces in the site's southern portion are expected to experience greater settlement than those to the north.

Terrace Composition:

The terraces would consist of a sand-filled core that is encapsulated by a high-strength blend of woven and non-woven geotextile fabrics. The sand for this material will come from nearby offsite sources and be pumped through the 1-inch diameter pipe described in Activity 2. Once the cores are in place, long-reach excavators would travel along the tops of the terraces and begin to shape the cross slopes. Existing adjacent material devoid of SAV would be mechanically dredged and placed over the sand-filled cores. The marsh terraces would be covered with 1 to 3 feet of suitable fill, depending on crest widths, and then planted with native emergent and brackish plant species to stabilize the terraces and provide wind-driven flood reduction benefits.

Relevant Objective(s): Objective 2

Deliverables:

- Conduct daily inspections to monitor construction progress of the marsh terraces.

Assumptions:

- It is anticipated that construction of the terraces will occur in two phases over two years from 2025 through 2026, with the following assumptions:
    - Construction activities are not permitted within BBNWR from October 31 through February 28, annually, to limit disturbance to wintering waterfowl and migration during those months.

Activity 3 – Stakeholder Engagement and Lessons-Learned Dissemination

As the first large scale terracing project on the Atlantic coast, the City recognizes the importance of documenting lessons learned and effective practices during each of the proposed activities: contractor procurement, construction, and post-construction monitoring. The City plans to develop a set of project marketing materials (PowerPoint presentations, StoryMap, information flyers, etc.) to cover key topics, such as:

- Lessons learned during contractor procurement, construction, and post-construction monitoring.
- Effective practices for contractor procurement, bid development, and evaluation. This project is expected to require a highly specialized contractor given the complexity of the project, very shallow water depths, and distance of the site from available construction access and staging areas.
- Guidance for identifying the best sources for local and regional materials for building the terraces and developing a project construction schedule with enough lead time for producing the quantity of material needed for large-scale marsh creation projects.
- Effective practices for developing a post-construction monitoring plan for marsh terraces that a) aligns with permitting, grant, and other requirements and b) enables quantification of project benefits and areas for improvement.

- Effective practices for communicating project benefits based on a combination of field data collection, numerical modeling, and post-construction monitoring.

The City plans to leverage the materials to facilitate dissemination to key stakeholders to increase likelihood of transferability of the approach to other areas in the region and state. The City's plan for engagement is summarized in the following table. In addition to these efforts, the City is committed to collaborating with DCR to identify any additional opportunities to help socialize the project's innovative design and lessons learned.

Table 8: Summary of opportunities for City, regional, state, and national stakeholder engagement; expected benefits.

	Description of Proposed Outreach Activities
CITY	• Facilitate internal municipal awareness, coordination, and approval to gain budgetary approval for funding to expand the approach to other sites in Back Bay (such as "The Great Narrows", Mackay Island and Princess Anne Wildlife Management Areas, and Ragged Island) through presentations to the: o Virginia Beach City Council o City Manager Working Group for SLR and Recurrent Flooding, comprised of representatives from all City departments, to facilitate awareness, coordination, and action to advance the project to the restoration phase. • City of Virginia Beach Management Leadership Team (MLT), which includes the City Manager, Deputy City Managers, and Department heads from across the City.
REGION	• Collaborate with the National Audubon Society and Albemarle-Pamlico National Estuarine Partnership (APNEP) to: o Highlight the marsh terrace project as a success story in the next iteration of the Currituck Sound Coalition Marsh Conservation Plan. o Explore opportunities for marsh terrace projects in the Knotts Island Channel, a key flood pathway into Back Bay, as well as other locations in the Currituck and Albemarle-Pamlico Sound. • Share lessons learned to regional and state stakeholders, improving knowledge-based, awareness, and capacity for future efforts through presentations to: o Hampton Roads Adaptation Forum – a regional dialogue for academics, non-profits, consultants, and municipalities committed to resilience measures. o The Hampton Roads Planning District Commission (HRPDC) Coastal Resiliency Committee . o Regional conferences on green infrastructure, coastal resilience, and SLR adaptation. • Collaborate with Wetlands Watch, a regional non-profit organization committed to the protection of wetlands using nature-based solutions, to socialize the project and disseminate lessons learned.

	Description of Proposed Outreach Activities
STATE	• Continue to coordinate with the Virginia Department of Conservation and Recreation (DCR) to: o Promote the project as a success story for the State Coastal Master Plan (CRMP), which highlighted the project as an "exemplary" resilience project that aligns with the Commonwealth's objective to protect and enhance the state's natural infrastructure. o Incorporate project updates and lessons learned on the CRMP website is an excellent mechanism for dissemination to all coastal Planning District Commissions (PDCs)/Regional Commissions (RCs) across the state. • Continue to collaborate with The Nature Conservancy (TNC), a national player in guiding the implementation of nature-based strategies, to help disseminate lessons learned on project implementation. The City has engaged in early discussions with TNC about partnering to host a state-level workshop that would draw from the network of TNC's local and regional chapters • Presentations at state-level conferences on water resources, floodplain management, and resilience, such as hosted by Resilient Virginia and Virginia Lakes and Watersheds Association.
NATION	• Disseminate lessons learned/effective practices through presentations at 1-2 relevant national conferences such as Restore America's Estuaries, Association of State Floodplain Managers, or the American Shore and Beach Preservation Association, etc. • Leverage working relationships and existing contract work with the U.S. Army Corps of Engineers and partners to integrate lessons learned into the International Natural and Nature-Based Feature Design Guidelines to promote consideration of marsh terraces within similar Back Bay environments (for example, in North Carolina, Maryland, New Jersey, and New York).

Relevant Objective(s): Objective 3

Deliverables:

- Project marketing materials.
- Records documenting number of stakeholders engaged during outreach activities.

Activities Not Included Under this Grant

Submerged Aquatic Vegetation Transplant Plan: The City will evaluate opportunities for restoring native submerged aquatic vegetation populations in Back Bay, such as Wild Celery (*Vallisneria americana*), through consultations with subject matter experts. After terrace construction, the City will formulate a plan for planting submerged aquatic vegetation in between the terraces in coordination with identified partners and the construction contractor.

Post-Construction Monitoring: Post-construction monitoring and inspections will occur for a minimum of five (5) years following construction. Given the period of performance for the CFPF grant, post-construction monitoring activities have not been included in this application.

Milestone Schedule

The scope of work proposed in this grant application are scheduled to occur between June 2024 and June 2027. Work activities are anticipated to complete in December 2026; however, the proposed schedule extends through June 2027 for contingency. The project's expected progression is shown in the following milestone schedule, noting deliverables for each milestone:

2024 Activities

- *1st Quarter* ***(pre-grant period activities):***
  - 100% Final PS&E
  - Submit Bid Documents
- *2nd Quarter (pre-grant period activities):*
  - Final Bid Coordination/Acceptance
  - Construction NTP
- ***Begin Year 1 Grant Activities – 2nd Quarter 2024:***
  - Mobilization for Shipps Cabin Road Construction Staging Area
  - Initiation of Marsh Terrace Material Production
- *3rd Quarter:*
  - Construction NTP and Mobilization for Slurry Basin Installation
- *4th Quarter:*
  - Completion of Shipps Cabin Road Construction Staging Area and Slurry Basin Construction

2025

- *1st Quarter*
  - Completion of Marsh Terrace Material Production
  - Construction Mobilization for Marsh Terraces (beginning on March 1, 2025)
  - Oversight, Management, and Inspection Services of Slurry Basin Installation
- ***Begin Year 2 Grant Activities - 2nd Quarter 2025***
  - Construction of Marsh Terraces #100 – 105
- *3rd Quarter*
  - Construction of Marsh Terraces #106 – 114
- *4th Quarter*
  - Construction of Marsh Terraces #115 – 119
  - Marsh Terrace Construction Demobilization (to accommodate break in construction period from October 31, 2025 – February 28, 2026)

2026

- *1st Quarter*
  - Construction Re-Mobilization for Marsh Terraces (beginning on March 1, 2026)
- ***Begin Year 3 Grant Activities - 2nd Quarter 2026***

  - Construction of Marsh Terraces #120 – 134
- *3rd Quarter*
  - Construction of Marsh Terraces #135 – 140
- *4th Quarter*
  - Shipps Cabin Road Construction Staging Area Final Improvements & Demobilization

2027

- *1st and 2nd Quarter*
  - *Contingency for any delays experienced through end of 2026*

End Year 3 Grant Activities

Project Partners

The following table highlights the specific project partners, their roles, and their capabilities concerning the proposed project.

Table 9: Potential Project Partners.

Entity	Role	Description
U.S. Fish and Wildlife Service, Back Bay National Wildlife Refuge	Project Partner / Advisor / Adjacent Land Owner	BBNWR owns the land adjacent to the project footprint and monitors migratory bird hunting within Presidential Proclamation boundaries. BBNWR has coordinated with the City on project design and will continue to be involved during project construction as a stakeholder and advisor.
Virginia Department of Wildlife Resources	Project Advisory / Stakeholder	The City has coordinated closely with VDWR on project design. Furthermore, VDWR has been monitoring SAV distribution in Back Bay for decades and will be a critical partner for identifying native seagrass species and techniques for restoration based on extensive experience from previous SAV restoration projects in Back Bay.
Virginia Beach Department of Planning & Community Development	Permit Compliance	The City's Department of Public Works has been in close coordination with the City's Department of Planning & Community Development throughout the design and permitting process. Continued involvement and coordination during construction and post-construction monitoring is anticipated.
Dewberry	Engineering Contractor	Engineering consultant to support the City with contractor procurement and construction administration.
To be Determined	Construction Contractors	Construction contractor for the Shipps Cabin Road Construction Staging Area and marsh terrace construction activities.

Entity	Role	Description
Friends of Back Bay	Project Advisory / Stakeholder	Friends of Back Bay was formed in the 1980s to lead efforts to expand and conserve BBNWR, including securing millions in funding to support the Refuge's expansion. The City has coordinated with the BBNWR Society throughout the design and permitting process and will continue this coordination through construction and post-construction monitoring.
Back Bay National Wildlife Refuge Society	Project Advisory / Stakeholder	The Back Bay National Wildlife Refuge Society (BBNWR Society) is an independent, 501(c)(3) non-profit group dedicated to supporting the mission of the USFWS National Wildlife Refuge System and specifically promoting awareness of the BBNWR through education and participation. The City has coordinated with BBNWR Society throughout the design and permitting process and will continue this coordination through construction and post-construction monitoring.
Back Bay Restoration Foundation	Project Advisory / Stakeholder	Back Bay Restoration Foundation (BBRF) is an independent, 501(c)(3) non-profit group focusing on growing concerns about issues such as recurrent flooding, sea level rise, and development in the Southern Rivers Watershed. The group aims to serve as an advocate for the Bay and surrounding residents. The City has coordinated with BBRF throughout the design and permitting process and will continue this coordination through construction and post-construction monitoring.

Relationship to Other Projects

This project represents the first nature-based project in the Southern Rivers Watershed to advance to design and construction to implement the City's Wise Resilience Plan. The project is also an aspect of the Stormwater Green Infrastructure aspect of the City's Flood Protection Plan. The City has received a $3M award from the CFPF to support another project in the Stormwater Green Infrastructure element of the Flood Protection Program – the Elizabeth River Wetland and Floodplain Restoration Project (Round 1 CFPF Grant Awards).

The City has also received two NFWF NRCF grants from the Marsh Restoration in Back Bay project. Approximately $135,000 in NFWF NRCF funding was awarded in 2020 for the previous phase (design and permitting) for the project. The City continues to meet the obligations and period of performance of this NFWF grant. In 2022, the NFWF NRCF awarded $9,886,400 to support construction activities.

In its Resilience Plan, Virginia Beach identifies an adaptation approach for the Southern Rivers Watershed that emphasizes natural mitigation methods and integrated systems of defenses. As a natural mitigation strategy, the marsh terrace project aims to serve as a first line of defense during flood events, reducing wind-driven fetch, wave energy, and flow velocities to protect the important marsh buffer surrounding the shorelines of Back Bay. Other projects are also needed to provide multi-layered flood protection to northern Back Bay communities (Figure 32). Several

of these projects are highlighted below. It should be noted that the projects described below are either not yet funded or will be funded in the future through the City's Capital Improvement Program.

Figure 32: Southern Rivers Watershed Adaptation Vision.

Marsh island restoration serves as a critical first line of defense of the multi-layered protection system in the Southern Rivers Watershed. The following map (Figure 33) shows the structural adaptation projects proposed for the Southern Rivers Watershed, including the Muddy Creek Road and Sandbridge flood defense systems. The City's numerical modeling shows that, if implemented, there is potential for small increases in flooding outside of these structural protection systems.[14] This emphasizes the need for complimentary measures, including the marsh terrace project, land acquisition, and conservation efforts, to mitigate this residual risk.

[14] City of Virginia Beach (2020). City-wide Structural Alternatives for Coastal Flood Protection (PDF).

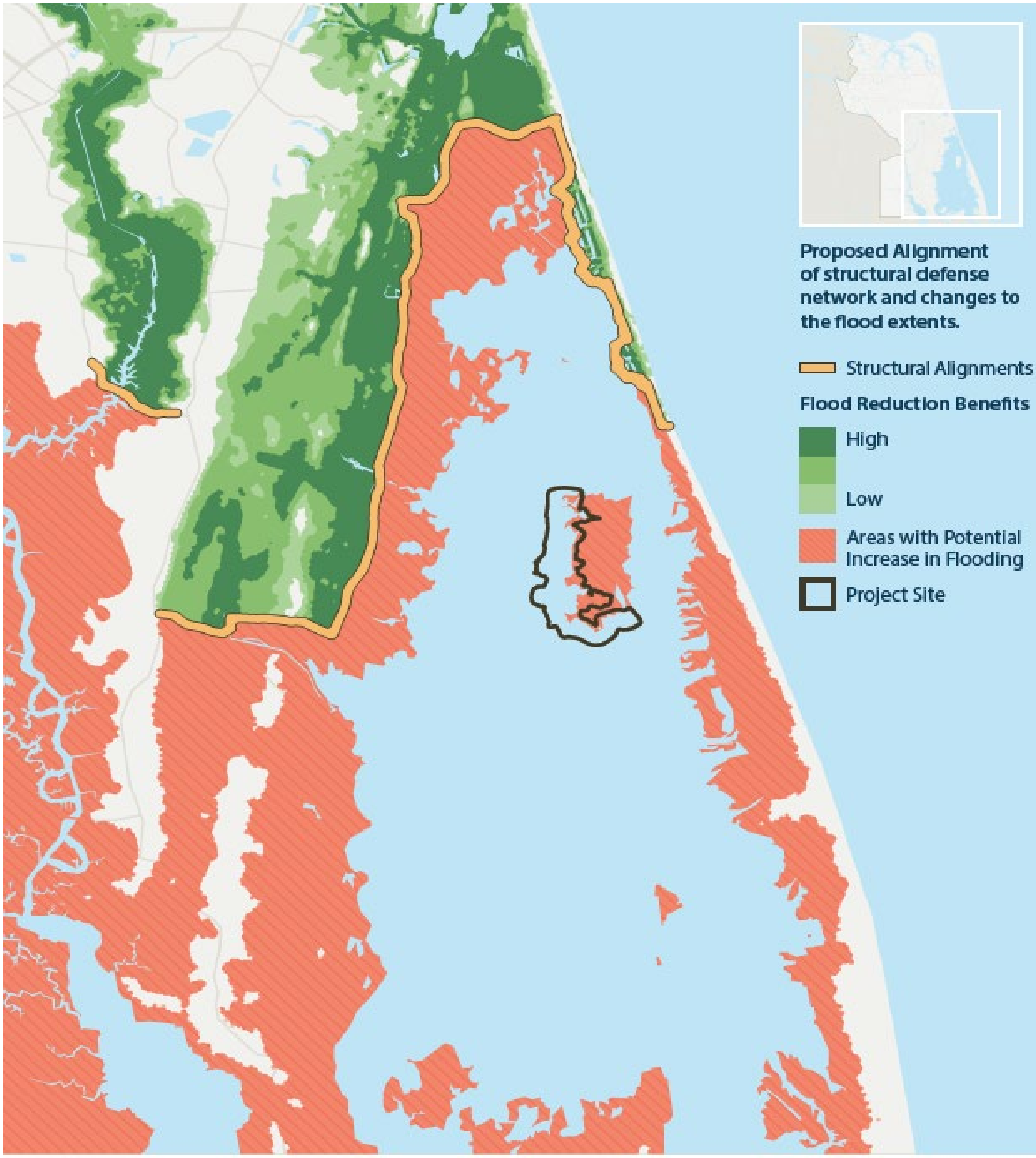

Figure 33: Structural adaptation projects proposed for the Southern Rivers Watershed, including the Muddy Creek Road and Sandridge flood defense systems.

Backside of Sandbridge Flood Defense System

Protection of the Sandbridge resort community from increasing coastal flood hazards would require a complex and expensive structural protection system because of the manufactured land configuration on the backside of Sandbridge. The proposed protection system includes elevating Sandbridge Road and constructing a network of seawalls, levees, and gates along the Back Bay shoreline of Sandbridge. This project does not have designated funding at this time.

Hell Point Creek Flood Defense System

As part of the integrated Sandbridge City-Wide flood defense network, a storm surge barrier across Hell Point Creek could block flood waters originating from Back Bay. Sandbridge Road would also need to be raised to ensure floodwaters could not flank the system. This project does not have designated funding at this time.

Sandbridge/New Bridge Intersection Improvements

Road and shoulder improvements are planned to increase safety at the New Bridge Road/Sandbridge Road intersection and reduce the need for road closures due to flooding from the adjacent Ashville Creek.

Muddy Creek Road Flood Defense System

Muddy Creek Road provides access to important rural and agricultural communities and Back Bay and the Wildlife Refuge. Muddy Creek Road is one of the lowest-lying roadways in all of Virginia Beach and frequently floods. This City-Wide Structural Alternative Flood Protection analysis identified this roadway as a critical location to provide flood protection. The proposed system, known as the Muddy Creek Road Alignment, would transform much of Muddy Creek Road into a levee, with the road on the top. The City's numerical modeling effort shows that the Muddy Creek Road Flood Defense System could potentially increase flood risk to the east of Muddy Creek Road, as shown in Figure 33. Therefore, the implementation of nature-based strategies suitable to the low-lying shorelines of Back Bay is essential to mitigate these impacts. This project does not have designated funding at this time.

Voluntary Acquisition Program

Virginia Beach City Council has recently funded a $2.0 million City-wide voluntary acquisition program to encourage flood-prone property owners to apply for a buyout. Parcels acquired by the City, in the Southern Rivers Watershed, would then be converted to open space to serve as flood storage and a marsh migration buffer.

Stormwater Master Plan

The City Council initiated an update of the City's Stormwater Master Plan in 2014. This effort is interchanging information with aspects of the City's Resilience Plan to account for the impact of sea level rise on the stormwater system's performance. Specific stormwater drainage improvement projects are included within the Lower Southern Rivers Watershed Drainage Basin.

Virginia Coastal Resilience Master Plan

The CRMP highlighted the marsh terrace project as an exemplary nature-based resilience project. The CRMP emphasizes Virginia Beach's strategic use of multiple funding streams to implement a large-scale nature-based project. DCR’s contribution to the project’s construction could be highlighted as a success story for implementation of the CRMP.

Audubon North Carolina Currituck Sound Coalition Marsh Conservation Plan

In coordination with Audubon North Carolina, the Currituck Sounds Coalition identified marsh restoration priorities based on criteria for siting restoration projects, including vulnerability to sea level rise, historic increase in surface water, and distance to hardened shorelines. This assessment identified Virginia Beach's marsh terrace project site as a high-priority area for restoration. There is an opportunity to highlight this project as a success story in the next iteration of the Audubon's Marsh Conservation Plan, which is slated to be updated every three years.

Maintenance Plan

Standard maintenance measures have been defined as part of the draft Annual Monitoring Plan and Post-Construction Monitoring Report developed for this project. See Attachment 5 for a copy of the draft report.

Subsequent to the monitoring period, project maintenance will be addressed by the City's Public Works Stormwater Operations Group, who will also respond to any maintenance issues identified by the monitoring effort or other observers. The City intends to maintain the construction staging area to support future project maintenance needs. The City will perform inspections every 2-5 years and make any repairs needed for the life of the project after completion of the initial monitoring program.

As described by the draft Annual Monitoring Plan and Post-Construction Monitoring Report, maintenance measures include the replacement of plantings (including upland, marsh and SAV plantings), the removal of debris from the terraces, the removal of invasive vegetation identified in the planting areas, the addition of sediment to eroding areas of the terraces, and the replacement of waterfowl barriers as necessary. In addition, structural maintenance measures that might be identified and prescribed during monitoring efforts include replacement of dislodged stones, addition of stone to address structure settlement, and general repair of sand cores or other structural elements. As proposed, these measures would become conditions of the wetland permits required for this project, in addition to standard commitments and requirements defined by the permitting agencies.

In addition to the commitments made in the monitoring plan, and those anticipated to be defined during the permitting process, it is the assumption that the placement of the proposed marsh terrace structures in state waters (subaqueous bottoms) will require the City to maintain the marsh terraces in perpetuity. As previously defined through coordination with VMRC, the City would obtain a compensable interest in the property that has been filled on top of state-owned subaqueous bottomlands (i.e. the terraces). As such, the City would be responsible for maintaining the proposed marsh terraces structures to ensure they fulfill their intended functions, as defined in the objectives and indicators of success previously defined in this proposal.

Criteria

The project receives a total score of **65 Points**. An explanation of how the project meets each

of the applicable scoring criteria contained in Appendix D is provided below.

Eligible Project (Type)

Category/Points: Wetland/floodplain restoration, Living shorelines and vegetated buffers (25 Points)

Explanation: Marsh terraces are considered a type of wetland restoration or a component of a living shoreline project:

- Wetland Restoration: Wetland restoration aims to reestablish or enhance natural wetland ecosystems. Marsh terraces can be constructed in areas where wetlands have been degraded or lost, and they help to recreation or support wetland functions. They provide habitat for various species, improve water quality, and can contribute to the overall health and resilience of a wetland ecosystem.
- Living Shoreline Project: Living shorelines are designed to protect shorelines from erosion while also promoting ecological and environmental benefits. Marsh terraces are often used as a component of living shoreline projects. They can serve as a buffer against wave action, stabilize shorelines, and create suitable habitat for marsh and aquatic species.

Social Vulnerability Index Score

Category/Points: Low Social Vulnerability (0 Points)

Explanation: Based on the Virginia Flood Risk Information System (VFRIS) Social Vulnerability Index Layer, the Social Vulnerability Index scores of the communities located in the two census block groups adjacent to Back Bay near the project site are -1.07 and -0.43 (an average of -0.75), which falls into the Low Social Vulnerability category.

Community Scale Benefits

Category/Points: More than one census block group (30 Points)

Explanation: As documented in the *Supporting Documentation - Project Information – Population* section of this document, the project is anticipated to benefit two census block groups (518100454.121 and 518100464.001).

Expected Lifespan of Project

Category/Points: Over 20 Years (10 Points)

Explanation: As documented in the *Supporting Documentation – Approach, Milestones, and Deliverables – Activity 3 (Marsh Terrace Construction)* section, the marsh terraces have a 30-year design life.

Budget Narrative

The following budget narrative details the proposed project expenditures. See Appendix B for completed budget spreadsheet.

Estimated Total Project Cost

The current estimated total project cost is **$53,378,490.** This estimate includes design, site acquisition for the construction staging area, construction, inspections and support, implementation, and contingencies, as shown in the below table. The design engineer's opinion of probable cost for construction is provided

Project Activity	Capital Improvement Program Estimate
Design	$276,800
Site Acquisition	$50,000
Construction	$41,839,900
Inspections and Support	$5,609,200
Implementation	$750,000
Contingencies	$4,852,590
Total:	$53,378,490

Funds Requested from the Fund

The City is requesting a total of **$5,000,000.00** in funding from the CFPF Round 4. These funds will support contractual services of the engineering consultant and construction contractor to execute Activity 2 (Construction Staging Area Preparation and Construction) and Activity 3 (Marsh Terrace Construction). No support is requested for City personnel.

These funds will be used to support ongoing construction activities through 2024-2026. Example activities include contractor construction services, mobilization/demobilization, construction staging area construction, slurry pipe installation, portions of the terrace materials, and waterfowl barriers. Construction costs are based on a detailed estimate from the design engineer that includes detailed breakdown of estimated quantities and costs from the 95% design package using industry standards for the anticipated aspects of the project construction. The City has withheld the detailed estimate as it provides information that would affect bidding on the construction.

Amount of Funds Available

The City as prime recipient is providing a cash match of $38,356,966 from funds fully programmed and available from the City's Flood Protection Program Capital Improvement Program to support the project. The Flood Protection Program is supported by a related bond referendum that provided $567.5M to fund more than 40 projects identified for Phase 1 of the Program. The program is tightly managed by the City, an independent contractor, and has a resident oversight board. The City is fully confident these funds will be available for constructing this project.

The City's dedicated funds will provide cash match to cover contractual services to support Activity 1 (Construction Staging Area Preparation and Construction), Activity 2 (Marsh Terrace Construction), Activity 3 (Stakeholder Engagement and Dissemination), and all related City support and direct overhead costs related for the project.

The National Fish and Wildlife Foundation is also supporting the project through two grant awards from the National Coastal Resilience Fund. This includes an initial award of $135,124 in 2020 for design and a second award of $9,886,400 in 2022 to support construction. The 2022 grant funds are dedicated to purchasing the native vegetation and a portion of the materials needed to build the marsh terraces.

A summary of project costs, funds available, and funds requested is provided below:

Item	Amount
Project Cost:	$53,378,490.00
Funding Sources Available	
NFWF Grant:	$10,021,524.00
CFPF Grant Request:	$5,000,000
City Funds Available:	$38,356,96600
Total Project Funding:	**$53,378,490.00**

Authorization to Request for Funding

Please refer to *attachment* for the documentation authorizing the funding request.

Attachment 1: Virginia Beach Resilience Plan DCR Approval

Matthew J. Strickler
Secretary of Natural Resources

Clyde E. Cristman
Director

COMMONWEALTH of VIRGINIA
DEPARTMENT OF CONSERVATION AND RECREATION

Rochelle Altholz
Deputy Director of Administration and Finance

Russell W. Baxter
Deputy Director of Dam Safety & Floodplain Management and Soil & Water Conservation

Nathan Burrell
Deputy Director of Government and Community Relations

Thomas L. Smith
Deputy Director of Operations

July 20, 2021

Toni Utterback, P.E.
Department of Public Works
2875 Sabre Street, Suite 250
Virginia Beach, VA 23452

RE: Virginia Beach Resilience Plan Second Submission - CFPF

Dear Ms. Utterback:

Thank you for the resubmission of the Sea Level Wise Adaptation Plan for City of Virginia Beach. After careful review and consideration, the Virginia Department of Conservation and Recreation has deemed the Plan complete and meets all the criteria outlined in the June 2021 Community Flood Preparedness Grant Manual. This approval will remain in effect for a period of three years, ending on July 31, 2024.

The following elements were evaluated as part of this review:

1. **Element 1: It is project-based with projects focused on flood control and resilience. DCR RESPONSE**

    a. Project-based: Four watersheds—each with a defined geographic area, analysis of community social and environmental characteristics, types of flooding, and a tailored flood resilience strategy with <u>discrete projects identified</u>.

Projects focused on flood control and resilience include:

Neighborhood	Flood Control Project
Elizabeth River	City-wide alignment, living shoreline, marsh restoration, land conservation
Lynnhaven	Chesapeake Bay alignment, Lesner Bridge Neighborhood alignment (East & West), beach & dune nourishment, ecological revetments, shellfish reef restoration, seagrass restoration
Oceanfront	Atlantic Oceanfront alignment, Rudee Heights alignment
Southern Rivers	West Neck Creek city-wide alignment, Muddy Creek Road city-wide alignment, Sandbridge city-wide alignment

**additional projects listed within the Sea Level Wise Adaptation Strategy.*

2. **Element 2: It incorporates nature-based infrastructure to the maximum extent possible. DCR RESPONSE**

a. Nature-based infrastructure: Flood mitigation projects throughout the city incorporate nature-based solutions and were identified for maximum use within specific watersheds.

3. **Element 3: It includes considerations of all parts of a locality regardless of socioeconomics or race. DCR RESPONSE**
    a. All parts of a locality: Locality divided into four watersheds, covering the entirety of the jurisdictional boundary.
    b. Social vulnerability: Social implications of flood hazards and analysis of populations at-risk documented.
    c. Demographic Analysis: Demographic and Population Vulnerability Analysis conducted by Dewberry and incorporated into the Plan.

4. **Element 4: It includes coordination with other local and inter-jurisdictional projects, plans, and activities and has a clearly articulated timeline or phasing for plan implementation. DCR RESPONSE**
    a. Coordination with other projects, plans, and activities: Contains the planning processes and frameworks which outline local and regional plans used by the City and address resilience; and how they have been integrated for flood adaptation planning.
    b. Clearly articulated timeline or phasing for plan implementation: Program phases clearly articulated and described in detail—Impact assessment, Adaptation research, Strategy development, and Long-term implementation.

5. **Element 5: Is based on the best available science, and incorporates climate change, sea level rise, storm surge (where appropriate), and current flood maps.**
    a. Technically backed water-resources analysis, sea level rise projections, storm surge, and climate change incorporated into strategic approach.

VA DCR looks forward to working with you as you work to make Virginia Beach a more resilient community. If you have questions or need additional assistance, please contact us at cfpf@dcr.virginia.gov. Again, thank you for your interest in the Community Flood Preparedness Fund.

Sincerely,

Wendy Howard Cooper

Wendy Howard Cooper, Director
Dam Safety and Floodplain Management

cc: Darryl Glover, DCR

Attachment 2: Authorization to request funding from the Fund from governing body or chief executive of the local government

City of Virginia Beach

DEPARTMENT OF BUDGET AND MANAGEMENT SERVICES
(757) 385-8234
(757) 385-1857 FAX

VBgov.com
MUNICIPAL CENTER
BUILDING 1, 3RD FLOOR
2401 COURTHOUSE DRIVE
VIRGINIA BEACH, VA 23456-9001

INTER-OFFICE MEMORANDUM

DATE: November 1, 2023

TO: Patrick A. Duhaney, City Manager

FROM: Stuart McCrery, Budget and Policy Analyst KJ for SM

SUBJECT: Application for Virginia Community Flood Preparedness Fund Grant

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The Department of Public Works is requesting permission to apply for the Virginia Community Flood Preparedness Fund Grant from the Virginia Department of Conservation and Recreation. The Virginia Community Flood Preparedness Fund was established in the 2020 session of the General Assembly. Money in this fund comes from the auction of carbon allowances through the Regional Greenhouse Gas Initiative. It was established to provide support to localities across Virginia to reduce the impacts of flooding, including flooding driven by climate change.

Public Works is requesting a total of $5,000,000 to construct marsh terraces in Back Bay to promote wetland restoration and mitigate frequent flooding. The City has already made significant investments into this project through CIP project 100551 "Stormwater Green Infrastructure."

This grant also requires a local match of 30% for projects that implement nature-based solutions; however, the City has more than met this requirement through its current appropriations to CIP project 1000551 "Stormwater Green Infrastructure" which currently total over $49 million from the Referendum and other grant awards.

Budget & Management Services recommends this grant application for approval. Please indicate approval or disapproval below. Applications are due by November 12, 2023.

11/1/2023

Approve (Date)

Disapprove (Date)

Attachment 3: Virginia Beach Floodplain Administrator Support Letter

City of Virginia Beach

VBgov.com

DEPARTMENT OF PLANNING & COMMUNITY DEVELOPMENT
PHONE (757) 385-4621
FAX (757) 385-5667
VA Relay Number TTY: 711

2875 SABRE STREET, SUITE 500
VIRGINIA BEACH, VA 23452-7385

November 7, 2023

Division of Dam Safety and Floodplain Management
600 East Main Street, 24th Floor
Richmond, Virginia 23219

RE: Community Flood Preparedness Fund – Marsh Terrace Creation, Back Bay

The proposed project is located in both open water and a Federal Emergency Management Agency (FEMA) mapped Special Flood Hazard Area (SFHA). Hydraulic modeling analysis identified Bonney Cove as a location where marsh restoration has the potential to reduce the propagation of floodwater through key pathways within Back Bay. This project aims to stabilize two critically eroding marsh islands that serve as a key flood pathway into northern Back Bay, promote the growth of aquatic vegetation, and provide flood risk reduction benefits to communities in the surrounding area. Within the two census block groups that would benefit from this project, there are 113 repetitive loss and severe repetitive loss properties.

If I can provide any further information or assistance, please call me at 757-385-4621, or e-mail me at wmcnamar@vbgov.com.

Sincerely,

Whitney McNamara

Whitney McNamara, CFM
Floodplain Administrator and CRS Coordinator

Attachment 4: Letters of Support

Back Bay Restoration Foundation

PO Box 57041 • Virginia Beach, Virginia • 23457• 757-818-4829

November 6, 2023

Department of Conservation and Recreation
Dam Safety and Floodplain Management
600 E. Main St., 24th Floor
Richmond, VA 23219

Re: Virginia Community Flood Preparedness Fund Grant

Grantors:

The Back Bay Restoration Foundation (BBRF), is a 35 year-old non-profit watershed organization, founded in 1986 by a group of local citizens concerned about deterioration of the Back Bay watershed visible then through decreases in Submerged Aquatic Vegetation (SAV), fish, and waterfowl. BBRF is the only voice solely dedicated to conserving and improving Virginia Beach's two Southern Watersheds; namely, the Back Bay and North Landing River watersheds. Our efforts focus on education, stewardship and outreach to conserve the largest watersheds in Virginia Beach. We team with other non-profits, and city, state and federal agencies to work toward best solutions for the future of the Back Bay and North Landing River watersheds. BBRF strives to raise awareness, addressing issues that negatively affect these watersheds such as sea level rise, land subsidence and land use changes.

Back Bay is a historical, nationally significant, watershed. With the Back Bay National Wildlife Refuge (NWR) and significant State conservation lands at its core, the watershed was recognized as an Aquatic Resource of National Importance (ARNI) in 2008 by both the US Fish and Wildlife Service and the US Army Corps of Engineers. Back Bay is a wind-tidal oligohaline estuary and is located at the northern tip of the Albemarle/Pamlico estuarine system, the second largest estuarine complex in the United States. The Albemarle/Pamlico estuarine system was designated as an Estuary of National Significance in 1987 and selected to be studied as part of the Environmental Protection Agency's National Estuary Program. Back Bay is a shallow-water aquatic ecosystem with an average depth of four feet. Winds can influence the water depth by as much as three feet.

BBRF supports the City of Virginia Beach's application for Round 4 of VADCR's Community Flood Preparedness Fund. We were strong advocates of the City's successful applications to the National Fish and Wildlife Foundation (NFWF), and have seen what they accomplished with the initial NFWF funding they received. With the combined funding of NFWF, the City of Virginia Beach, and this application for DCR funding, their project of creating a Marsh Terrace Network to Achieve Restoration and Flood Resilience has overachieved by any measure. From community engagement and the NEPA process to conceptual and preliminary designs as described in the recent Army Corps Public Notice, the City has been productive and completely transparent.

As noted above, the City's community engagement and partnerships with organizations like ours has been transparent and resulted in broad support. Although the current project is localized in its first application, we expect the results will significantly mitigate SLR, land subsidence and wind tides in Back Bay. Similarly, this restoration will provide the biotic building blocks to maintain the watershed's national importance for wildlife. The innovative designs proposed will inform future projects at the landscape level. Although innovative, we believe the project is technically sound based on BBRF's 35 years of experience in habitat restoration.

Please feel free to contact us for further information.

Jared Brandwein

Jared Brandwein

Executive Director
Back Bay Restoration Foundation

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Back Bay National Wildlife Refuge
1324 Sandpiper Road
Virginia Beach, VA 23456

October 30, 2023

Wendy Howard Cooper
Division of Dam Safety and Floodplain Management
600 East Main Street, 24th Floor
Richmond, Virginia 23219

Dear Ms. Cooper,

The City of Virginia Beach is proposing to install marsh terraces in the waters of Back Bay adjacent to Back Bay National Wildlife Refuge. This project is expected to reduce wave energy and thus decrease the speed of erosion of remaining islands in the project area, many of which are managed by the U.S. Fish and Wildlife Service and provide habitat for migratory birds and other species. Additionally, the addition of multiple vegetative structures added to the bay will supplement habitat and provide nesting grounds for multiple species.

The mission of the U.S. Fish and Wildlife Service is *working with others to conserve, protect, and enhance fish, wildlife, plants, and their habitats for the continuing benefit of the American people*. Although much work is conducted on federal property to achieve this mission, the Service equally coordinates with external partners to further mutual goals. The proposed marsh terrace project is an excellent example of local and federal government coordination, and we support the City of Virginia Beach's proposed project.

Megan Reed

Megan Reed
Refuge Manager

Albemarle-Pamlico
National Estuary Partnership

Our mission is to identify, protect, and restore
the significant resources of the Albemarle-Pamlico estuarine system.

October 26, 2023

Wendy Howard Cooper
Virginia Dept. of Conservation and Recreation
Division of Dam Safety and Floodplain Management
600 E. Main St., 24th Floor
Richmond, VA 23219

Dear Wendy,

The Albemarle-Pamlico National Estuary Partnership (APNEP) strongly endorses the City of Virginia Beach and partners' application to Round 4 of The Virginia Community Flood Preparedness Fund (CFPF). The proposal is to support construction of the Back Bay Marsh Terrace Restoration Project.

APNEP relies on regional partnerships and collaboration to implement our 2012-2022 Comprehensive Conservation & Management Plan (CCMP) within the waterways of our congressionally designated "estuary of national significance." The proposed partnership between the City of Virginia Beach and the U.S. Fish and Wildlife Service will also advance our 2020 Memorandum of Understanding between Virginia and North Carolina to protect the ecosystem resources in the shared waterways between our two states. The project also addresses a "high priority" area for restoring and enhancing vulnerable marshes with high flood risk reduction benefits and habitat value, as identified by Audubon's Currituck Sound Coalition Marsh Conservation Plan released in 2021.

The marsh terrace project employs the use of natural features to build resilience to flooding in the Back Bay watershed. The project offers coastal resilience and habitat protection and conservation co-benefits including preserving marsh islands, restoring Submerged Aquatic Vegetation, migratory bird and fish habitat, reducing flow that could exacerbate wind tide flooding in local communities, and filling a gap in prior applied research on predominantly fresh water coastal lagoons. These features support the following CCMP actions:

- A2.3: Support research on adapting to impacts associated with climate change and sea level rise.
- C3.2: Develop and implement a coordinated wetland restoration strategy.
- C3.3: Develop and implement a submerged aquatic vegetation (SAV) restoration strategy.
- D3.3: Provide assistance to state, regional, and local governments to incorporate climate change and sea level rise considerations into their planning processes.

In closing, we strongly support the full funding of the City of Virginia Beach's proposal to Round 4 of The Virginia Community Flood Preparedness Fund (CFPF). Please contact Steve Anderson, Partnership Coordinator, at (919) 707-8743 with questions.

Sincerely,

W. Crowell

William L. Crowell, Jr., Ph.D., AICP, CEE
Director

1601 Mail Service Center, Raleigh, North Carolina 27699-1601
Phone/Fax: 919-707-8633 | www.apnep.org

Attachment 5: Copy of the Current Floodplain Ordinance

ORD-3685

AN ORDINANCE TO AMEND SECTIONS 1.1, 1.2, 1.3, 1.8, 2.1, 2.2, 2.3, 2.4, 2.8, 2.11, 3.1, 4.1, 4.2, 4.3, 4.4, 4.6, 4.8, 4.9, 4.10, 5.1, 6.1, AND 6.3 OF APPENDIX K, FLOODPLAIN ORDINANCE OF THE CITY CODE PERTAINING TO HOUSEKEEPING THE DELETION OF PUBLIC WORKS REQUIREMENTS AND THE ADDITION OF A COASTAL A ZONE AND A COASTAL HIGH HAZARD ZONE

Sections Amended: 1.1, 1.2, 1.3, 1.8, 2.1, 2.2, 2.3, 2.4, 2.8, 2.11, 3.1, 4.1, 4.2, 4.3, 4.4, 4.6, 4.8, 4.9, 4.10, 5.1, 6.1, and 6.3 of Appendix K, Floodplain Ordinance

WHEREAS, the public necessity, convenience, general welfare and good zoning practice so require;

BE IT ORDAINED BY THE CITY COUNCIL OF THE CITY OF VIRGINIA BEACH, VIRGINIA:

That Sections 1.1, 1.2, 1.3, 1.8, 2.1, 2.2, 2.3, 2.4, 2.8, 2.11, 3.1, 4.1, 4.2, 4.3, 4.4, 4.6, 4.8, 4.9, 4.10, 5.1, 6.1, and 6.3 of Appendix K, Floodplain Ordinance is hereby amended and reordained to read as follows:

APPENDIX K FLOODPLAIN ORDINANCE

ARTICLE I. GENERAL PROVISIONS

Sec. 1.1. Statutory authorization and purpose.

A. This ordinance is adopted pursuant to the authority granted to localities by Code of Virginia § ~~10.1-600 et seq~~ 15.2-984.

B. The city council finds the purpose of these provisions is to prevent the loss of life and property, the creation of health and safety hazards, the disruption of commerce and governmental services, the extraordinary and unnecessary expenditure of public funds for flood protection and relief, and the impairment of the tax base by:

1. Regulating uses, activities, and development that, alone or in combination with other existing or future uses, activities, and development, will cause unacceptable increases in flood heights, velocities, and frequencies;

2. Restricting or prohibiting certain uses, activities, and development from locating within districts subject to flooding;
3. Requiring all uses, activities, and developments that do occur in flood-prone districts be protected or flood-proofed against flooding and flood damage;

4. Protecting individuals from buying land and structures that are unsuited for intended purposes because of flood hazards; and

5. Acknowledging that the tide data over the last one hundred (100) years shows that Virginia Beach is facing an increased danger of flooding caused by both sea level rise and subsidence and has adopted the Sea Level Wise Adaptation Report as part of the Comprehensive Plan.

Sec. 1.2. Applicability.

These provisions shall apply to all privately and publicly owned lands within the jurisdiction of the City of Virginia Beach and identified as areas ~~of special flood hazard~~ at risk of flooding by the City of Virginia Beach or shown ~~according to~~ on the Flood Insurance Rate Map (FIRM) or included on the flood insurance study (FIS) that ~~is~~ are provided to the City of Virginia Beach by the Federal Emergency Management Agency (FEMA) and dated January 16, 2015 ~~or identified as floodplains subject to special restrictions in section 4.10 of this ordinance~~.

Sec. 1.3. Definitions.

. . . .

City manager. The City Manager of the City of Virginia Beach, or his designees.

Design Flood Elevation (regulatory flood protection elevation). The base flood elevation plus the freeboard required by this ordinance.

. . . .

Recreational vehicle. A vehicle that is:

1. Built on a single chassis;
2. Four hundred (400) square feet or less when measured at the largest horizontal projection;
3. Designed to be self-propelled or permanently towable by a light duty truck; and
4. Designed primarily not for use as a permanent dwelling but as temporary living quarters for recreational camping, travel, or seasonal use.

~~*Regulatory flood protection elevation (design flood elevation)*. The base flood elevation plus the freeboard required by this ordinance.~~

. . . .

Sec. 1.8. Penalty for violations.

Any person who fails to comply with any of the requirements or provisions of this ordinance or directions of the ~~d~~Directors of ~~p~~Planning ~~or public works~~ or any authorized employee of the City of Virginia Beach shall be guilty of the appropriate violation and subject to the penalties therefore. Any violation of the provision of this ordinance shall be punishable by a fine of not more than one hundred dollars ($100.00). Each person shall be deemed guilty of a separate offense for each and every day or portion thereof during which any violation of any of the provisions of this ordinance is committed.

The Virginia Uniform Statewide Building Code (VA USBC) addresses building code violations and the associated penalties in ~~section 104 and section 115~~ VA USBC § 104 and § 115. Violations and associated penalties of the Zoning Ordinance for the City of Virginia Beach are addressed in § 104 of the Zoning Ordinance.

In addition to the above penalties, all other actions are hereby reserved, including an action in equity for the proper enforcement of this ordinance. The imposition of a fine or penalty for any violation of, or noncompliance with, this ordinance shall not excuse the violation or noncompliance or permit it to continue, and all such persons shall be required to correct or remedy such violations within a reasonable time. Any structure constructed, reconstructed, enlarged, altered, or relocated in noncompliance with this ordinance may be declared by the City of Virginia Beach to be a public nuisance and abatable as such. Flood insurance may be withheld from structures constructed in violation of this ordinance.

ARTICLE II. ADMINISTRATION

Sec. 2.1. Designation of the floodplain administrator.

The City Manager of the City of Virginia Beach is hereby appointed the floodplain administrator to administer and implement this ordinance. The floodplain administrator has delegated the duties and responsibilities set forth in this ordinance to the ~~departments of public works and planning, as specified below~~ Department of Planning and Community Development.

Sec. 2.2. Duties and responsibilities of the ~~department of public works~~ floodplain administrator or his designee.

The duties and responsibilities of the ~~department of public works~~ floodplain administrator of his designee shall include but are not limited to:

A. Interpreting floodplain boundaries and providing available base flood elevation and flood hazard information;

B. Verifying that applicants proposing an alteration of a watercourse have notified adjacent communities, the department of conservation and recreation (division of dam safety and floodplain management), and other appropriate agencies (Virginia Department of Environmental Quality (VADEQ), United States Army Corps of Engineers (USACE), etc.) and have submitted copies of such notifications to FEMA;

C. Advising applicants for new construction or substantial improvement of structures that are located within an area of the coastal barrier resources system established by the Coastal Barrier Resources Act that Federal flood insurance is not available on such structures; areas subject to this limitation are shown on FIRMs as coastal barrier resource system areas or otherwise protected areas;

D. Submitting to FEMA, or requiring applicants to submit to FEMA, data and information necessary to maintain FIRMs, including hydrologic and hydraulic engineering analyses prepared by or for the city, within six (6) months after such data and information becomes available if the analyses indicate changes in base flood elevations;

E. Maintaining and permanently keeping records that are necessary for the administration of these regulations, including:

1. ~~flood~~ Flood insurance studies, FIRMs (including historic studies and maps and current effective studies and maps) and letters of map change; and

2. Documentation supporting issuance and denial of permits, Elevation Certificates, documentation of the elevation (in relation to the datum on the FIRM) to which structures have been floodproofed, inspection records, other required design certifications, variances, and records of enforcement actions taken to correct violations of these regulations.

F. Notifying FEMA when the corporate boundaries of the City of Virginia Beach have been modified and:

1. Providing a map that clearly delineates the new corporate boundaries or the new area for which the authority to regulate pursuant to this ordinance has either been assumed or relinquished through annexation; and

2. If the FIRM for any annexed area includes SFHAs that have flood zones with regulatory requirements that are not set forth in this

ordinance, prepare amendments to this ordinance to adopt the FIRM and appropriate requirements, and submit the amendments to the city council for adoption; such adoption shall take place at the same time as or prior to the date of annexation and a copy of the amended ordinance shall be provided to the department of conservation and recreation (division of dam safety and floodplain management) and FEMA.

G. Upon the request of FEMA, completing and submitting a report concerning participation in the NFIP, which may request information regarding the number of buildings in the SFHA, the number of permits issued for development in the SFHA, and the number of variances issued for development in the SFHA.

H. Reviewing applications for permits to determine whether proposed activities will be located in the SFHA;

I. Reviewing applications to determine whether proposed activities will be reasonably safe from flooding and requiring new construction and substantial improvements to meet the requirements of this ordinance;

J. Reviewing applications to determine whether all necessary permits have been obtained from the federal, state, or local agencies from which prior or concurrent approval is required; in particular, permits from state agencies for any construction, reconstruction, repair, or alteration of a dam, reservoir, or waterway obstruction (including bridges, culverts, structures), any alteration of a watercourse, or any change of the course, current, or cross section of a stream or body of water, including any change to the SFHAs of free-flowing non-tidal waters of the state;

K. Approving applications and issuing permits to develop in flood hazard areas if the provisions of this ordinance have been met, or disapproving applications if the provisions of this ordinance have not been met;

L. Granting administrative variances pursuant to section 6.1 of this ordinance;

M. Inspecting, or causing to be inspected, buildings, structures, and other development for which permits have been issued to determine compliance with this ordinance or to determine if non-compliance has occurred or violations have been committed;

N. Reviewing elevation certificates and requiring incomplete or deficient certificates to be corrected;

O. Maintaining and permanently keeping documentation supporting the issuance and denial of permits, elevation certificates, documentation of the elevation (in relation to the datum on the FIRM) to which structures have been flood proofed, and other required design certifications, variances, and records of enforcement actions taken to correct violations of this ordinance;

P. Enforcing the provisions of this ordinance, investigating violations, issuing notices of violations or stop work orders, and requiring permit holders to take corrective action;

Q. Advising the city council regarding the intent of this ordinance and, for each application for a variance, preparing a staff report and recommendation; and

R. Administering the requirements related to proposed work on existing buildings:

1. Making determinations as to whether buildings and structures that are located in flood hazard areas and that are damaged by any cause have been substantially damaged; and

2. Making reasonable efforts to notify owners of substantially damaged structures of the need to obtain a permit to repair, rehabilitate, or reconstruct, and prohibit the non-compliant repair of substantially damaged buildings except for temporary emergency protective measures necessary to secure a property or stabilize a building or structure to prevent additional damage.

S. Undertaking, as determined appropriate by the floodplain administrator due to the circumstances, other actions that may include but are not limited to: issuing press releases, public service announcements, and other public information materials related to permit requests and repair of damaged structures; coordinating with other federal, state, and local agencies to assist with substantial damage determinations; providing owners of damaged structures information related to the proper repair of damaged structures in SFHAs; and assisting property owners with documentation necessary to file claims for increased cost of compliance coverage under National Flood Insurance Program (NFIP) flood insurance policies; and

T. It is the duty of the city floodplain administrator to take into account flood, mudslide, and flood-related erosion hazards, to the extent that they are known, in all official actions relating to land management and use throughout the entire jurisdictional area of the city, whether or not those

hazards have been specifically delineated geographically (e.g., via mapping or surveying).

~~Sec. 2.3. Duties and responsibilities of the department of planning.~~ Reserved.

~~The duties and responsibilities of the department of planning shall include but are not limited to:~~

~~A. Reviewing applications for permits to determine whether proposed activities will be located in the SFHA;~~

~~B. Reviewing applications to determine whether proposed activities will be reasonably safe from flooding and requiring new construction and substantial improvements to meet the requirements of this ordinance;~~

~~C. Reviewing applications to determine whether all necessary permits have been obtained from the federal, state, or local agencies from which prior or concurrent approval is required; in particular, permits from state agencies for any construction, reconstruction, repair, or alteration of a dam, reservoir, or waterway obstruction (including bridges, culverts, structures), any alteration of a watercourse, or any change of the course, current, or cross section of a stream or body of water, including any change to the SFHAs of free-flowing non-tidal waters of the state;~~

~~D. Approving applications and issuing permits to develop in flood hazard areas if the provisions of this ordinance have been met, or disapproving applications if the provisions of this ordinance have not been met;~~

~~E. Granting administrative variances pursuant to section 6.1 of this ordinance;~~

~~F. Inspecting, or causing to be inspected, buildings, structures, and other development for which permits have been issued to determine compliance with this ordinance or to determine if non-compliance has occurred or violations have been committed;~~

~~G. Reviewing elevation certificates and requiring incomplete or deficient certificates to be corrected;~~

~~H. Maintaining and permanently keeping documentation supporting the issuance and denial of permits, elevation certificates, documentation of the elevation (in relation to the datum on the FIRM) to which structures have been flood proofed, and other required design certifications, variances, and records of enforcement actions taken to correct violations of this ordinance;~~

~~I. Enforcing the provisions of this ordinance, investigating violations, issuing notices of violations or stop work orders, and requiring permit holders to take corrective action;~~

~~J. Advising the city council regarding the intent of this ordinance and, for each application for a variance, preparing a staff report and recommendation; and~~

~~K. Administering the requirements related to proposed work on existing buildings:~~

~~1. Making determinations as to whether buildings and structures that are located in flood hazard areas and that are damaged by any cause have been substantially damaged; and~~
~~2. Making reasonable efforts to notify owners of substantially damaged structures of the need to obtain a permit to repair, rehabilitate, or reconstruct, and prohibit the non-compliant repair of substantially damaged buildings except for temporary emergency protective measures necessary to secure a property or stabilize a building or structure to prevent additional damage.~~

~~Sec. 2.4. Shared duties and responsibilities.~~ Reserved.

~~The duties and responsibilities shared by the departments of public works and Planning shall include but are not limited to:~~

~~A. Undertaking, as determined appropriate by the floodplain administrator due to the circumstances, other actions that may include but are not limited to: issuing press releases, public service announcements, and other public information materials related to permit requests and repair of damaged structures; coordinating with other federal, state, and local agencies to assist with substantial damage determinations; providing owners of damaged structures information related to the proper repair of damaged structures in SFHAs; and assisting property owners with documentation necessary to file claims for increased cost of compliance coverage under National Flood Insurance Program (NFIP) flood insurance policies; and~~

~~B. It is the duty of the city floodplain administrator to take into account flood, mudslide, and flood-related erosion hazards, to the extent that they are known, in all official actions relating to land management and use throughout the entire jurisdictional area of the city, whether or not those hazards have been specifically delineated geographically (e.g., via mapping or surveying).~~

. . . .

Sec. 2.8. Interpretation of district boundaries.

Initial interpretations of the boundaries of the floodplain districts shall be made by the floodplain administrator. Should a dispute arise concerning the boundaries of any of the districts~~, the city council shall make the necessary determination. The person questioning or contesting the location of the district boundary shall be given a reasonable opportunity to present his case to the city council and to submit his own technical evidence if he so desires~~ a surveyor shall provide either an elevation certificate or recent survey showing topographic elevations and delineating the Special Flood Hazard Area.

. . . .

Sec. 2.11. Appeals to decisions made by the floodplain administrator.

It is further provided that any decision of the floodplain administrator or his designee may be modified, reversed, or affirmed by the city council upon appeal by any aggrieved party to such decision, if such appeal is filed with the floodplain administrator within thirty (30) days of such decision through the application for a Floodplain Variance outlined in Section VI of this ordinance.

ARTICLE III. ESTABLISHMENT OF FLOODPLAIN DISTRICTS

Sec. 3.1. Description of floodplain districts.

A. Special flood hazard areas (SFHA). The SFHAs shall include land in the floodplain subject to a one (1) percent or greater chance of being flooded in any given year. The basis for the delineation of these districts shall be the FIS and the FIRM for the City of Virginia Beach prepared by FEMA, Federal Insurance Administration, dated January 16, 2015, and any subsequent revisions or amendments thereto.

The boundaries of the SFHAs are established as shown on the FIRM, which is declared to be a part of this ordinance and shall be kept on file at the City of Virginia Beach Department of ~~Public Works~~ Planning and Community Development, and include the following districts:

1. The Floodway District is in an AE Zone and is delineated, for the purposes of this ordinance, using the criterion that certain areas within the floodplain must be capable of carrying the waters of the one (1) percent annual chance flood without increasing the water surface elevation of that flood more than one (1) foot at any point. The areas included in this district are specifically defined in Table 7 of the above-referenced FIS and shown on the accompanying FIRM.

2. The AE or AH Zones on the FIRM accompanying the FIS shall be those areas for which one (1) percent annual chance flood elevations have been provided and the floodway has not been delineated.

3. The A Zone on the FIRM accompanying the FIS shall be those areas for which no detailed flood profiles or elevations are provided, but the one (1) percent annual chance floodplain boundary has been approximated.

4. The AO Zone on the FIRM accompanying the FIS shall be those areas of shallow flooding identified as AO on the FIRM.

5. ~~Reserved.~~ The Coastal A Zone on the FIRM accompanying the FIS shall be those areas labeled as AE and are located seaward of the limit of moderate wave action (LiMWA) line.

6. The VE or V Zones on FIRMs accompanying the FIS shall be those areas that are known as coastal high hazard areas, extending from offshore to the inland limit of a primary frontal dune along an open coast and any other area subject to high velocity wave action from storm or seismic sources.

B. ~~Floodplain subject to special restrictions~~ *Local Flood Hazard Areas*. The City of Virginia Beach may identify and regulate local flood hazard or ponding areas that are not delineated on the FIRM. These areas are ~~identified in section 4.10 and may be delineated on a map using best available topographic data and locally derived information such as flood of record, historic high water marks, or approximate study methodologies~~ identified as follows:~~.~~

a. *Other areas of flood risk*. The X and the X(Shaded) Zone on the FIRM where the City of Virginia Beach Stormwater Master Plan has identified areas, outside SFHAs delineated on the FIRM, that area susceptible to flooding. The most recent updated version of the modeling shall be used to identify areas that are likely to experience flooding.

b. *Floodplain Subject to Special Restrictions*. The Floodplain Subject to Special Restrictions is identified in section 4.10 and includes areas in the southern part of the city which are characterized by wind tides, low topography, and poorly draining soils.

ARTICLE IV. FLOODPLAIN DISTRICT PROVISIONS

Sec. 4.1. Permit and application requirements.

. . . .

B. Site plans and permit applications. All applications for development within any floodplain district and all building permits issued within ~~the~~ any floodplain district shall incorporate the following information:

1. For any addition, conversion of any non-habitable space to habitable space, or the construction or installation of a new accessory structure that requires a building permit.

   a. A physical survey, performed after the effective date of the FIRM that:

      i. accurately depicts current improvements on the property;
      ii. provides a flood zone determination and BFE or flood depth at the stie; and
      iii. delineates the location of the flood zones on the property.

   b. For structures located in the SFHA delineated on the FIRM, a current elevation certificate sealed by a licensed design professional.

2. For new construction and any substantial improvement of the principal structure:

   a. a proposed site plan sealed by a registered design professional that provides:

      ~~1~~i. The elevation of the base flood at the site;

      ~~2~~ii. The elevation of the lowest floor (including basement) or, in V Zones, the lowest horizontal structural member;

      ~~3~~iii. For structures to be flood-proofed (non-residential only), the elevation to which the structure will be flood-proofed; and

      4iv. Topographic information showing existing and proposed ground elevations.

Sec. 4.2. General standards.

. . . .

5. Electrical, heating, ventilation, plumbing, air conditioning equipment, and other service facilities, including duct work, shall be designed and/or ~~located so as to prevent water from entering or accumulating within the components during conditions of flooding~~ or above the design flood elevation.

6. New and replacement water supply systems shall be designed to minimize or eliminate infiltration of flood waters into the system.

7. New and replacement sanitary sewage systems shall be designed to minimize or eliminate infiltration of flood waters into the systems and discharges from the systems into flood waters.

8. On-site waste disposal systems shall be located and constructed to avoid impairment to them or contamination from them during flooding.

9. No use shall be permitted if such use will increase the amounts of potentially damaging materials, including those likely to be injurious to health, that might be transported in floods.

10. For properties located in SFHAs delineated on the FIRM, an elevation certificate and, if applicable, a flood-proofing certificate shall be provided to the Floodplain Administrator prior to any foundation inspection, final inspections, and the issuance of any certificates of occupancy, in order to assure compliance with these floodplain regulations.

11. Prior to any proposed alteration or relocation of any channels or of any watercourse or stream within the city, a permit shall be obtained from the USACE, VADEQ, the Virginia Marine Resources Commission, and the Wetlands Board through the joint permit application process. Furthermore, notification of the proposal shall be given by the applicant to all affected adjacent jurisdictions, the department of conservation and recreation (division of dam safety and floodplain management), other required agencies, and FEMA.

12. The flood carrying capacity within an altered or relocated portion of any watercourse shall be maintained.

~~B. In all SFHAs, the following additional provisions shall apply:~~

~~1. Prior to any proposed alteration or relocation of any channels or of any watercourse or stream, within the city a permit shall be obtained from the USACE, VADEQ, the Virginia Marine Resources Commission, and the Wetlands Board through the joint permit application process. Furthermore, notification of the proposal shall be given by the applicant to all affected adjacent jurisdictions, the department of conservation and recreation (division of dam safety and floodplain management), other required agencies, and FEMA.~~

~~2. The flood carrying capacity within an altered or relocated portion of any watercourse shall be maintained.~~

~~3. Sand dunes, barrier beaches, and other natural protective barriers shall remain intact to provide protection against wind, waves, and erosion drainage. Any person who desires to use or alter any coastal primary sand dune, other than for the purpose of conducting the activities specified in section 1602 of the Zoning Ordinance of the City of Virginia Beach, shall first obtain a permit from the USACE, VADEQ, the Virginia Marine Resources Commission, and the Wetlands Board through the joint permit application process.~~

Sec. 4.3. Elevation and construction requirements.

In all ~~SFHAs where base flood elevations have been provided in the FIS or generated by a licensed professional in accordance with section 4.6 of this ordinance~~ floodplain districts, with the exception of Coastal A and Coastal High Hazard (VE) zones, the following provisions shall apply:

A. Residential construction requirements. ~~New construction or substantial improvement of any residential structure or manufactured home in Zones AE, AH, and A with detailed base flood elevations shall have the lowest floor, including basement, elevated to a minimum of two (2) feet above the base flood level.~~ The lowest flood, including basement, shall be set to the higher of the following:

i. A minimum of two (2) feet above the base flood elevation established on the most recent FIRM or by the most recent FIS or,

ii. A minimum of one (1) foot above the 100-year HGL elevation measured at the nearest existing or proposed public drainage structure or BMP, in the City Stormwater Master Plan.

B. Non-residential construction requirements. New construction or substantial improvement of any commercial, industrial, or non-residential building or manufactured home shall have the lowest floor, including basement, elevated as ~~minimum of two (2) feet above the base flood level~~ established in Section 4.3 A of this ordinance. Buildings ~~located in AE or AH Zones~~ may be flood-proofed in lieu of being elevated provided that all areas of the building components below the ~~elevation corresponding to the base flood elevation plus a minimum of two (2) feet freeboard~~ design flood elevation are watertight with walls substantially impermeable to the passage of water, and use structural components having the capability of resisting hydrostatic and hydrodynamic loads and the effect of buoyancy. A professional engineer or architect licensed by the Commonwealth of Virginia shall certify that the standards of this subsection are satisfied. Such certification, including the specific elevation (in relation to NAVD88) to which such structures are flood proofed, shall be maintained by the building official.

C. ~~Space below the lowest floor requirements. In Zones A, AE, AH, and AO, f~~Fully enclosed areas of new construction or substantially improved existing structures that are below the ~~regulatory~~ design flood protection elevation shall:

1. Not be designed or used for human habitation, but shall only be used for parking of vehicles, building access, or limited storage of maintenance equipment used in connection with the premises. Access to the enclosed area shall be the minimum necessary to allow for parking of vehicles (garage door), limited storage of maintenance equipment (standard exterior door), or entry to the living area (stairway or elevator).

2. Be constructed entirely of flood resistant materials below the ~~regulatory~~ design flood ~~protection~~ elevation.

3. Space below the lowest floor of SFHAs delineated on the FIRM shall ~~I~~include measures to automatically equalize hydrostatic flood forces on walls by allowing for the entry and exit of floodwaters. To meet this requirement, the openings shall either be certified by a professional engineer or architect licensed by the Commonwealth of Virginia or meet or exceed the following minimum design criteria:

. . . .

Sec. 4.4. Floodway requirements.

. . . .

B. The placement of new or replacement manufactured homes (mobile homes) is prohibited.

~~C. The following uses and structures may be permitted in the floodway district, subject to the requirements of articles III, IV, V, and VI of this ordinance:~~

~~1. Public and private outdoor recreational facilities;~~

~~2. Agricultural uses, including farming, grazing, and the raising of poultry or livestock; provided, that poultry or livestock shall not be housed within five hundred (500) feet of any residential, apartment, or hotel district;~~

~~3. Open uses, such as public and private roadways, off street parking, or loading and unloading areas related to uses in adjoining districts;~~

4. ~~Commercial mining, soil removal, and sand pits subject to regulations applicable to extractive industries as set forth in the conditional use provisions of the Zoning Ordinance of the City of Virginia Beach;~~

5. ~~Public improvements, such as dams, levees and channel improvements, and utilities installations and substations, including temporary storage of materials, except flammable, toxic or noxious materials, and temporary location of maintenance installations; and~~

6. ~~Uses and structures customarily accessory and clearly incidental and subordinate to uses listed above, including in connection with agricultural uses; roadside stands for the sale of agricultural products produced on the premises; provided that:~~

   a. ~~Only one (1) such stand shall be permitted per lot;~~

   b. ~~No such stand shall exceed five hundred (500) square feet in floor area; and~~

   c. ~~No such stand on the street frontage shall be erected within twenty (20) feet of the property line.~~

. . . .

Sec. 4.6. A Zone requirements.

. . . .

B. The floodplain administrator reserves the right to require a hydrologic and hydraulic analysis for any development and to determine the base flood elevation. When such base flood elevation data is utilized, the lowest floor shall be elevated to minimum of two (2) feet above the base flood level. During the permitting process, the floodplain administrator shall obtain:

   1. The elevation of the lowest floor (including the basement) of all new and substantially improved structures; and

   2. If the structure has been flood-proofed in accordance with the requirements of this ordinance, the elevation (in relation to NAVD88) to which the structure has been flood-proofed.

C. ~~When the data is not available from any source, the lowest floor of the structure shall be elevated to not less than two (2) feet above the highest adjacent grade.~~

Sec. 4.8. ~~Reserved~~ X and X(Shaded) Zone requirements. (Other Areas of Flood Risk).

A. *Residential construction requirements*. The lowest floor, including basements, shall be set to a minimum of one (1) foot above the 100-year HGL elevation measured at the nearest existing or proposed public drainage structure or BMP, in the City Stormwater Master Plan.

B. *Non-residential construction requirements*. New construction or substantial improvement of any commercial, industrial, or non-residential building or manufactured home shall have the lowest floor, including basement, elevated as established in Section 4.8 A of this ordinance above. Buildings may be flood-proofed in lieu of being elevated provided that all areas of the building components below the design flood elevation are watertight with walls substantially impermeable to the passage of water, and use structural components having the capability of resisting hydrostatic and hydrodynamic loads and the effect of buoyancy. A professional engineer or architect licensed by the Commonwealth of Virginia shall certify that the standards of this subsection area satisfied. Such certification, including the specific elevation (in relation to NAVD88) to which such structures are flood proofed, shall be maintained by the building official.

Sec. 4.9. – Coastal High Hazard (~~V and~~ VE Zone) requirements.

The following provisions shall apply within ~~V and VE Zones~~ Coastal A Zones and Coastal High Hazard Areas:

A. All new construction and substantial improvements, including to manufactured homes, shall be elevated on pilings or columns so that:

1. The bottom of the lowest horizontal structural member of the lowest floor (excluding the pilings or columns) is elevated to a minimum of ~~two~~ three (~~2~~3) feet above the base flood ~~level~~ elevation; and

2. The pile or column foundation and structure attached thereto is anchored to resist flotation, collapse, and lateral movement due to the effects of wind and water loads acting simultaneously on all building components. Wind and water loading values shall each have a one (1) percent chance of being equaled or exceeded in any given year.

B. A professional engineer or architect licensed by the Commonwealth of Virginia shall develop or review the structural design, specifications, and plans for the construction and shall certify that the design and methods of construction to be used are in accordance with accepted standards of practice for meeting the provisions of article IV, section 4.6 A. A V Zone

Design Certificate shall be submitted to Permits and Inspections with plans for a building permit.

. . . .

I. ~~The man-made alteration of sand dunes, which would increase potential flood damage, is prohibited.~~ Sand dunes, barrier beaches, and other natural protective barriers shall remain intact to provide protection against wind, waves, and erosion drainage. Any person who desires to use or alter any coastal primary sand dune or beaches, other than for the purpose of conducting the activities specified in Article 1600, Section 1602 of the Zoning Ordinance of the City of Virginia Beach, shall first obtain a permit, or authorization, from the USACE, VADEQ, the Virginia Marine Resources Commission, and the Wetlands Board through the joint permit application process.

J. Manufactured homes are prohibited.

Sec. 4.10. Floodplain subject to special restrictions.

A. All ~~FIRM delineated~~ SFHAs that ultimately drain to Back Bay or the Currituck Sound ~~located in the following areas~~ shall be identified as a floodplain subject to special restrictions~~:~~.

~~1. North Landing River and its tributaries south of Lynnhaven Parkway;~~

~~2. West Neck Creek and its tributaries south of Shipps Corner Road, London Bridge Road, and the portion of Dam Neck Road east of its intersection with London Bridge Road; and~~

~~3. Bays, creeks, lakes, guts, coves, wetlands, marshes and swamps and their tributaries comprising the Back Bay and Small Coastal South watersheds south of South Birdneck Road and east of Princess Anne Road and General Booth Boulevard.~~

B. The following provisions shall apply within the floodplain subject to special restrictions:

1. Notwithstanding any provision of this ordinance to the contrary, no filling shall be permitted, including filling with material excavated from the same floodplain except for:

a. The purpose of public roadway or other similar public works construction undertaken by the Department of Public Works or Virginia Department of Transportation, or their agent for

construction. This construction includes flood protection and flood mitigation projects;

b. The maintenance, alteration, or relocation of bona fide agricultural ditches, swales, or agricultural pathways or those ditches required for proper lot drainage;

c. For shoreline stabilization or maintenance projects, such as riprap revetment, bulkheads, or other treatment used to stabilize and protect the banks of waterways, the city manager or his designee may approve the placement of fill provided the following criteria are met:

i. A joint permit application is submitted;

ii. The alignment of the stabilization structure is along the escarpment or in line with adjacent stabilization structures; ~~and~~

iii. If there is an existing shoreline stabilization structure, any proposed replacement structure shall be no more than six (6) inches higher than the existing structure; and

~~iii~~iv. Fill must be the minimum necessary to support the stabilization project.

2. The city manager, or his designee, may approve the placement of fill provided that the following criteria are met:

a. Proposed fill within the floodplain:

i. Shall be mitigated to result in no decrease in flood storage volume on the site;

ii. Shall be mitigated entirely on the same site that will incur the fill;

iii. Shall be contiguous to the existing floodplain that is being filled; and

iv. Shall be limited to the smallest amount of area and volume possible to correct irregularities within the boundary of the project.

b. The combined areas of fill and mitigation shall not exceed five (5) percent of the total area within the floodplain located on the site that will incur the fill.

3. Residential dwelling structures shall not be located within the floodplains subject to special restrictions on lots created after October 23, 2001. Residential dwelling structures located in ~~local flood hazard areas as of~~ a SFHA and constructed prior to October 23, 2001 may be expanded with attached additions to a total footprint of less than one thousand (1,000) square feet; such additions shall also comply with the requirements set forth in article V of this ordinance.

. . . .

ARTICLE V. EXISTING STRUCTURES IN FLOODPLAIN AREAS

Sec. 5.1. Existing structures.

A structure or use of a structure or premises that lawfully existed prior to the adoption of this ordinance, but which is not in conformity with this ordinance, may be continued subject to the following conditions:

A. Any existing structures in the floodway area shall not be expanded or enlarged unless it has been demonstrated through hydrologic and hydraulic analyses performed in accordance with standard engineering practices that the proposed expansion or enlargement would not result in any increase in the base flood elevation.

B. Any modification, alteration, repair, reconstruction, or improvement of any kind to a structure and/or use located in any floodplain ~~areas~~ district to an extent or amount of less than fifty (50) percent of its market value shall conform to the VA USBC and meet the freeboard height in effect at the start of construction for the original structure.

C. Any modification, alteration, repair, reconstruction, or improvement of any kind to a structure and/or use, in any floodplain ~~area~~ district to an extent or amount of fifty (50) percent or more of its market value shall be undertaken only in full compliance with this ordinance and shall require the entire structure to conform to the VA USBC.

ARTICLE VI. VARIANCES AND APPEALS

Sec. 6.1. Administrative variances.

The floodplain administrator shall approve or deny an application requesting an administrative variance after receipt of a complete application. Administrative variances may only be granted for the following uses, development, or redevelopment:

A. As defined in section 4.10, floodplains subject to special restrictions, for filling only.

B. Any structure or use sustaining damage not caused by flood to an extent or amount of fifty (50) percent or more of its market value to allow the structure to be rebuilt to the freeboard height in effect at the start of construction for the original structure. If the structure is a pre-FIRM structure, full compliance with the current VAUSBC freeboard above the base flood elevation is required. Structures that are utilizing an approved land management plan for their on-site waste disposal may be allowed to continue the use of the land management plan as long as it is approved by the city and the health department, even for damage or destruction resulting from flood.

C. As defined in section 4.8 B, X and X(Shaded) Zone requirements. (Other Areas of Flood Risk), and 4.3 A(ii) when the required finished floor is higher than the BFE plus two feet of freeboard, where the floodplain administrator, in consultation with the Development Services Center, has determined that the proposed stormwater engineering design will approximately mitigate any impacts to the finished floor of the nonresidential development.

Sec. 6.3. Application process.

A. Applications for variances from the requirements of this ordinance shall be made to the city council and filed with the director of planning. The fee for such applications shall be ~~six hundred fifty dollars~~ seven hundred eighty ($~~650~~780.00). Such fee shall include all costs of notifications and advertising. Except in cases in which such fee is waived, the director shall not accept any application not accompanied by payment of the required fee. The procedure for the advertising, hearing and determination of applications for floodplain variances shall be in accordance with the requirements pertaining to applications for subdivision variances, as set forth in section 9.4 of the subdivision ordinance. In cases in which a variance application is filed by reason of a natural disaster that is the subject of a federal declaration of emergency, application and associated advertising fees shall be waived and such application shall be given expedited processing to the maximum practical extent.

B. All applications shall be accompanied by the following:

1. A separate map, on a 1″ = 100′ or greater scale, identifying all proposed land disturbance, including fill and mitigation areas, and the limits of the existing and proposed SFHAs, tidal and non-tidal wetlands, Southern Rivers Watershed Management Area Buffer, and CBPA Resource Protection Area Buffer; and

2. A preliminary floodplain study addressing the physical and environmental characteristics of the floodplain located on adjoining properties and in the general area. Such study shall be sufficient to show that the variance, if granted, will meet the standards defined in section 6.~~3~~4 and in addition thereto, shall:

   a. Contain supporting data and calculations required for a Preliminary Stormwater Engineering Analysis as appropriate~~, given the preliminary nature of the floodplain study~~;

   b. Comply with the Public Works Design Standards Manual; and

   c. Be certified by a professional engineer, architect, surveyor, landscape architect or practitioner of a related field having a valid license issued by the Commonwealth of Virginia or who is exempt from licensure pursuant to applicable provisions of the Virginia Code.

Adopted by the Council of the City of Virginia Beach, Virginia, on the 1st day of February, 2022.

Attachment 6: Copy of Monitoring/Maintenance Plan

Dewberry

[DRAFT] Annual Monitoring Plan and Post-Construction Monitoring Report

Marsh Restoration in Back Bay, Virginia Beach, VA

Prepared by: Dewberry Engineers, Inc.

[July 6, 2023]

[REPORT VERSION [DRAFT]]

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INTRODUCTION

This project is intended to implement one of the nature-based projects proposed in Virginia Beach's "Sea Level Wise" (SLW) Adaptation Strategy[1] adopted by the Virginia Beach City Council in June 2020. The SLW Adaptation Strategy presents a holistic framework for addressing flood risks across the City, consisting of four general strategies – natural mitigations, engineered defenses, adapted structures, and prepared communities. These strategies were applied to each major watershed in the City and tailored to their unique characteristics and risk profiles. The adaptation vision for the Lower Southern Rivers Drainage Basin, where the proposed project is located, focuses on employing natural mitigation methodologies to strategically reduce flow into and within Back Bay, along with an integrated system of defense structures and complementary adaptation measures, such as land-use strategies, to improve flood storage and overall coastal resiliency. The Bonney Cove area of Back Bay, where the project site is proposed, is particularly suitable for the use of nature-based strategies given the low elevations of marshlands and documented historic degradation of habitat. Participants at the 'near-neighbor' public engagement meetings held during the SLW Adaptation Strategy development were supportive of these types of strategies.

The City has several dedicated Capital Improvement Program (CIP) initiatives for the Lower Southern Rivers Drainage Basin for implementation of these strategies. The City's Stormwater Green Infrastructure CIP has obligated approximately $421,700 in contracts to support field investigations, environmental assessments, and engineering designs of the project – a true indication of the City's commitment to nature-based approaches and the critical first step in a broader effort. During the General Election on November 2, 2021, Virginia Beach residents voted to authorize $567.5 million dollars in debt to fund the design and construction of 21 Phase 1 projects in the citywide Flood Protection Program. [2] The Back Bay Marsh Terrace project is included under the Stormwater Green Infrastructure Master Project.[3] Other Southern Watershed projects that received funding under the Flood Protection Program include the West Neck Creek Bridge City-Wide Sea Level Rise Strategy, the Pungo Ferry Road Improvements, and the Sandbridge/New Bridge Intersection Improvements projects.

Outside of this project, the Virginia Beach City Council has recently funded a $5.2 million dollar voluntary acquisition program to encourage flood-prone properties to apply for a buyout to enable the City to convert parcels to open space to serve as flood storage and a marsh migration buffer. The City's

[1] City of Virginia Beach Sea Level Wise Adaptation Strategy webpage: https://www.vbgov.com/government/departments/public-works/comp-sea-level-rise/Pages/default.aspx

[2] City of Virginia Beach Flood Protection Program webpage: https://www.vbgov.com/government/departments/public-works/flood-protection-program/Pages/Flood-Protection-Program.aspx.

[3] Stormwater Green Infrastructure Page: https://www.vbgov.com/government/departments/public-works/flood-protection-program/Pages/Stormwater-Green-Infrastructure-.aspx

Stormwater Green Infrastructure CIP is also supporting the implementation of other natural and nature-based projects across the City, including a wetland and floodplain restoration project along the Eastern Branch of the Elizabeth River.

An assessment of restoration opportunities in the City's Lower Southern Rivers Drainage Basin with dual flood reduction and habitat restoration benefits identified the Bonney Cove area as a potential project site for several reasons. The Bonney Cove site has experienced significant historical ecological degradation. Historical shoreline data from 1869 indicates approximately 50% of present-day open water in Bonney Cove (260 acres) was previously marsh (Figure 1). Loss of the marsh island habitat within Bonney Cove has resulted in the opening of a secondary channel allowing increased flow exchange between the upper and lower bays. In comparison to shore-adjacent restoration, off-shore marsh restoration leveraging hydraulic modeling identified Bonney Cove as a location where marsh restoration has the potential to reduce the propagation of floodwaters through key pathways within Back Bay. The United States Fish and Wildlife Service (USFWS) and the Virginia Department of Wildlife Resources (VDWR) also identified Bonney Cove as a restoration priority as this area serves as an ideal location for Submerged Aquatic Vegetation (SAV) reestablishment and vital habitat for migratory birds and fish.

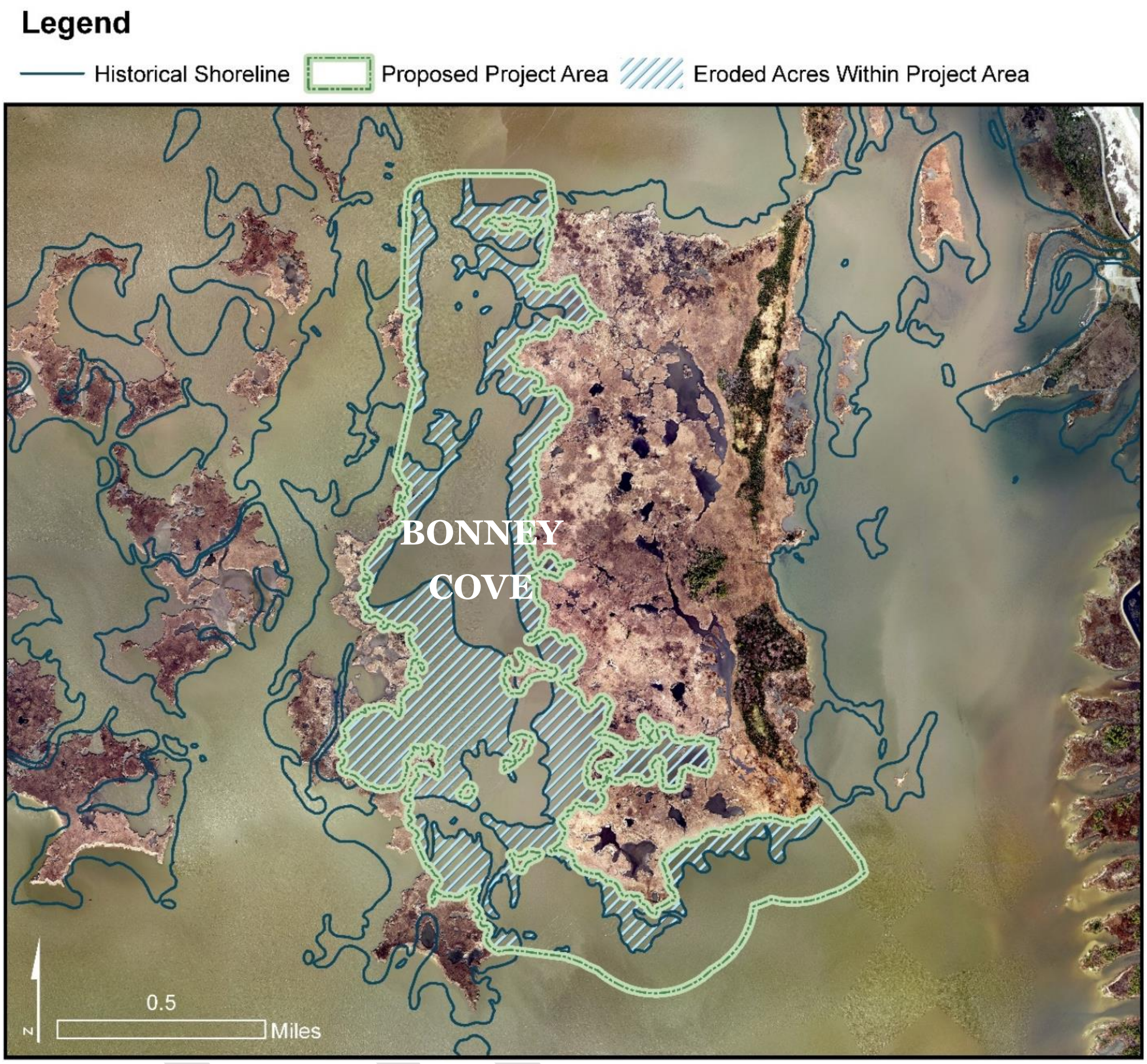

Figure 1: Historical marsh erosion within the project area.

The project is situated within the Bonney Cove area of Back Bay, spanning the western and southern lengths of Long Island, as shown in Figure 1.

Project Background

Marsh island restoration through terracing was identified as a particularly viable solution given Back Bay's shallow bottom and the historical loss of habitat. The marsh terraces are narrow man-made islands that will be arranged across areas that were historically marsh but are now shallow open water. A series of these islands, or terraces, are typically arranged in a chevron pattern. The overall field of terraces dissipates waves and slows down water moving through the area. In turn, the calmer water allows more sunlight to penetrate to the shallow bottom, promoting establishment and growth of marsh

and SAV habitats.   Further, as opposed to one continuous marsh platform, marsh terraces maximize habitat for a variety of fish and wildlife species.

The Preferred Alternative includes the creation of 41 individual marsh terraces totaling approximately 25,000 linear feet (or an approximately 47-acre footprint) across Bonney Cove. These 47 acres of terraces are comprised of approximately 13 acres of emergent (low and high marsh) vegetated habitat, 14 acres of upland vegetated habitat, and 16 acres of submerged terrace habitat. Approximately 310 acres of suitable SAV habitat will remain in between the terraces.

Terrace Construction and Orientation

Terrace construction will begin in the northern extent of the project site, and the contractor will work towards the southern extent of the site. The contractor will complete each terrace, including installing plants, before moving to the next. Marsh terrace construction will occur over two years (2025 to 2026) and will pause annually between October 31st and March 1st to limit disturbance to wintering waterfowl and migration, in accommodation of BBNWR’s requirement. Approximately 20 terraces will be constructed in 2025 ("Phase 1"), and 21 terraces will be constructed in 2026 ("Phase 2"). The following sections summarize the proposed design and construction approach.

Terraces will be generally oriented perpendicular to the predominant wind direction (south-southwest) to maximize wave energy reduction. The terraces will be segmented in a chevron (duck-wing) pattern to create the most favorable fish and swimming crustacean (termed "nekton") habitat, facilitate adequate circulation, and maintain navigability throughout the project area. The terraces will not be connected to the adjacent marsh to maintain a physical open water barrier to deter the invasion of Common Reed (*Phragmites australis*) stands.

The terraces will be spaced at approximately 300-foot intervals in the northern and southern quarters and span 15 feet in width, and at least 600-foot intervals in the center and span 30 feet in width. This arrangement will lessen the amount of open water and subsequent wave action at the northern and southern ends of the site and provide space for marine-based construction equipment. The design team reviewed the final spacing layout of the terraces to ensure navigability of a watercraft through the project site which will be required for post-construction monitoring, any needed maintenance, as well as community recreational access.

The terraces would consist of a sand filled core encapsulated by a high-strength blend of woven and non-woven geotextile fabrics (“geobags”). The sand for this material would need to come from offsite sources. Back Bay is too shallow to accommodate conventional barges for material placement. To avoid extensive impacts to the bottom of the bay, the slurry basin will pump sand for the project from the proposed Shipps Cabin Road staging area to Bonney Cove. The slurry pipeline will consist of approximately 10,424 linear feet of 12” diameter HDPE fused/welded pipeline that will be assembled on land and floated into its proposed alignment within Back Bay. The pipe would be marked by floats

every 5 feet and temporary signage as reasonable. It is anticipated the pipeline will be submerged to the bottom of the bay at channel crossings and adjacent to a duck hunting cabin adjacent to the alignment. By establishing a floating pipeline, it will limit disturbances to the subaqueous bottomlands along the alignment and allow for the retraction of the pipeline during the winter inactive periods and inclement weather events. Booster stations would be placed approximately every mile. These booster stations would consist of a pontoon mounted diesel engine pump capable of moving the sand slurry from the laydown area to the site. Given the distance to the site, four or five of these booster stations are anticipated to be necessary to create the sand cores of the terrace. It is estimated that 450 Gallons Per Minute (GPM) of sand slurry would be pumped through the pipe.

Once the cores are in place, long reach excavators would travel along the tops of the terraces and begin to shape the cross slopes. Appropriate materials for establishing vegetation atop the terraces will be primarily sourced from materials dredged during the Sandbridge Road Nimmo Parkway Phase VII-A project located immediately north of Back Bay (VMRC 15-1564, USACE IP NAO-2015-00151). Materials will be tested and screened to remove organics prior to application to the terraces. As needed, dredging sites adjacent to the proposed terrace locations that are confirmed to be devoid of SAV will be utilized to provide supplemental soil materials to top the proposed terraces[4]. It was determined that the in-situ bay sediment would be suitable for vegetation growth. The marsh terraces would be covered with 1 to 3 feet of suitable fill, depending on crest widths. Jute netting will cover the topsoil to control erosion and promote vegetation establishment. Coir logs will be places along the terrace slope controls to further promote vegetation establishment along the slope.

SAV Plantings

The City has partnered with Virginia Polytechnic Institute and State University ("Virginia Tech") to evaluate opportunities for restoring populations of native Wild Celery (*Vallisneria americana*) in Back Bay. The Virginia Tech research team has developed an innovative technique to grow Wild Celery in an aquaculture center that results in larger, mature plants that can better withstand Back Bay's turbidity. Once transplanted, plants are surrounded by cages to prevent predation. These founder colonies can be used for propagation throughout Back Bay. After terrace construction, the City will transplant Wild Celery in an area adjacent to the site. This founder colony will be used to strategically transplant Wild Celery in between the terraces for 5 years after construction (2026 – 2029) with the ultimate goal of establishing 10 acres of SAV vegetation in between the marsh terraces.

[4] The 60% preliminary design showed preliminary siting of these dredge areas based on avoidance of existing SAV habitat; however, pre-construction surveys of SAV would be required to re-delineate these dredging areas.

Terrace Plantings – Upland and Marsh Vegetation

The terraces' intertidal perimeter will be planted with appropriate emergent estuarine plant species (e.g., Saltmarsh Cordgrass [*Spartina alterniflora*] and Salt Meadow Hay [*Spartina patens*]) and brackish plant species (e.g., Big Cordgrass [*Spartina cynosuroides*]). These plants will be installed as soon as possible after construction to stabilize planting areas and protect the terrace from erosion. In addition to emergent grass, woody growth (i.e., shrubs and trees) within the terrace crest will be incorporated to protect the terraces' surfaces from rain and wind erosion and hold the landform together through substantial root systems.

Appropriate native species were identified based on the review of the reference marshes surrounding the project site and a review of water levels in Back Bay. Since the Bay's water levels are not affected by lunar tides and instead by wind-driven fluctuations, the project team evaluated average water elevations at the U.S. Geological Survey (USGS) Beggars Bridge Creek Gauge (Gauge ID 0204300267) from 2016 – 2021 to determine ranges of inundation to achieve functional marsh elevations throughout the project life, defined as:

- *Mean Low Water (MLW)*: the average low water at the site (10th Percentile: -0.62 ft NAVD88)
- *Mean High Water (MHW)*: the average high water at the site (95th Percentile: 1.22 ft NAVD88)
- *Mean Tide Level (MTL)*: halfway between MLW and MHW (0.3 ft NAVD88)
- *Upper Limit of Wetlands (ULW)*: approximately 1.5 times the mean tide range at the site (2.76 ft NAVD88)

These elevations were correlated to suitability for low marsh, high marsh, and upland species, as shown in Table 1.

Table 1: Proposed planting elevation zones.

Planting Zone	Definition	Elevation Range	Elevation (feet NAVD88)	Percentage of record where water reaches these elevations
Low Marsh	Marsh that is flooded frequently but exposed sometimes	MTL - MHW	0.3 – 1.2 ft	48%
High Marsh	Marsh that is generally only flooded during higher-than average water conditions	MHW – ULW	1.2 to 2.8 ft	7%
Upland Habitat	Habitat that is rarely flooded, only during extreme conditions	> ULW	> 2.8 ft	0%

Five planting schemas were identified to provide the highest possible environmental benefit in terms of erosion control, habitat diversity, and fetch reduction. The wider (30-foot) terraces will be planted with Bald Cypress (*Taxodium districhum*) trees capable of withstanding rising water levels. The full list of species and quantities is provided in the 95% design plan set.

The final engineered design component is the strategic placement of rock on the exposed perimeter terraces on the project site's north, west, and southern extents. The need for the rock armor was determined through analysis of wind data both from NOAA and ASCE-7-10 50-year return period anticipated 3-second gust values. These values were used to calculate fetch-generated waves at the project site. The calculations performed confirmed that armored protection would be required to protect the proposed terraces from the forces created by wave action. The stone sizes required for these features (Class II rip rap) were calculated following the procedures laid out in the USACE Coastal Engineering Manual (CEM) and Virginia Institute of Marine Science (VIMS) Living Shoreline Design Guidelines for Shore Protection in Virginia's Estuarine Environments. Two calculation methods, Hudson (1974) and Van Der Meer (1988), from the CEM were utilized to evaluate the range of acceptable rock armor for the exposed perimeter. These two methods calculate the armor stone size based on several design inputs including initial wave height, allowable damage level, revetment slope, and breaking versus non-breaking waves. The two methods often result in corresponding values that are used by the engineer to make an experienced determination on the final rock armor sizing. The rock armor will serve as a nature-based design element by acting as a substrate for the Wild Celery grass that has proven to be successful for SAV establishment in Back Bay (see Figure 2).

Figure 2: Example Back Bay SAV experiment; photo courtesy of Virginia Tech.

Monitoring Goals and Objectives

Annual post-construction monitoring of the site is required by the Virginia Marine Resource Commission (VMRC) (TBD) Permit (VMRC #XXXX-XXXX) and the U.S. Army Corps of Engineers (USACE) Individual Permit (NOA-20XX-XXXXX). [Insert details of the relevant permits and permit conditions]. The following goals, objectives, and metrics were established to enable consistent tracking of the primary living shoreline project components across each monitoring year.

1. **Monitoring Goal 1**: Establishment of a Sustainable Coastal Marsh Island System
   a. Objective 1a: Establish Emergent Marsh Habitat
      - Metric: For each monitoring year, the project area should maintain or increase the overall coverage of emergent marsh vegetation. There should be no significant signs of herbivory or invasive species establishment.

   b. Objective 1b: Establish Upland Habitat
      - Metric: For each monitoring year, the project area should maintain or increase the overall coverage of upland vegetation. There should be no significant signs of herbivory or invasive species establishment.
2. **Monitoring Goal 2**: Stability of Marsh Terraces
   a. Objective 2: Marsh Terrace Structures
      - Metric: For each monitoring year, the terrace structures should show no significant signs of damage, deterioration or extreme settlement.
3. **Monitoring Goal 3**: Establishment of a Sustainable SAV Community
   a. Objective 3: Establish SAV Communities

- Metric: For each monitoring year, the SAV planting areas should maintain or increase the overall coverage of SAV vegetation. There should be no significant signs of herbivory or invasive species establishment.

MONITORING PLAN

The monitoring plan includes stakeholders, a schedule for the annual monitoring inspections, the monitoring strategy/sampling plan, and approach for addressing any needs for maintenance.

Monitoring Stakeholders

An Environmental Scientist from Dewberry Engineers Inc. will perform the annual monitoring inspections and provide a copy of the monitoring report to the City of Virginia Beach, USACE, VDEQ, VMRC, and the City of Virginia Beach Wetlands Board as necessary. As owners of the project, the City of Virginia Beach will review monitoring recommendations and perform corrective actions as necessary.

Annual Inspection Schedule

Monitoring inspections should be conducted annually, during the peak growing season, which is defined by VMRC as between June and August. To enable consistent tracking of project performance from year to year, annual monitoring inspections will be conducted prior to the end of the growing season in September of each year, with annual reports to be submitted to regulatory stakeholders prior to November 30th [or an annual date defined in the permit conditions] of each year. The following outlines the monitoring inspection schedule and deliverables.

Phase 1 Post-Construction As-Built Report (Date: Prior to December 31st, 2025)

To serve as a baseline for the post-construction annual monitoring, an as-built report for the Phase 1 terraces will be completed following the construction of each phase of terraces and submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following.

- Coordinates and diagrams of established transects, as well as site photographs from photo stations 1-40 as defined in the Methods section.
- Final location of all planted vegetation (upland plantings, high marsh plantings and low marsh plantings).
- Final grade topographic surveys (plan, profile, and cross sections).
- Discussion of the project design versus as-built conditions.

Phase 2 Post-Construction As-Built Report (Date: Prior to December 31st, 2026)

To serve as a baseline for the post-construction annual monitoring, an as-built report for the Phase 2 terraces will be completed following the construction of each phase of terraces and submitted to the

City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following.

- Coordinates and diagrams of established transects, as well as site photographs from photo stations 41-80 as defined in the Methods section.
- Final location of all planted vegetation (upland plantings, high marsh plantings and low marsh plantings).
- Final location and extent of SAV plantings.
- Final grade topographic surveys (plan, profile, and cross sections).
- Discussion of the project design versus as-built conditions.

Year 1a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2026)

At the end of the first full growing season following planting of the Phase 1 terraces, a Year 1a monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 40 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 1 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion; it is anticipated that the wetland planting contractor will provide a one-year post construction maintenance and guarantee period for the wetland plantings.

Year 1b/2a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2027)

At the end of the first full growing season following planting of the Phase 2 terraces following planting, and the second full growing season of the Phase 1 terraces, a Year 1b/2a monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 1 conditions (for Phase 2 terraces) and to Year 2 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).

- Estimated percent cover and change in coverage from planted conditions to Year 1 conditions for SAV planting quadrants
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion; it is anticipated that the wetland planting contractor will provide a one-year post construction maintenance and guarantee period for the wetland plantings.

Year 2b/3a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2028)

At the end of the second full growing season of the Phase 2 terraces following planting, and the third full growing season of the Phase 1 terraces, a Year 2b/3a monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 2 conditions (for Phase 2 terraces) and to Year 3 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- Estimated percent cover and change in coverage from planted conditions to Year 2 conditions for SAV planting quadrants
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

Year 3b/4a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2029)

At the end of the third full growing season of the Phase 2 terraces following planting, and the fourth full growing season of the Phase 1 terraces, a Year 3b/4a monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 3 conditions (for Phase 2 terraces) and to Year 4 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).

- Estimated percent cover and change in coverage from planted conditions to Year 3 conditions for SAV planting quadrants
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

Year 4b/5a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2030)

At the end of the fourth full growing season of the Phase 2 terraces following planting, and the fifth full growing season of the Phase 1 terraces, a Year 4b/Final (Year 5a) monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 4 conditions (for Phase 2 terraces) and to Year 5 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- Estimated percent cover and change in coverage from planted conditions to Year 4 conditions for SAV planting quadrants
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

Year 5b Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2031)

At the end of the fifth full growing season of the Phase 2 terraces following planting, a Final (Year 5b) monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 41 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 5 conditions (for Phase 2 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- Estimated percent cover and change in coverage from planted conditions to Year 5 conditions for SAV planting quadrants

- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

Monitoring Strategy

The monitoring strategy consists of established transects with photo stations and quadrants that cover the area between transects. This approach enables monitoring of the four primary features of the living shoreline: uplands, low-marsh plantings, high-marsh plantings, and SAV*.

*Note: The planting scheme for SAV has not yet been established but it is anticipated that some SAV will be planted along the submerged portions of the marsh terraces. If more suitable planting locations are determined to be between terraces, separate transects will be established and sampled to track SAV survival apart from the proposed terrace transects.

Transects/Photo Points

A total of eighty (80) transects will be established across the project site, with 10 transects located along each of 8 terraces. Transects will span perpendicular to the length of each terrace from the ridge to the edge of the planted/vegetated area. See Figures 3 and 4 for graphic depictions of the proposed transect locations and layouts. Terraces were selected using a random stratified method to ensure representative terraces in each location within the project area (North Interior, North Exterior, South Interior, South Exterior), and of each planting scheme, were represented in the proposed monitoring plan. The selected terraces are as follows:

- North Interior: T-110, T-113
- North Exterior: T-100, T-106
- South Interior: T-124, T-131
- South Exterior: T-123, T-140

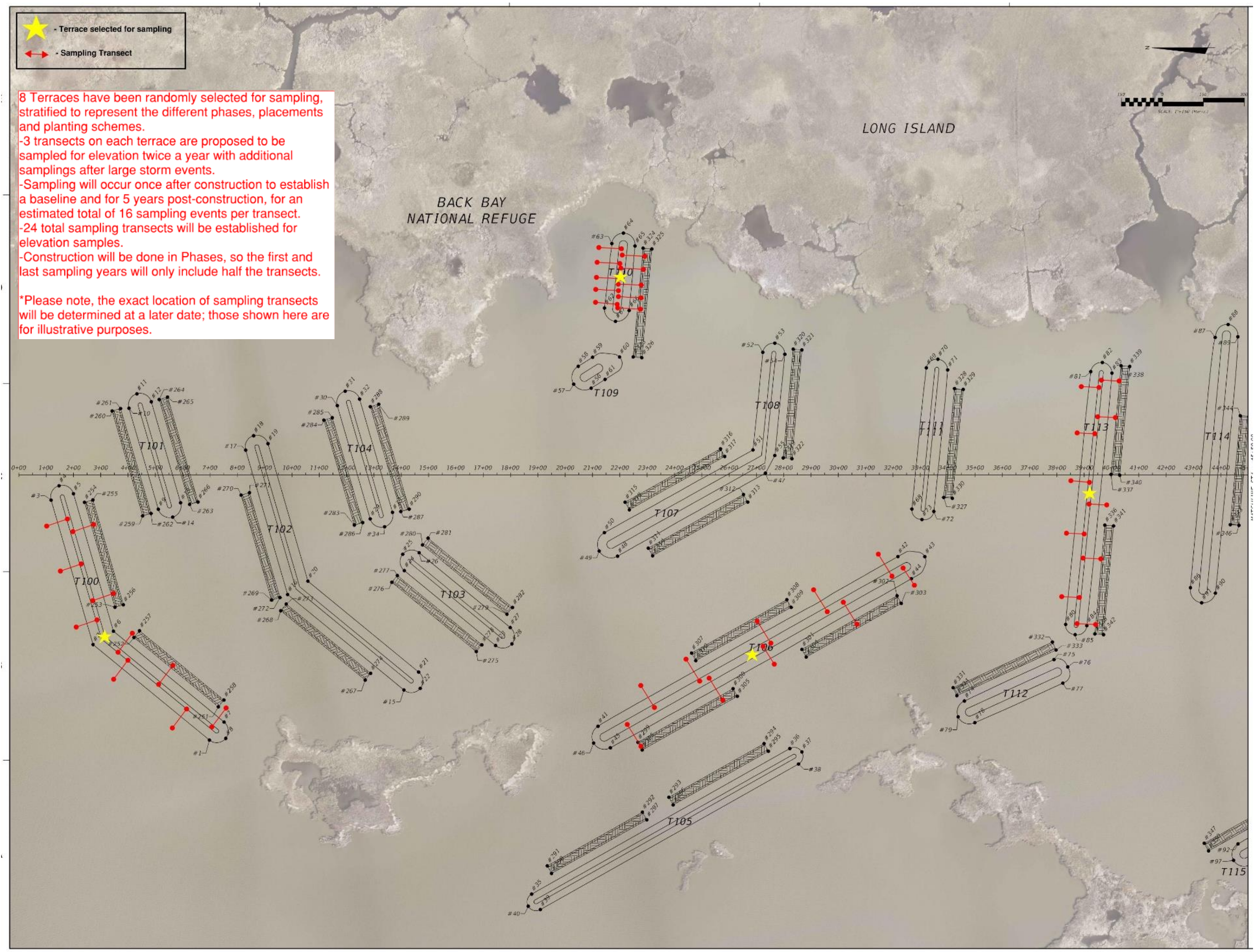

Figure 3: Monitoring design site plan – North Terraces

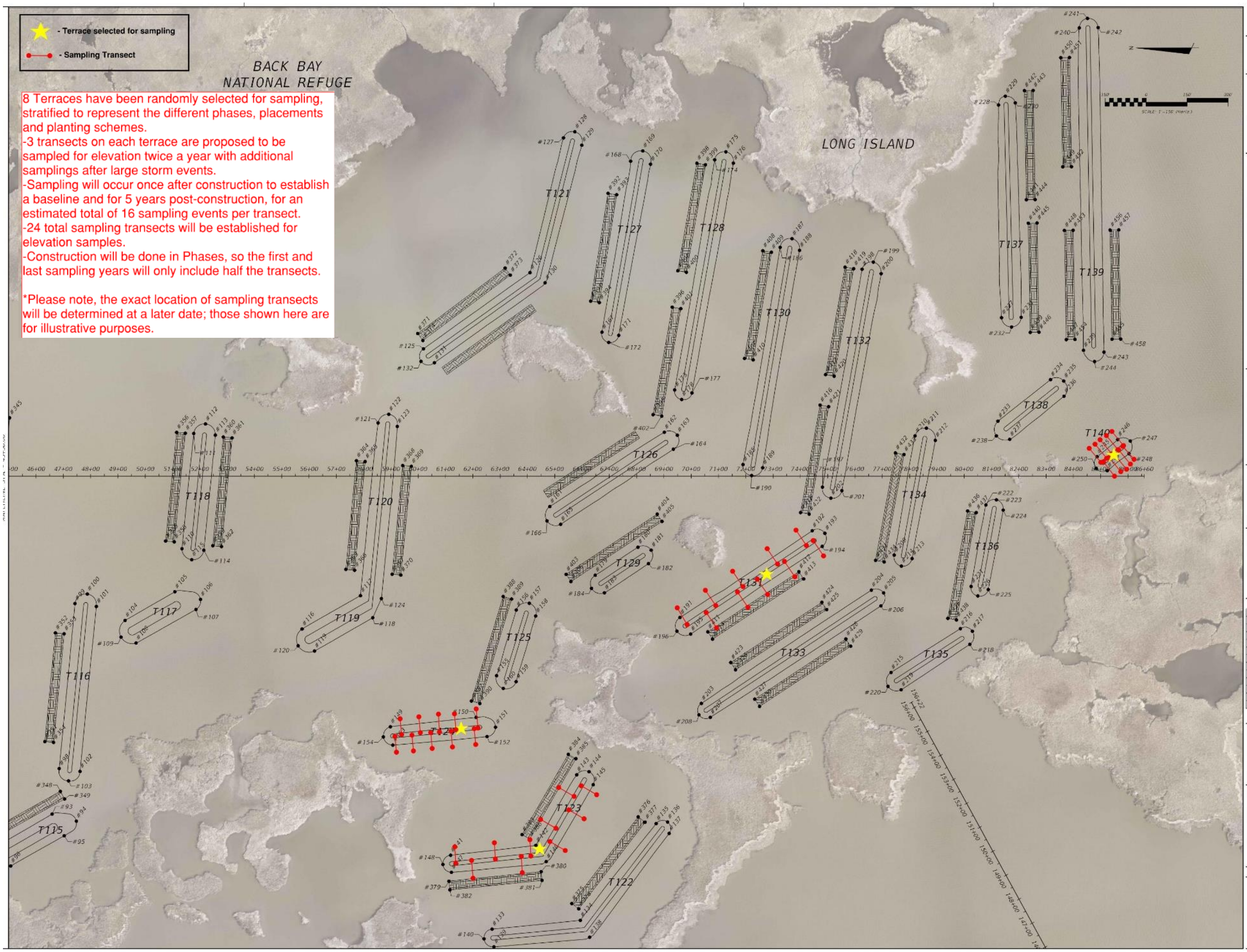

Figure 4: Monitoring design site plan – South Terraces

Permanent photo stations will be established at each quadrant along each transect to capture the design features/established habitats and vegetation. Figure 5 shows the general proposed locations (indicated by the red arrows/labels) for each quadrant and photograph station along each transect. Photos were shot from each photo location on [DATE]. These photos will be collected annually and compiled in Appendix B.

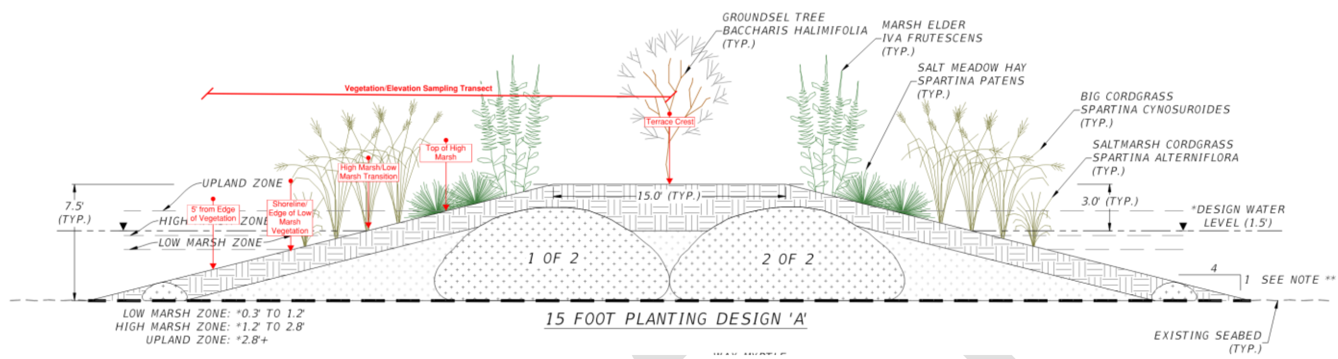

Figure 5: Photo station layout example

Quadrants

To estimate percent cover of vegetation, four (4) quadrants along each of ten (10) transects will be established on the eight selected terraces to allow for estimates of habitat coverage and planting survival. Estimates of coverage and survival were compared to post-construction conditions to evaluate changes.

Further, the following guiding questions were established to monitor overall project performance, presence of invasive species, and identify any needs for maintenance:

1. Are there specific problem areas where plants are dying or appear unhealthy?
2. Were any signs of herbivory observed?
3. Are there any undesirable plant species present?
4. Condition of the terrace structures: Is there any observed settlement, dislodged stone, significant debris etc.?
5. If an updated survey was conducted, are there any significant changes in the profile of the marsh terraces?
6. Does the upland portion of each terrace show any significant signs of erosion or loss of vegetation?

MONITORING RESULTS

Table 2: Low Marsh Vegetation Percent Cover Monitoring Results (Example Table – Terrace 1).

		Estimated Percent Coverage						Percent Change in Coverage (from Baseline)				
Terrace/ Transect	Photo Station Reference	Baseline (2024)	Year 1 (2025)	Year 2 (2026)	Year 3 (2027)	Year 4 (2028)	Year 5 (2029)	Baseline to Year 1	Baseline to Year 2	Baseline to Year 3	Baseline to Year 4	Baseline to Year 5
1 - 1	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 2	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
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1 - 4	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 5	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 6	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 7	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
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1 - 9	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
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Overall		**Choose an item.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**

Table 3: High Marsh Vegetation Percent Cover Monitoring Results (Example Table – Terrace 1).

		Estimated Percent Coverage						Percent Change in Coverage (from Baseline)				
Terrace/ Transect	Photo Station Reference	Baseline (2024)	Year 1 (2025)	Year 2 (2026)	Year 3 (2027)	Year 4 (2028)	Year 5 (2029)	Baseline to Year 1	Baseline to Year 2	Baseline to Year 3	Baseline to Year 4	Baseline to Year 5
1 - 1	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 2	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
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1 - 4	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 5	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
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1 – 7	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 8	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 9	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 10	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
Overall		**Choose an item.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**

Table 4: General Observations for Wetland Planting Areas on the Marsh Terraces (Example Table – Terrace 1)

Monitoring Questions	Terrace/Transect									
	1 - 1	1 - 2	1 - 3	1 - 4	1 - 5	1 - 6	1 - 7	1 - 8	1 - 9	1 - 10
Are there specific problem areas where plants are dying or appear unhealthy?	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.
Were any herbivory issues observed?	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.
Are there any undesirable plant species present?	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.
If updated survey was conducted, are there any significant changes in the profile of the living shoreline system?	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.

Table 5: General Observations for the Unplanted Structural Components of the Marsh Terraces (Example Table – Terrace 1)

Terrace/Transect										
Monitoring Questions	1 - 1	1 - 2	1 - 3	1 - 4	1 - 5	1 - 6	1 - 7	1 - 8	1 - 9	1 - 10
Are there any structural issues with the planted terrace structures (e.g. observed settlement, loss of topsoil, etc.)?	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.
Is there any observed growth in SAV on or adjacent to the marsh terraces?	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.

Are there any structural issues with the rock armoring on the terraces (e.g. observed settlement, dislodged stone, significant debris, etc.)?	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.

MAINTENANCE RECOMMENDATIONS

The following table outlines the recommendations for maintenance, including estimated quantities and specific guidance, based on the results of the [YEAR] monitoring results.

Table 6: Maintenance Recommendations Checklist

Design Feature/ Monitoring Objective	Maintenance Elements	Location & Estimated Quantity	Specific Guidance
Terrace Upland and Wetland Habitats and Wetland Soils – Monitoring Objectives 1a/1b	☐ Replace plants	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Add new plants	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Remove debris	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Remove invasive vegetation	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Add sand to eroding areas	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Replace waterfowl barrier	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.

Design Feature/ Monitoring Objective	Maintenance Elements	Location & Estimated Quantity	Specific Guidance
Terrace Structures & Stone Armoring, Monitoring Objective 2a/2b	☐ Re-place dislodged stones	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Add additional stone to address settlement	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Remove debris	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Repair sand cores or other structural elements	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
SAV Establishment, Monitoring Objective 3	☐ Replace plants	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Add new plants	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.

APPENDIX A: AS-BUILT PLANS

[Page left intentionally blank; as-built plans will be included in the Year 1 monitoring report]

APPENDIX B: MONITORING PHOTOGRAPHS

Table 7: Terrace 1 Transect 1 Photographs

Photograph from Photo Location 1A	Photograph from Photo Location 1B
Additional photos of any problem areas.	

Table 8: Terrace 1 Transect 2 Photographs

Photograph from Photo Location 2A	Photograph from Photo Location 2B
Photograph from Photo Location 2C	Additional photos of any problem areas.

Table 9: Terrace 1 Transect 3 Photographs

Photograph from Photo Location 3A	Photograph from Photo Location 3B
Photograph from Photo Location 3C	Additional photos of any problem areas.

Table 10: Terrace 1 Transect 4 Photographs

Photograph from Photo Location 4A	Photograph from Photo Location 4B
Photograph from Photo Location 4C	Additional photos of any problem areas.

Table 11: Terrace 1 Transect 5 Photographs

Photograph from Photo Location 5A	Photograph from Photo Location 5B
Photograph from Photo Location 5C	Additional photos of any problem areas.

Table 12: Terrace 1 Transect 6 Photographs

Photograph from Photo Location 6A	Photograph from Photo Location 6B
Photograph from Photo Location 6C	Additional photos of any problem areas.

Table 13: Terrace 1 Transect 7 Photographs

Photograph from Photo Location 7A	Photograph from Photo Location 7B
Photograph from Photo Location 7C	Additional photos of any problem areas.

Table 14: Terrace 1 Transect 7 Photographs

Photograph from Photo Location 7A	Photograph from Photo Location 7B
Photograph from Photo Location 7C	Additional photos of any problem areas.

Table 15: Terrace 1 Transect 8 Photographs

Photograph from Photo Location 8A	Photograph from Photo Location 8B
Photograph from Photo Location 8C	Additional photos of any problem areas.

Table 16: Terrace 1 Transect 9 Photographs

Photograph from Photo Location 9A	Photograph from Photo Location 9B
Photograph from Photo Location 9C	Additional photos of any problem areas.

Table 17: Terrace 1 Transect 10 Photographs

Photograph from Photo Location 9A	Photograph from Photo Location 9B
Photograph from Photo Location 9C	Additional photos of any problem areas.

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2023 Virginia Community Flood Preparedness Fund

Marsh Restoration in Back Bay, Virginia Beach

CITY OF VIRGINIA BEACH

Table of Contents

Appendix A – Application Form

Applicants must have prior approval from the Department to submit <u>applications, forms, and supporting documents by mail in lieu of the WebGrants portal.</u>

Appendix A: Application Form for Grant and Loan Requests for All Categories

Virginia Department of Conservation and Recreation
Virginia Community Flood Preparedness Fund Grant Program

Name of Local Government:

Category Being Applied for (check one):

☐ **Capacity Building/Planning**

☑ **Project**

☐ **Study**

NFIP/DCR Community Identification Number (CID) 515531

Name of Authorized Official and Title: Toni Utterback, Stormwater Engineering Center Administrator

Signature of Authorized Official: Katie E Shannon for Toni Utterback

Mailing Address (1): 2875 Sabre Street, Suite 250

Mailing Address (2): ______

City: Virginia Beach **State:** Virginia **Zip:** 23452

Telephone Number: (757) 385-8746 **Cell Phone Number:** (____) ______

Email Address: TPUtterback@vbgov.com

Contact and Title (If different from authorized official): C.J. Bodnar, Technical Services Program Manager

Type text here

Mailing Address (1): 2875 Sabre Street, Suite 250

Mailing Address (2): ____________________

City: Virginia Beach **State:** Virginia **Zip:** 23452

Telephone Number: (757) 385-8430 **Cell Phone Number:** (____) ____________

Email Address: CBodnar@vbgov.com

Is the proposal in this application intended to benefit a low-income geographic area as defined in the Part 1 Definitions? Yes ____ No ✓

Categories (select applicable activities that will be included in the project and used for scoring criterion):

Capacity Building and Planning Grants

☐ Floodplain Staff Capacity.

☐ Resilience Plan Development

- ☐ Revisions to existing resilience plans and modifications to existing comprehensive and hazard mitigation plans.
- ☐ Resource assessments, planning, strategies, and development.
  - Policy management and/or development.
  - Stakeholder engagement and strategies.

☐ Other: ____________________

Study Grants (Check All that Apply)

☐ Studies to aid in updating floodplain ordinances to maintain compliance with the NFIP, or to incorporate higher standards that may reduce the risk of flood damage. This must include establishing processes for implementing the ordinance, including but not limited to, permitting, record retention, violations, and variances. This may include revising a floodplain ordinance when the community is getting new Flood Insurance Rate Maps (FIRMs), updating a floodplain ordinance to include floodplain setbacks, freeboard, or other

higher standards, RiskMAP public noticing requirements, or correcting issues identified in a Corrective Action Plan.

- ☐ Revising other land use ordinances to incorporate flood protection and mitigation goals, standards, and practices.
- ☐ Conducting hydrologic and hydraulic (H&H) studies of floodplains. *Changes to the base flood, as demonstrated by the H&H must be submitted to FEMA within 6 months of the data becoming available.*
- ☐ Studies and Data Collection of Statewide and Regional Significance.
- ☐ Revisions to existing resilience plans and modifications to existing comprehensive and hazard.
- ☐ Other relevant flood prevention and protection project or study.

Project Grants and Loans (Check All that Apply – Hybrid Solutions will include items from both the “Nature-Based” and “Other” categories)

Nature-based solutions

- ☐ Acquisition of property (or interests therein) and/or structures for purposes of allowing floodwater inundation, strategic retreat of existing land uses from areas vulnerable to flooding; the conservation or enhancement of natural flood resilience resources; or acquisition of structures, provided the acquired property will be protected in perpetuity from further development, <u>and where the flood mitigation benefits will be achieved as a part of the same project as the property acquisition.</u>
- ☑ Wetland restoration.
- ☐ Floodplain restoration.
- ☐ Construction of swales and settling ponds.
- ☑ Living shorelines and vegetated buffers.
- ☐ Permanent conservation of undeveloped lands identified as having flood resilience value by *ConserveVirginia* Floodplain and Flooding Resilience layer or a similar data driven analytic tool, or the acquisition of developed land for future conservation.
- ☐ Dam removal.
- ☐ Stream bank restoration or stabilization.
- ☐ Restoration of floodplains to natural and beneficial function.

Other Projects

- ☐ Structural floodwalls, levees, berms, flood gates, structural conveyances.
- ☐ Storm water system upgrades.
- ☐ Medium and large-scale Low Impact Development (LID) in urban areas.

☐ Developing flood warning and response systems, which may include gauge installation, to notify residents of potential emergency flooding events.

☐ Dam restoration.

☐ Beneficial reuse of dredge materials for flood mitigation purposes

☐ Removal or relocation of structures from flood-prone areas where the land will not be returned to open space.

☐ Acquisition of property (or interests therein) and/or structures for purposes of allowing floodwater inundation, strategic retreat of existing land uses from areas vulnerable to flooding; the conservation or enhancement of natural flood resilience resources; or acquisition of structures, provided the acquired property will be protected in perpetuity from further development, <u>and where the flood mitigation benefits will **not be** achieved as a part of the same project as the property acquisition.</u>

☐ Other project identified in a DCR-approved Resilience Plan.

Location of Project or Activity (Include Maps): Bonney Cove in Back Bay, Virginia Beach

NFIP Community Identification Number (CID#) : 515531

Is Project Located in an NFIP Participating Community? ☑ Yes ☐ No

Is Project Located in a Special Flood Hazard Area? ☑ Yes ☐ No

Flood Zone(s) (If Applicable): Zone VE (EL 5 Feet), Zone AE (EL 4 Feet), Zone Open Water

Flood Insurance Rate Map Number(s) (If Applicable): 5155310215G and 5155310220G

Total Cost of Project: $53,378,490

Total Amount Requested $5,000,000

Amount Requested as Grant $5,000,000

Amount Requested as Project Loan (not including short-term loans for up-front costs) ____________________

Amount Requested as Short-Term loan for Up-Front Costs (not to exceed 20% of amount requested as Grant) __________________________

For projects, planning, capacity building, and studies in low-income geographic areas: Are you requesting that match be waived? □ Yes □ No

<u>Additional Information for Loan Requests</u>
Requested Loan Security: ______________________________

(General Obligation, Lease, Revenue, Special Fund Revenue, and/or Moral obligation from other government entity)

Desired loan term: __________________________________

Since the date of your latest financial statements, did the applicant issue any new debt? ______
(If yes, provide details)

Is there any pending or potential litigation by or against the applicant? ______________

Attach five years of current audited financial statements (FY18-22) or refer to website if posted
(Not necessary for existing VRA borrowers)

Attach FY2024 adopted budget or refer to website

Attach current Capital Improvement Plan

Attach adopted Financial Policies

Attach a list of the ten largest employers in the Applicant's jurisdiction.

Attach a list of the ten largest taxpayers in the Applicant's jurisdiction

Appendix B: Budget Form

Appendix B: Budget Narrative Template

Applicant Name:
Community Flood Preparedness Fund &
Resilient Virginia Revolving Loan Fund
Detailed Budget Narrative
Period of Performance: June 2024 through June 2027
Submission Date: November 12, 2023

	Grand Total State Funding Request	$ 5,000,000
	Grand Total Local Share of Project	$ 38,356,966
National Fish and Wildlife Foundation Grants	Federal Funding (if applicable)	$ 10,021,524
	Project Grand Total	$ 53,378,490
	Locality Cost Match	% 71.85

Breakout By Cost Type	Personnel	Fringe	Travel	Equipment	Supplies	Contracts	Indirect Costs	Other Costs	Total
Federal Share (if applicable)								10,021,524	10,021,524
Local Share								37,330,166	37,330,166
State Share								5,000,000	5,000,000
Pre-Award/Startup								276,800	276,800
Maintenance								750,000	750,000
Total	$	$	$	$	$	$	$	$53,378,490	$ 53,378,490

1. Federal Share represents National Fish and Wildlife Foundation (NFWF) Grants. NFWF is not a federal agency.
2. Local Share represents the total project cost less design and implementation (monitoring and initial maintenance) costs.
3. State Share represents the CFPF grant request.
4. Pre-Award costs represent project design costs.
5. Maintenance costs represent implementation (monitoring and initial maintenance costs).

Scope of Work Narrative

Introduction

The City of Virginia Beach ("City") is pleased to submit the Marsh Restoration in Back Bay project for consideration under the Flood Prevention and Protection Projects category in the 2023 Virginia Community Flood Preparedness Fund. The City has made significant investments in the study of historical flooding data, current and future hydrology, and the projected increase in flood frequency due to changing rainfall patterns and sea level rise. These studies culminated in Virginia Beach's Resilience Plan, socialized as "Sea Level Wise,"[1] which includes a conceptual suite of projects focused on flood control and resilience. The Virginia Beach Resilience Plan leverages four overarching adaptation strategies to identify actionable projects for each of the City's four unique major watersheds. This project represents the first adaptation project to advance to construction to implement the City's Resilience Plan.

The adaptation strategy for the Southern Rivers Watershed, which includes Back Bay, is presented in Figure 1. The strategy focuses on employing natural mitigation methods, an integrated system of defense structures, and complementary measures, such as land-use strategies. Collectively these approaches are designed to strategically reduce flow into and within Back Bay and improve flood storage and overall coastal resiliency. Marsh restoration was identified as a key resilience-building strategy as part of an extensive evaluation of structural and non-structural alternatives. Marsh restoration provides multiple benefits of flood risk reduction, enhanced habitat, and improved water quality.

As part of the Virginia Coastal Resilience Master Planning Framework, a precursor to the first phase of the Virginia Coastal Resilience Master Plan (CRMP), the Commonwealth of Virginia identified guiding principles for a statewide resilience strategy. One of these guiding principles is recognizing the importance of protecting and enhancing natural infrastructure and prioritizing nature-based infrastructure.[2] The City's marsh restoration project aligns with this principle and was highlighted as an exemplary nature-based project in the CRMP (refer to pages 178-179).[3]

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[1] City of Virginia Beach (2020). Virginia Beach Sea Level Wise Adaptation Strategy (Website).

[2] Office of Governor Ralph S. Northam Commonwealth of Virginia. (2020). Virginia Coastal Resilience Master Planning Framework (PDF).

[3] Office of Governor Ralph S. Northam Commonwealth of Virginia. (2021). Virginia Coastal Resilience Master Plan Phase 1 (PDF).

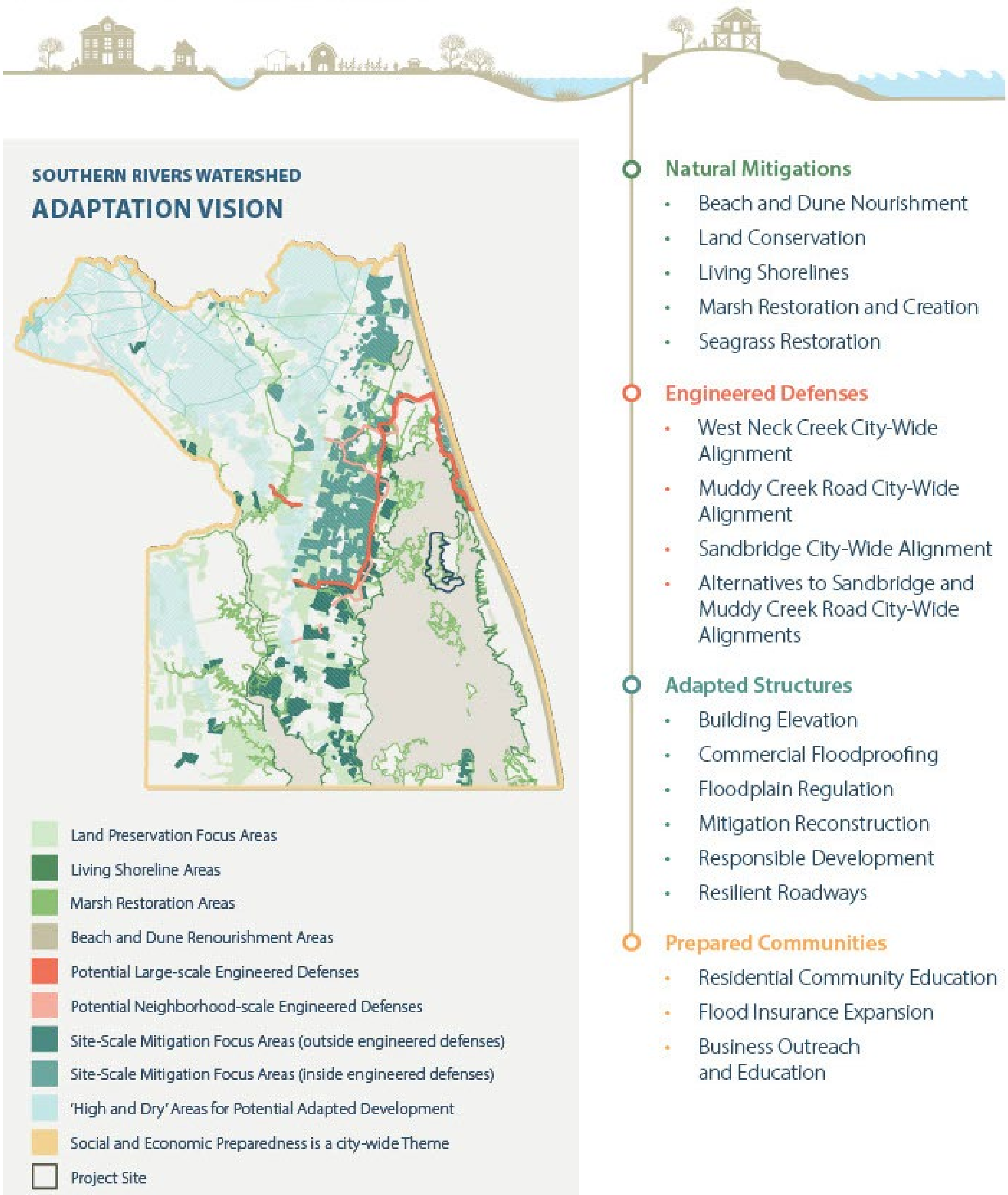

Figure 1: Adaptation Vision for the Southern Rivers Watershed.

Hydraulic modeling analysis identified Bonney Cove as a location where marsh restoration has the potential to reduce the propagation of floodwater through key pathways within Back Bay (Figure 2). The City prioritized this project as the first to advance to construction due to its significant benefits to community and habitat resilience.

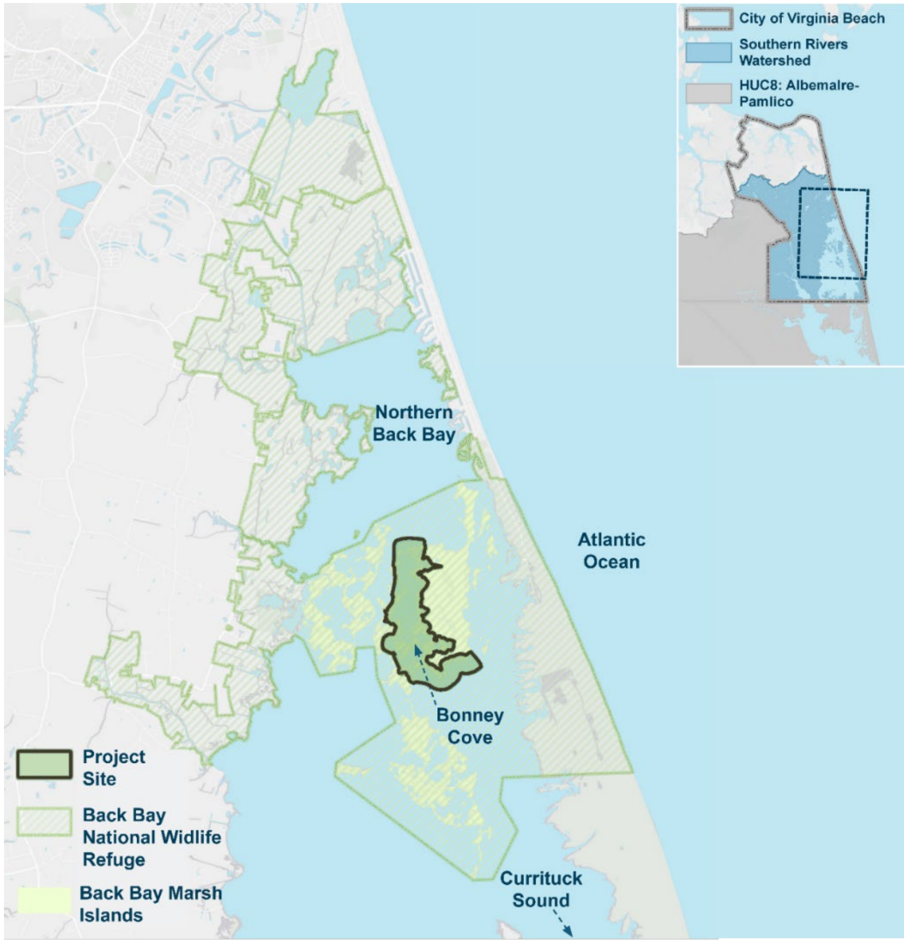

Figure 2: Project site location map.

This project represents a collaborative effort between the City's Department of Public Works alongside other City departments, public constituents, local nonprofits, and state and federal agencies. In selecting the project location and developing the design approach, the City has coordinated closely with the Back Bay National Wildlife Refuge (BBNWR), part of the U.S. Fish and Wildlife Service (USFWS), and the Virginia Department of Wildlife Resources (VDWR). Environmental organizations committed to stewardship of Back Bay have also contributed input throughout the design process, including the Back Bay Restoration Foundation (BBRF), Friends of Back Bay, the Back Bay National Wildlife Refuge Society, and the Albemarle-Pamlico National Estuary Partnership (APNEP). Project field investigations involved local support from Old Dominion University (ODU) and others, and outside expertise from Louisiana. The National Fish and Wildlife Foundation (NFWF) provided grant funding under the National Coastal Resilience Fund (NCRF) to support design, permitting, and environmental assessments. Broad support of the project is demonstrated by contributions from the organizations noted above along with other stakeholders engaged in the restoration effort.

Needs and Problems

Specific Problem Being Solved – Habitat Degradation and "Wind Tide" Flooding

Marshes are vital to the Southern Rivers Watershed for the ecological and flood reduction benefits they provide. The Southern Rivers Watershed contains 90% of the City's land area under an elevation of three feet, making this area particularly susceptible to flood impacts. As illustrated in Figure 3, sustained southerly winds push water up from the Albemarle-Pamlico Sound through the Currituck Sound and into Back Bay, creating a phenomenon referred to locally as "wind tide flooding". Marsh habitat loss has contributed to the opening of a secondary channel in Bonney Cove that has increased water flow during wind tide and other flood events to areas with high community exposure.

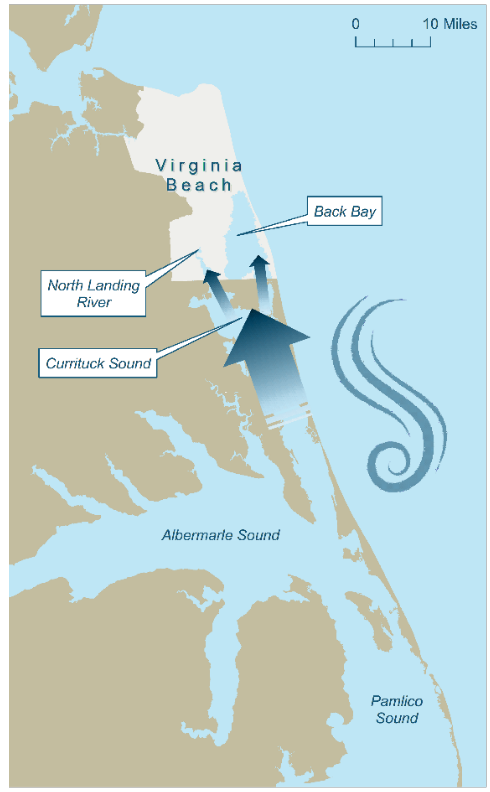

Figure 3: Flood pathways in the Southern Rivers Watershed.

Within today's marsh system, it takes between two to five days of sustained southerly winds to cause flooding, depending on the wind speed and direction. Over the last four years, more than five wind tide flooding events have occurred in this area. The increasing frequency of flooding events is primarily attributed to a foot of relative sea level rise in the last 50 years and degradation of marsh and seagrass habitat.

This marsh restoration project aims to address the challenges of habitat degradation and "wind tide" flooding by stabilizing two critically eroding marsh islands, decreasing turbidity to promote the growth of aquatic vegetation, and providing flood risk reduction benefits through increased friction and wave attenuation.

Factors Contributing to the Identified Problem

This growing flood risk in the Southern Rivers Watershed can be attributed mainly to the reduced friction in the water column from the increased water depth and eroded vegetation, which allows water to move more quickly through key hydraulic pathways. Another term for this is "fetch", which is defined as the open water distance over which a given wind can blow and generate higher waves without obstruction. Unmitigated, the continued loss of these marsh island systems and aquatic vegetation is expected to result in more frequent and intense wind tide flooding events.

Emergent Marsh Degradation

Approximately 50% of former marshland at the site (260 acres) has eroded into open water leading to the opening of a wide secondary channel ("Bonney Cove") that is about two miles

long and half a mile wide (Figure 4). The southern exposed edge of the adjacent marsh islands is exposed to approximately 1.5 miles of fetch in the predominant wind direction.

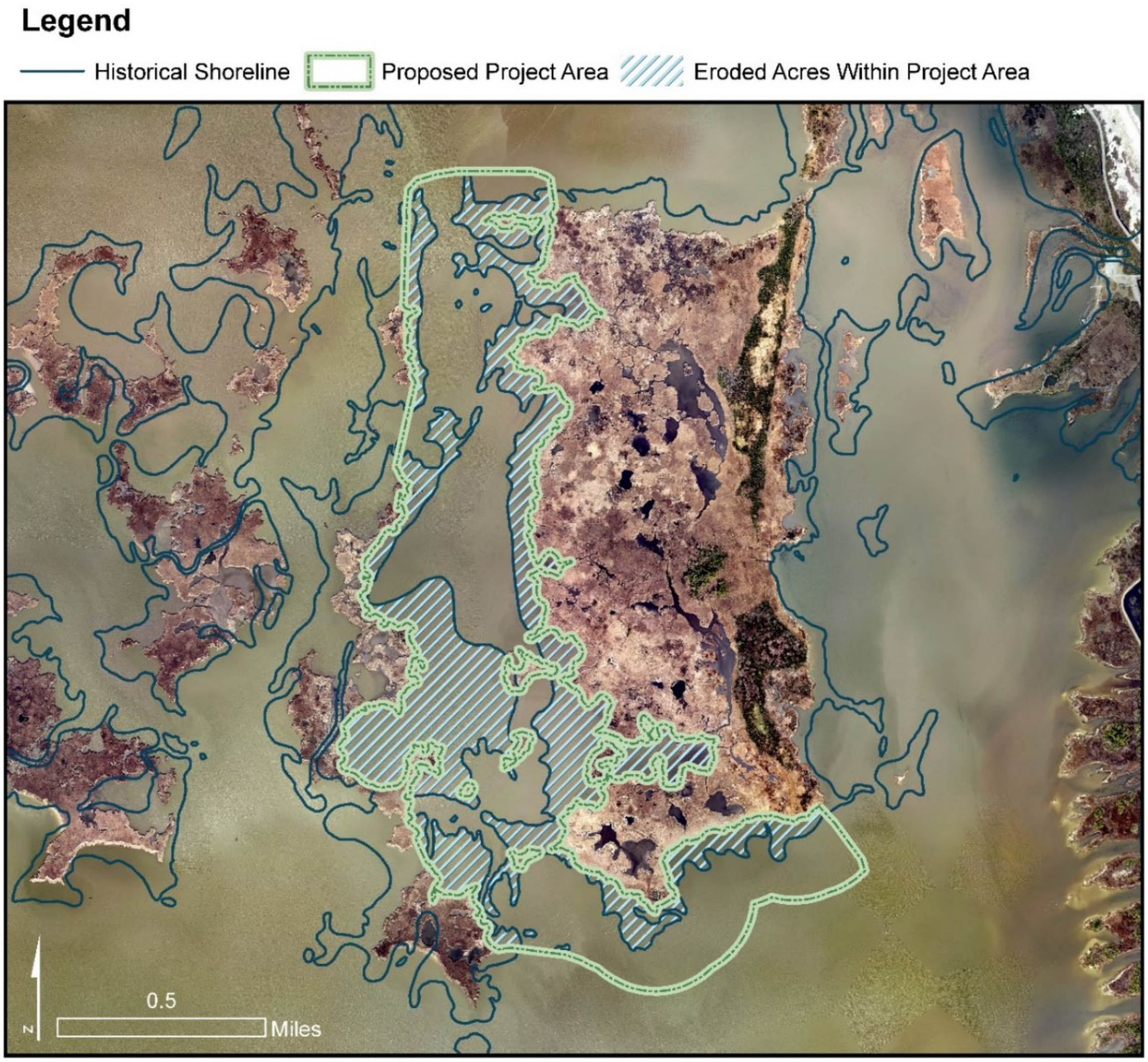

Figure 4: Historical marsh erosion within the project area.

Submerged Aquatic Vegetation (SAV) Loss

SAV used to be abundant at the site (around 45% coverage, overall) but is now extremely sparse, ranging from 0% to 10% coverage across the site, on average. Field studies conducted by the VDWR show that wind-driven waves and high flow velocities are the primary drivers of this loss, particularly in the last 5 years as shown in Figure 5.

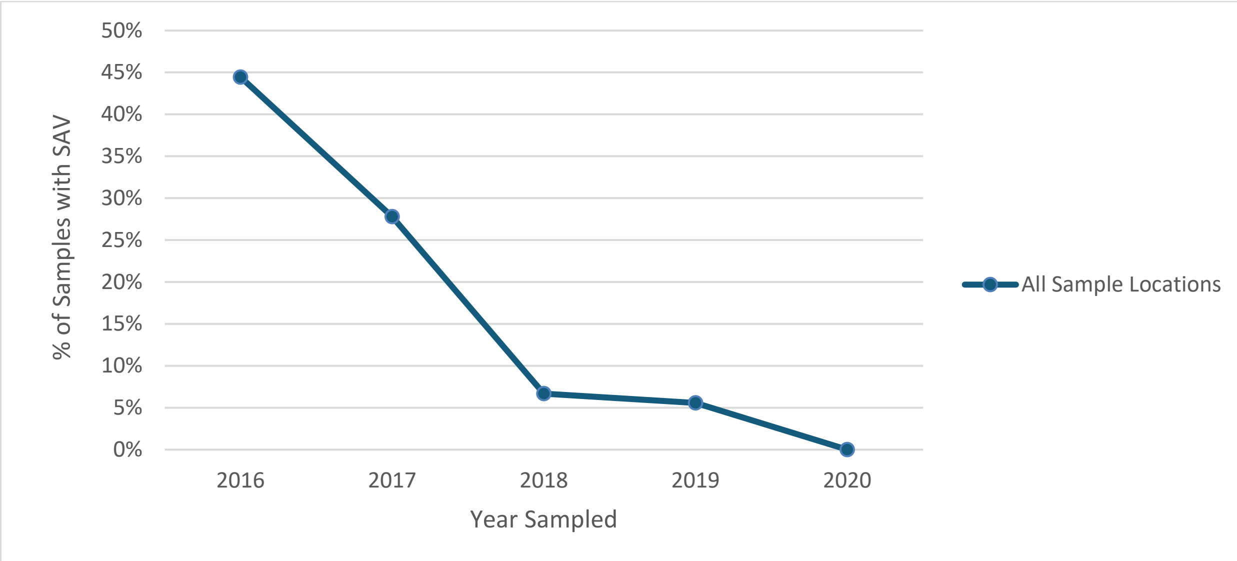

Figure 5: SAV sampling data from VDWR within the project vicinity.

Why is the Project Needed Locally/Regionally?

Pilot Project

The City's design concept for the marsh restoration project leverages "marsh terracing," an innovative coastal engineering technique widely used in Texas and Louisiana to convert shallow subtidal bottom to marsh. This technique has not yet been implemented along the U.S. East Coast and has not yet been implemented in the Mid-Atlantic region. Through the export of proven expertise from successful marsh terraces, this project would lay the foundation for future projects in the region, Virginia, and other states along the East Coast. The project would document detailed cost estimates, demonstrate effective construction practices for large-scale marsh creation projects, identify best sources for local/regional materials, and establish partnerships with permitting officials at various levels of government. The City has outlined a preliminary sequencing plan for marsh island restoration projects in Back Bay to strategically close hydraulic pathways and address priority restoration areas as shown in Figure 6. Some of these projects would require coordination with the State of North Carolina to realize its broader resilience efforts.

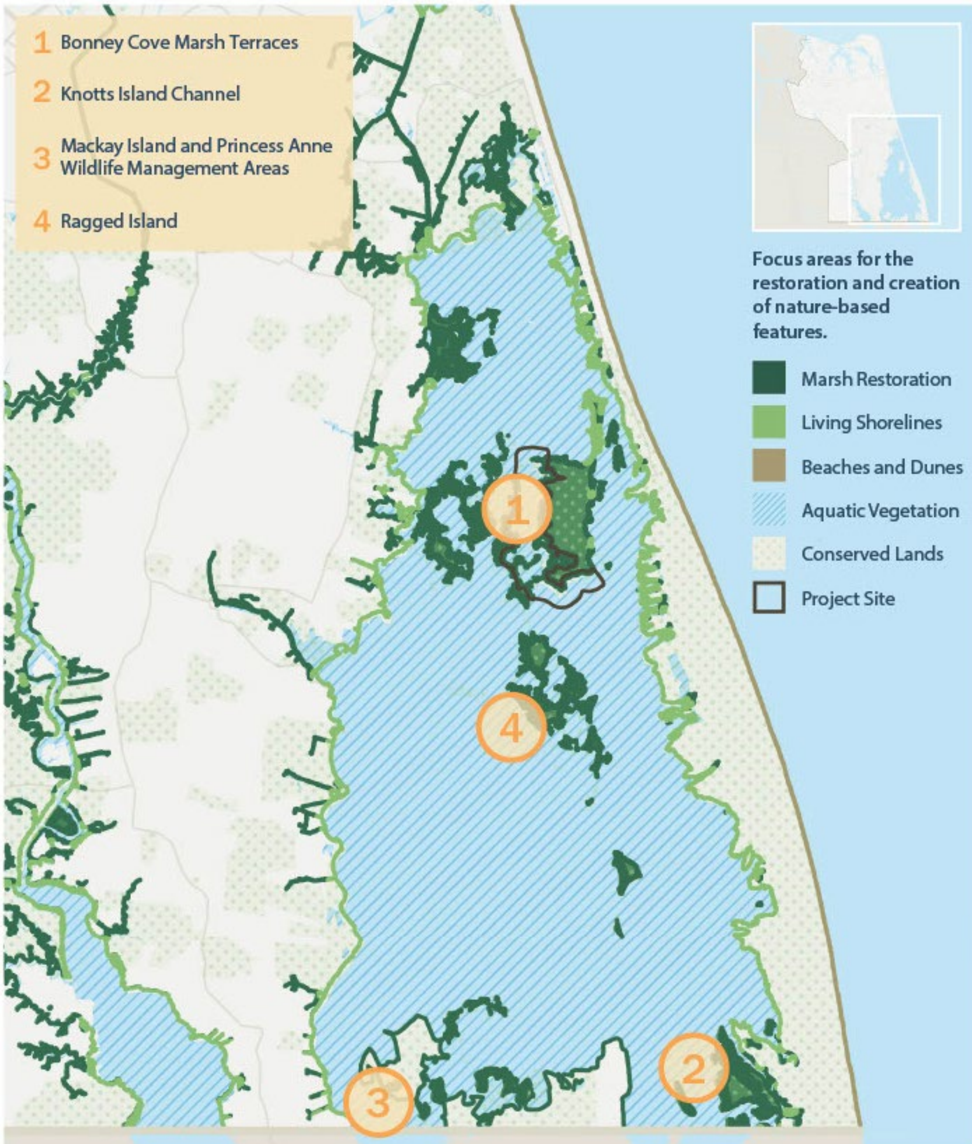

Figure 6: Preliminary Sequencing Restoration Plan.

Virginia Coastal Resilience Master Plan Exemplary Project

The CRMP impact assessment shows a high vulnerability of nature-based features to coastal flood hazards that is consistent with the City's analysis. In the Hampton Roads region, the CRMP impact assessment estimates a decrease from 40,600 acres to 2,940 acres of tidal wetlands by 2080, representing a 93% decline in tidal wetlands.[4] Back Bay was identified as a hotspot for tidal wetland loss, emphasizing the critical location of the City's marsh restoration effort. Specifically, the Virginia CRMP impact assessment shows that portions of tidal wetlands within the project area have "High" and "Very High" impact levels, which indicates areas of tidal marsh

[4] Office of Governor Ralph S. Northam Commonwealth of Virginia and Virginia Department of Conservation and Recreation (2021). Virginia Coastal Resilience Master Plan Phase 1 (PDF).

that are anticipated to be lost through inundation causing conversion to open water (Figure 7).

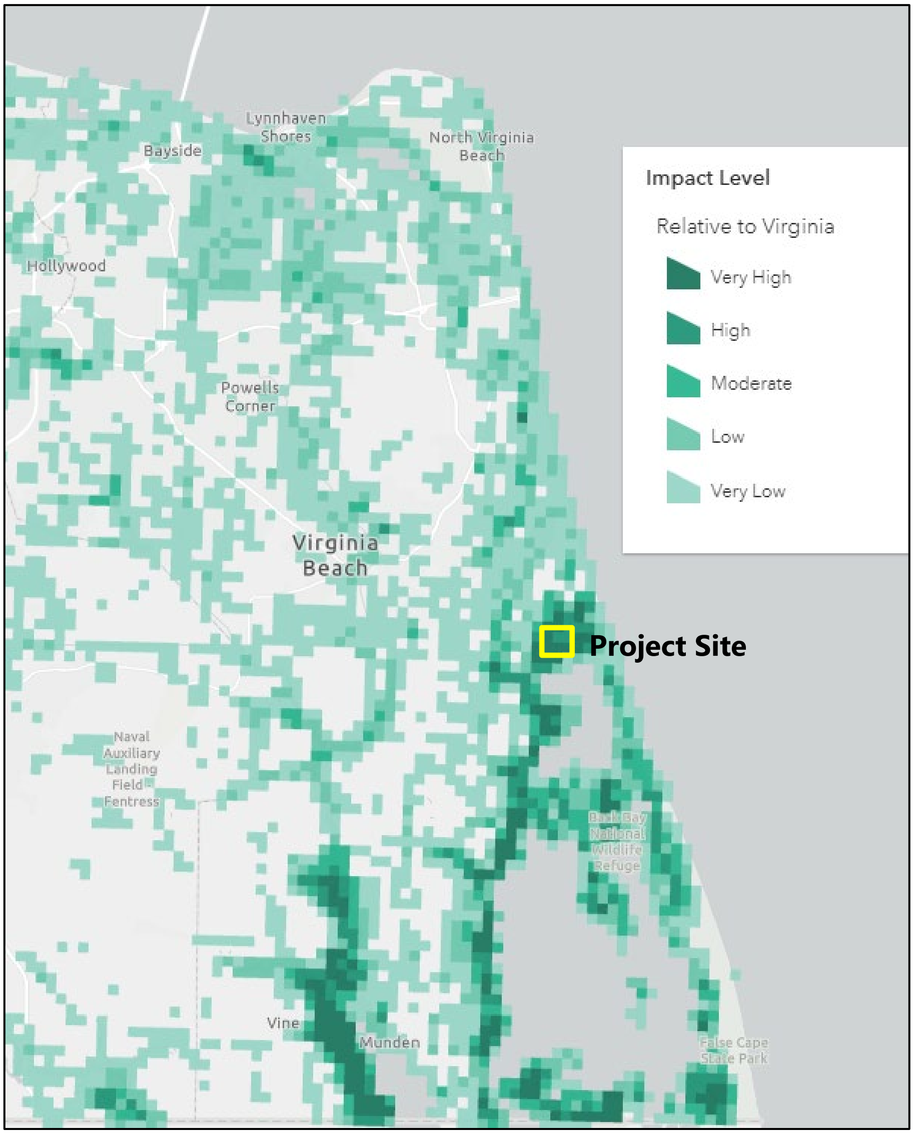

Figure 7: Virginia CRMP Impact Assessment for Tidal Wetlands.

Currituck Sound Coalition High Priority Area

In coordination with Audubon North Carolina, the Currituck Sounds Coalition designated the project site as a High Priority Area for restoring and enhancing vulnerable and degraded marshes with "high flood risk reduction benefits and habitat value" as shown in Figure 8[5].

[5] Audubon North Carolina. (2021). Currituck Sound Coalition Marsh Conservation Plan. (PDF)

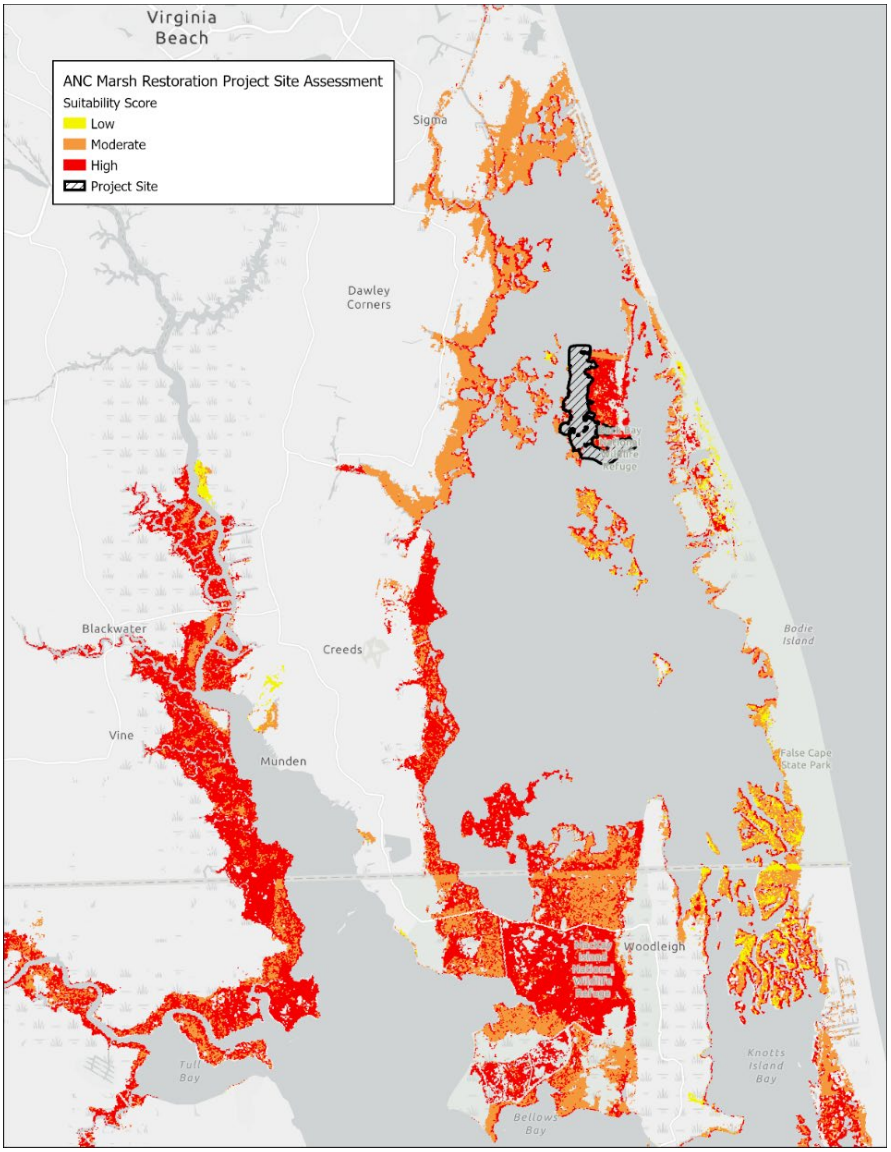

Figure 8: Audubon North Carolina Marsh Restoration Project Site Assessment

Ecological Core for Flood Resilience

The Virginia Department of Conservation and Recreation Natural Heritage Data Explorer provides data from ConserveVirginia v3.0 and other data to support conservation planning. The following map in Figure 9 displays Ecological Cores and the Floodplains and Flooding Resilience Category layer (blue polygon) from ConserveVirginia. The project area contains "High" (C3) and "General" (C5) Ecological Cores and is within the boundaries of the Floodplain and Flooding Resilience area.

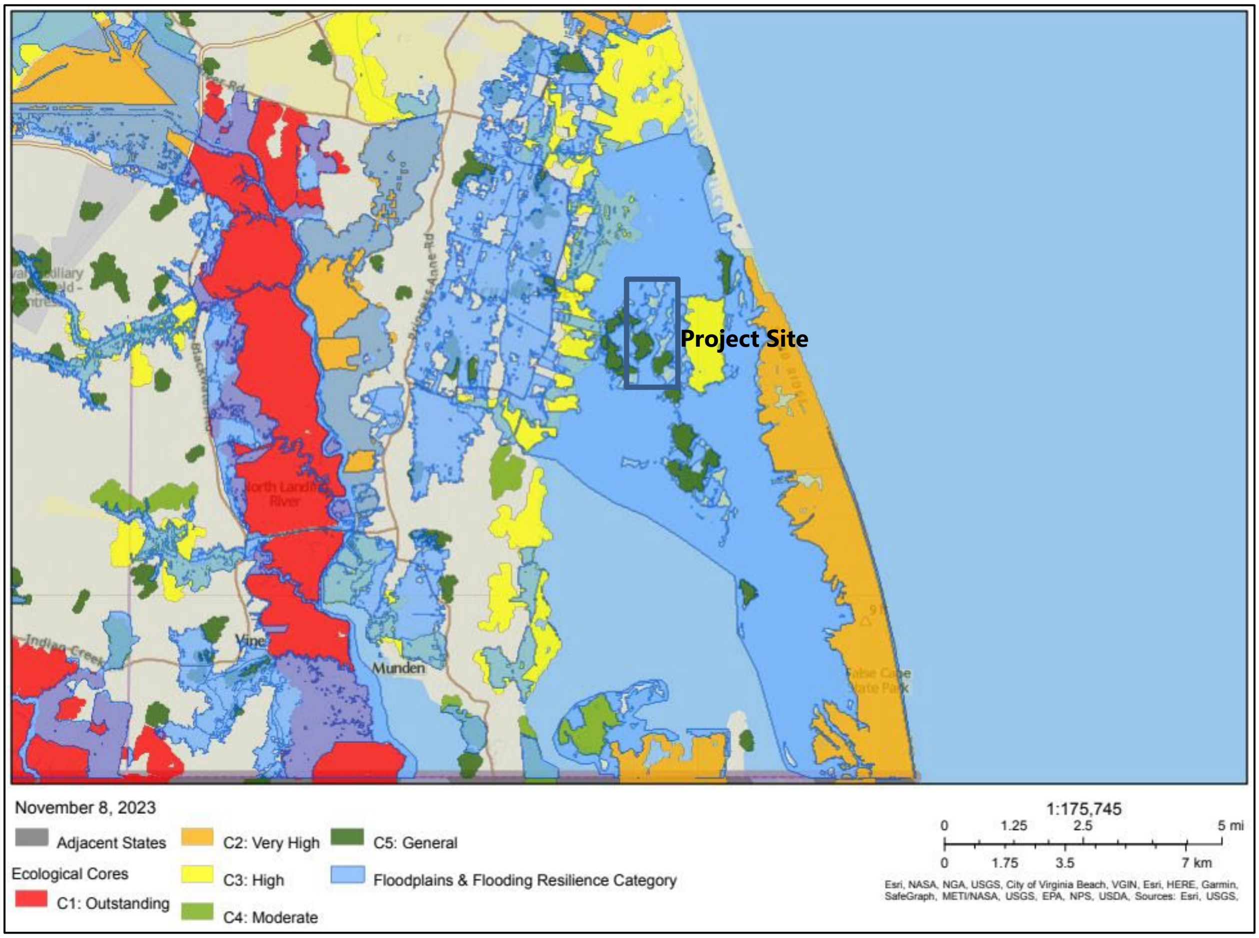

Figure 9: Virginia Natural Heritage Data Explorer Ecological Cores and ConserveVirginia Data.

The safety threats, or environmental concerns related to flood risk.

The City's risk assessment forecasts that approximately 70% of the remaining marsh (730 acres) surrounding the project site will convert to open water with three feet of sea level rise if unmitigated. Fragmentation of this adjacent marsh would result in about eight miles of fetch acting on the southern extent of the site in the predominant wind direction. Without these central marsh islands, the northern shorelines of Back Bay would be exposed to 12 miles of fetch from the Knotts Island Channel at the Virginia-North Carolina boundary. This condition would leave the fringing marshes highly vulnerable to accelerated erosion.

How does the project decrease the risk to public safety through flood risk reduction?

Construction of the forty-one individual marsh terraces, totaling 27,000 linear feet (a 51-acre footprint), across Bonney Cove offers a nature-based technique that will stabilize and protect the marsh island in the center of the bay and reduce erosion of the fringing marsh systems to the north. Numerical modeling was leveraged to quantify specific erosion reduction benefits of the project for wave heights and flow velocities:

- **Wave Height Reduction**: The marsh terraces are expected to reduce wave heights within the project site by approximately 45%. This reduction is consistent with other field studies, which have found that average wave heights within two terraced sites were 37% to 48% lower than those observed at the reference site (Brasher 2015). Wave energy reduction is anticipated to increase the potential for sediment deposition on the terraces' leeward side, leading to the growth of new emergent marsh and reducing erosion of adjacent marsh. Approximately five miles of marsh island shoreline around Bonney Cove will benefit directly from the erosion reduction associated with the computed wave attenuation.
- **Flow Velocity Reduction**: The marsh terraces reduce flow velocity within the project area. This reduction in velocity will reduce bottom shear stress, decrease turbidity, increase light penetration into the water column and promote the growth of SAV. Reducing bottom shear stress will make conditions more suitable for SAV growth between the terraces. Field studies of marsh terraces in Texas and Louisiana document an approximately 45% to 56% reduction in turbidity and the emergence of SAV in the years following terrace construction (Brasher 2015).
- **Wind Shear Stress Reduction**: Although not included as a parameter within the numerical modeling effort, the bald cypress trees planted on the terraces within the middle of the site are expected to reduce wind speed within the project site. This will further reduce wind-generated waves within the project site on the terraces' leeward and windward sides. Research shows that trees that grow to at least 30 feet at maturity result in lower wind speeds of up to 60 to 150 ft on the windward side and up to 900 ft on the leeward side (USDA).

How does the project protect or conserve natural resources?

The proposed project aims to restore marsh island communities in Bonney Cove that have historically provided environmental and flood reduction benefits to the communities in northern Back Bay. As illustrated in Figure 10, when an intact marsh begins to fragment and convert to open water, fetch increases and enables greater wave energy, increasing marsh erosion rates, and ultimately accelerating conversion to an ever-expanding body of open water. Strategic marsh restoration and creation in Bonney Cove would help mitigate the cycle of marsh island erosion and loss of SAV currently occurring in Back Bay, thereby protecting the remaining marsh islands and reducing fetch and wave energy.

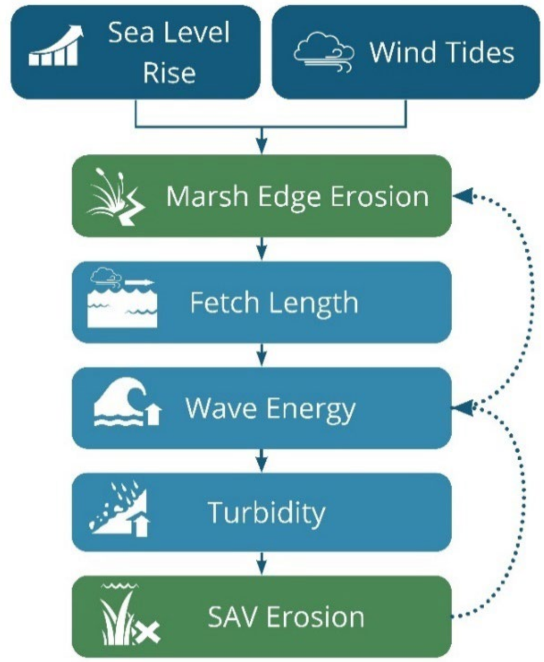

Figure 10: Cycle of marsh erosion, SAV loss, and increased wind-driven flooding.

The primary objective of this project is to create a sustainable coastal marsh island system in Back Bay through reclamation of historically lost marsh habitat and protection of existing marsh complexes from erosion. This restoration effort aims to provide multiple benefits of reduced flood impacts, enhanced fish and wildlife habitat, and improved water quality. The project is designed to achieve the following outcomes:

- Decrease turbidity to create conditions that promote the growth of emergent vegetation and aquatic grasses;
- Maximize habitat value for ecologically important fish and wildlife populations (e.g. Largemouth Bass, Bluegill, Yellow Perch, Striped Bass, Blueback Herring, Alewife, American Eel, etc.); and,
- Reduce fetch, wave heights, and flow velocities to mitigate erosion of fringing marsh systems that provide a buffer for the low-lying neighborhoods and roads that experience frequent flooding in northern Back Bay.

The City selected marsh terracing as the preferred restoration approach because the design is compatible with Back Bay's shallow bottom and the historical loss of habitat. Marsh terraces are narrow, man-made islands placed in shallow open water to restore previous marsh environments. Typically arranged in a chevron pattern, the overall field of marsh terraces dissipates waves, decreases turbidity, and slows down the moving water. The resulting calmer water conditions allow more sunlight to penetrate to the shallow bottom, promoting the establishment and growth of marsh seagrass and ultimately improving habitat quality for fish and wildlife. Further, as opposed to one continuous marsh platform, marsh terraces maximize habitat for a variety of fish and wildlife species, as illustrated in Figure 11.

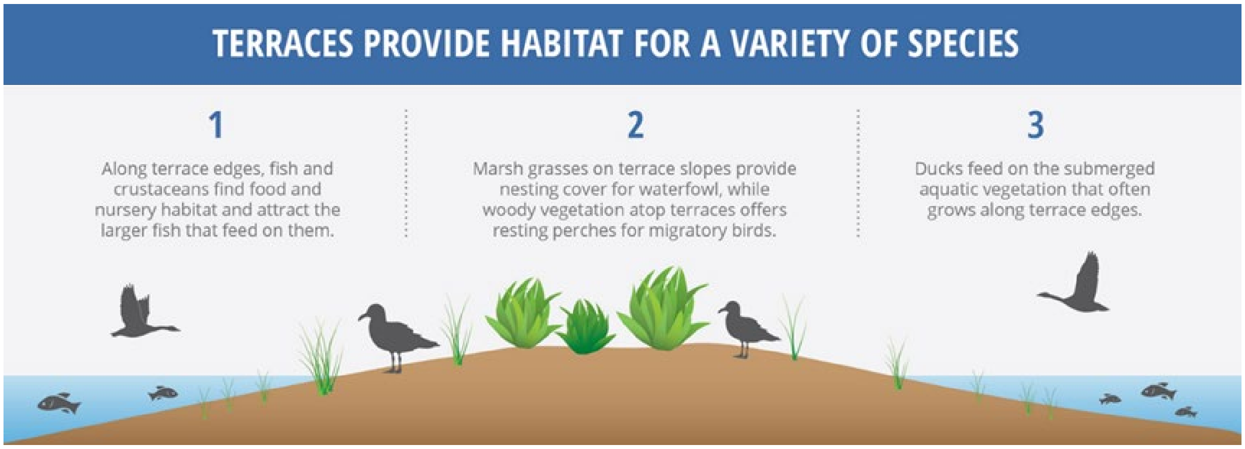

Figure 11: Conceptual diagram of marsh terraces.

Groups to be targeted who might directly benefit from this flood risk reduction effort.

The northern Back Bay communities adjacent to the project area and interested stakeholders have been engaged in the planning effort through public meetings. These meetings provided an opportunity for the community to provide feedback on the 30% and 95% designs and artistic renderings. We anticipate the project to benefit properties and infrastructure assets in northern Back Bay, including the following:

- **Reduce erosion rates along approximately 8 miles of shoreline by reducing wind and wave energy north of the project site.** Most of the properties along this reach of shoreline are not protected by traditional erosion risk reduction measures, such as bulkheads. Maintaining a naturalized shoreline while protecting fringe marsh is a priority of the City and its project partners. This approach will ensure that these marsh systems can migrate landward in response to sea level rise.
- **Reduce flood risk to commercial and residential properties north of the project site.** There are approximately 70 commercial and 2,350 residential structures within the two census block groups surrounding the project site. Around 635 of those structures are vulnerable to flooding during a 50-year event today. With three feet of sea level rise, approximately 2,060 structures are expected to be vulnerable to flooding during a 50-year return period event, representing about 85% of the residential structures within the project vicinity. These numbers underscore the importance of implementing the proposed project alongside complimentary flood risk reduction projects.
- **Reduce the magnitude and duration of flooding along critical access roads and critical facilities.** In addition to Muddy Creek Road, two other critical access roads are anticipated to benefit from delayed flooding. This includes Shipps Cabin Road (intersecting with Muddy Creek Road) and Sandpiper Road, which runs parallel to the eastern bank of Back Bay and provides ingress/egress out of the Sandbridge community (Figure 12).

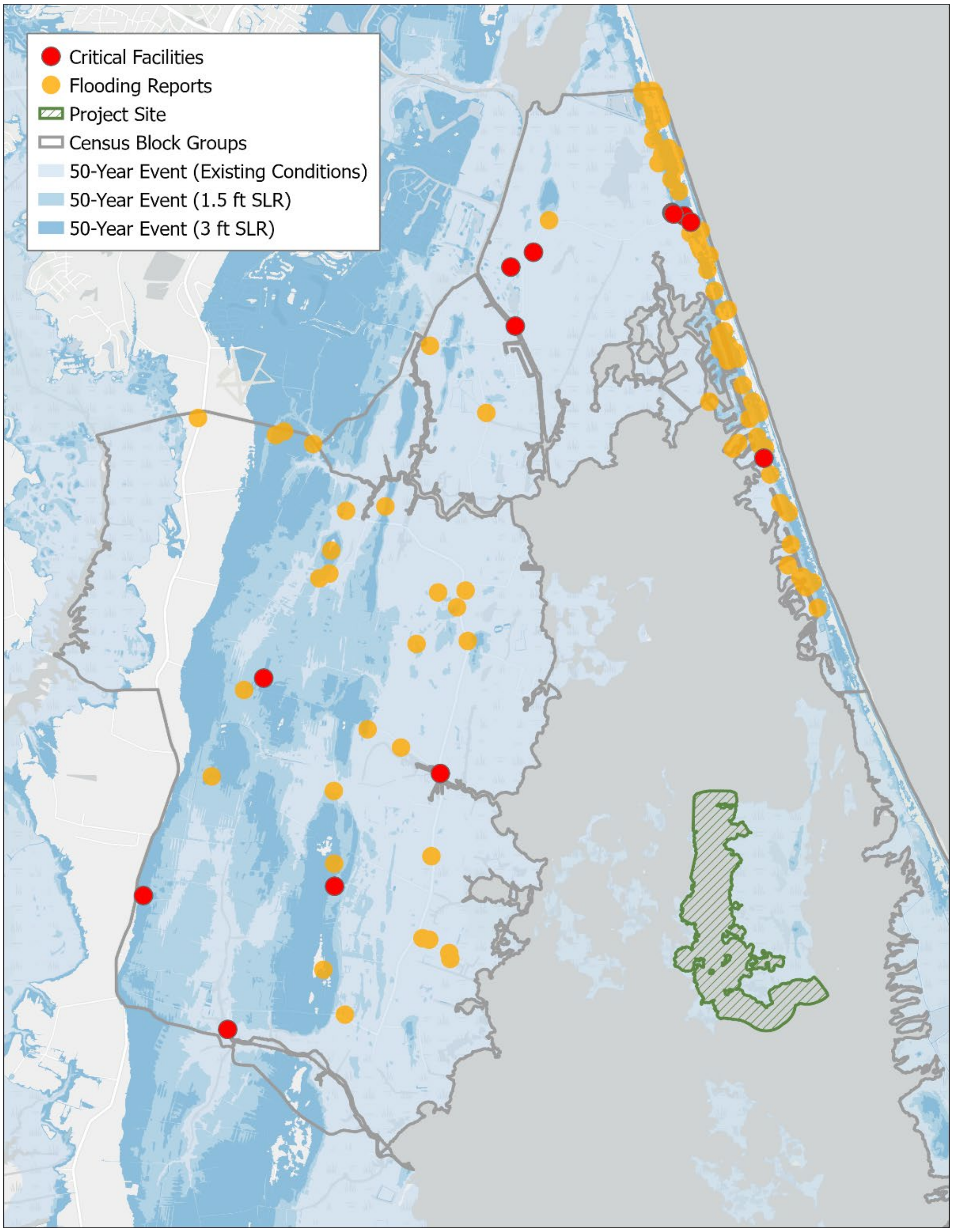

Figure 12: Critical facilities and flooding reports within project vicinity.

What would happen (or not happen) if the applicant does not receive funding?

If this project does not advance from design to construction, erosion of the adjacent marsh would continue to occur, resulting in fragmented habitat lacking the capacity to reduce wave action and slow water velocities. It is anticipated that wind-driven flooding events will continue to increase in frequency, resulting in increasing flooding of the low-lying properties and roadways surrounding northern Back Bay.

Alternatives Analysis

The proposed project offers the best approach for addressing the needs and problem statement outlined in this Scope of Work narrative. The project would result in the creation of 46.5 acres of marsh terraces, which would produce a net gain of approximately 16 acres of low/high marsh habitat by the end of the project construction compared to the No Action Alternative. The integrated system of marsh terrace ridges and perimeter rock armoring would stabilize the two critically eroding marsh islands (Long Island to the east, and a series of smaller unnamed islands to the west) from continued degradation. The tall terrace design improves the functionality and resiliency of the marsh system while also providing diversified habitat for fish and wildlife in the form of increased marsh edge as sea level rises. Numerical modeling of the preferred alternative demonstrated that the project would decrease wave heights and decrease the overall flow velocity of water moving through the project site, reducing water exchange in Back Bay during flooding events, encouraging sediment deposition, mitigating wave effects and consequent erosion, and result in localized water quality benefits. The proposed terraces would not only create a platform for vegetation growth within the marsh, but also reduce wave fetch in these large open water areas. The reduction in wave energy would lead to improved water clarity to promote the growth of SAV in the area between the terraces (approximately 310 acres).

Dredging in between the terraces to obtain sediment for the terrace cap would ensure no invasive vegetation is introduced into Back Bay, which is a high priority of the USFWS and VRMC. The dredging areas would also create valuable fish habitat to attract signature Back Bay fish and wildlife populations such as Largemouth Bass. The proposed dredging areas in between the terraces was evaluated and not anticipated to increase erosion of the adjacent marsh system. Furthermore, dredging in-situ material for building terraces is a widely accepted approach in Gulf Coast region marsh creation/terracing projects, as determined through conversations with project owners in Louisiana. Some terrace cap material will also be obtained from the Nimmo VII-A project. Through export of proven expertise from successful marsh terracing projects, this project would lay the foundation for future similar projects in the region through the development of detailed cost estimates, identification of best sources for local/regional materials, and establishment of partnerships with permitting officials at various levels of government.

Goals and Objectives

The overarching goal of this project is to construct the City's first nature-based adaptation project in the Southern Rivers Watershed and one of the CRMP's exemplary nature-based projects. This project aims to stabilize two critically eroding marsh islands from further degradation, decrease turbidity to promote the growth of aquatic vegetation, and provide flood risk reduction benefits through increased friction and wave attenuation. Table 1 below provides a high-level overview of the specific objectives established to solve the problem/need identified – specifically habitat degradation and wind tide flooding along with measure(s) of success. A more detailed description of these objectives is provided in the Supporting Documentation section.

Table 1: Overview of Project Objectives.

Objectives	Description	Measure(s) of Success	Timing of Measures
Objective 1	Create a Construction Access and Staging Area	a. Secured permits for construction. b. Contractor Selection. c. Construction of Staging Area.	a. December 2023 b. April-May 2023 c. June 2023 -February 2024
Objective 2	Restore Marsh and Aquatic Vegetation	a. Secured permits for construction. b. Restoration of 46.5 acres of habitat.	a. December 2023 b. March - October 2025 and March – October 2026
Objective 3	Engage Stakeholders and Disseminate Effective Practices	Number of people meaningfully engaged in the process of the project within the agreement period.	Continuous through period of performance.

Work Plan

Current Status and Ongoing Activities

The marsh terrace project design is progressing and will be ready for construction in the CFPF grant timeline. Table 2 summarizes ongoing tasks related to the project and an anticipated schedule for completion.

Table 2: Completed, ongoing, and anticipated activities leading up to construction.

Activity	Description	Schedule
Stakeholder Scoping Workshop	In November 2020, the City hosted a virtual workshop to receive initial input from project stakeholders.	Completed (Fall 2020)
Site Characterization and Vegetation Survey	In fall 2020, a site characterization and vegetation survey within Bonney Cove was conducted under a USFWS Special Use Permit (SUP). The purpose of the survey was to document existing emergent marsh and submerged aquatic vegetation (SAV) species composition and percent coverage within the proposed project area. MAP Environmental, Inc. conducted a literature review of marsh terracing projects in the Gulf Coast region to identify effective practices for project planning and design.	Completed (Fall 2020)
Bathymetric Survey	An updated bathymetric survey of Bonney Cove, also covered under a USFWS SUP, was completed in March 2021. This data serves as an input to identify appropriate design elevations to determine quantities of materials necessary to build the proposed marsh terraces and for numerical modeling of project alternatives.	Completed (Spring 2021)
Geotechnical Investigation	A geotechnical investigation of Bonney Cove was conducted in the spring of 2021. The permitted survey, (Virginia Marine Resources Commission (VMRC) Permit No. 2020-2286, U.S. Army Corps of Engineers (USACE) Permit No. 2020-02439, and USFWS SUP) included the collection of 10 soil borings in locations that avoided aquatic vegetation habitat. The soil samples were retrieved by drilling with a specialized airboat-mounted drill rig which was essential for drilling in shallow areas as it avoids disruption to bottom habitat. The soil samples were analyzed to determine the suitability and physical characteristics of the soils within the project area. Additional soil analysis was conducted to determine the suitability of Back Bay sediments for building components of the marsh terraces.	Completed (Spring 2021)

Activity	Description	Schedule
Water Quality and Hydrodynamic Survey	ODU conducted a water quality and hydrodynamic survey of Bonney Cove in the spring of 2021. The USFWS permitted survey collected water samples and deployment/retrieval of hydrodynamic sensors (pressure sensors, acoustic Doppler current profilers, and optical backscatter sensors) at three sampling points in Bonney Cove. Sensor equipment was deployed for two one-month periods (3/10/2021 – 4/12/2021 and 5/19/2021 – 6/8/2021). The water level, wave, and current data served as an input to the numerical model calibration. The water quality parameters (including pH, salinity, temperature, dissolved oxygen, chlorophyll, and turbidity) will serve as a reference to compare pre-and post-construction water quality conditions.	Completed (Summer 2021)
30% Design	Dewberry leveraged the field-collected data to establish design criteria for the project to ensure that it will be resilient in the face of changing future conditions during wind-tide events. Artistic design renderings were developed to enable stakeholders to visualize the implemented project.	Completed (Fall 2021)
Public Engagement – 30% Design	The City held a public information meeting on October 14, 2021, at Creeds Elementary School. The project team delivered a 10-minute presentation of the proposed project followed by an open-format discussion where participants reviewed the preliminary (30%) designs and artistic renderings and submitted comments regarding environmental and community impacts.	Completed (Fall 2021)
Numerical Modeling	Numerical modeling has been completed to evaluate the proposed project's impact on water levels, wave heights, and flow velocities within and surrounding the project area. Potential water quality impacts were also evaluated. The numerical modeling effort involved the development of an XBeach model, which is a nearshore model that accounts for wave-vegetation interactions based on field-derived drag coefficients.	Completed (Winter 2021)
Environmental Assessment and Scoping	In coordination with the USFWS and with technical assistance from Dewberry, the City evaluated the potential environmental impacts of the project. The draft environmental assessment document was distributed to key stakeholders with jurisdictional authority or a vested interest in the project for review and comment.	Completed (Summer 2023)

Activity	Description	Schedule
60% Design	After numerical modeling and stakeholder review of the 30% design, the engineering design plans were advanced from 30% to 60%.	Completed (Spring 2023)
95% Design and Public Engagement	The engineering design team prepared 95% engineering design plans to address comments on the 60% plan set. The City held a second public information meeting from 6:00 – 7:30 p.m. on July 13, 2023, at the Senior Resource Center in Virginia Beach where the project team delivered a 10-minute presentation of the proposed project followed by an open-format discussion where participants reviewed the 95% designs, updated artistic renderings, and submitted comments.	Completed (Fall 2023)
Construction Permit Applications Submitted	The City submitted the Joint Permit Applications for the proposed project, including the initial post-construction monitoring plan, to VMRC and the USACE in August 2023.	Completed (Summer 2023)
Modeling of Potential Adverse Impacts	In response to public concerns, the City performed additional numerical modeling of both northerly and southerly wind events and reviewed water level responses at locations in Back Bay for any potential adverse impacts. No adverse impacts were found for either type of event.	Completed (Fall 2023)
Publication of Frequently Asked Questions	The City will be publishing findings for the potential adverse impacts modeling, along with other responses to public concerns raised at the question in a Frequently Asked Questions webpage in November 2023.	In Progress (Fall 2023)
100% Design	The engineering design team prepared and submitted the 100% engineering design plans to the City for review. The plans will be finalized on receipt of any comments from the permitting process, anticipated to occur by end of 2023.	In Progress (Fall 2023)
Contractor Procurement	The engineering team will provide final plans, specifications, and construction estimates (PS&E). The City will prepare the bid Request for Proposal (RFP), provide Bid Packages, and review bids obtained, and select a construction contractor.	Planned (Winter 2023 - Spring 2024

What are the major activities and tasks?

The key activities and tasks to be competed under the agreement period are summarized in Table 3. Please refer to the Supporting Documentation section for a more detailed description of these activities and tasks.

Table 3: Overview of Activities and Tasks.

Activities	Description	Tasks
Activity 1	Construction Staging Area Preparation and Construction	1. Mobilize equipment 2. Stabilize road, establish construction staging area, abutments, install pre-engineered bridge, construct ramp to water and slurry basins. 3. Establish traffic flagging stations. 4. Install pipe and booster stations.
Activity 2	Marsh Terrace Construction	1. Construct 41 terraces (2-phased approach). 2. Demobilize equipment.
Activity 3	Stakeholder Engagement	1. Develop project marketing materials. 2. Attend and document engagement activities.

Who is responsible for completing the activities and tasks?

Responsibility for completing the project's activities and tasks lies with a collaborative effort led by the City's Department of Public Works. To ensure the successful execution of the project, the City has assembled a diverse team of consultants, advisors and subject matter experts. For a comprehensive understanding of the specific roles and responsibilities of each entity involved in carrying out the proposed scope of work, please refer to the *Supporting Documentation – Approach, Milestones, and Deliverables – Project Partner*s section of this report, which provides a detailed description of how each team member contributes to the project's overall success.

What is the timeframe for accomplishing activities and tasks?

An overview of the planned project timeline is shown in Figure 13. Grant activities will initiated in Summer 2024 with construction of the staging area and material acquisition. Please refer to the *Supporting Documentation – Approach, Milestones, and Deliverables –Milestone Schedule* section of this report for a detailed outline for each activity and associated deliverables.

Figure 13. Timeline overview for project implementation.

Identify the required partners to ensure success and where they are represented in the workplan.

A diverse team of consultants, advisors, and subject matter experts, led by the City's Department of Public Works, has been assembled to complete the project's activities and tasks. Please refer to the *Supporting Documentation – Approach, Milestones, and Deliverables – Project Partner*s section of this report for a detailed description of each team member's role, responsibilities, and contribution to the project's overall success.

Deliverables

An overview of the project deliverables is provided in Table 4. Please refer to the *Supporting Documentation – Approach, Milestones, and Deliverables* section of this report for more detail.

Table 4: Summary of Deliverables.

Activities	Deliverables
Activity 1: Construction Staging Area Preparation and Construction	1. Material acquisition. 2. Progression and completion of the construction staging area, with daily inspections to monitor progress. 3. Documented progress and completion through quarterly reports to DCR.
Activity 2: Marsh Terrace Construction	1. Progression and completion of the 2025 and 2026 construction phases, including plantings, with daily inspections to monitor progress. 2. Demobilization and removal of equipment from construction staging area. 3. Documented progress and completion through quarterly reports to DCR.
Activity 3: Stakeholder Engagement and Lessons-Learned Dissemination	1. Project marketing materials. 2. Records documenting number of stakeholders engaged during the outreach activities.

Maintenance plan tied to the identified viability of the project. Plan for sustaining the project after the agreement period (if applicable)

The City has developed a draft Annual Monitoring Plan and Post-Construction Monitoring Report that was submitted along with the Joint Permit Application for the project. See Attachment 5 for a copy of the draft report.

Project maintenance will be addressed by the City of Virginia Beach's Public Works Stormwater Operations Group. Any maintenance issues identified by the monitoring effort or other observers will be flagged to the Operations Group to address. The City intends to maintain the construction staging area to support future project maintenance needs. After completion of the monitoring program, the City will perform inspections every 2-5 years and make any repairs needed for the life of the project.

Evaluation

Indicators of Success

Indicators of success for this project have been identified during the development of the monitoring plan. Three (3) indicators of success were defined in relation to the primary objectives of the project (as defined elsewhere in this document), and include:

- The establishment of a sustainable coastal marsh island system.
- Stability of the marsh terrace structures.
- Establishment of a sustainable SAV community.

What data will be collected and how will it be used to measure success?

Data collection for the project has been detailed in the proposed monitoring plan and includes two sets of data: one set associated with as-built surveys to establish baseline reference conditions for subsequent monitoring efforts, and monitoring data to assess the success of the project in meeting the indicators defined above. Baseline and monitoring data will be compiled in an annual report and distributed to permitting agencies, and stakeholders as appropriate, to fulfill monitoring requirements and ensure success criteria are being met and maintenance needs are addressed.

Baseline data, which is proposed to be collected after the completion of each of two phases of terrace installation, will include the following data:

- Coordinates and diagrams of established transects, as well as site photographs from photo stations established along each sampling transect, as defined in the Methods section of the monitoring plan.
- Final location of all planted vegetation (upland plantings, high marsh plantings and low marsh plantings).
- Final location and extent of SAV plantings.
- Final grade topographic surveys (plan, profile, and cross sections).
- Discussion of the project design versus as-built conditions.

Monitoring data will be collected at the end of the full growing season during each monitoring year and include the following:

- Site photographs from photo stations defined in the Methods section of the monitoring report.
- Estimated percent cover and change in coverage from the as-built conditions to sampling year conditions for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- Estimated percent cover and change in coverage from planted conditions to sampling year conditions for SAV planting quadrants

- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

This monitoring data will be used to define success by tracking the establishment of the proposed vegetative communities on and between the proposed marsh terraces as well as the structural integrity of the marsh terrace structures themselves. Vegetation cover thresholds for each year will be defined to ensure planted communities are appropriately established on each marsh terrace. Acceptable measures of deviation will be defined for structural elements to ensure design requirements are met. Maintenance and mitigation measures defined in the monitoring plan will be implemented as required if success criteria are not met during any particular monitoring year.

How was cost effectiveness evaluated and measured against the expected outcomes?

Through a BCA approach using FEMA methods and ecosystem service valuations, a BCR of 1.17 was calculated for the project. This BCR is greater than 1, indicating the project can be considered cost-effective. The project also provides an additional $9.2M in value over the current estimated project costs.

A description of the BCA analysis and methods is provided in the following Benefit Cost Analysis Section.

What products, services, meetings, outreach efforts etc. will be conducted and how will success be measured?

The City is firmly dedicated to fostering meaningful engagement with project partners and external stakeholders throughout the project, with the goal of raising awareness about the project's approach and its benefits and enhancing the likelihood of its successful adoption in other areas within the region and the state.

Activity 4, titled "Stakeholder Engagement and Lessons-Learned Dissemination," provides a comprehensive outline of the City's outreach strategy, encompassing proposed deliverables and outreach endeavors. This strategic plan entails the development of project marketing materials, along with the facilitation of presentations and meetings with local and regional stakeholders, as well as participation in state and national-level conferences.

To gauge the effectiveness of our efforts, the City will employ metrics to track and document the number of individuals engaged throughout the project. This information will be regularly communicated to DCR to serve as a key performance indicator for project success.

For a more detailed breakdown of the tasks and deliverables associated with Activity 4, please refer to the Supporting Documentation section of this application.

Project Progress Monitoring Plan

The City's Project Progress Monitoring Plan is designed to guarantee the seamless and effective execution of the project. We have established a robust internal system to oversee the entire project lifecycle, ensuring that all key stakeholders are aligned with the project's objectives, activities, deliverables, and schedule.

The process commences with a kickoff meeting involving all project partners, where we collectively set the stage for the project. During this meeting, we thoroughly review the project's objectives and scope, ensuring that everyone is on the same page. This initial step is instrumental in fostering a shared understanding of the project's vision and goals among all involved parties.

In addition to the kickoff meeting, we place a strong emphasis on quality assurance and control. We meticulously assess each contractor's quality management system to ensure that well-defined procedures are in place to maintain the highest standards of quality throughout the project. This dedication to quality is paramount to delivering a successful project that meets the City's standards and the expectations of our stakeholders.

The City is committed to ongoing and transparent communication with our design and construction contractors, as well as our advisory stakeholders. Regular meetings will be held to monitor progress, address any potential challenges, and ensure the project adheres to the proposed milestone schedule and deliverables as outlined in this grant application. This proactive approach to project monitoring allows us to stay on track, identify and address issues promptly, and uphold our commitment to the successful completion of the project.

Supporting Documentation

Project Information

The following sections provide details regarding the project site and highlight the impacted population, residential and commercial structures, and critical facilities. This section also provides an overview of the historical, existing, and projected flood conditions in and around the project site.

Population

As shown in Figure 14, two census block groups (518100454.121 and 518100464.001) adjacent to Back Bay are within the extent of the anticipated project benefits. The total population of these two block groups is 3,531.[6] The residential population has grown approximately 1.8% in the past two decades. The median household income in 2021 dollars is $99,078. There are approximately 2,500 residential housing units, of which 43.1% are owner-occupied, 11.4% are renter-occupied, and 45.5% are vacant. The high percentage of vacant housing units can likely be attributed to seasonal rentals within the Sandbridge Resort Area. The race and ethnicity demographics of the community are 94.4% White, 1.4% Black, 3.4% Hispanic, and less than 1% Asian and American Indian.

[6] Population, household income, housing units, and demographic data obtained from Esri ArcGIS Community Analyst (2022). Esri forecasts for 2021 based on U.S. Census Bureau 2010 data.

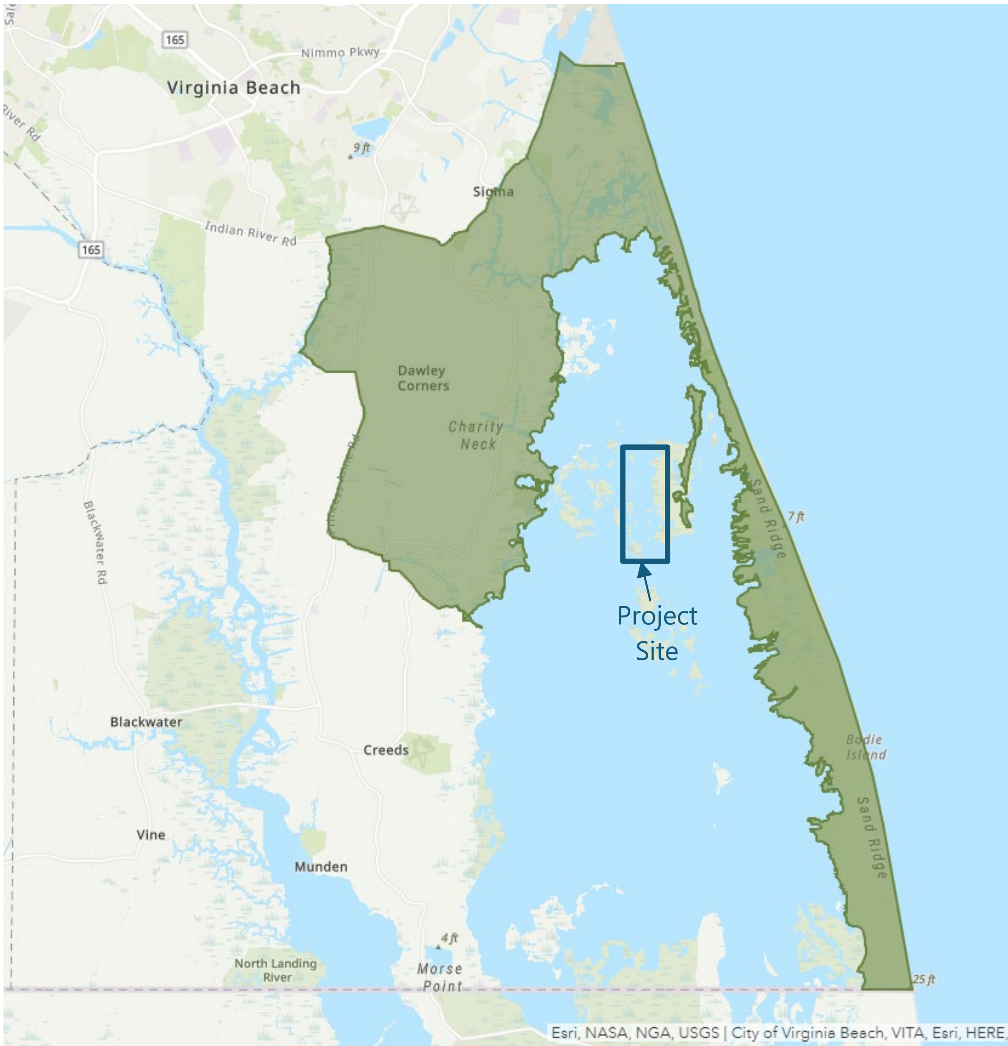

Figure 14: Census block groups selected for population estimates.

Historic Flooding Data and Hydrologic Studies Projecting Flood Frequency

Historical and Existing Flood Data

The project is located within a Federal Emergency Management Agency (FEMA) mapped Special Flood Hazard Area (SFHA), as shown in Figure 15 and Figure 16. Based on the City's current flood maps (effective January 16, 2015), the project site's flood zones are VE, AE, and Open Water. Portions of the site are within Otherwise Protected areas.

The following maps provide an overview of the existing flood hazards for the project area, including the northern boundary (Figure 15) and southern boundary (Figure 16). Based on the City's current flood maps (effective January 16, 2015), the project site contains VE and AE flood zones and Open Water.

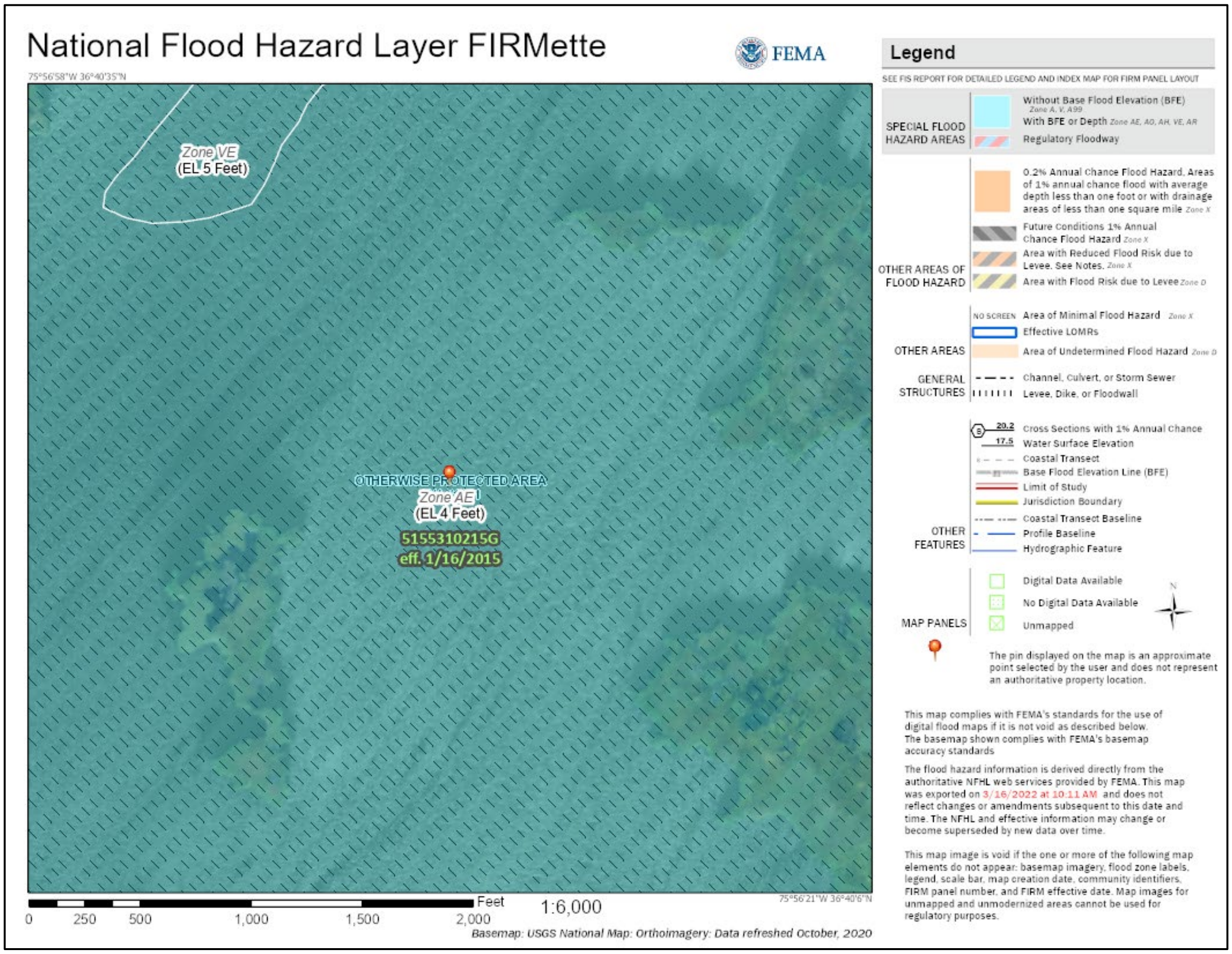

Figure 15: FIRMette for the project area (northern boundary).

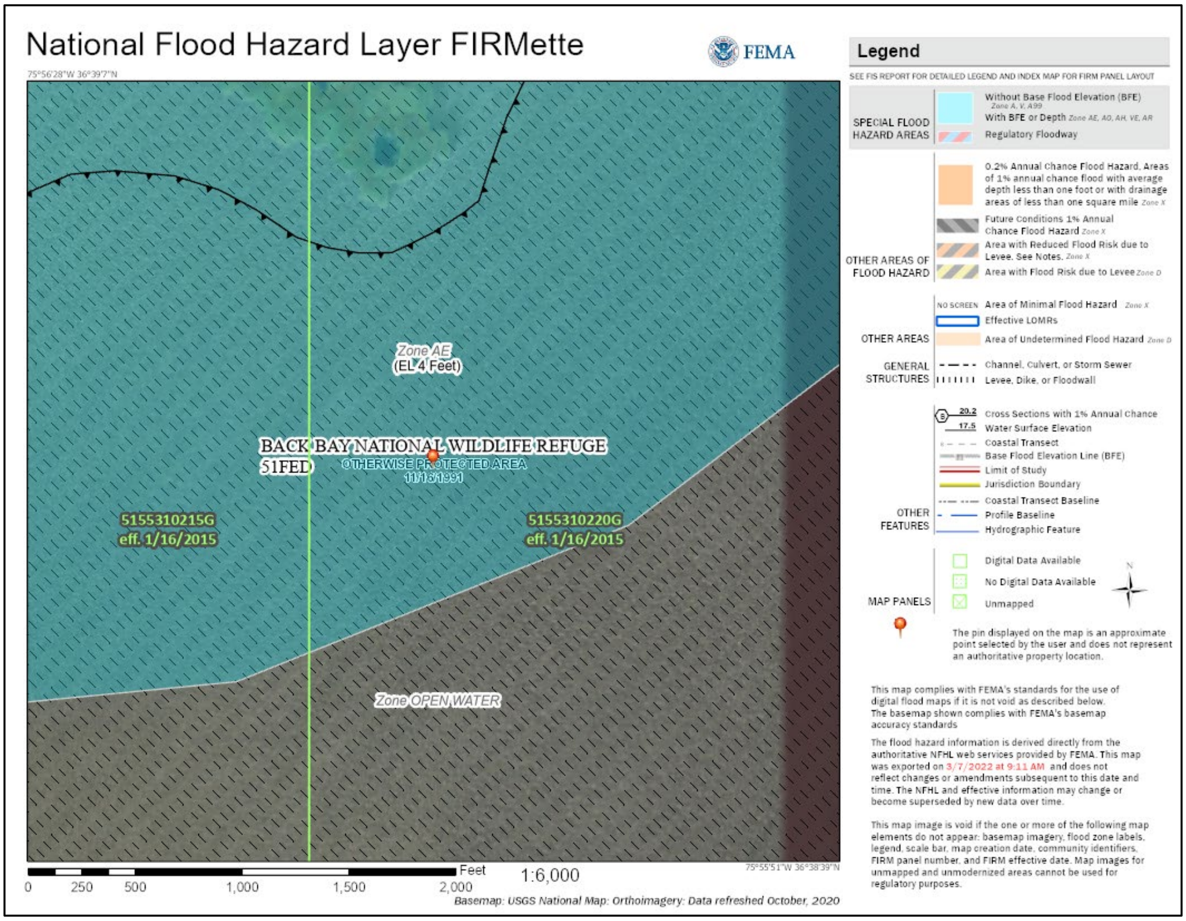

Figure 16: FIRMette for the project area (southern boundary).

The City maintains records of where residents report flood issues and what type of flooding is causing the issue. Residents regularly report flood issues through a hotline, which are then recorded in a flood event database. The census block groups adjacent to the project area reported 111 flood issues associated with heavy rain or high tide between 2001 and 2019. Critical facilities and flood incidences are relatively concentrated in the Sandbridge Resort Area.

Projected Flood Frequency

The USFWS, the City, and other stakeholders have made significant investments in detailed assessments, sophisticated computer models, and water level gauges to better understand historical and future wind tide flooding. Figure 17 displays the projected flood pathways under the 10-year and 100-year storm event under a 3 feet sea level rise scenario surrounding the project site.

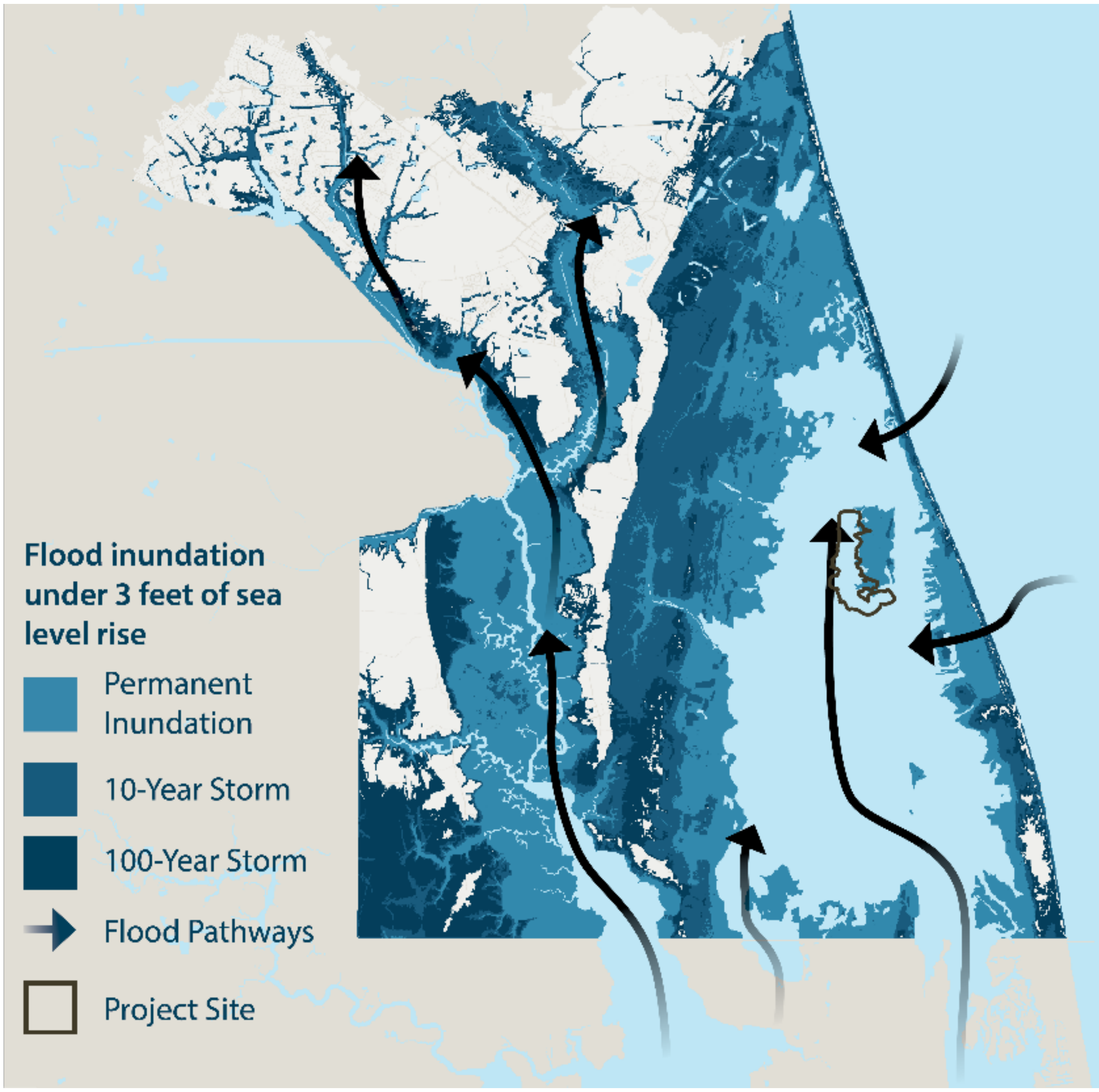

Figure 17: Flood pathways into the Southern Rivers Watershed with 3 feet of sea level rise.

Numerical modeling also shows that as sea levels continue to rise, a shorter duration wind event will produce more wind-induced flooding in less time. The three lines in Figure 18 represent the water level response to a sustained 15-mph wind for each sea level rise scenario. With the existing marsh system today (blue line), it takes approximately five days of sustained southerly wind to cause flooding. With 1.5 feet (yellow line) and 3 feet (red line) of sea level rise, the peak water level could be reached two to three days sooner, respectively. Model simulations showed that marsh island creation across Back Bay would help delay the onset of flooding by several days, which would allow the City and residents more preparation time[7].

[7] City of Virginia Beach. (2018). Analysis of Marsh Response to Sea Level Rise (PDF).

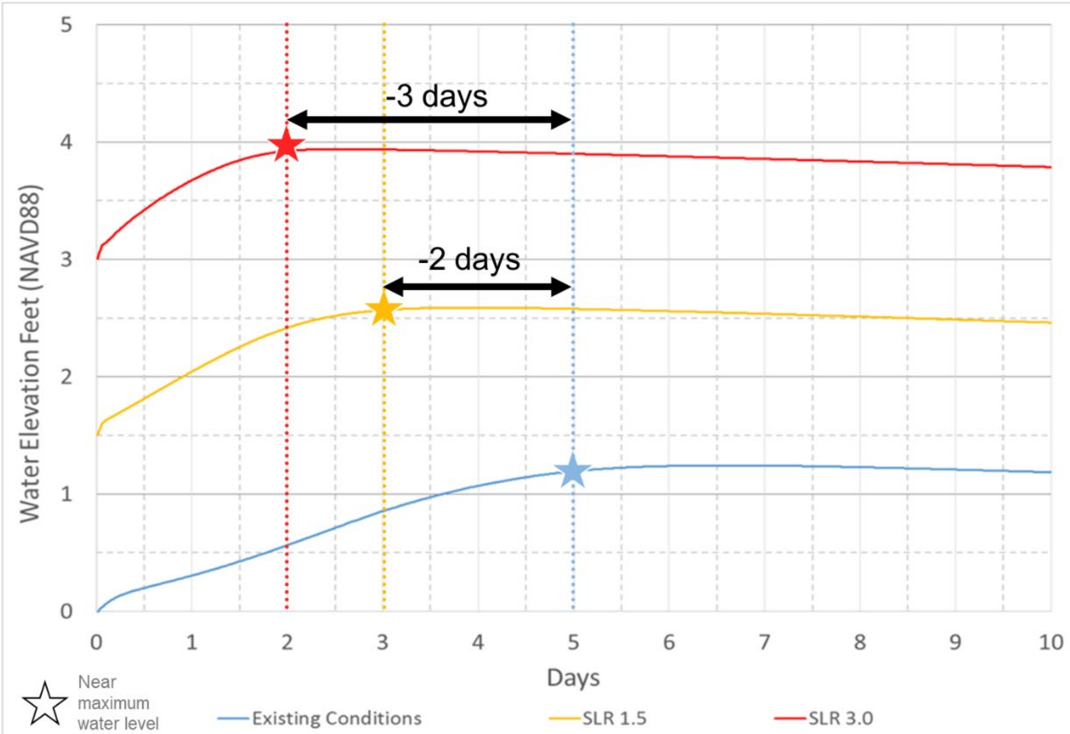

Figure 18: Water-level response under sustained 15-mph southerly wind.

The City analyzed future marsh conditions using the Sea Level Affecting Marshes Model (SLAMM).[7] Figure 19 illustrates areas likely to experience accelerated degradation of marsh in Back Bay due to rising water levels. If no action is taken, substantial marsh loss is projected in Bonney Cove under 3 feet of sea level rise. Within a 1-mile radius of Bonney Cove, the City's SLAMM model predicts that approximately 730 additional acres could be eroded into open water in response to sea level rise. This represents more than a 70% reduction as compared to the existing marsh system surrounding Bonney Cove today. It is also presumed that open water areas would continue to experience high levels of turbidity, which will continue to negatively affect SAV communities in Back Bay.

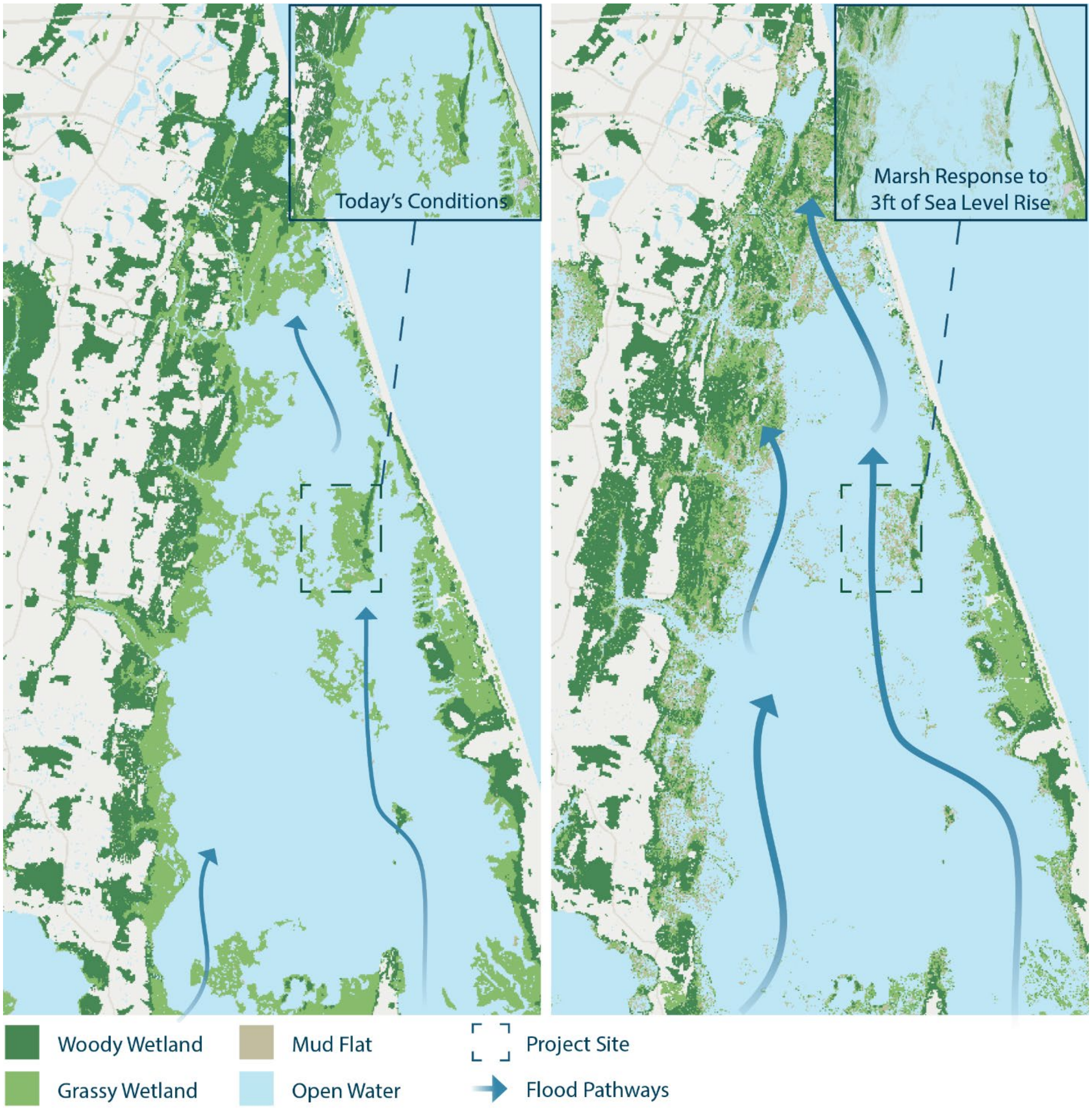

Figure 19: Comparison of current marsh conditions to future marsh conditions with 3 feet of sea level rise.

The proposed project site in Bonney Cove has a predominant south-southwest wind direction, which contributes to significant wave generation in the large unobstructed open-water areas and provides a continuous source of scouring and erosion in those areas. Marsh loss is likely to continue in the project area, creating a negative feedback cycle as continued fragmentation of the marsh would further deteriorate the remaining stands of healthy marsh and increase fetch. Today, the site faces low to medium fetch exposure, but in the future, the site could experience high to very high fetch exposure, as defined by the Virginia Institute of Marine Science (VIMS)

Shoreline Design Guidelines for Shore Protection in Virginia's Estuarine Environments.[8] Projections of increasing fetch at the site, along with the transects used for the wind fetch analysis, are summarized in Figure 20.

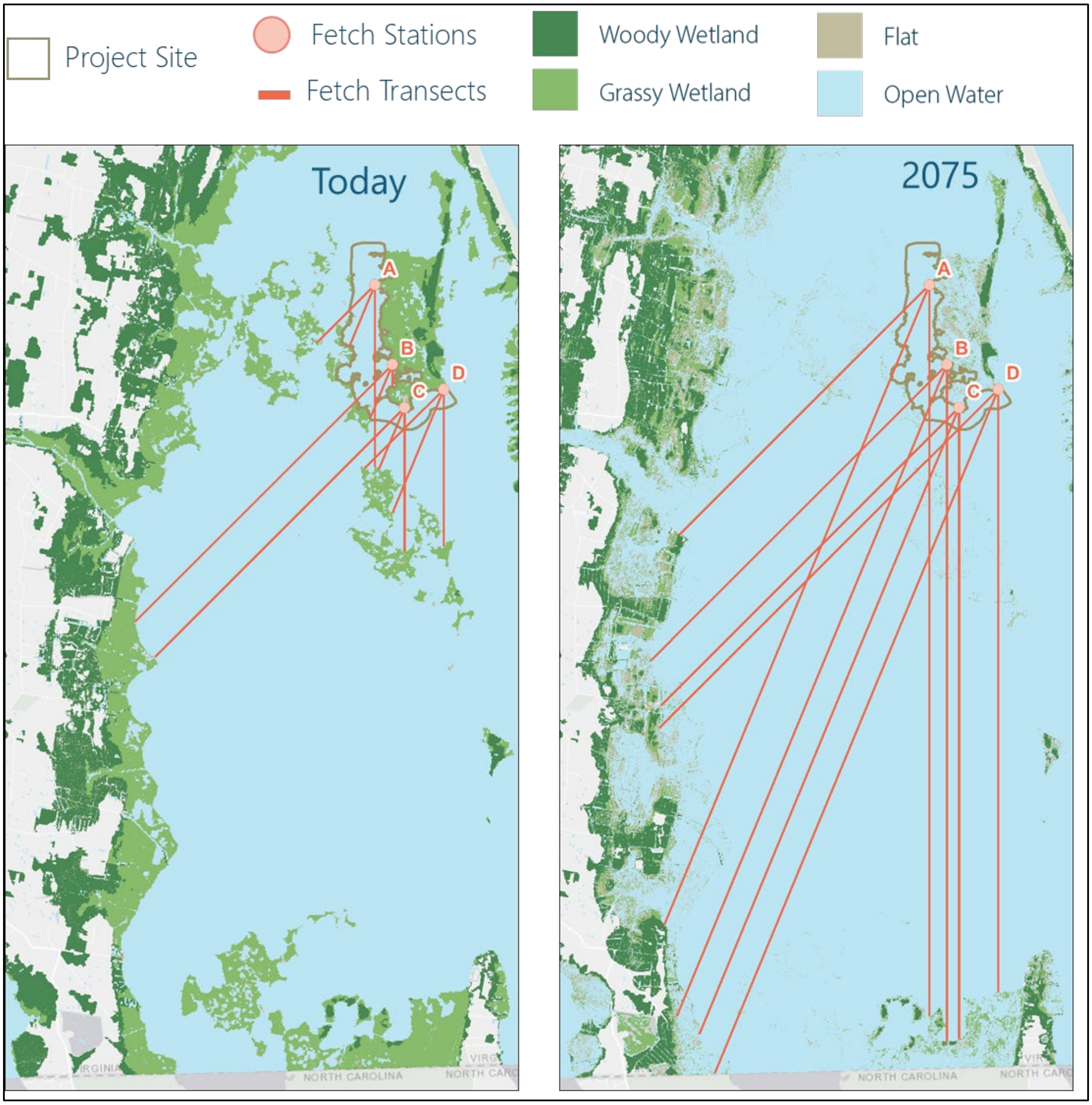

Figure 20: Wind fetch analysis of project area.

The following table displays specific values of fetch distances and classifications that correspond with the transects displayed in Figure 20 above.

[8] Virginia Institute of Marine Science. (2010). Living Shoreline Design Guidelines for Shore Protection in Virginia's Estuarine Environments; Version 1.2 (PDF).

Table 5: Measurements of fetch transects referenced in Figure 20.

Fetch Transect	Length, Miles (Today)	Classification	Length, Miles (3 feet SLR)	Classification
A-SW	0.9	Low	3.7	High
A-SSW	0.7	Low	7.3	Very High
A-S	1.9	Medium	7.7	Very High
B-SW	3.8	Medium	4.4	High
B-SSW	0.6	Low	7.4	Very High
B-S	0.2	Very Low	7.2	Very High
C-SW	3.7	Medium	4.4	High
C-SSW	0.7	Low	7.2	Very High
C-S	1.5	Medium	6.7	Very High
D-SW	1.2	Medium	5.1	Very High
D-SSW	1.4	Medium	7.8	Very High
D-S	1.7	Medium	6.4	Very High

No Adverse Impact

The City conducted additional hydraulic numerical modeling to identify any potential adverse impacts in response to concerns raised during a public meeting in July 2023. The City utilized a Danish Hydraulic Institute MIKE FLOOD model developed for stormwater master planning activities in Lower Southern Rivers Watershed of Virginia Beach. This model encompasses the entirety of Back Bay and extends into North Carolina’s Currituck Sound. Model performance has been validated against observations from multiple flood events.

The effort looked at water level and velocities in response to a historical southerly wind tide flood in May 2017 and a northerly wind event associated with Tropical Storm Ophelia in September 2022. These events were ran with model grids depicting with- and without project conditions, considering the 100% project design specifications. The northerly wind event was

included to address concerns from residents of Knott's Island, at the southern end of Back Bay. Both the terrace field and the construction staging area were included in the with-project condition. The modeling found that there were no increases in water levels to areas within Back Bay or to Knotts Island. Negligible changes in water velocity (0.2 ft/s or less) were observed in the channel to the west of the terrace field. No increases in water levels were observed in the area of the construction staging area.

Local Government to Provide its Share of the Cost

The City of Virginia Beach is fully prepared to cover the cost share of the proposed project, as highlighted in the attached budget narrative, "Amount of Cash Funds Available." The funding for the grant match is contained within the City budget.

Benefit-Cost Analysis

FEMA recognizes the economic value of restoration projects and has provided ecosystem service economic valuations for benefit cost considerations. The approach and values used here are consistent with FEMA Benefit-Cost-Assessment (BCA) toolkit approaches and ecosystem service valuations published in "FEMA Ecosystem Service Value Updates, June 2022[9]." The 2022 FEMA guidance provides methods and values for various nature-based projects, including coastal wetlands. The valuations recognize ecosystem services for coastal wetlands including aesthetic value, climate regulation (carbon sequestration), flood and storm hazard reduction, habitat, recreation/tourism, water filtration and supply benefits of coastal wetland features.

Feasibility and Effectives Criteria

The project meets FEMA's Feasibility and Effectives Criteria for a Coastal Wetland as defined in the 2022 guidance, including:

- Land cover associated with the project is a "Estuarine and Marine Wetland" as classified for NWI for remaining marsh within and adjacent to the study area. The area of the project is also a historical marsh.
- The project demonstrates "ecosystem restoration" by using the terrace approach to recover degraded, damaged, and destroyed wetlands and submerged aquatic vegetation in the Back Bay ecosystem.
- The project meetings EPA concepts of restoration through direct creation of marshes (the terraces themselves) and enhancement of the ecosystem (reduction of water turbidity to enhance growth of submerged aquatic vegetation).
- The project will result in notable increased health and function of the local ecosystem in the "after mitigation" scenario through reduction of wave heights, water flow, and significantly decreased turbidity within the project area, as well as reduction of wave heights to adjacent areas.

[9] FEMA Ecosystem Service Value Updates, June 2022 (PDF).

- The project approach was aligned with established principles and techniques on wetland restoration, as outlined in the Coastal Wetlands and Tidal Flats section of the International Guidelines on Natural and Nature-base Features for Flood Risk Management10.

Design Life

As mentioned, the project useful life is 30-years. The FEMA 2022 guidance allows 50-years a typical lifespan; however, as stated in the project description, the elevation of the terraces was set based on a 30-year design life and estimated settlement.

Ecosystem Services Valuation

- The 2022 guidance values ecosystem services for coastal wetlands at $8,955 in 2021 U.S. dollars (USD), per acre, per year.
- The project will restore 46.5 acres of intertidal and upland marsh through direct creation of the marsh terraces. The project will also promote the growth of SAV in between the terraces, an area estimated at 310 acres. This provide for a total project benefit area of (46.5 + 310) = 356.5 acres.
- Project benefits occur over a period of time into the future; while most of the project costs are incurred up front and in the present. FEMA conducts its BCAs on a net present value basis, meaning the present value of the benefits gained from the project over the life of the project are compared to the total project cost to establish the BCR. Because project benefits accumulate over time, project benefits are calculated on an average annual basis ("annualized") and then multiplied by a Present Value Coefficient (PVC) to determine the present value of the annualized benefits.
- The present value coefficient is calculate as follows:

$$PVC = \left[\frac{1-(1-r)^{-T}}{r}\right]$$

where *r* is the discount rate and *T* is the useful life of the project. The CFPF 2023 Grant Manual does not specify a discount rate for the benefits calculation; therefore, the latest FEMA program grant guidance was reviewed. For the 2023 FEMA Building Resilient Infrastructure and Communities (BRIC) and Floodplain Mitigation Assistance Grant Program (FMA) cycles FEMA has established a set discount rate of 3%[11]. The 3% discount rate provides for a PVC of 19.60 for a 30-year lifecycle for the project.

- Project benefits were calculated by:

$$Benefits = PVC \times Project\ Area \times Coastal\ Wetland\ Benefits$$

- The benefit cost ratio (BCR) was calculated as:

[10] International Guidelines on Natural and Nature-Based Features for Flood Risk Management - Engineering With Nature (dren.mil)

[11] FEMA Fact Sheet. Notice of Funding Opportunity for Fiscal Year 2023 Building Resilient Infrastructure and Communities Program (PDF).

$$BCR = \frac{Benefits}{Costs}.$$

A summary of the calculated values is provided in the below table:

Table 6. Summary of BCA parameters and results.

Project Area	Benefits (acre / year, 2021 USD)	Project Lifespan	Benefits, 3% discount rate	Project Cost	BCR, 3% discount rate
356.5	8,954	30	$62,566,588	$53,378,490	1.17

The calculated BCR for the project was 1.17, based on the FEMA ecosystem services valuation approach. This BCR is greater than 1, indicating the project can be considered cost-effective. The project also provides an additional $9.19M in value over the project cost.

Local Floodplain Management Regulations

The City recognizes the vital importance of floodplains in the natural movement of water through the community. Appendix K of the Virginia Beach Code of Ordinances regulates development in the community's floodplains. The City requires that a permit is obtained for any construction or development in the Special Flood Hazard Area. For more information and details regarding the City's floodplain management and ordinances, please refer to the following:

- Link to current floodplain ordinance: Virginia Beach Floodplain Ordinance.

In addition, a copy of the current floodplain ordinance has been included in *Part IV, Section E5*. For further information regarding the City's hazard mitigation and comprehensive planning, please refer to the following:

- Link to current hazard mitigation plan: Regional Hazard Mitigation Planning.
- Link to current comprehensive plan: Virginia Beach Comprehensive Planning.

Other Necessary Information to Establish Project Priority

Repetitive Loss and/or Severe Repetitive Loss Properties

The repetitive loss database shows 113 repetitive loss and severe repetitive loss properties within the two census block groups (518100454.121 and 518100464.001) associated with the project area.

Residential and/or Commercial Structures

A detailed economic flood loss assessment presented in the City's Resilience Plan showed that approximately 45% of the entire future risk exposure in the City is concentrated in the Southern Rivers watershed. Of that risk, 65% is concentrated in three communities north of Back Bay

(Figure 21).[12] Under a "no action" scenario, average annualized flood losses would increase from $974 thousand, representing present day conditions, to $6 million with 1.5 feet of sea level rise as anticipated by 2050. This figure equals an increase of six times present day conditions. With 3 feet of sea level rise as anticipated by 2080, annualized losses are expected to drastically increase to $80 million, more than 80 times today's conditions.

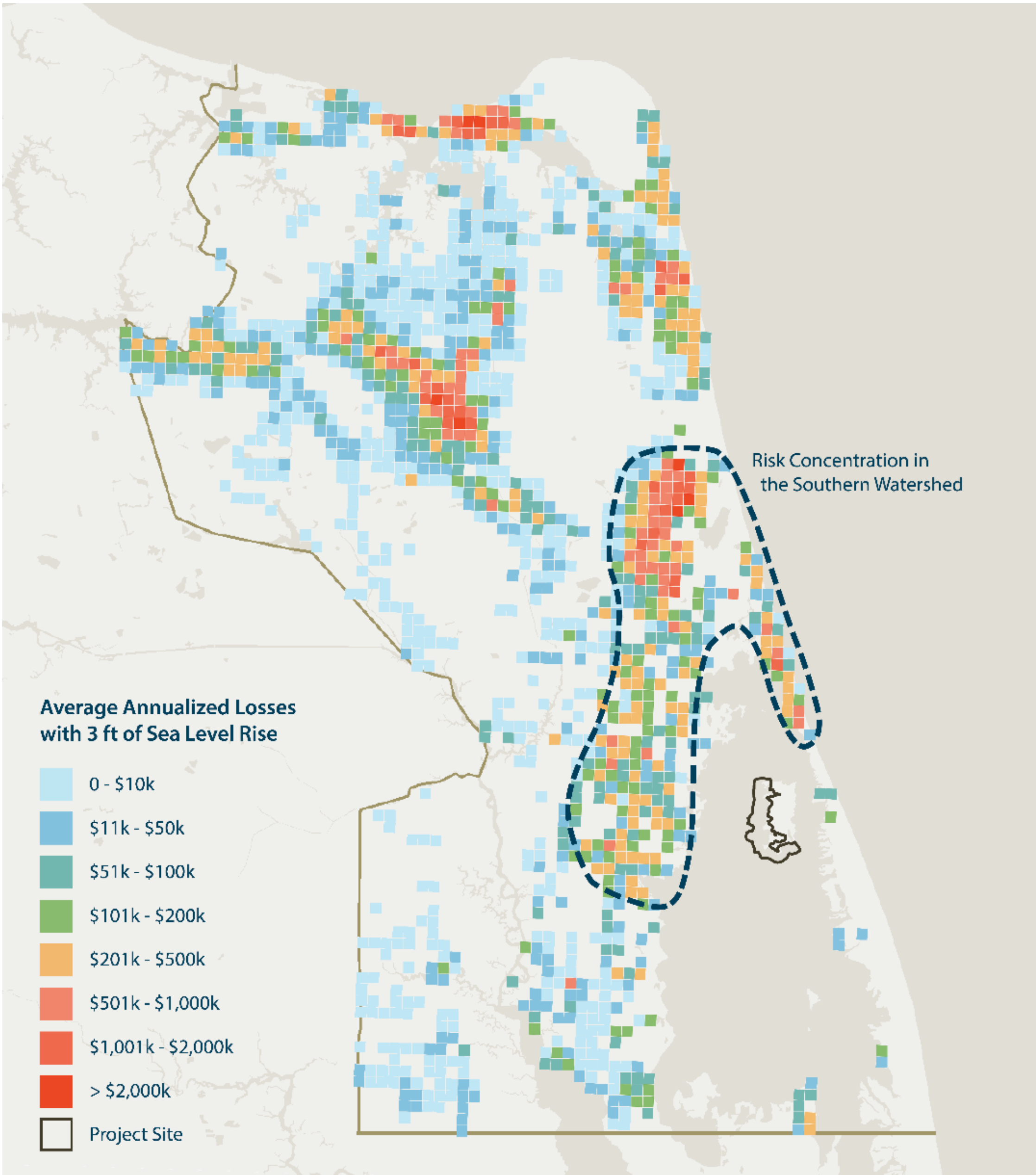

Figure 21: Concentration of average annualized losses estimated with 3 feet of sea level rise under a "no action" scenario presented in the City's Resilience Plan.

[12] City of Virginia Beach. (2020). Coastal Flooding and Economic Loss Analysis (PDF).

Within the two census block groups adjacent to Back Bay near the project area, there are approximately 70 commercial structures and 2,350 residential structures. Of those structures, approximately 635 structures are vulnerable to flooding during a 50-year event today. With 3 feet of sea level rise, approximately 2,060 structures are expected to be vulnerable during a 50-year event, representing approximately 85% of the residential structures within the project vicinity. These numbers underscore the importance of implementing the proposed project alongside complimentary flood risk reduction projects.

Critical Facilities

The two census block groups near the project site include 10 critical facilities. Table 7 summarizes critical facilities by type, total number, and the number of facilities exposed to the 50-year storm scenario under current and future "no action" scenarios. Under current 50-year storm conditions, 2 communication facilities and 1 electric power station would be exposed to flooding. With 3 feet of sea level rise, the number of critical facilities exposed to flooding increases to 9 total facilities.

Table 7: Summary of critical facilities located in the selected census block groups and flood hazard exposure to the 50-year storm event under current conditions and with 1.5 feet and 3 feet of sea level rise.

Type of Facility	Number of Facilities	Current 50-year storm	50-year storm with 1.5 feet sea level rise	50-year storm with 3 feet sea level rise
Communication	3	2 (66%)	2 (66%)	3 (100%)
Electric Power	1	1 (100%)	1 (100%)	1 (100%)
Fire Station	1	0	0	0
Potable Water	2	0	2 (100%)	2 (100%)
School	1	0	0	1 (100%)
Wastewater Treatment	2	0	0	2 (100%)

Need for Assistance

The City of Virginia Beach has invested significant time, money, and staff resources in understanding, communicating, and planning for the threats of sea level rise and recurrent flooding to the community. The City is ready to begin the implementation of adaptation measures, and the marsh terrace project is the first project to advance to construction from the City's Resilience Plan. The project represents the first step in restoring Back Bay and the larger Albemarle-Pamlico estuary, and serves as a pilot for additional restoration projects. Virginia Beach understands that flood mitigation costs are substantial and is seeking funds to support project implementation alongside dedicated resources procured by the City. The City's

Department of Public Works Stormwater Engineering Center has closely coordinated with the City's Department of Planning & Community Development throughout the design and permitting process. The Department of Public Works will oversee the construction of the marsh terrace project, including providing construction inspectors to monitor that the project is built to the City's design standards and technical specifications. Additionally, the City has access to necessary software, including AutoCAD and ArcGIS Desktop, and support from consultants to augment the City's technical capabilities.

Examples of City staff who will support the project include the following:

- Program Manager for the Technical Services Division of the Stormwater Engineering Center.
- Project Manager for Green Infrastructure Projects for the Technical Services Division of the Stormwater Engineering Center.
- Environmental Planner / Certified Floodplain Manager from the Wetlands & Shoreline Construction Team of the Planning Administration Division of the Department of Planning & Community Development.
- Planning Evaluation Coordinator from the Chesapeake Bay Preservation Area & Southern Rivers Watershed Team of the Planning Administration Division of the Department of Planning & Community Development.
- Full-time Construction Inspector assigned exclusively to this project from the City's Construction Bureau or under contract with the City Public Works Engineering Division.
- Grant Coordinator from the City's Public Works Engineering Division.

Additional staffing will be provided as needed to ensure project success.

This project benefits communities in northern Back Bay with a high concentration of flood losses (as shown in Figure 21). These communities contribute significantly to Virginia Beach's rural economy, including agriculture, forestry, fishing, hunting, and eco-tourism. In Hampton Roads, these industries contribute a combined $100 million in gross domestic product.[13] Protection of vulnerable natural infrastructure, such as the marshes in Back Bay, is critical to ensuring these industries can continue to thrive within the region.

Alternatives

Several other alternatives were considered but not advanced due to technical and environmental limitations. These alternatives are briefly summarized below.

[13] Office of Governor Ralph S. Northam Commonwealth of Virginia and Virginia Department of Conservation and Recreation. (2021). Virginia Coastal Resilience Master Plan Phase 1 (PDF); data referenced sourced from the US Bureau of Economic Analysis. (2019).

Alternative 1 - No Action Alternative

Under this alternative, no action would be taken to restore marsh habitat in the shallow open water channel of Bonney Cove. Erosion of the adjacent marsh would continue to occur, resulting in fragmented habitat lacking the capacity to reduce wave action and slow water velocities. It is anticipated that wind-driven flooding events will continue to increase in frequency, resulting in increasing flooding of the low-lying properties and roadways surrounding northern Back Bay.

Alternative 2 - Alternative Terrace Configuration Design(s)

Several configuration alternatives for the terraces were considered during the design process. These included four alternative layouts with different spacing and terrace top widths:

- **Alternative 2a** (Figure 22): Terraces would be spaced at approximately 300-foot intervals and have a top width of 15 feet. Between the base of the terraces, there would be approximately 220 feet for potential establishment of SAV habitat.
- **Alternative 2b** (Figure 23): Terraces would be spaced at approximately 300-foot intervals and have a top width of 30 feet. Between the base of the terraces, there would be approximately 200 feet for potential establishment of SAV habitat.
- **Alternative 2c** (Figure 24): Terraces would be spaced at approximately 600-foot intervals and have a top width of 15 feet. Between the base of the terraces, there would be approximately 520 feet for potential establishment of SAV habitat.
- **Alternative 2d** (Figure 25): Terraces would be spaced at approximately 600-foot intervals and have a top width of 30 feet. Between the base of the terraces, there would be approximately 500 feet for potential establishment of SAV habitat.

A common feature across all of these design alternatives was a breakwater that spanned the entire length of the southern extent of Long Island and a northern breakwater that spanned the northern exposed section of the project site.

Alternative 2a and 2b were eliminated due to constructability concerns regarding the quantity of sediment that would be required and due to the limited amount of room for SAV establishment in between the terraces (approximately 220- and 200- feet of potential SAV habitat between terraces for Alternative 2a and 2b, respectively).

Alternatives 2c and 2d were discussed extensively amongst the project team; however, it was ultimately determined that they did not maximize the opportunity for species diversity (by including both smaller and larger terraces). These alternatives were combined to form the preferred alternative presented in this document. Additional refinements that were made to these alternatives include the removal of the perimeter breakwater, as the proposed design elevation evaluated in the geotechnical analysis revealed stability issues with these large features.

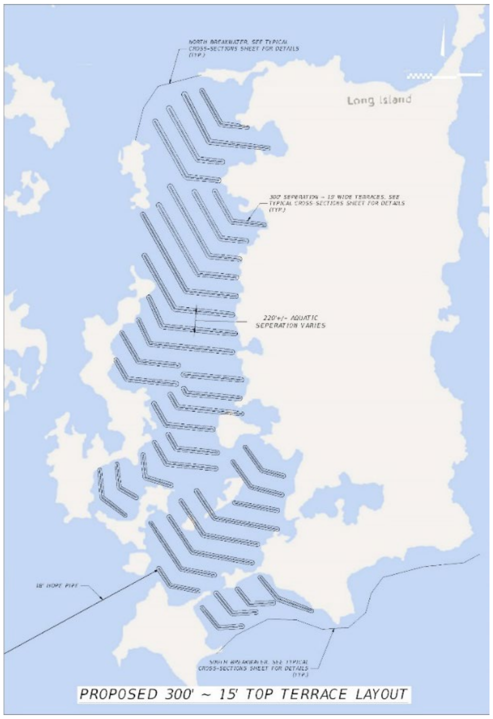

Figure 22: Alternative 2a.

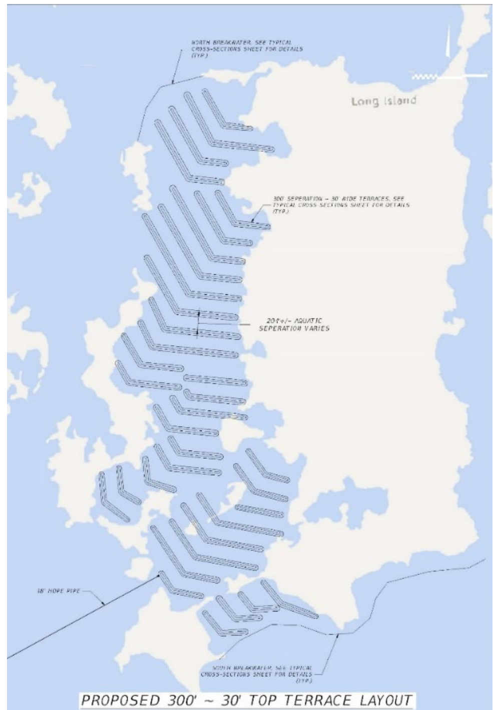

Figure 23: Alternative 2b.

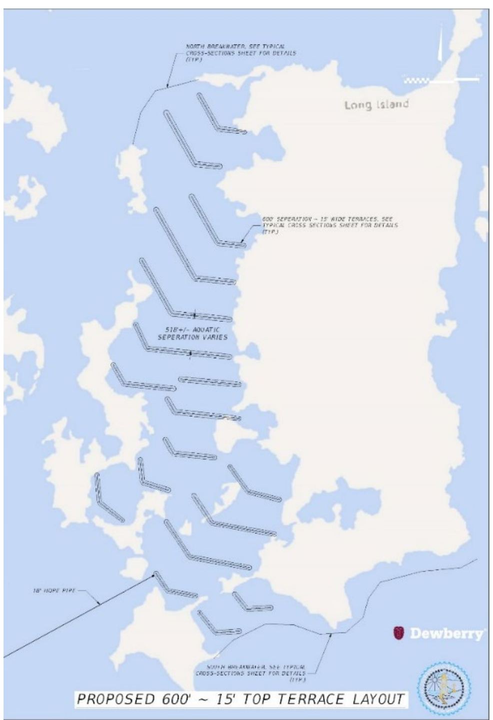

Figure 24: Alternative 2c.

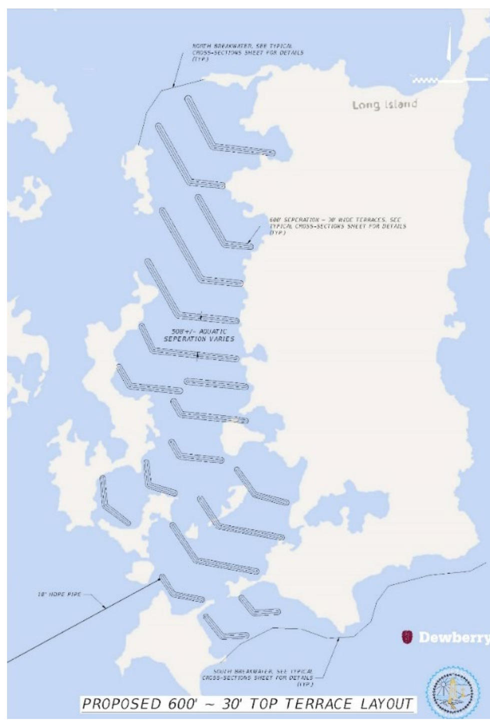

Figure 25: Alternative 2d.

Alternative Terrace Core Material Sources and Transportation – Alternative 3

In the proposed alternative with sand cores, a no-dredging alternative was considered. However, in order to successfully complete the project and establish the vegetation desired, material would need to be sourced, blended, transported, and placed. The City helped identify two potential borrow sources of material: Bow Creek Golf Course (Figure 26) and the Whitehurst Dredged Material Management Area (DMMA) (Figure 27).

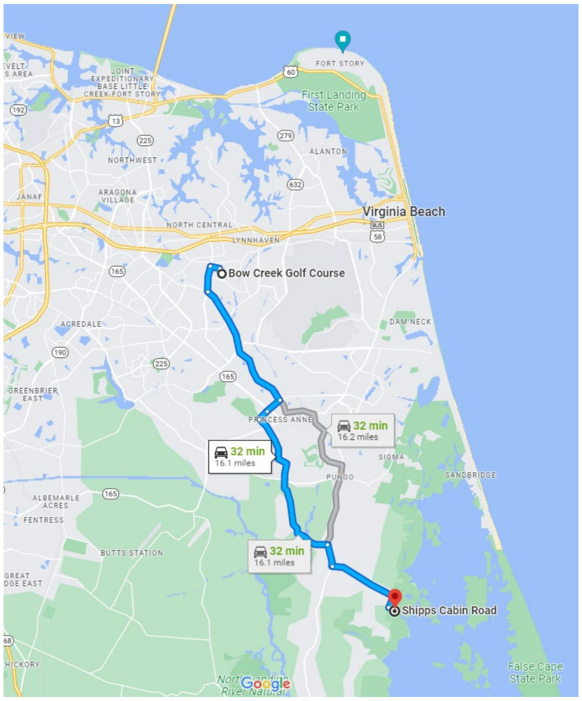

Figure 26: Distance from Bow Creek Golf Course to the proposed Shipps Cabin staging area.

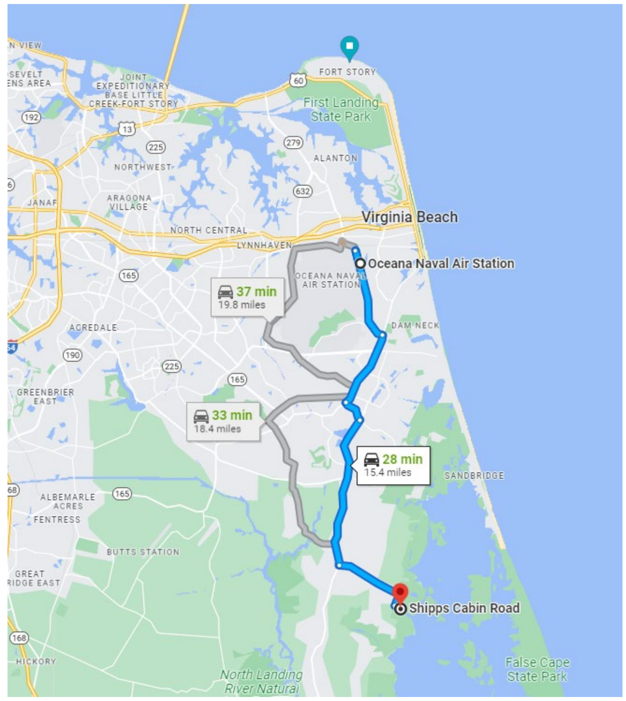

Figure 27: Distance from Whitehurst DMMA to the proposed Shipps Cabin staging area.

Bow Creek Golf Course: Bow Creek Golf Course is located approximately 16 miles from the proposed Shipps Cabin staging area. In the next few years, The Bow Creek Golf Course is scheduled to be converted into a Stormwater Park as one of 21 projects funded by the City's Stormwater Flood Protection Program. Large quantities of materials will be removed from the site for use within the City. The material from Bow Creek would need to be excavated, screened, and tested for foreign seeds and contaminants. Most likely, this material would have to be processed before it could be loaded again on dump trucks and hauled approximately 16 miles to a potential staging area where it would be loaded again on shallow draft barges.

Whitehurst DMMA: The Whitehurst DMMA is a similar distance to the proposed Shipps Cabin Road Construction Staging Area. The material at Whitehurst may not have to be processed as much; however, it would need to be tested for foreign seeds and contaminants. Because of the organic components in this soil and the need for the material to establish vegetation on the terraces, this material is not able to be hydraulically blended and pumped to the site. Therefore, this material would need to be loaded on shallow draft barges and then

placed by mechanical means. Further, the amount of material needed to cap the proposed terraces is approximately 110,000 cubic yards which equates to roughly 5,500 quad-axle dump trucks traveling city streets and damaging other infrastructure.

Barging of all materials was considered. Dewberry conducted meetings, site investigations, and talked with both industry leaders in maritime construction and locals who know the water in Back Bay. A typical 35-foot by 95-foot construction barge drafts approximately 7 feet. This type of barge is not able to be trucked to the landing site, nor is it able to be brought into Back Bay. There are truckable barges, but again the drafts of those barges can be in the 4 to 5 feet range when loaded and would require dredging a channel for access. Shallow draft barges can be used in Back Bay that only draft 1 to 3 feet, and they would need to be off-loaded from a staging site. To bring any materials such as stone, sandy fill, or terrace cap material by barge around Knotts Island is not feasible. The actual channel into the southern point of Back Bay has a height restriction due to the causeway serving Knotts Island.

Continuous Marsh Platform – Alternative 4

A continuous marsh platform to fill in the areas of historical marsh would help to restore this eroded habitat but would not provide conditions suitable for SAV establishment or optimize the wave/flow velocity attenuation through the project area. Furthermore, for a single marsh platform across Bonney Cove, the amount of material required would be more than 3 or 4 million cubic yards of material. To achieve that volume of material by dredging, significant areas of existing SAV present in Back Bay would need to be impacted. As the geotechnical report indicated, the existing material of the project site and surrounding areas is not capable of supporting itself in a constructed arrangement and would slough off back into the water. Further, providing this amount of material without dredging would require bringing external sediment sources into Back Bay, which could introduce invasive species. Finally, while the platform will reclaim marshland, it is not anticipated to establish extensive areas appropriate for SAV reestablishment and would eliminate deeper water areas preferred by some endemic wildlife species.

Goals and Objectives

The overarching goal of this project is to construct the City's first nature-based adaptation project in the Southern Rivers Watershed and one of the CRMP's exemplary nature-based projects. This project aims to stabilize two critically eroding marsh islands from further degradation, decrease turbidity to promote the growth of aquatic vegetation and provide flood risk reduction benefits through increased friction and wave attenuation. The following section summarizes the objectives through which this goal will be realized.

Objective 1 – Create a Construction Access and Staging Area

The project's first objective is to employ a construction approach that is compatible with the shallow nature of Back Bay and the large quantity of material required to build the marsh terraces. The engineering team performed a constructability review of suitable landing sites to

stage construction operations for the terraces. A property located at the end of Shipps Cabin Road (Figure 28) was identified as the preferred staging and construction access location for the following reasons:

- Shipps Cabin Road Construction Staging Area Proximity to site (2 miles).
- Shipps Cabin Road Construction Staging Area Proximity to sand borrow sources.
- Shipps Cabin Road between Muddy Creek Road and the Construction Staging Area is in disrepair and was identified as an opportunity to improve the condition of the road as part of the construction activities.

Figure 28: Proposed Construction Access.

On completion of the project, the City plans to retain the staging area for future monitoring and maintenance needs for the project. This future use is consistent with the sentiments of local stakeholders, as communicated during public engagement meetings for the study.

Expected Benefits:

- Enables constructability of the marsh terraces.
- Enable access to the project for post-construction monitoring and future marsh restoration projects.

Objective 2 – Restore Marsh and Aquatic Vegetation

The second objective of the project is to restore marsh and aquatic vegetation for habitat and flood resilience. Specifically, the City's construction of the marsh terraces will result in the restoration of approximately 46 acres of habitat within Back Bay, consisting of:

- 10 acres of low marsh habitat; low marsh plantings would include Big Cordgrass (*Spartina cynosuroides*) and Saltmarsh Cordgrass (*Spartina alterniflora*).
- 6 acres of high marsh habitat; high marsh plantings would include Black Needlerush (*Juncus roemerianus*) and Salt Meadow Hay (*Spartina patens*).
- 14 acres of upland vegetated habitat; upland vegetation would include Arrow-leaf Tearthumb (*Persicaria sagittate*), Groundsel Tree (*Baccharis halimifolia*), Wax Myrtle (*Myrica cerifera*), and Bald Cypress (*Taxodium distichum*).
- 16 acres of submerged terrace habitat anticipated to create suitable conditions for the emergence of SAV.

Additionally, approximately 310 acres of open water SAV habitat would remain between the proposed marsh terraces, and it is anticipated that construction of the terraces would create conditions within the project area favorable to the re-establishment of SAV populations.

Expected Benefits:

- Reduce wave heights, flow velocities, and wind sheer stress within the project area to protect marsh islands from continued erosion.
- Restore the natural buffer that helps protect low-lying neighborhoods and critical access roads from wind-driven flooding.
- Improved water quality by removing excess nutrients.
- Lowered transport of suspended sediment and prevention of resuspension of fine sediments in the water.
- Reduced flow velocity and absorbing wave/wind energy to reduce shoreline erosion.
- Creation of habitat (nursery and feeding areas) for fish (such as Largemouth Bass, Bluegill Yellow Perch, Striped, Blueback Herring, Alewife, and American Eel), migratory waterfowl (such as the Canvasback Duck [*Aythya vallisineria*]), and other aquatic animals.

Objective 3 – Engage Stakeholders and Disseminate Effective Practices

The City is committed to continued meaningful engagement with project partners and external stakeholders throughout the restoration and monitoring phases to ensure transferability to other sites in the region and state.

Expected Benefits:

- Ensure that the lessons from this project can be transferred and scaled to other sites in the state or region.

Approach, Milestones, and Deliverables

The following approach, milestones, and deliverables lay out a plan of action. The milestone schedule follows in *Section B: Milestone Schedule*.

Approach & Deliverables

Activity 1 – Construction Staging Area Preparation and Construction

Activity 1 involves preparing the Shipps Cabin Road property as a construction staging area. Construction activities will include stabilization of the road, laying geotextile to stabilize the ground under the construction staging area, filling with material for the construction staging area, adding fencing, creating bridge abutments and installing a temporary bridge and ramp for waterfront construction access, construction of slurry basins, and establishment of traffic flagging stations.

In the final step, the contractor will install pipe to pump the slurry material from the Shipps Cabin staging area to Bonney Cove. The pipe will be floated with subaqueous tie-downs at channels and certain points of access to maintain boat crossings. Those subaqueous locations will be marked by a buoy every 10 feet and temporary signage as reasonable. The contractor will install two booster stations along the alignment, one approximately half-way between the landing and Bonney Cove, and one at the edge of Bonney Cove. These booster stations will consist of a pontoon-mounted diesel engine pump capable of moving the sand slurry from the construction staging area to the site. It is estimated that 150 CY per hour of sand slurry would be pumped through the pipe in a 60:40 ratio. Additional booster stations may be required for manifolding and supplying slurry stations to individual terraces.

Relevant Objective(s): Objective 1

Deliverables:

- Conduct daily inspections to monitor construction progress of the Shipps Cabin Road Construction Staging Area preparation.

Assumptions:

- It is anticipated that the Shipps Cabin Road Construction Staging Area construction activities can occur simultaneously with material production in Year 1 (2024).

Activity 2 – Marsh Terrace Construction

Once the Shipps Cabin Construction Staging Area preparation is complete, marsh terrace construction activities can commence. The contractor will construct the terraces according to the 100% Final PS&E documents. The most recent engineering designs and design report are available upon request; they are not included as an attachment to this proposal due to file size. Figure 29 shows the overall layout of the terraces, and Figure 30 and Figure 31 show the project renderings. Terrace construction will begin in the northern extent of the project site at Terrace #100, noted in Figure 29, and the contractor will work south towards Terrace #140. The contractor will complete each terrace (including installation of plants) before moving onto the next.

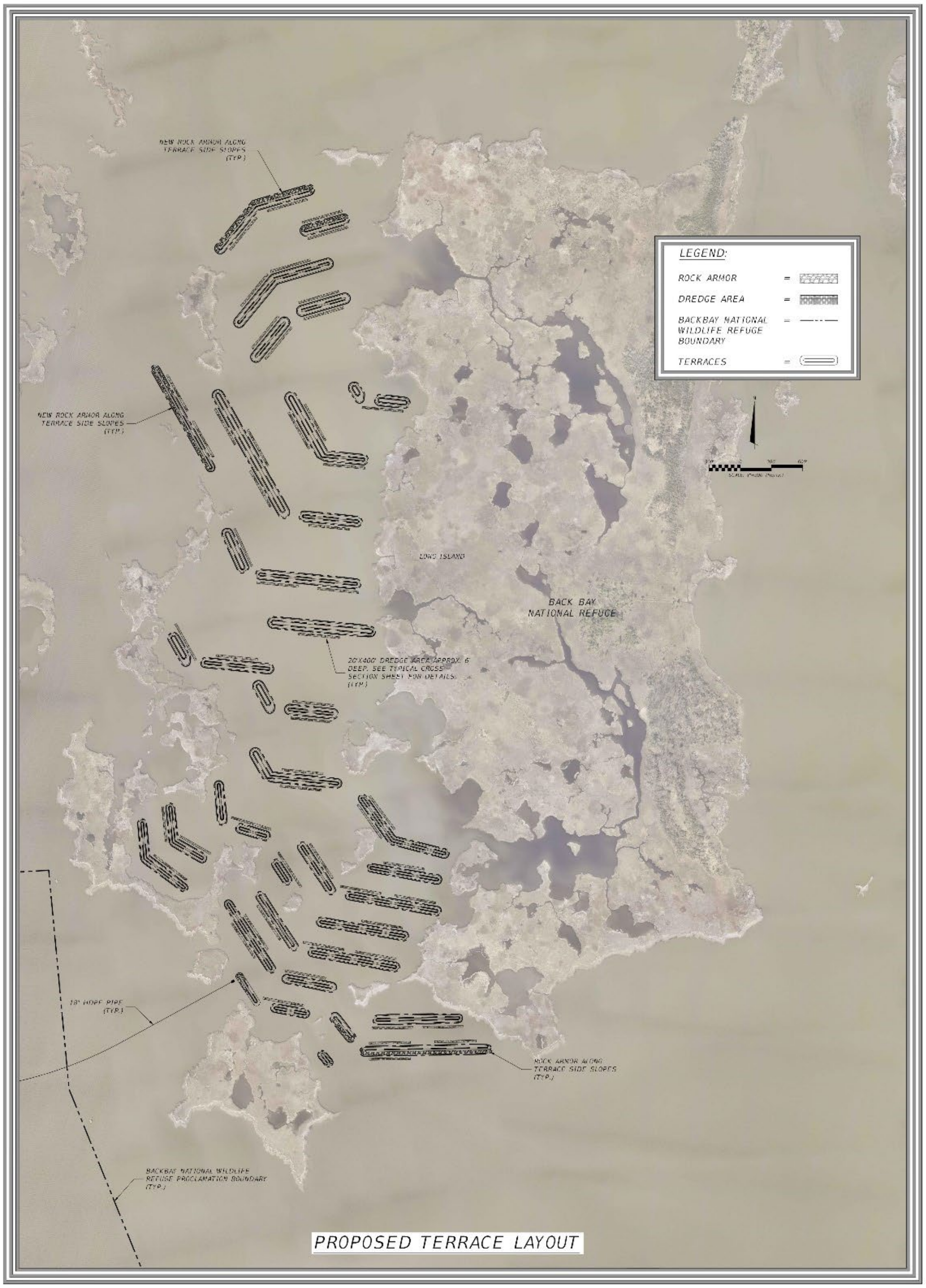

Figure 29: Marsh terrace layout across Bonney Cove.

Figure 30: Marsh terrace design rendering.

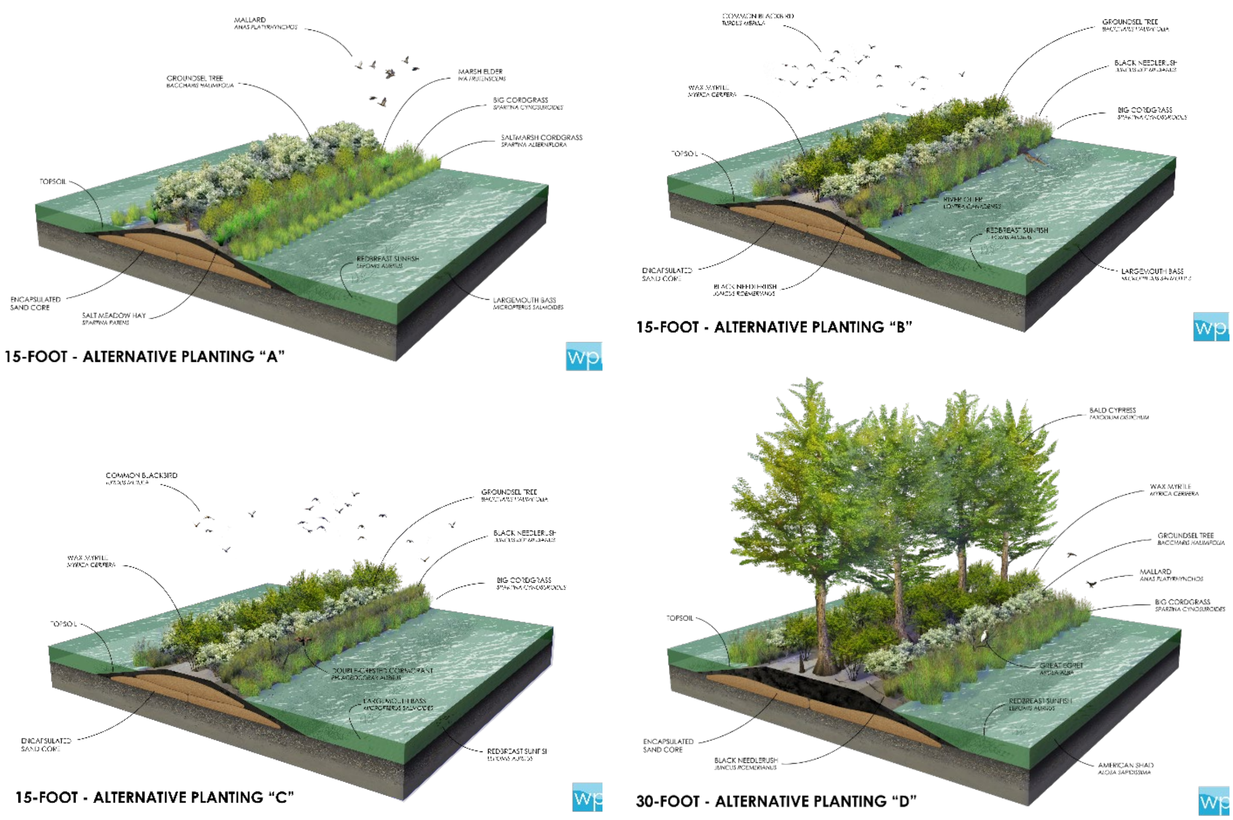

Figure 31: Marsh terrace cross-section design renderings.

The following section provides a high-level description of the proposed design and

construction approach.

Terrace Orientation:

The orientation of the terraces will be perpendicular to the predominant wind direction (south-southwest) to maximize wave energy reduction. The terraces in the northern extent of the project site will be angled perpendicular to a north-northwest wind direction. The terraces would be segmented in a chevron pattern (duck-wing pattern) to provide the most favorable fish and swimming crustacean (termed "nekton") habitat while also allowing adequate circulation to promote sedimentation and maintaining navigability throughout the project area. The terraces would not be connected to the adjacent marsh; this gap, or physical open water barrier, is intended to deter the invasion of Common Reed (*Phragmites australis*) stands from adjacent marshes.

Spacing:

The terraces would be spaced at approximately 300-foot intervals in the northern and southern quarters, and then 600-foot or greater intervals in the center. This arrangement aims to lessen the open water and subsequent wave action at the northern and southern ends of the site and allow adequate construction space for marine-based construction equipment.

Terrace Elevation and Width:

To achieve a sustainable marsh elevation throughout the project life, the marsh terraces would initially be built to a higher elevation during construction and allowed to settle to the desired target elevation over time. Taller terraces improve the functionality and resiliency of the system while also providing diversified habitat for fish and wildlife. The goal is that, by the end of the 30-year design life and with 1.5 feet of relative sea level rise, the terraces will be at or above the elevation of a moderate wind tide event (when Back Bay water levels are anticipated to reach +3.0 feet NAVD88 over the design water level). This threshold was determined to ensure the terraces would not be fully overtopped during a future wind tide event and maintain resiliency to anticipated sea level rise. The 1.5 feet sea level rise scenario is consistent with the near-term planning scenarios identified in the City's Resilience Plan to represent conditions from 2035 to 2050 and adopted by the Hampton Roads Planning District Commission (HRPDC) as part of resolution number 2018-01.

The terraces would have a top width of 15 or 30 feet and be built to an elevation of +4.5 to +5.0 feet NAVD88, depending on the width of the crest, underlying soils, and local bottom depth, with side slopes of 4 horizontal to 1 vertical (4H:1V). The +4.5- to +5.0-foot elevation is calculated based on a target elevation of +3.0 feet NAVD88 or higher at the end of the project's 30-year design life and an estimated settlement of approximately 1 to 2 feet, depending on where the terrace is located. The geotechnical investigation revealed that terraces in the site's southern portion are expected to experience greater settlement than those to the north.

Terrace Composition:

The terraces would consist of a sand-filled core that is encapsulated by a high-strength blend of woven and non-woven geotextile fabrics. The sand for this material will come from nearby offsite sources and be pumped through the 1-inch diameter pipe described in Activity 2. Once the cores are in place, long-reach excavators would travel along the tops of the terraces and begin to shape the cross slopes. Existing adjacent material devoid of SAV would be mechanically dredged and placed over the sand-filled cores. The marsh terraces would be covered with 1 to 3 feet of suitable fill, depending on crest widths, and then planted with native emergent and brackish plant species to stabilize the terraces and provide wind-driven flood reduction benefits.

Relevant Objective(s): Objective 2

Deliverables:

- Conduct daily inspections to monitor construction progress of the marsh terraces.

Assumptions:

- It is anticipated that construction of the terraces will occur in two phases over two years from 2025 through 2026, with the following assumptions:
    - Construction activities are not permitted within BBNWR from October 31 through February 28, annually, to limit disturbance to wintering waterfowl and migration during those months.

Activity 3 – Stakeholder Engagement and Lessons-Learned Dissemination

As the first large scale terracing project on the Atlantic coast, the City recognizes the importance of documenting lessons learned and effective practices during each of the proposed activities: contractor procurement, construction, and post-construction monitoring. The City plans to develop a set of project marketing materials (PowerPoint presentations, StoryMap, information flyers, etc.) to cover key topics, such as:

- Lessons learned during contractor procurement, construction, and post-construction monitoring.
- Effective practices for contractor procurement, bid development, and evaluation. This project is expected to require a highly specialized contractor given the complexity of the project, very shallow water depths, and distance of the site from available construction access and staging areas.
- Guidance for identifying the best sources for local and regional materials for building the terraces and developing a project construction schedule with enough lead time for producing the quantity of material needed for large-scale marsh creation projects.
- Effective practices for developing a post-construction monitoring plan for marsh terraces that a) aligns with permitting, grant, and other requirements and b) enables quantification of project benefits and areas for improvement.

- Effective practices for communicating project benefits based on a combination of field data collection, numerical modeling, and post-construction monitoring.

The City plans to leverage the materials to facilitate dissemination to key stakeholders to increase likelihood of transferability of the approach to other areas in the region and state. The City's plan for engagement is summarized in the following table. In addition to these efforts, the City is committed to collaborating with DCR to identify any additional opportunities to help socialize the project's innovative design and lessons learned.

Table 8: Summary of opportunities for City, regional, state, and national stakeholder engagement; expected benefits.

	Description of Proposed Outreach Activities

CITY	• Facilitate internal municipal awareness, coordination, and approval to gain budgetary approval for funding to expand the approach to other sites in Back Bay (such as "The Great Narrows", Mackay Island and Princess Anne Wildlife Management Areas, and Ragged Island) through presentations to the:
	  o Virginia Beach City Council
	  o City Manager Working Group for SLR and Recurrent Flooding, comprised of representatives from all City departments, to facilitate awareness, coordination, and action to advance the project to the restoration phase.
	• City of Virginia Beach Management Leadership Team (MLT), which includes the City Manager, Deputy City Managers, and Department heads from across the City.

REGION	• Collaborate with the National Audubon Society and Albemarle-Pamlico National Estuarine Partnership (APNEP) to:
	  o Highlight the marsh terrace project as a success story in the next iteration of the Currituck Sound Coalition Marsh Conservation Plan.
	  o Explore opportunities for marsh terrace projects in the Knotts Island Channel, a key flood pathway into Back Bay, as well as other locations in the Currituck and Albemarle-Pamlico Sound.
	• Share lessons learned to regional and state stakeholders, improving knowledge-based, awareness, and capacity for future efforts through presentations to:
	  o Hampton Roads Adaptation Forum – a regional dialogue for academics, non-profits, consultants, and municipalities committed to resilience measures.
	  o The Hampton Roads Planning District Commission (HRPDC) Coastal Resiliency Committee .
	  o Regional conferences on green infrastructure, coastal resilience, and SLR adaptation.
	• Collaborate with Wetlands Watch, a regional non-profit organization committed to the protection of wetlands using nature-based solutions, to socialize the project and disseminate lessons learned.

	Description of Proposed Outreach Activities

STATE	• Continue to coordinate with the Virginia Department of Conservation and Recreation (DCR) to:
	  o Promote the project as a success story for the State Coastal Master Plan (CRMP), which highlighted the project as an "exemplary" resilience project that aligns with the Commonwealth's objective to protect and enhance the state's natural infrastructure.
	  o Incorporate project updates and lessons learned on the CRMP website is an excellent mechanism for dissemination to all coastal Planning District Commissions (PDCs)/Regional Commissions (RCs) across the state.
	• Continue to collaborate with The Nature Conservancy (TNC), a national player in guiding the implementation of nature-based strategies, to help disseminate lessons learned on project implementation. The City has engaged in early discussions with TNC about partnering to host a state-level workshop that would draw from the network of TNC's local and regional chapters
	• Presentations at state-level conferences on water resources, floodplain management, and resilience, such as hosted by Resilient Virginia and Virginia Lakes and Watersheds Association.

NATION	• Disseminate lessons learned/effective practices through presentations at 1-2 relevant national conferences such as Restore America's Estuaries, Association of State Floodplain Managers, or the American Shore and Beach Preservation Association, etc. • Leverage working relationships and existing contract work with the U.S. Army Corps of Engineers and partners to integrate lessons learned into the International Natural and Nature-Based Feature Design Guidelines to promote consideration of marsh terraces within similar Back Bay environments (for example, in North Carolina, Maryland, New Jersey, and New York).

Relevant Objective(s): Objective 3

Deliverables:

- Project marketing materials.
- Records documenting number of stakeholders engaged during outreach activities.

Activities Not Included Under this Grant

Submerged Aquatic Vegetation Transplant Plan: The City will evaluate opportunities for restoring native submerged aquatic vegetation populations in Back Bay, such as Wild Celery (*Vallisneria americana*), through consultations with subject matter experts. After terrace construction, the City will formulate a plan for planting submerged aquatic vegetation in between the terraces in coordination with identified partners and the construction contractor.

Post-Construction Monitoring: Post-construction monitoring and inspections will occur for a minimum of five (5) years following construction. Given the period of performance for the CFPF grant, post-construction monitoring activities have not been included in this application.

Milestone Schedule

The scope of work proposed in this grant application are scheduled to occur between June 2024 and June 2027. Work activities are anticipated to complete in December 2026; however, the proposed schedule extends through June 2027 for contingency. The project's expected progression is shown in the following milestone schedule, noting deliverables for each milestone:

2024 Activities

- *1st Quarter* ***(pre-grant period activities):***
  - 100% Final PS&E
  - Submit Bid Documents
- *2nd Quarter (pre-grant period activities):*
  - Final Bid Coordination/Acceptance
  - Construction NTP
- ***Begin Year 1 Grant Activities – 2nd Quarter 2024:***
  - Mobilization for Shipps Cabin Road Construction Staging Area
  - Initiation of Marsh Terrace Material Production
- *3rd Quarter:*
  - Construction NTP and Mobilization for Slurry Basin Installation
- *4th Quarter:*
  - Completion of Shipps Cabin Road Construction Staging Area and Slurry Basin Construction

2025

- *1st Quarter*
  - Completion of Marsh Terrace Material Production
  - Construction Mobilization for Marsh Terraces (beginning on March 1, 2025)
  - Oversight, Management, and Inspection Services of Slurry Basin Installation
- ***Begin Year 2 Grant Activities - 2nd Quarter 2025***
  - Construction of Marsh Terraces #100 – 105
- *3rd Quarter*
  - Construction of Marsh Terraces #106 – 114
- *4th Quarter*
  - Construction of Marsh Terraces #115 – 119
  - Marsh Terrace Construction Demobilization (to accommodate break in construction period from October 31, 2025 – February 28, 2026)

2026

- *1st Quarter*
  - Construction Re-Mobilization for Marsh Terraces (beginning on March 1, 2026)
- ***Begin Year 3 Grant Activities - 2nd Quarter 2026***

    - Construction of Marsh Terraces #120 – 134
- *3rd Quarter*
    - Construction of Marsh Terraces #135 – 140
- *4th Quarter*
    - Shipps Cabin Road Construction Staging Area Final Improvements & Demobilization

2027

- *1st and 2nd Quarter*
    - *Contingency for any delays experienced through end of 2026*

End Year 3 Grant Activities

Project Partners

The following table highlights the specific project partners, their roles, and their capabilities concerning the proposed project.

Table 9: Potential Project Partners.

Entity	Role	Description
U.S. Fish and Wildlife Service, Back Bay National Wildlife Refuge	Project Partner / Advisor / Adjacent Land Owner	BBNWR owns the land adjacent to the project footprint and monitors migratory bird hunting within Presidential Proclamation boundaries. BBNWR has coordinated with the City on project design and will continue to be involved during project construction as a stakeholder and advisor.
Virginia Department of Wildlife Resources	Project Advisory / Stakeholder	The City has coordinated closely with VDWR on project design. Furthermore, VDWR has been monitoring SAV distribution in Back Bay for decades and will be a critical partner for identifying native seagrass species and techniques for restoration based on extensive experience from previous SAV restoration projects in Back Bay.
Virginia Beach Department of Planning & Community Development	Permit Compliance	The City's Department of Public Works has been in close coordination with the City's Department of Planning & Community Development throughout the design and permitting process. Continued involvement and coordination during construction and post-construction monitoring is anticipated.
Dewberry	Engineering Contractor	Engineering consultant to support the City with contractor procurement and construction administration.
To be Determined	Construction Contractors	Construction contractor for the Shipps Cabin Road Construction Staging Area and marsh terrace construction activities.

Entity	Role	Description
Friends of Back Bay	Project Advisory / Stakeholder	Friends of Back Bay was formed in the 1980s to lead efforts to expand and conserve BBNWR, including securing millions in funding to support the Refuge's expansion. The City has coordinated with the BBNWR Society throughout the design and permitting process and will continue this coordination through construction and post-construction monitoring.
Back Bay National Wildlife Refuge Society	Project Advisory / Stakeholder	The Back Bay National Wildlife Refuge Society (BBNWR Society) is an independent, 501(c)(3) non-profit group dedicated to supporting the mission of the USFWS National Wildlife Refuge System and specifically promoting awareness of the BBNWR through education and participation. The City has coordinated with BBNWR Society throughout the design and permitting process and will continue this coordination through construction and post-construction monitoring.
Back Bay Restoration Foundation	Project Advisory / Stakeholder	Back Bay Restoration Foundation (BBRF) is an independent, 501(c)(3) non-profit group focusing on growing concerns about issues such as recurrent flooding, sea level rise, and development in the Southern Rivers Watershed. The group aims to serve as an advocate for the Bay and surrounding residents. The City has coordinated with BBRF throughout the design and permitting process and will continue this coordination through construction and post-construction monitoring.

Relationship to Other Projects

This project represents the first nature-based project in the Southern Rivers Watershed to advance to design and construction to implement the City's Wise Resilience Plan. The project is also an aspect of the Stormwater Green Infrastructure aspect of the City's Flood Protection Plan. The City has received a $3M award from the CFPF to support another project in the Stormwater Green Infrastructure element of the Flood Protection Program – the Elizabeth River Wetland and Floodplain Restoration Project (Round 1 CFPF Grant Awards).

The City has also received two NFWF NRCF grants from the Marsh Restoration in Back Bay project. Approximately $135,000 in NFWF NRCF funding was awarded in 2020 for the previous phase (design and permitting) for the project. The City continues to meet the obligations and period of performance of this NFWF grant. In 2022, the NFWF NRCF awarded $9,886,400 to support construction activities.

In its Resilience Plan, Virginia Beach identifies an adaptation approach for the Southern Rivers Watershed that emphasizes natural mitigation methods and integrated systems of defenses. As a natural mitigation strategy, the marsh terrace project aims to serve as a first line of defense during flood events, reducing wind-driven fetch, wave energy, and flow velocities to protect the important marsh buffer surrounding the shorelines of Back Bay. Other projects are also needed to provide multi-layered flood protection to northern Back Bay communities (Figure 32). Several

of these projects are highlighted below. It should be noted that the projects described below are either not yet funded or will be funded in the future through the City's Capital Improvement Program.

Figure 32: Southern Rivers Watershed Adaptation Vision.

Marsh island restoration serves as a critical first line of defense of the multi-layered protection system in the Southern Rivers Watershed. The following map (Figure 33) shows the structural adaptation projects proposed for the Southern Rivers Watershed, including the Muddy Creek Road and Sandbridge flood defense systems. The City's numerical modeling shows that, if implemented, there is potential for small increases in flooding outside of these structural protection systems.[14] This emphasizes the need for complimentary measures, including the marsh terrace project, land acquisition, and conservation efforts, to mitigate this residual risk.

[14] City of Virginia Beach (2020). City-wide Structural Alternatives for Coastal Flood Protection (PDF).

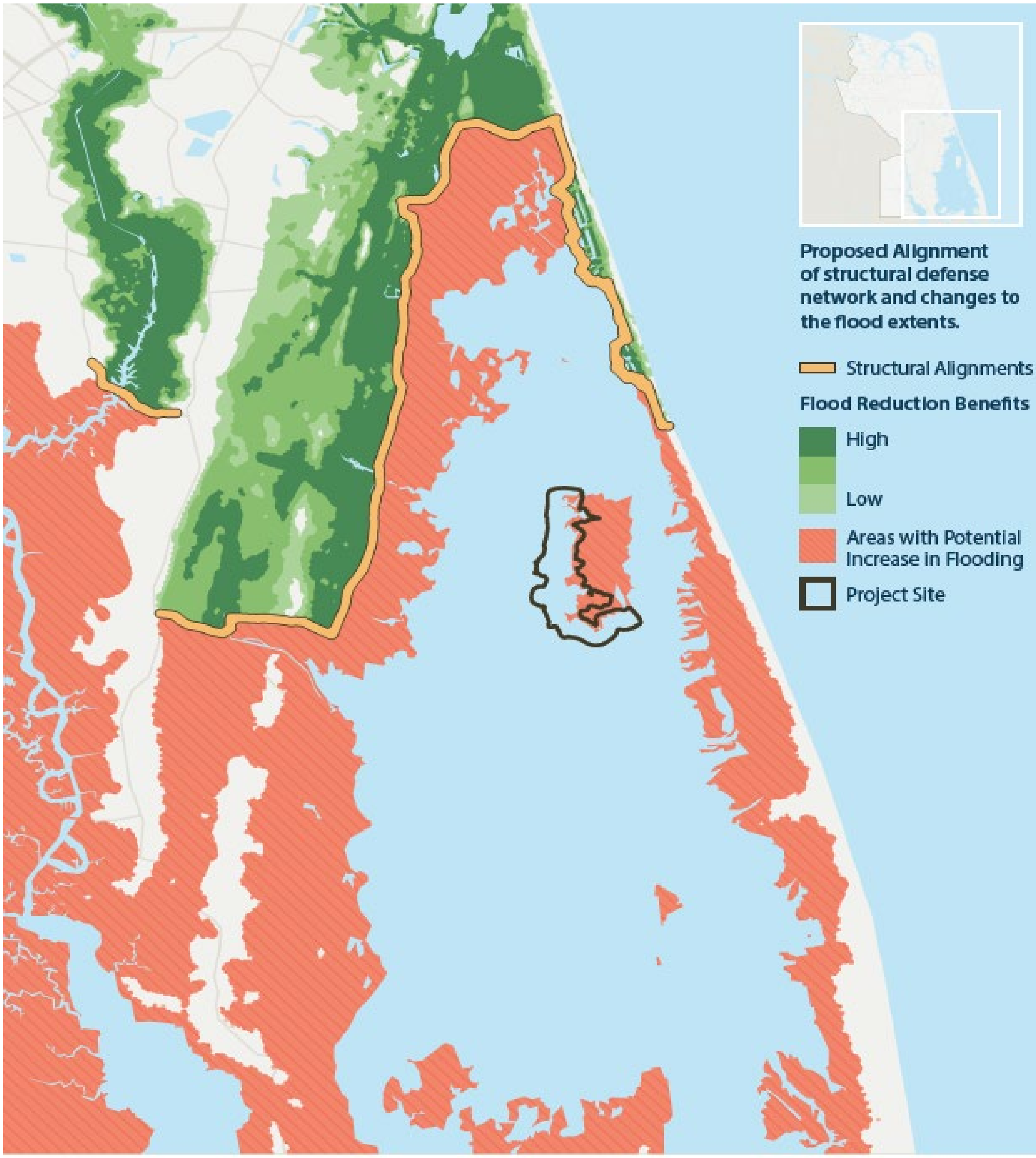

Figure 33: Structural adaptation projects proposed for the Southern Rivers Watershed, including the Muddy Creek Road and Sandridge flood defense systems.

Backside of Sandbridge Flood Defense System

Protection of the Sandbridge resort community from increasing coastal flood hazards would require a complex and expensive structural protection system because of the manufactured land configuration on the backside of Sandbridge. The proposed protection system includes elevating Sandbridge Road and constructing a network of seawalls, levees, and gates along the Back Bay shoreline of Sandbridge. This project does not have designated funding at this time.

Hell Point Creek Flood Defense System

As part of the integrated Sandbridge City-Wide flood defense network, a storm surge barrier across Hell Point Creek could block flood waters originating from Back Bay. Sandbridge Road would also need to be raised to ensure floodwaters could not flank the system. This project does not have designated funding at this time.

Sandbridge/New Bridge Intersection Improvements

Road and shoulder improvements are planned to increase safety at the New Bridge Road/Sandbridge Road intersection and reduce the need for road closures due to flooding from the adjacent Ashville Creek.

Muddy Creek Road Flood Defense System

Muddy Creek Road provides access to important rural and agricultural communities and Back Bay and the Wildlife Refuge. Muddy Creek Road is one of the lowest-lying roadways in all of Virginia Beach and frequently floods. This City-Wide Structural Alternative Flood Protection analysis identified this roadway as a critical location to provide flood protection. The proposed system, known as the Muddy Creek Road Alignment, would transform much of Muddy Creek Road into a levee, with the road on the top. The City's numerical modeling effort shows that the Muddy Creek Road Flood Defense System could potentially increase flood risk to the east of Muddy Creek Road, as shown in Figure 33. Therefore, the implementation of nature-based strategies suitable to the low-lying shorelines of Back Bay is essential to mitigate these impacts. This project does not have designated funding at this time.

Voluntary Acquisition Program

Virginia Beach City Council has recently funded a $2.0 million City-wide voluntary acquisition program to encourage flood-prone property owners to apply for a buyout. Parcels acquired by the City, in the Southern Rivers Watershed, would then be converted to open space to serve as flood storage and a marsh migration buffer.

Stormwater Master Plan

The City Council initiated an update of the City's Stormwater Master Plan in 2014. This effort is interchanging information with aspects of the City's Resilience Plan to account for the impact of sea level rise on the stormwater system's performance. Specific stormwater drainage improvement projects are included within the Lower Southern Rivers Watershed Drainage Basin.

Virginia Coastal Resilience Master Plan

The CRMP highlighted the marsh terrace project as an exemplary nature-based resilience project. The CRMP emphasizes Virginia Beach's strategic use of multiple funding streams to implement a large-scale nature-based project. DCR’s contribution to the project’s construction could be highlighted as a success story for implementation of the CRMP.

Audubon North Carolina Currituck Sound Coalition Marsh Conservation Plan

In coordination with Audubon North Carolina, the Currituck Sounds Coalition identified marsh restoration priorities based on criteria for siting restoration projects, including vulnerability to sea level rise, historic increase in surface water, and distance to hardened shorelines. This assessment identified Virginia Beach's marsh terrace project site as a high-priority area for restoration. There is an opportunity to highlight this project as a success story in the next iteration of the Audubon's Marsh Conservation Plan, which is slated to be updated every three years.

Maintenance Plan

Standard maintenance measures have been defined as part of the draft Annual Monitoring Plan and Post-Construction Monitoring Report developed for this project. See Attachment 5 for a copy of the draft report.

Subsequent to the monitoring period, project maintenance will be addressed by the City's Public Works Stormwater Operations Group, who will also respond to any maintenance issues identified by the monitoring effort or other observers. The City intends to maintain the construction staging area to support future project maintenance needs. The City will perform inspections every 2-5 years and make any repairs needed for the life of the project after completion of the initial monitoring program.

As described by the draft Annual Monitoring Plan and Post-Construction Monitoring Report, maintenance measures include the replacement of plantings (including upland, marsh and SAV plantings), the removal of debris from the terraces, the removal of invasive vegetation identified in the planting areas, the addition of sediment to eroding areas of the terraces, and the replacement of waterfowl barriers as necessary. In addition, structural maintenance measures that might be identified and prescribed during monitoring efforts include replacement of dislodged stones, addition of stone to address structure settlement, and general repair of sand cores or other structural elements. As proposed, these measures would become conditions of the wetland permits required for this project, in addition to standard commitments and requirements defined by the permitting agencies.

In addition to the commitments made in the monitoring plan, and those anticipated to be defined during the permitting process, it is the assumption that the placement of the proposed marsh terrace structures in state waters (subaqueous bottoms) will require the City to maintain the marsh terraces in perpetuity. As previously defined through coordination with VMRC, the City would obtain a compensable interest in the property that has been filled on top of state-owned subaqueous bottomlands (i.e. the terraces). As such, the City would be responsible for maintaining the proposed marsh terraces structures to ensure they fulfill their intended functions, as defined in the objectives and indicators of success previously defined in this proposal.

Criteria

The project receives a total score of **65 Points**. An explanation of how the project meets each

of the applicable scoring criteria contained in Appendix D is provided below.

Eligible Project (Type)

Category/Points: Wetland/floodplain restoration, Living shorelines and vegetated buffers (25 Points)

Explanation: Marsh terraces are considered a type of wetland restoration or a component of a living shoreline project:

- Wetland Restoration: Wetland restoration aims to reestablish or enhance natural wetland ecosystems. Marsh terraces can be constructed in areas where wetlands have been degraded or lost, and they help to recreation or support wetland functions. They provide habitat for various species, improve water quality, and can contribute to the overall health and resilience of a wetland ecosystem.
- Living Shoreline Project: Living shorelines are designed to protect shorelines from erosion while also promoting ecological and environmental benefits. Marsh terraces are often used as a component of living shoreline projects. They can serve as a buffer against wave action, stabilize shorelines, and create suitable habitat for marsh and aquatic species.

Social Vulnerability Index Score

Category/Points: Low Social Vulnerability (0 Points)

Explanation: Based on the Virginia Flood Risk Information System (VFRIS) Social Vulnerability Index Layer, the Social Vulnerability Index scores of the communities located in the two census block groups adjacent to Back Bay near the project site are -1.07 and -0.43 (an average of -0.75), which falls into the Low Social Vulnerability category.

Community Scale Benefits

Category/Points: More than one census block group (30 Points)

Explanation: As documented in the *Supporting Documentation - Project Information – Population* section of this document, the project is anticipated to benefit two census block groups (518100454.121 and 518100464.001).

Expected Lifespan of Project

Category/Points: Over 20 Years (10 Points)

Explanation: As documented in the *Supporting Documentation – Approach, Milestones, and Deliverables – Activity 3 (Marsh Terrace Construction)* section, the marsh terraces have a 30-year design life.

Budget Narrative

The following budget narrative details the proposed project expenditures. See Appendix B for completed budget spreadsheet.

Estimated Total Project Cost

The current estimated total project cost is **$53,378,490.** This estimate includes design, site acquisition for the construction staging area, construction, inspections and support, implementation, and contingencies, as shown in the below table. The design engineer's opinion of probable cost for construction is provided

Project Activity	Capital Improvement Program Estimate
Design	$276,800
Site Acquisition	$50,000
Construction	$41,839,900
Inspections and Support	$5,609,200
Implementation	$750,000
Contingencies	$4,852,590
Total:	$53,378,490

Funds Requested from the Fund

The City is requesting a total of **$5,000,000.00** in funding from the CFPF Round 4. These funds will support contractual services of the engineering consultant and construction contractor to execute Activity 2 (Construction Staging Area Preparation and Construction) and Activity 3 (Marsh Terrace Construction). No support is requested for City personnel.

These funds will be used to support ongoing construction activities through 2024-2026. Example activities include contractor construction services, mobilization/demobilization, construction staging area construction, slurry pipe installation, portions of the terrace materials, and waterfowl barriers. Construction costs are based on a detailed estimate from the design engineer that includes detailed breakdown of estimated quantities and costs from the 95% design package using industry standards for the anticipated aspects of the project construction. The City has withheld the detailed estimate as it provides information that would affect bidding on the construction.

Amount of Funds Available

The City as prime recipient is providing a cash match of $38,356,966 from funds fully programmed and available from the City's Flood Protection Program Capital Improvement Program to support the project. The Flood Protection Program is supported by a related bond referendum that provided $567.5M to fund more than 40 projects identified for Phase 1 of the Program. The program is tightly managed by the City, an independent contractor, and has a resident oversight board. The City is fully confident these funds will be available for constructing this project.

The City's dedicated funds will provide cash match to cover contractual services to support Activity 1 (Construction Staging Area Preparation and Construction), Activity 2 (Marsh Terrace Construction), Activity 3 (Stakeholder Engagement and Dissemination), and all related City support and direct overhead costs related for the project.

The National Fish and Wildlife Foundation is also supporting the project through two grant awards from the National Coastal Resilience Fund. This includes an initial award of $135,124 in 2020 for design and a second award of $9,886,400 in 2022 to support construction. The 2022 grant funds are dedicated to purchasing the native vegetation and a portion of the materials needed to build the marsh terraces.

A summary of project costs, funds available, and funds requested is provided below:

Item	Amount
Project Cost:	$53,378,490.00
Funding Sources Available	
NFWF Grant:	$10,021,524.00
CFPF Grant Request:	$5,000,000
City Funds Available:	$38,356,96600
Total Project Funding:	**$53,378,490.00**

Authorization to Request for Funding

Please refer to *attachment* for the documentation authorizing the funding request.

Attachment 1: Virginia Beach Resilience Plan DCR Approval

Matthew J. Strickler
Secretary of Natural Resources

Clyde E. Cristman
Director

COMMONWEALTH of VIRGINIA
DEPARTMENT OF CONSERVATION AND RECREATION

Rochelle Altholz
Deputy Director of Administration and Finance

Russell W. Baxter
Deputy Director of Dam Safety & Floodplain Management and Soil & Water Conservation

Nathan Burrell
Deputy Director of Government and Community Relations

Thomas L. Smith
Deputy Director of Operations

July 20, 2021

Toni Utterback, P.E.
Department of Public Works
2875 Sabre Street, Suite 250
Virginia Beach, VA 23452

RE: Virginia Beach Resilience Plan Second Submission - CFPF

Dear Ms. Utterback:

Thank you for the resubmission of the Sea Level Wise Adaptation Plan for City of Virginia Beach. After careful review and consideration, the Virginia Department of Conservation and Recreation has deemed the Plan complete and meets all the criteria outlined in the June 2021 Community Flood Preparedness Grant Manual. This approval will remain in effect for a period of three years, ending on July 31, 2024.

The following elements were evaluated as part of this review:

1. **Element 1: It is project-based with projects focused on flood control and resilience. DCR RESPONSE**

    a. Project-based: Four watersheds—each with a defined geographic area, analysis of community social and environmental characteristics, types of flooding, and a tailored flood resilience strategy with <u>discrete projects identified</u>.

Projects focused on flood control and resilience include:

Neighborhood	Flood Control Project
Elizabeth River	City-wide alignment, living shoreline, marsh restoration, land conservation
Lynnhaven	Chesapeake Bay alignment, Lesner Bridge Neighborhood alignment (East & West), beach & dune nourishment, ecological revetments, shellfish reef restoration, seagrass restoration
Oceanfront	Atlantic Oceanfront alignment, Rudee Heights alignment
Southern Rivers	West Neck Creek city-wide alignment, Muddy Creek Road city-wide alignment, Sandbridge city-wide alignment

**additional projects listed within the Sea Level Wise Adaptation Strategy.*

2. **Element 2: It incorporates nature-based infrastructure to the maximum extent possible. DCR RESPONSE**

   a. Nature-based infrastructure: Flood mitigation projects throughout the city incorporate nature-based solutions and were identified for maximum use within specific watersheds.

3. **Element 3: It includes considerations of all parts of a locality regardless of socioeconomics or race. DCR RESPONSE**
   a. All parts of a locality: Locality divided into four watersheds, covering the entirety of the jurisdictional boundary.
   b. Social vulnerability: Social implications of flood hazards and analysis of populations at-risk documented.
   c. Demographic Analysis: Demographic and Population Vulnerability Analysis conducted by Dewberry and incorporated into the Plan.

4. **Element 4: It includes coordination with other local and inter-jurisdictional projects, plans, and activities and has a clearly articulated timeline or phasing for plan implementation. DCR RESPONSE**
   a. Coordination with other projects, plans, and activities: Contains the planning processes and frameworks which outline local and regional plans used by the City and address resilience; and how they have been integrated for flood adaptation planning.
   b. Clearly articulated timeline or phasing for plan implementation: Program phases clearly articulated and described in detail—Impact assessment, Adaptation research, Strategy development, and Long-term implementation.

5. **Element 5: Is based on the best available science, and incorporates climate change, sea level rise, storm surge (where appropriate), and current flood maps.**
   a. Technically backed water-resources analysis, sea level rise projections, storm surge, and climate change incorporated into strategic approach.

VA DCR looks forward to working with you as you work to make Virginia Beach a more resilient community. If you have questions or need additional assistance, please contact us at cfpf@dcr.virginia.gov. Again, thank you for your interest in the Community Flood Preparedness Fund.

Sincerely,

Wendy Howard Cooper, Director
Dam Safety and Floodplain Management

cc: Darryl Glover, DCR

Attachment 2: Authorization to request funding from the Fund from governing body or chief executive of the local government

DEPARTMENT OF BUDGET AND MANAGEMENT SERVICES
(757) 385-8234
(757) 385-1857 FAX

City of Virginia Beach

VBgov.com
MUNICIPAL CENTER
BUILDING 1, 3RD FLOOR
2401 COURTHOUSE DRIVE
VIRGINIA BEACH, VA 23456-9001

INTER-OFFICE MEMORANDUM

DATE: November 1, 2023

TO: Patrick A. Duhaney, City Manager

FROM: Stuart McCrery, Budget and Policy Analyst KJ for SM

SUBJECT: Application for Virginia Community Flood Preparedness Fund Grant

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The Department of Public Works is requesting permission to apply for the Virginia Community Flood Preparedness Fund Grant from the Virginia Department of Conservation and Recreation. The Virginia Community Flood Preparedness Fund was established in the 2020 session of the General Assembly. Money in this fund comes from the auction of carbon allowances through the Regional Greenhouse Gas Initiative. It was established to provide support to localities across Virginia to reduce the impacts of flooding, including flooding driven by climate change.

Public Works is requesting a total of $5,000,000 to construct marsh terraces in Back Bay to promote wetland restoration and mitigate frequent flooding. The City has already made significant investments into this project through CIP project 100551 "Stormwater Green Infrastructure."

This grant also requires a local match of 30% for projects that implement nature-based solutions; however, the City has more than met this requirement through its current appropriations to CIP project 1000551 "Stormwater Green Infrastructure" which currently total over $49 million from the Referendum and other grant awards.

Budget & Management Services recommends this grant application for approval. Please indicate approval or disapproval below. Applications are due by November 12, 2023.

11/1/2023

Approve (Date) Disapprove (Date)

Attachment 3: Virginia Beach Floodplain Administrator Support Letter

City of Virginia Beach

VBgov.com

DEPARTMENT OF PLANNING & COMMUNITY DEVELOPMENT
PHONE (757) 385-4621
FAX (757) 385-5667
VA Relay Number TTY: 711

2875 SABRE STREET, SUITE 500
VIRGINIA BEACH, VA 23452-7385

November 7, 2023

Division of Dam Safety and Floodplain Management
600 East Main Street, 24th Floor
Richmond, Virginia 23219

RE: Community Flood Preparedness Fund – Marsh Terrace Creation, Back Bay

The proposed project is located in both open water and a Federal Emergency Management Agency (FEMA) mapped Special Flood Hazard Area (SFHA). Hydraulic modeling analysis identified Bonney Cove as a location where marsh restoration has the potential to reduce the propagation of floodwater through key pathways within Back Bay. This project aims to stabilize two critically eroding marsh islands that serve as a key flood pathway into northern Back Bay, promote the growth of aquatic vegetation, and provide flood risk reduction benefits to communities in the surrounding area. Within the two census block groups that would benefit from this project, there are 113 repetitive loss and severe repetitive loss properties.

If I can provide any further information or assistance, please call me at 757-385-4621, or e-mail me at wmcnamar@vbgov.com.

Sincerely,

Whitney McNamara

Whitney McNamara, CFM
Floodplain Administrator and CRS Coordinator

Attachment 4: Letters of Support

Back Bay
Restoration
Foundation

PO Box 57041 • Virginia Beach, Virginia • 23457• 757-818-4829

November 6, 2023

Department of Conservation and Recreation
Dam Safety and Floodplain Management
600 E. Main St., 24th Floor
Richmond, VA 23219

Re: Virginia Community Flood Preparedness Fund Grant

Grantors:

The Back Bay Restoration Foundation (BBRF), is a 35 year-old non-profit watershed organization, founded in 1986 by a group of local citizens concerned about deterioration of the Back Bay watershed visible then through decreases in Submerged Aquatic Vegetation (SAV), fish, and waterfowl. BBRF is the only voice solely dedicated to conserving and improving Virginia Beach's two Southern Watersheds; namely, the Back Bay and North Landing River watersheds. Our efforts focus on education, stewardship and outreach to conserve the largest watersheds in Virginia Beach. We team with other non-profits, and city, state and federal agencies to work toward best solutions for the future of the Back Bay and North Landing River watersheds. BBRF strives to raise awareness, addressing issues that negatively affect these watersheds such as sea level rise, land subsidence and land use changes.

Back Bay is a historical, nationally significant, watershed. With the Back Bay National Wildlife Refuge (NWR) and significant State conservation lands at its core, the watershed was recognized as an Aquatic Resource of National Importance (ARNI) in 2008 by both the US Fish and Wildlife Service and the US Army Corps of Engineers. Back Bay is a wind-tidal oligohaline estuary and is located at the northern tip of the Albemarle/Pamlico estuarine system, the second largest estuarine complex in the United States. The Albemarle/Pamlico estuarine system was designated as an Estuary of National Significance in 1987 and selected to be studied as part of the Environmental Protection Agency's National Estuary Program. Back Bay is a shallow-water aquatic ecosystem with an average depth of four feet. Winds can influence the water depth by as much as three feet.

BBRF supports the City of Virginia Beach's application for Round 4 of VADCR's Community Flood Preparedness Fund. We were strong advocates of the City's successful applications to the National Fish and Wildlife Foundation (NFWF), and have seen what they accomplished with the initial NFWF funding they received. With the combined funding of NFWF, the City of Virginia Beach, and this application for DCR funding, their project of creating a Marsh Terrace Network to Achieve Restoration and Flood Resilience has overachieved by any measure. From community engagement and the NEPA process to conceptual and preliminary designs as described in the recent Army Corps Public Notice, the City has been productive and completely transparent.

As noted above, the City's community engagement and partnerships with organizations like ours has been transparent and resulted in broad support. Although the current project is localized in its first application, we expect the results will significantly mitigate SLR, land subsidence and wind tides in Back Bay. Similarly, this restoration will provide the biotic building blocks to maintain the watershed's national importance for wildlife. The innovative designs proposed will inform future projects at the landscape level. Although innovative, we believe the project is technically sound based on BBRF's 35 years of experience in habitat restoration.

Please feel free to contact us for further information.

Jared Brandwein

Jared Brandwein

Executive Director
Back Bay Restoration Foundation

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Back Bay National Wildlife Refuge
1324 Sandpiper Road
Virginia Beach, VA 23456

October 30, 2023

Wendy Howard Cooper
Division of Dam Safety and Floodplain Management
600 East Main Street, 24th Floor
Richmond, Virginia 23219

Dear Ms. Cooper,

The City of Virginia Beach is proposing to install marsh terraces in the waters of Back Bay adjacent to Back Bay National Wildlife Refuge. This project is expected to reduce wave energy and thus decrease the speed of erosion of remaining islands in the project area, many of which are managed by the U.S. Fish and Wildlife Service and provide habitat for migratory birds and other species. Additionally, the addition of multiple vegetative structures added to the bay will supplement habitat and provide nesting grounds for multiple species.

The mission of the U.S. Fish and Wildlife Service is *working with others to conserve, protect, and enhance fish, wildlife, plants, and their habitats for the continuing benefit of the American people*. Although much work is conducted on federal property to achieve this mission, the Service equally coordinates with external partners to further mutual goals. The proposed marsh terrace project is an excellent example of local and federal government coordination, and we support the City of Virginia Beach's proposed project.

Megan Reed
Refuge Manager

Albemarle-Pamlico
National Estuary Partnership

Our mission is to identify, protect, and restore
the significant resources of the Albemarle-Pamlico estuarine system.

October 26, 2023

Wendy Howard Cooper
Virginia Dept. of Conservation and Recreation
Division of Dam Safety and Floodplain Management
600 E. Main St., 24th Floor
Richmond, VA 23219

Dear Wendy,

The Albemarle-Pamlico National Estuary Partnership (APNEP) strongly endorses the City of Virginia Beach and partners' application to Round 4 of The Virginia Community Flood Preparedness Fund (CFPF). The proposal is to support construction of the Back Bay Marsh Terrace Restoration Project.

APNEP relies on regional partnerships and collaboration to implement our 2012-2022 Comprehensive Conservation & Management Plan (CCMP) within the waterways of our congressionally designated "estuary of national significance." The proposed partnership between the City of Virginia Beach and the U.S. Fish and Wildlife Service will also advance our 2020 Memorandum of Understanding between Virginia and North Carolina to protect the ecosystem resources in the shared waterways between our two states. The project also addresses a "high priority" area for restoring and enhancing vulnerable marshes with high flood risk reduction benefits and habitat value, as identified by Audubon's Currituck Sound Coalition Marsh Conservation Plan released in 2021.

The marsh terrace project employs the use of natural features to build resilience to flooding in the Back Bay watershed. The project offers coastal resilience and habitat protection and conservation co-benefits including preserving marsh islands, restoring Submerged Aquatic Vegetation, migratory bird and fish habitat, reducing flow that could exacerbate wind tide flooding in local communities, and filling a gap in prior applied research on predominantly fresh water coastal lagoons. These features support the following CCMP actions:

- A2.3: Support research on adapting to impacts associated with climate change and sea level rise.
- C3.2: Develop and implement a coordinated wetland restoration strategy.
- C3.3: Develop and implement a submerged aquatic vegetation (SAV) restoration strategy.
- D3.3: Provide assistance to state, regional, and local governments to incorporate climate change and sea level rise considerations into their planning processes.

In closing, we strongly support the full funding of the City of Virginia Beach's proposal to Round 4 of The Virginia Community Flood Preparedness Fund (CFPF). Please contact Steve Anderson, Partnership Coordinator, at (919) 707-8743 with questions.

Sincerely,

W. Crowell

William L. Crowell, Jr., Ph.D., AICP, CEE
Director

Attachment 5: Copy of the Current Floodplain Ordinance

ORD-3685

AN ORDINANCE TO AMEND SECTIONS 1.1, 1.2, 1.3, 1.8, 2.1, 2.2, 2.3, 2.4, 2.8, 2.11, 3.1, 4.1, 4.2, 4.3, 4.4, 4.6, 4.8, 4.9, 4.10, 5.1, 6.1, AND 6.3 OF APPENDIX K, FLOODPLAIN ORDINANCE OF THE CITY CODE PERTAINING TO HOUSEKEEPING THE DELETION OF PUBLIC WORKS REQUIREMENTS AND THE ADDITION OF A COASTAL A ZONE AND A COASTAL HIGH HAZARD ZONE

Sections Amended: 1.1, 1.2, 1.3, 1.8, 2.1, 2.2, 2.3, 2.4, 2.8, 2.11, 3.1, 4.1, 4.2, 4.3, 4.4, 4.6, 4.8, 4.9, 4.10, 5.1, 6.1, and 6.3 of Appendix K, Floodplain Ordinance

WHEREAS, the public necessity, convenience, general welfare and good zoning practice so require;

BE IT ORDAINED BY THE CITY COUNCIL OF THE CITY OF VIRGINIA BEACH, VIRGINIA:

That Sections 1.1, 1.2, 1.3, 1.8, 2.1, 2.2, 2.3, 2.4, 2.8, 2.11, 3.1, 4.1, 4.2, 4.3, 4.4, 4.6, 4.8, 4.9, 4.10, 5.1, 6.1, and 6.3 of Appendix K, Floodplain Ordinance is hereby amended and reordained to read as follows:

APPENDIX K FLOODPLAIN ORDINANCE

ARTICLE I. GENERAL PROVISIONS

Sec. 1.1. Statutory authorization and purpose.

A. This ordinance is adopted pursuant to the authority granted to localities by Code of Virginia § ~~10.1-600 et seq~~ 15.2-984.

B. The city council finds the purpose of these provisions is to prevent the loss of life and property, the creation of health and safety hazards, the disruption of commerce and governmental services, the extraordinary and unnecessary expenditure of public funds for flood protection and relief, and the impairment of the tax base by:

1. Regulating uses, activities, and development that, alone or in combination with other existing or future uses, activities, and development, will cause unacceptable increases in flood heights, velocities, and frequencies;

2. Restricting or prohibiting certain uses, activities, and development from locating within districts subject to flooding;
3. Requiring all uses, activities, and developments that do occur in flood-prone districts be protected or flood-proofed against flooding and flood damage;

4. Protecting individuals from buying land and structures that are unsuited for intended purposes because of flood hazards; and

5. Acknowledging that the tide data over the last one hundred (100) years shows that Virginia Beach is facing an increased danger of flooding caused by both sea level rise and subsidence and has adopted the Sea Level Wise Adaptation Report as part of the Comprehensive Plan.

Sec. 1.2. Applicability.

These provisions shall apply to all privately and publicly owned lands within the jurisdiction of the City of Virginia Beach and identified as areas ~~of special flood hazard~~ at risk of flooding by the City of Virginia Beach or shown ~~according to~~ on the Flood Insurance Rate Map (FIRM) or included on the flood insurance study (FIS) that ~~is~~ are provided to the City of Virginia Beach by the Federal Emergency Management Agency (FEMA) and dated January 16, 2015 ~~or identified as floodplains subject to special restrictions in section 4.10 of this ordinance~~.

Sec. 1.3. Definitions.

. . . .

City manager. The City Manager of the City of Virginia Beach, or his designees.

Design Flood Elevation (regulatory flood protection elevation). The base flood elevation plus the freeboard required by this ordinance.

. . . .

Recreational vehicle. A vehicle that is:

1. Built on a single chassis;
2. Four hundred (400) square feet or less when measured at the largest horizontal projection;
3. Designed to be self-propelled or permanently towable by a light duty truck; and
4. Designed primarily not for use as a permanent dwelling but as temporary living quarters for recreational camping, travel, or seasonal use.

~~*Regulatory flood protection elevation (design flood elevation)*. The base flood elevation plus the freeboard required by this ordinance.~~

. . . .

Sec. 1.8. Penalty for violations.

Any person who fails to comply with any of the requirements or provisions of this ordinance or directions of the ~~d~~Directors of ~~p~~Planning ~~or public works~~ or any authorized employee of the City of Virginia Beach shall be guilty of the appropriate violation and subject to the penalties therefore. Any violation of the provision of this ordinance shall be punishable by a fine of not more than one hundred dollars ($100.00). Each person shall be deemed guilty of a separate offense for each and every day or portion thereof during which any violation of any of the provisions of this ordinance is committed.

The Virginia Uniform Statewide Building Code (VA USBC) addresses building code violations and the associated penalties in ~~section 104 and section 115~~ VA USBC § 104 and § 115. Violations and associated penalties of the Zoning Ordinance for the City of Virginia Beach are addressed in § 104 of the Zoning Ordinance.

In addition to the above penalties, all other actions are hereby reserved, including an action in equity for the proper enforcement of this ordinance. The imposition of a fine or penalty for any violation of, or noncompliance with, this ordinance shall not excuse the violation or noncompliance or permit it to continue, and all such persons shall be required to correct or remedy such violations within a reasonable time. Any structure constructed, reconstructed, enlarged, altered, or relocated in noncompliance with this ordinance may be declared by the City of Virginia Beach to be a public nuisance and abatable as such. Flood insurance may be withheld from structures constructed in violation of this ordinance.

ARTICLE II. ADMINISTRATION

Sec. 2.1. Designation of the floodplain administrator.

The City Manager of the City of Virginia Beach is hereby appointed the floodplain administrator to administer and implement this ordinance. The floodplain administrator has delegated the duties and responsibilities set forth in this ordinance to the ~~departments of public works and planning, as specified below~~ Department of Planning and Community Development.

Sec. 2.2. Duties and responsibilities of the ~~department of public works~~ floodplain administrator or his designee.

The duties and responsibilities of the ~~department of public works~~ floodplain administrator of his designee shall include but are not limited to:

A. Interpreting floodplain boundaries and providing available base flood elevation and flood hazard information;

B. Verifying that applicants proposing an alteration of a watercourse have notified adjacent communities, the department of conservation and recreation (division of dam safety and floodplain management), and other appropriate agencies (Virginia Department of Environmental Quality (VADEQ), United States Army Corps of Engineers (USACE), etc.) and have submitted copies of such notifications to FEMA;

C. Advising applicants for new construction or substantial improvement of structures that are located within an area of the coastal barrier resources system established by the Coastal Barrier Resources Act that Federal flood insurance is not available on such structures; areas subject to this limitation are shown on FIRMs as coastal barrier resource system areas or otherwise protected areas;

D. Submitting to FEMA, or requiring applicants to submit to FEMA, data and information necessary to maintain FIRMs, including hydrologic and hydraulic engineering analyses prepared by or for the city, within six (6) months after such data and information becomes available if the analyses indicate changes in base flood elevations;

E. Maintaining and permanently keeping records that are necessary for the administration of these regulations, including:

1. ~~flood~~ Flood insurance studies, FIRMs (including historic studies and maps and current effective studies and maps) and letters of map change; and

2. Documentation supporting issuance and denial of permits, Elevation Certificates, documentation of the elevation (in relation to the datum on the FIRM) to which structures have been floodproofed, inspection records, other required design certifications, variances, and records of enforcement actions taken to correct violations of these regulations.

F. Notifying FEMA when the corporate boundaries of the City of Virginia Beach have been modified and:

1. Providing a map that clearly delineates the new corporate boundaries or the new area for which the authority to regulate pursuant to this ordinance has either been assumed or relinquished through annexation; and

2. If the FIRM for any annexed area includes SFHAs that have flood zones with regulatory requirements that are not set forth in this

ordinance, prepare amendments to this ordinance to adopt the FIRM and appropriate requirements, and submit the amendments to the city council for adoption; such adoption shall take place at the same time as or prior to the date of annexation and a copy of the amended ordinance shall be provided to the department of conservation and recreation (division of dam safety and floodplain management) and FEMA.

G. Upon the request of FEMA, completing and submitting a report concerning participation in the NFIP, which may request information regarding the number of buildings in the SFHA, the number of permits issued for development in the SFHA, and the number of variances issued for development in the SFHA.

H. Reviewing applications for permits to determine whether proposed activities will be located in the SFHA;

I. Reviewing applications to determine whether proposed activities will be reasonably safe from flooding and requiring new construction and substantial improvements to meet the requirements of this ordinance;

J. Reviewing applications to determine whether all necessary permits have been obtained from the federal, state, or local agencies from which prior or concurrent approval is required; in particular, permits from state agencies for any construction, reconstruction, repair, or alteration of a dam, reservoir, or waterway obstruction (including bridges, culverts, structures), any alteration of a watercourse, or any change of the course, current, or cross section of a stream or body of water, including any change to the SFHAs of free-flowing non-tidal waters of the state;

K. Approving applications and issuing permits to develop in flood hazard areas if the provisions of this ordinance have been met, or disapproving applications if the provisions of this ordinance have not been met;

L. Granting administrative variances pursuant to section 6.1 of this ordinance;

M. Inspecting, or causing to be inspected, buildings, structures, and other development for which permits have been issued to determine compliance with this ordinance or to determine if non-compliance has occurred or violations have been committed;

N. Reviewing elevation certificates and requiring incomplete or deficient certificates to be corrected;

O. Maintaining and permanently keeping documentation supporting the issuance and denial of permits, elevation certificates, documentation of the elevation (in relation to the datum on the FIRM) to which structures have been flood proofed, and other required design certifications, variances, and records of enforcement actions taken to correct violations of this ordinance;

P. Enforcing the provisions of this ordinance, investigating violations, issuing notices of violations or stop work orders, and requiring permit holders to take corrective action;

Q. Advising the city council regarding the intent of this ordinance and, for each application for a variance, preparing a staff report and recommendation; and

R. Administering the requirements related to proposed work on existing buildings:

1. Making determinations as to whether buildings and structures that are located in flood hazard areas and that are damaged by any cause have been substantially damaged; and

2. Making reasonable efforts to notify owners of substantially damaged structures of the need to obtain a permit to repair, rehabilitate, or reconstruct, and prohibit the non-compliant repair of substantially damaged buildings except for temporary emergency protective measures necessary to secure a property or stabilize a building or structure to prevent additional damage.

S. Undertaking, as determined appropriate by the floodplain administrator due to the circumstances, other actions that may include but are not limited to: issuing press releases, public service announcements, and other public information materials related to permit requests and repair of damaged structures; coordinating with other federal, state, and local agencies to assist with substantial damage determinations; providing owners of damaged structures information related to the proper repair of damaged structures in SFHAs; and assisting property owners with documentation necessary to file claims for increased cost of compliance coverage under National Flood Insurance Program (NFIP) flood insurance policies; and

T. It is the duty of the city floodplain administrator to take into account flood, mudslide, and flood-related erosion hazards, to the extent that they are known, in all official actions relating to land management and use throughout the entire jurisdictional area of the city, whether or not those

hazards have been specifically delineated geographically (e.g., via mapping or surveying).

~~Sec. 2.3. Duties and responsibilities of the department of planning.~~ Reserved.

~~The duties and responsibilities of the department of planning shall include but are not limited to:~~

~~A. Reviewing applications for permits to determine whether proposed activities will be located in the SFHA;~~

~~B. Reviewing applications to determine whether proposed activities will be reasonably safe from flooding and requiring new construction and substantial improvements to meet the requirements of this ordinance;~~

~~C. Reviewing applications to determine whether all necessary permits have been obtained from the federal, state, or local agencies from which prior or concurrent approval is required; in particular, permits from state agencies for any construction, reconstruction, repair, or alteration of a dam, reservoir, or waterway obstruction (including bridges, culverts, structures), any alteration of a watercourse, or any change of the course, current, or cross section of a stream or body of water, including any change to the SFHAs of free-flowing non-tidal waters of the state;~~

~~D. Approving applications and issuing permits to develop in flood hazard areas if the provisions of this ordinance have been met, or disapproving applications if the provisions of this ordinance have not been met;~~

~~E. Granting administrative variances pursuant to section 6.1 of this ordinance;~~

~~F. Inspecting, or causing to be inspected, buildings, structures, and other development for which permits have been issued to determine compliance with this ordinance or to determine if non-compliance has occurred or violations have been committed;~~

~~G. Reviewing elevation certificates and requiring incomplete or deficient certificates to be corrected;~~

~~H. Maintaining and permanently keeping documentation supporting the issuance and denial of permits, elevation certificates, documentation of the elevation (in relation to the datum on the FIRM) to which structures have been flood proofed, and other required design certifications, variances, and records of enforcement actions taken to correct violations of this ordinance;~~

~~I. Enforcing the provisions of this ordinance, investigating violations, issuing notices of violations or stop work orders, and requiring permit holders to take corrective action;~~

~~J. Advising the city council regarding the intent of this ordinance and, for each application for a variance, preparing a staff report and recommendation; and~~

~~K. Administering the requirements related to proposed work on existing buildings:~~

~~1. Making determinations as to whether buildings and structures that are located in flood hazard areas and that are damaged by any cause have been substantially damaged; and~~
~~2. Making reasonable efforts to notify owners of substantially damaged structures of the need to obtain a permit to repair, rehabilitate, or reconstruct, and prohibit the non-compliant repair of substantially damaged buildings except for temporary emergency protective measures necessary to secure a property or stabilize a building or structure to prevent additional damage.~~

~~Sec. 2.4. Shared duties and responsibilities.~~ <u>Reserved.</u>

~~The duties and responsibilities shared by the departments of public works and Planning shall include but are not limited to:~~

~~A. Undertaking, as determined appropriate by the floodplain administrator due to the circumstances, other actions that may include but are not limited to: issuing press releases, public service announcements, and other public information materials related to permit requests and repair of damaged structures; coordinating with other federal, state, and local agencies to assist with substantial damage determinations; providing owners of damaged structures information related to the proper repair of damaged structures in SFHAs; and assisting property owners with documentation necessary to file claims for increased cost of compliance coverage under National Flood Insurance Program (NFIP) flood insurance policies; and~~

~~B. It is the duty of the city floodplain administrator to take into account flood, mudslide, and flood-related erosion hazards, to the extent that they are known, in all official actions relating to land management and use throughout the entire jurisdictional area of the city, whether or not those hazards have been specifically delineated geographically (e.g., via mapping or surveying).~~

. . . .

Sec. 2.8. Interpretation of district boundaries.

Initial interpretations of the boundaries of the floodplain districts shall be made by the floodplain administrator. Should a dispute arise concerning the boundaries of any of the districts~~, the city council shall make the necessary determination. The person questioning or contesting the location of the district boundary shall be given a reasonable opportunity to present his case to the city council and to submit his own technical evidence if he so desires~~ a surveyor shall provide either an elevation certificate or recent survey showing topographic elevations and delineating the Special Flood Hazard Area.

. . . .

Sec. 2.11. Appeals to decisions made by the floodplain administrator.

It is further provided that any decision of the floodplain administrator or his designee may be modified, reversed, or affirmed by the city council upon appeal by any aggrieved party to such decision, if such appeal is filed with the floodplain administrator within thirty (30) days of such decision through the application for a Floodplain Variance outlined in Section VI of this ordinance.

ARTICLE III. ESTABLISHMENT OF FLOODPLAIN DISTRICTS

Sec. 3.1. Description of floodplain districts.

A. Special flood hazard areas (SFHA). The SFHAs shall include land in the floodplain subject to a one (1) percent or greater chance of being flooded in any given year. The basis for the delineation of these districts shall be the FIS and the FIRM for the City of Virginia Beach prepared by FEMA, Federal Insurance Administration, dated January 16, 2015, and any subsequent revisions or amendments thereto.

The boundaries of the SFHAs are established as shown on the FIRM, which is declared to be a part of this ordinance and shall be kept on file at the City of Virginia Beach Department of ~~Public Works~~ Planning and Community Development, and include the following districts:

1. The Floodway District is in an AE Zone and is delineated, for the purposes of this ordinance, using the criterion that certain areas within the floodplain must be capable of carrying the waters of the one (1) percent annual chance flood without increasing the water surface elevation of that flood more than one (1) foot at any point. The areas included in this district are specifically defined in Table 7 of the above-referenced FIS and shown on the accompanying FIRM.

2. The AE or AH Zones on the FIRM accompanying the FIS shall be those areas for which one (1) percent annual chance flood elevations have been provided and the floodway has not been delineated.

3. The A Zone on the FIRM accompanying the FIS shall be those areas for which no detailed flood profiles or elevations are provided, but the one (1) percent annual chance floodplain boundary has been approximated.

4. The AO Zone on the FIRM accompanying the FIS shall be those areas of shallow flooding identified as AO on the FIRM.

5. ~~Reserved.~~ The Coastal A Zone on the FIRM accompanying the FIS shall be those areas labeled as AE and are located seaward of the limit of moderate wave action (LiMWA) line.

6. The VE or V Zones on FIRMs accompanying the FIS shall be those areas that are known as coastal high hazard areas, extending from offshore to the inland limit of a primary frontal dune along an open coast and any other area subject to high velocity wave action from storm or seismic sources.

B. ~~Floodplain subject to special restrictions~~ *Local Flood Hazard Areas*. The City of Virginia Beach may identify and regulate local flood hazard or ponding areas that are not delineated on the FIRM. These areas are ~~identified in section 4.10 and may be delineated on a map using best available topographic data and locally derived information such as flood of record, historic high water marks, or approximate study methodologies~~ identified as follows:~~.~~

a. *Other areas of flood risk*. The X and the X(Shaded) Zone on the FIRM where the City of Virginia Beach Stormwater Master Plan has identified areas, outside SFHAs delineated on the FIRM, that area susceptible to flooding. The most recent updated version of the modeling shall be used to identify areas that are likely to experience flooding.

b. *Floodplain Subject to Special Restrictions*. The Floodplain Subject to Special Restrictions is identified in section 4.10 and includes areas in the southern part of the city which are characterized by wind tides, low topography, and poorly draining soils.

ARTICLE IV. FLOODPLAIN DISTRICT PROVISIONS

Sec. 4.1. Permit and application requirements.

. . . .

B. Site plans and permit applications. All applications for development within any floodplain district and all building permits issued within ~~the~~ any floodplain district shall incorporate the following information:

1. For any addition, conversion of any non-habitable space to habitable space, or the construction or installation of a new accessory structure that requires a building permit.

   a. A physical survey, performed after the effective date of the FIRM that:

      i. accurately depicts current improvements on the property;
      ii. provides a flood zone determination and BFE or flood depth at the stie; and
      iii. delineates the location of the flood zones on the property.

   b. For structures located in the SFHA delineated on the FIRM, a current elevation certificate sealed by a licensed design professional.

2. For new construction and any substantial improvement of the principal structure:

   a. a proposed site plan sealed by a registered design professional that provides:

      ~~1~~i. The elevation of the base flood at the site;

      ~~2~~ii. The elevation of the lowest floor (including basement) or, in V Zones, the lowest horizontal structural member;

      ~~3~~iii. For structures to be flood-proofed (non-residential only), the elevation to which the structure will be flood-proofed; and

      4iv. Topographic information showing existing and proposed ground elevations.

Sec. 4.2. General standards.

. . . .

5. Electrical, heating, ventilation, plumbing, air conditioning equipment, and other service facilities, including duct work, shall be designed and/or ~~located so as to prevent water from entering or accumulating within the components during conditions of flooding~~ or above the design flood elevation.

6. New and replacement water supply systems shall be designed to minimize or eliminate infiltration of flood waters into the system.

7. New and replacement sanitary sewage systems shall be designed to minimize or eliminate infiltration of flood waters into the systems and discharges from the systems into flood waters.

8. On-site waste disposal systems shall be located and constructed to avoid impairment to them or contamination from them during flooding.

9. No use shall be permitted if such use will increase the amounts of potentially damaging materials, including those likely to be injurious to health, that might be transported in floods.

10. For properties located in SFHAs delineated on the FIRM, an elevation certificate and, if applicable, a flood-proofing certificate shall be provided to the Floodplain Administrator prior to any foundation inspection, final inspections, and the issuance of any certificates of occupancy, in order to assure compliance with these floodplain regulations.

11. Prior to any proposed alteration or relocation of any channels or of any watercourse or stream within the city, a permit shall be obtained from the USACE, VADEQ, the Virginia Marine Resources Commission, and the Wetlands Board through the joint permit application process. Furthermore, notification of the proposal shall be given by the applicant to all affected adjacent jurisdictions, the department of conservation and recreation (division of dam safety and floodplain management), other required agencies, and FEMA.

12. The flood carrying capacity within an altered or relocated portion of any watercourse shall be maintained.

~~B. In all SFHAs, the following additional provisions shall apply:~~

~~1. Prior to any proposed alteration or relocation of any channels or of any watercourse or stream, within the city a permit shall be obtained from the USACE, VADEQ, the Virginia Marine Resources Commission, and the Wetlands Board through the joint permit application process. Furthermore, notification of the proposal shall be given by the applicant to all affected adjacent jurisdictions, the department of conservation and recreation (division of dam safety and floodplain management), other required agencies, and FEMA.~~

~~2. The flood carrying capacity within an altered or relocated portion of any watercourse shall be maintained.~~

~~3. Sand dunes, barrier beaches, and other natural protective barriers shall remain intact to provide protection against wind, waves, and erosion drainage. Any person who desires to use or alter any coastal primary sand dune, other than for the purpose of conducting the activities specified in section 1602 of the Zoning Ordinance of the City of Virginia Beach, shall first obtain a permit from the USACE, VADEQ, the Virginia Marine Resources Commission, and the Wetlands Board through the joint permit application process.~~

Sec. 4.3. Elevation and construction requirements.

In all ~~SFHAs where base flood elevations have been provided in the FIS or generated by a licensed professional in accordance with section 4.6 of this ordinance~~ floodplain districts, with the exception of Coastal A and Coastal High Hazard (VE) zones, the following provisions shall apply:

A. Residential construction requirements. ~~New construction or substantial improvement of any residential structure or manufactured home in Zones AE, AH, and A with detailed base flood elevations shall have the lowest floor, including basement, elevated to a minimum of two (2) feet above the base flood level.~~ The lowest flood, including basement, shall be set to the higher of the following:

i. A minimum of two (2) feet above the base flood elevation established on the most recent FIRM or by the most recent FIS or,

ii. A minimum of one (1) foot above the 100-year HGL elevation measured at the nearest existing or proposed public drainage structure or BMP, in the City Stormwater Master Plan.

B. Non-residential construction requirements. New construction or substantial improvement of any commercial, industrial, or non-residential building or manufactured home shall have the lowest floor, including basement, elevated as ~~minimum of two (2) feet above the base flood level~~ established in Section 4.3 A of this ordinance. Buildings ~~located in AE or AH Zones~~ may be flood-proofed in lieu of being elevated provided that all areas of the building components below the ~~elevation corresponding to the base flood elevation plus a minimum of two (2) feet freeboard~~ design flood elevation are watertight with walls substantially impermeable to the passage of water, and use structural components having the capability of resisting hydrostatic and hydrodynamic loads and the effect of buoyancy. A professional engineer or architect licensed by the Commonwealth of Virginia shall certify that the standards of this subsection are satisfied. Such certification, including the specific elevation (in relation to NAVD88) to which such structures are flood proofed, shall be maintained by the building official.

C. ~~Space below the lowest floor requirements. In Zones A, AE, AH, and AO, f~~Fully enclosed areas of new construction or substantially improved existing structures that are below the ~~regulatory~~ design flood protection elevation shall:

1. Not be designed or used for human habitation, but shall only be used for parking of vehicles, building access, or limited storage of maintenance equipment used in connection with the premises. Access to the enclosed area shall be the minimum necessary to allow for parking of vehicles (garage door), limited storage of maintenance equipment (standard exterior door), or entry to the living area (stairway or elevator).

2. Be constructed entirely of flood resistant materials below the ~~regulatory~~ design flood ~~protection~~ elevation.

3. Space below the lowest floor of SFHAs delineated on the FIRM shall ~~I~~include measures to automatically equalize hydrostatic flood forces on walls by allowing for the entry and exit of floodwaters. To meet this requirement, the openings shall either be certified by a professional engineer or architect licensed by the Commonwealth of Virginia or meet or exceed the following minimum design criteria:

. . . .

Sec. 4.4. Floodway requirements.

. . . .

B. The placement of new or replacement manufactured homes (mobile homes) is prohibited.

~~C. The following uses and structures may be permitted in the floodway district, subject to the requirements of articles III, IV, V, and VI of this ordinance:~~

~~1. Public and private outdoor recreational facilities;~~

~~2. Agricultural uses, including farming, grazing, and the raising of poultry or livestock; provided, that poultry or livestock shall not be housed within five hundred (500) feet of any residential, apartment, or hotel district;~~

~~3. Open uses, such as public and private roadways, off street parking, or loading and unloading areas related to uses in adjoining districts;~~

4. ~~Commercial mining, soil removal, and sand pits subject to regulations applicable to extractive industries as set forth in the conditional use provisions of the Zoning Ordinance of the City of Virginia Beach;~~

5. ~~Public improvements, such as dams, levees and channel improvements, and utilities installations and substations, including temporary storage of materials, except flammable, toxic or noxious materials, and temporary location of maintenance installations; and~~

6. ~~Uses and structures customarily accessory and clearly incidental and subordinate to uses listed above, including in connection with agricultural uses; roadside stands for the sale of agricultural products produced on the premises; provided that:~~

    a. ~~Only one (1) such stand shall be permitted per lot;~~

    b. ~~No such stand shall exceed five hundred (500) square feet in floor area; and~~

    c. ~~No such stand on the street frontage shall be erected within twenty (20) feet of the property line.~~

. . . .

Sec. 4.6. A Zone requirements.

. . . .

B. The floodplain administrator reserves the right to require a hydrologic and hydraulic analysis for any development and to determine the base flood elevation. When such base flood elevation data is utilized, the lowest floor shall be elevated to minimum of two (2) feet above the base flood level. During the permitting process, the floodplain administrator shall obtain:

1. The elevation of the lowest floor (including the basement) of all new and substantially improved structures; and

2. If the structure has been flood-proofed in accordance with the requirements of this ordinance, the elevation (in relation to NAVD88) to which the structure has been flood-proofed.

~~C.~~ ~~When the data is not available from any source, the lowest floor of the structure shall be elevated to not less than two (2) feet above the highest adjacent grade.~~

Sec. 4.8. ~~Reserved~~ X and X(Shaded) Zone requirements. (Other Areas of Flood Risk).

A. *Residential construction requirements*. The lowest floor, including basements, shall be set to a minimum of one (1) foot above the 100-year HGL elevation measured at the nearest existing or proposed public drainage structure or BMP, in the City Stormwater Master Plan.

B. *Non-residential construction requirements*. New construction or substantial improvement of any commercial, industrial, or non-residential building or manufactured home shall have the lowest floor, including basement, elevated as established in Section 4.8 A of this ordinance above. Buildings may be flood-proofed in lieu of being elevated provided that all areas of the building components below the design flood elevation are watertight with walls substantially impermeable to the passage of water, and use structural components having the capability of resisting hydrostatic and hydrodynamic loads and the effect of buoyancy. A professional engineer or architect licensed by the Commonwealth of Virginia shall certify that the standards of this subsection area satisfied. Such certification, including the specific elevation (in relation to NAVD88) to which such structures are flood proofed, shall be maintained by the building official.

Sec. 4.9. – Coastal High Hazard (~~V and~~ VE Zone) requirements.

The following provisions shall apply within ~~V and VE Zones~~ Coastal A Zones and Coastal High Hazard Areas:

A. All new construction and substantial improvements, including to manufactured homes, shall be elevated on pilings or columns so that:

1. The bottom of the lowest horizontal structural member of the lowest floor (excluding the pilings or columns) is elevated to a minimum of ~~two~~ three (~~2~~3) feet above the base flood ~~level~~ elevation; and

2. The pile or column foundation and structure attached thereto is anchored to resist flotation, collapse, and lateral movement due to the effects of wind and water loads acting simultaneously on all building components. Wind and water loading values shall each have a one (1) percent chance of being equaled or exceeded in any given year.

B. A professional engineer or architect licensed by the Commonwealth of Virginia shall develop or review the structural design, specifications, and plans for the construction and shall certify that the design and methods of construction to be used are in accordance with accepted standards of practice for meeting the provisions of article IV, section 4.6 A. A V Zone

Design Certificate shall be submitted to Permits and Inspections with plans for a building permit.

. . . .

I. ~~The man-made alteration of sand dunes, which would increase potential flood damage, is prohibited.~~ Sand dunes, barrier beaches, and other natural protective barriers shall remain intact to provide protection against wind, waves, and erosion drainage. Any person who desires to use or alter any coastal primary sand dune or beaches, other than for the purpose of conducting the activities specified in Article 1600, Section 1602 of the Zoning Ordinance of the City of Virginia Beach, shall first obtain a permit, or authorization, from the USACE, VADEQ, the Virginia Marine Resources Commission, and the Wetlands Board through the joint permit application process.

J. Manufactured homes are prohibited.

Sec. 4.10. Floodplain subject to special restrictions.

A. All ~~FIRM delineated~~ SFHAs that ultimately drain to Back Bay or the Currituck Sound ~~located in the following areas~~ shall be identified as a floodplain subject to special restrictions~~:~~.

~~1. North Landing River and its tributaries south of Lynnhaven Parkway;~~

~~2. West Neck Creek and its tributaries south of Shipps Corner Road, London Bridge Road, and the portion of Dam Neck Road east of its intersection with London Bridge Road; and~~

~~3. Bays, creeks, lakes, guts, coves, wetlands, marshes and swamps and their tributaries comprising the Back Bay and Small Coastal South watersheds south of South Birdneck Road and east of Princess Anne Road and General Booth Boulevard.~~

B. The following provisions shall apply within the floodplain subject to special restrictions:

1. Notwithstanding any provision of this ordinance to the contrary, no filling shall be permitted, including filling with material excavated from the same floodplain except for:

a. The purpose of public roadway or other similar public works construction undertaken by the Department of Public Works or Virginia Department of Transportation, or their agent for

construction. This construction includes flood protection and flood mitigation projects;

b. The maintenance, alteration, or relocation of bona fide agricultural ditches, swales, or agricultural pathways or those ditches required for proper lot drainage;

c. For shoreline stabilization or maintenance projects, such as riprap revetment, bulkheads, or other treatment used to stabilize and protect the banks of waterways, the city manager or his designee may approve the placement of fill provided the following criteria are met:

i. A joint permit application is submitted;

ii. The alignment of the stabilization structure is along the escarpment or in line with adjacent stabilization structures; ~~and~~

iii. If there is an existing shoreline stabilization structure, any proposed replacement structure shall be no more than six (6) inches higher than the existing structure; and

~~iii~~iv. Fill must be the minimum necessary to support the stabilization project.

2. The city manager, or his designee, may approve the placement of fill provided that the following criteria are met:

a. Proposed fill within the floodplain:

i. Shall be mitigated to result in no decrease in flood storage volume on the site;

ii. Shall be mitigated entirely on the same site that will incur the fill;

iii. Shall be contiguous to the existing floodplain that is being filled; and

iv. Shall be limited to the smallest amount of area and volume possible to correct irregularities within the boundary of the project.

b. The combined areas of fill and mitigation shall not exceed five (5) percent of the total area within the floodplain located on the site that will incur the fill.

3. Residential dwelling structures shall not be located within the floodplains subject to special restrictions on lots created after October 23, 2001. Residential dwelling structures located in ~~local flood hazard areas as of~~ a SFHA and constructed prior to October 23, 2001 may be expanded with attached additions to a total footprint of less than one thousand (1,000) square feet; such additions shall also comply with the requirements set forth in article V of this ordinance.

. . . .

ARTICLE V. EXISTING STRUCTURES IN FLOODPLAIN AREAS

Sec. 5.1. Existing structures.

A structure or use of a structure or premises that lawfully existed prior to the adoption of this ordinance, but which is not in conformity with this ordinance, may be continued subject to the following conditions:

A. Any existing structures in the floodway area shall not be expanded or enlarged unless it has been demonstrated through hydrologic and hydraulic analyses performed in accordance with standard engineering practices that the proposed expansion or enlargement would not result in any increase in the base flood elevation.

B. Any modification, alteration, repair, reconstruction, or improvement of any kind to a structure and/or use located in any floodplain ~~areas~~ district to an extent or amount of less than fifty (50) percent of its market value shall conform to the VA USBC and meet the freeboard height in effect at the start of construction for the original structure.

C. Any modification, alteration, repair, reconstruction, or improvement of any kind to a structure and/or use, in any floodplain ~~area~~ district to an extent or amount of fifty (50) percent or more of its market value shall be undertaken only in full compliance with this ordinance and shall require the entire structure to conform to the VA USBC.

ARTICLE VI. VARIANCES AND APPEALS

Sec. 6.1. Administrative variances.

The floodplain administrator shall approve or deny an application requesting an administrative variance after receipt of a complete application. Administrative variances may only be granted for the following uses, development, or redevelopment:

A. As defined in section 4.10, floodplains subject to special restrictions, for filling only.

B. Any structure or use sustaining damage not caused by flood to an extent or amount of fifty (50) percent or more of its market value to allow the structure to be rebuilt to the freeboard height in effect at the start of construction for the original structure. If the structure is a pre-FIRM structure, full compliance with the current VAUSBC freeboard above the base flood elevation is required. Structures that are utilizing an approved land management plan for their on-site waste disposal may be allowed to continue the use of the land management plan as long as it is approved by the city and the health department, even for damage or destruction resulting from flood.

C. As defined in section 4.8 B, X and X(Shaded) Zone requirements. (Other Areas of Flood Risk), and 4.3 A(ii) when the required finished floor is higher than the BFE plus two feet of freeboard, where the floodplain administrator, in consultation with the Development Services Center, has determined that the proposed stormwater engineering design will approximately mitigate any impacts to the finished floor of the nonresidential development.

Sec. 6.3. Application process.

A. Applications for variances from the requirements of this ordinance shall be made to the city council and filed with the director of planning. The fee for such applications shall be ~~six hundred fifty dollars~~ seven hundred eighty ($~~650~~780.00). Such fee shall include all costs of notifications and advertising. Except in cases in which such fee is waived, the director shall not accept any application not accompanied by payment of the required fee. The procedure for the advertising, hearing and determination of applications for floodplain variances shall be in accordance with the requirements pertaining to applications for subdivision variances, as set forth in section 9.4 of the subdivision ordinance. In cases in which a variance application is filed by reason of a natural disaster that is the subject of a federal declaration of emergency, application and associated advertising fees shall be waived and such application shall be given expedited processing to the maximum practical extent.

B. All applications shall be accompanied by the following:

1. A separate map, on a 1″ = 100′ or greater scale, identifying all proposed land disturbance, including fill and mitigation areas, and the limits of the existing and proposed SFHAs, tidal and non-tidal wetlands, Southern Rivers Watershed Management Area Buffer, and CBPA Resource Protection Area Buffer; and

2. A preliminary floodplain study addressing the physical and environmental characteristics of the floodplain located on adjoining properties and in the general area. Such study shall be sufficient to show that the variance, if granted, will meet the standards defined in section 6.~~3~~4 and in addition thereto, shall:

    a. Contain supporting data and calculations required for a Preliminary Stormwater Engineering Analysis as appropriate~~, given the preliminary nature of the floodplain study~~;

    b. Comply with the Public Works Design Standards Manual; and

    c. Be certified by a professional engineer, architect, surveyor, landscape architect or practitioner of a related field having a valid license issued by the Commonwealth of Virginia or who is exempt from licensure pursuant to applicable provisions of the Virginia Code.

Adopted by the Council of the City of Virginia Beach, Virginia, on the 1st day of February, 2022.

Attachment 6: Copy of Monitoring/Maintenance Plan

[DRAFT] Annual Monitoring Plan and Post-Construction Monitoring Report

Marsh Restoration in Back Bay, Virginia Beach, VA

Prepared by: Dewberry Engineers, Inc.

[July 6, 2023]

[REPORT VERSION [DRAFT]]

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INTRODUCTION

This project is intended to implement one of the nature-based projects proposed in Virginia Beach's "Sea Level Wise" (SLW) Adaptation Strategy[1] adopted by the Virginia Beach City Council in June 2020. The SLW Adaptation Strategy presents a holistic framework for addressing flood risks across the City, consisting of four general strategies – natural mitigations, engineered defenses, adapted structures, and prepared communities. These strategies were applied to each major watershed in the City and tailored to their unique characteristics and risk profiles. The adaptation vision for the Lower Southern Rivers Drainage Basin, where the proposed project is located, focuses on employing natural mitigation methodologies to strategically reduce flow into and within Back Bay, along with an integrated system of defense structures and complementary adaptation measures, such as land-use strategies, to improve flood storage and overall coastal resiliency. The Bonney Cove area of Back Bay, where the project site is proposed, is particularly suitable for the use of nature-based strategies given the low elevations of marshlands and documented historic degradation of habitat. Participants at the 'near-neighbor' public engagement meetings held during the SLW Adaptation Strategy development were supportive of these types of strategies.

The City has several dedicated Capital Improvement Program (CIP) initiatives for the Lower Southern Rivers Drainage Basin for implementation of these strategies. The City's Stormwater Green Infrastructure CIP has obligated approximately $421,700 in contracts to support field investigations, environmental assessments, and engineering designs of the project – a true indication of the City's commitment to nature-based approaches and the critical first step in a broader effort. During the General Election on November 2, 2021, Virginia Beach residents voted to authorize $567.5 million dollars in debt to fund the design and construction of 21 Phase 1 projects in the citywide Flood Protection Program. [2] The Back Bay Marsh Terrace project is included under the Stormwater Green Infrastructure Master Project.[3] Other Southern Watershed projects that received funding under the Flood Protection Program include the West Neck Creek Bridge City-Wide Sea Level Rise Strategy, the Pungo Ferry Road Improvements, and the Sandbridge/New Bridge Intersection Improvements projects.

Outside of this project, the Virginia Beach City Council has recently funded a $5.2 million dollar voluntary acquisition program to encourage flood-prone properties to apply for a buyout to enable the City to convert parcels to open space to serve as flood storage and a marsh migration buffer. The City's

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[1] City of Virginia Beach Sea Level Wise Adaptation Strategy webpage: https://www.vbgov.com/government/departments/public-works/comp-sea-level-rise/Pages/default.aspx

[2] City of Virginia Beach Flood Protection Program webpage: https://www.vbgov.com/government/departments/public-works/flood-protection-program/Pages/Flood-Protection-Program.aspx.

[3] Stormwater Green Infrastructure Page: https://www.vbgov.com/government/departments/public-works/flood-protection-program/Pages/Stormwater-Green-Infrastructure-.aspx

Stormwater Green Infrastructure CIP is also supporting the implementation of other natural and nature-based projects across the City, including a wetland and floodplain restoration project along the Eastern Branch of the Elizabeth River.

An assessment of restoration opportunities in the City's Lower Southern Rivers Drainage Basin with dual flood reduction and habitat restoration benefits identified the Bonney Cove area as a potential project site for several reasons. The Bonney Cove site has experienced significant historical ecological degradation. Historical shoreline data from 1869 indicates approximately 50% of present-day open water in Bonney Cove (260 acres) was previously marsh (Figure 1). Loss of the marsh island habitat within Bonney Cove has resulted in the opening of a secondary channel allowing increased flow exchange between the upper and lower bays. In comparison to shore-adjacent restoration, off-shore marsh restoration leveraging hydraulic modeling identified Bonney Cove as a location where marsh restoration has the potential to reduce the propagation of floodwaters through key pathways within Back Bay. The United States Fish and Wildlife Service (USFWS) and the Virginia Department of Wildlife Resources (VDWR) also identified Bonney Cove as a restoration priority as this area serves as an ideal location for Submerged Aquatic Vegetation (SAV) reestablishment and vital habitat for migratory birds and fish.

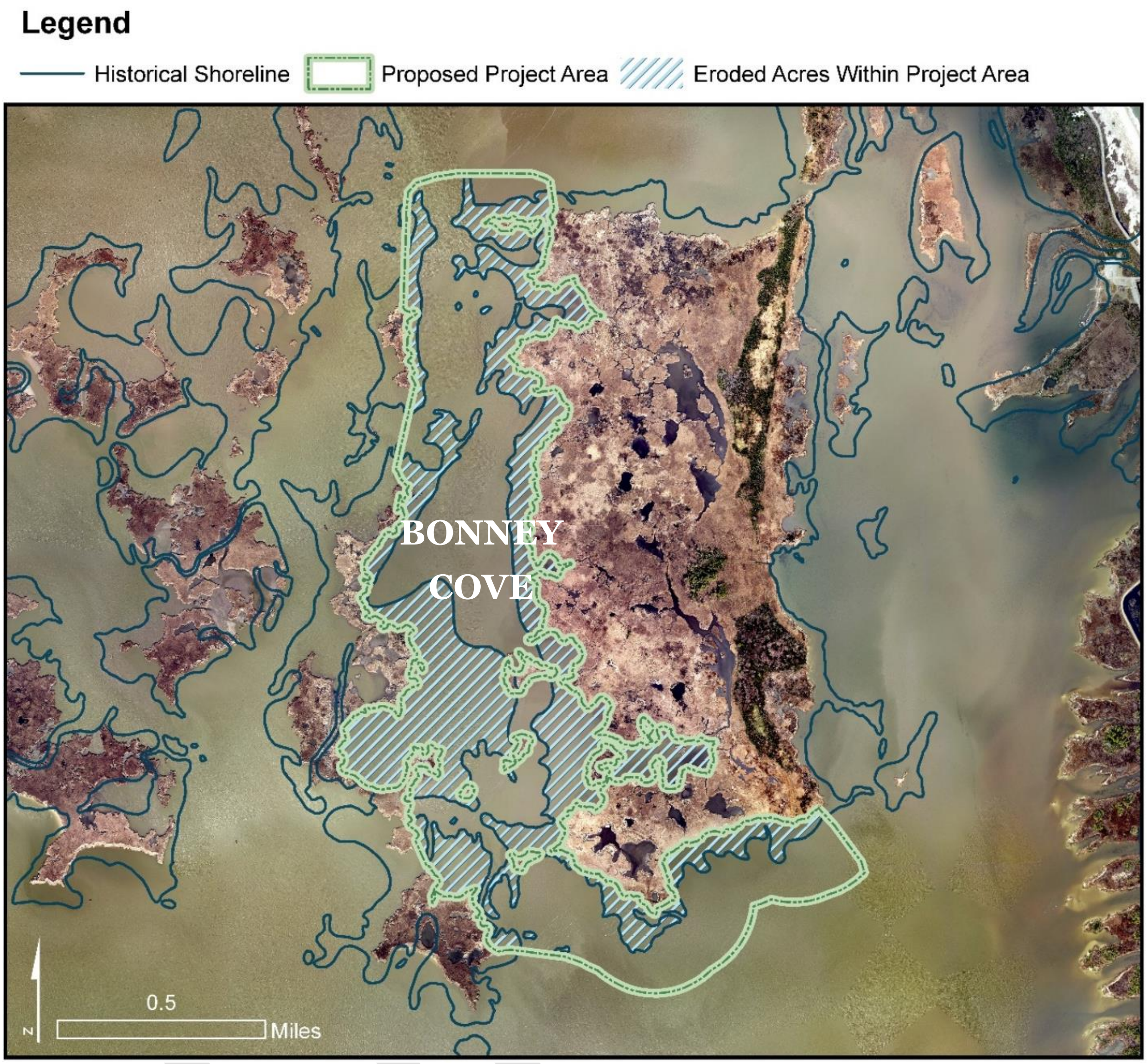

Figure 1: Historical marsh erosion within the project area.

The project is situated within the Bonney Cove area of Back Bay, spanning the western and southern lengths of Long Island, as shown in Figure 1.

Project Background

Marsh island restoration through terracing was identified as a particularly viable solution given Back Bay's shallow bottom and the historical loss of habitat. The marsh terraces are narrow man-made islands that will be arranged across areas that were historically marsh but are now shallow open water. A series of these islands, or terraces, are typically arranged in a chevron pattern. The overall field of terraces dissipates waves and slows down water moving through the area. In turn, the calmer water allows more sunlight to penetrate to the shallow bottom, promoting establishment and growth of marsh

and SAV habitats. Further, as opposed to one continuous marsh platform, marsh terraces maximize habitat for a variety of fish and wildlife species.

The Preferred Alternative includes the creation of 41 individual marsh terraces totaling approximately 25,000 linear feet (or an approximately 47-acre footprint) across Bonney Cove. These 47 acres of terraces are comprised of approximately 13 acres of emergent (low and high marsh) vegetated habitat, 14 acres of upland vegetated habitat, and 16 acres of submerged terrace habitat. Approximately 310 acres of suitable SAV habitat will remain in between the terraces.

Terrace Construction and Orientation

Terrace construction will begin in the northern extent of the project site, and the contractor will work towards the southern extent of the site. The contractor will complete each terrace, including installing plants, before moving to the next. Marsh terrace construction will occur over two years (2025 to 2026) and will pause annually between October 31st and March 1st to limit disturbance to wintering waterfowl and migration, in accommodation of BBNWR's requirement. Approximately 20 terraces will be constructed in 2025 ("Phase 1"), and 21 terraces will be constructed in 2026 ("Phase 2"). The following sections summarize the proposed design and construction approach.

Terraces will be generally oriented perpendicular to the predominant wind direction (south-southwest) to maximize wave energy reduction. The terraces will be segmented in a chevron (duck-wing) pattern to create the most favorable fish and swimming crustacean (termed "nekton") habitat, facilitate adequate circulation, and maintain navigability throughout the project area. The terraces will not be connected to the adjacent marsh to maintain a physical open water barrier to deter the invasion of Common Reed (*Phragmites australis*) stands.

The terraces will be spaced at approximately 300-foot intervals in the northern and southern quarters and span 15 feet in width, and at least 600-foot intervals in the center and span 30 feet in width. This arrangement will lessen the amount of open water and subsequent wave action at the northern and southern ends of the site and provide space for marine-based construction equipment. The design team reviewed the final spacing layout of the terraces to ensure navigability of a watercraft through the project site which will be required for post-construction monitoring, any needed maintenance, as well as community recreational access.

The terraces would consist of a sand filled core encapsulated by a high-strength blend of woven and non-woven geotextile fabrics ("geobags"). The sand for this material would need to come from offsite sources. Back Bay is too shallow to accommodate conventional barges for material placement. To avoid extensive impacts to the bottom of the bay, the slurry basin will pump sand for the project from the proposed Shipps Cabin Road staging area to Bonney Cove. The slurry pipeline will consist of approximately 10,424 linear feet of 12" diameter HDPE fused/welded pipeline that will be assembled on land and floated into its proposed alignment within Back Bay. The pipe would be marked by floats

every 5 feet and temporary signage as reasonable. It is anticipated the pipeline will be submerged to the bottom of the bay at channel crossings and adjacent to a duck hunting cabin adjacent to the alignment. By establishing a floating pipeline, it will limit disturbances to the subaqueous bottomlands along the alignment and allow for the retraction of the pipeline during the winter inactive periods and inclement weather events. Booster stations would be placed approximately every mile. These booster stations would consist of a pontoon mounted diesel engine pump capable of moving the sand slurry from the laydown area to the site. Given the distance to the site, four or five of these booster stations are anticipated to be necessary to create the sand cores of the terrace. It is estimated that 450 Gallons Per Minute (GPM) of sand slurry would be pumped through the pipe.

Once the cores are in place, long reach excavators would travel along the tops of the terraces and begin to shape the cross slopes. Appropriate materials for establishing vegetation atop the terraces will be primarily sourced from materials dredged during the Sandbridge Road Nimmo Parkway Phase VII-A project located immediately north of Back Bay (VMRC 15-1564, USACE IP NAO-2015-00151). Materials will be tested and screened to remove organics prior to application to the terraces. As needed, dredging sites adjacent to the proposed terrace locations that are confirmed to be devoid of SAV will be utilized to provide supplemental soil materials to top the proposed terraces[4]. It was determined that the in-situ bay sediment would be suitable for vegetation growth. The marsh terraces would be covered with 1 to 3 feet of suitable fill, depending on crest widths. Jute netting will cover the topsoil to control erosion and promote vegetation establishment. Coir logs will be places along the terrace slope controls to further promote vegetation establishment along the slope.

SAV Plantings

The City has partnered with Virginia Polytechnic Institute and State University ("Virginia Tech") to evaluate opportunities for restoring populations of native Wild Celery (*Vallisneria americana*) in Back Bay. The Virginia Tech research team has developed an innovative technique to grow Wild Celery in an aquaculture center that results in larger, mature plants that can better withstand Back Bay's turbidity. Once transplanted, plants are surrounded by cages to prevent predation. These founder colonies can be used for propagation throughout Back Bay. After terrace construction, the City will transplant Wild Celery in an area adjacent to the site. This founder colony will be used to strategically transplant Wild Celery in between the terraces for 5 years after construction (2026 – 2029) with the ultimate goal of establishing 10 acres of SAV vegetation in between the marsh terraces.

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[4] The 60% preliminary design showed preliminary siting of these dredge areas based on avoidance of existing SAV habitat; however, pre-construction surveys of SAV would be required to re-delineate these dredging areas.

Terrace Plantings – Upland and Marsh Vegetation

The terraces' intertidal perimeter will be planted with appropriate emergent estuarine plant species (e.g., Saltmarsh Cordgrass [*Spartina alterniflora*] and Salt Meadow Hay [*Spartina patens*]) and brackish plant species (e.g., Big Cordgrass [*Spartina cynosuroides*]). These plants will be installed as soon as possible after construction to stabilize planting areas and protect the terrace from erosion. In addition to emergent grass, woody growth (i.e., shrubs and trees) within the terrace crest will be incorporated to protect the terraces' surfaces from rain and wind erosion and hold the landform together through substantial root systems.

Appropriate native species were identified based on the review of the reference marshes surrounding the project site and a review of water levels in Back Bay. Since the Bay's water levels are not affected by lunar tides and instead by wind-driven fluctuations, the project team evaluated average water elevations at the U.S. Geological Survey (USGS) Beggars Bridge Creek Gauge (Gauge ID 0204300267) from 2016 – 2021 to determine ranges of inundation to achieve functional marsh elevations throughout the project life, defined as:

- *Mean Low Water (MLW)*: the average low water at the site (10th Percentile: -0.62 ft NAVD88)
- *Mean High Water (MHW)*: the average high water at the site (95th Percentile: 1.22 ft NAVD88)
- *Mean Tide Level (MTL)*: halfway between MLW and MHW (0.3 ft NAVD88)
- *Upper Limit of Wetlands (ULW)*: approximately 1.5 times the mean tide range at the site (2.76 ft NAVD88)

These elevations were correlated to suitability for low marsh, high marsh, and upland species, as shown in Table 1.

Table 1: Proposed planting elevation zones.

Planting Zone	Definition	Elevation Range	Elevation (feet NAVD88)	Percentage of record where water reaches these elevations
Low Marsh	Marsh that is flooded frequently but exposed sometimes	MTL - MHW	0.3 – 1.2 ft	48%
High Marsh	Marsh that is generally only flooded during higher-than average water conditions	MHW – ULW	1.2 to 2.8 ft	7%
Upland Habitat	Habitat that is rarely flooded, only during extreme conditions	> ULW	> 2.8 ft	0%

Five planting schemas were identified to provide the highest possible environmental benefit in terms of erosion control, habitat diversity, and fetch reduction. The wider (30-foot) terraces will be planted with Bald Cypress (*Taxodium districhum*) trees capable of withstanding rising water levels. The full list of species and quantities is provided in the 95% design plan set.

The final engineered design component is the strategic placement of rock on the exposed perimeter terraces on the project site's north, west, and southern extents. The need for the rock armor was determined through analysis of wind data both from NOAA and ASCE-7-10 50-year return period anticipated 3-second gust values. These values were used to calculate fetch-generated waves at the project site. The calculations performed confirmed that armored protection would be required to protect the proposed terraces from the forces created by wave action. The stone sizes required for these features (Class II rip rap) were calculated following the procedures laid out in the USACE Coastal Engineering Manual (CEM) and Virginia Institute of Marine Science (VIMS) Living Shoreline Design Guidelines for Shore Protection in Virginia's Estuarine Environments. Two calculation methods, Hudson (1974) and Van Der Meer (1988), from the CEM were utilized to evaluate the range of acceptable rock armor for the exposed perimeter. These two methods calculate the armor stone size based on several design inputs including initial wave height, allowable damage level, revetment slope, and breaking versus non-breaking waves. The two methods often result in corresponding values that are used by the engineer to make an experienced determination on the final rock armor sizing. The rock armor will serve as a nature-based design element by acting as a substrate for the Wild Celery grass that has proven to be successful for SAV establishment in Back Bay (see Figure 2).

Figure 2: Example Back Bay SAV experiment; photo courtesy of Virginia Tech.

Monitoring Goals and Objectives

Annual post-construction monitoring of the site is required by the Virginia Marine Resource Commission (VMRC) (TBD) Permit (VMRC #XXXX-XXXX) and the U.S. Army Corps of Engineers (USACE) Individual Permit (NOA-20XX-XXXXX). [Insert details of the relevant permits and permit conditions]. The following goals, objectives, and metrics were established to enable consistent tracking of the primary living shoreline project components across each monitoring year.

1. **Monitoring Goal 1**: Establishment of a Sustainable Coastal Marsh Island System
   a. Objective 1a: Establish Emergent Marsh Habitat
      - Metric: For each monitoring year, the project area should maintain or increase the overall coverage of emergent marsh vegetation. There should be no significant signs of herbivory or invasive species establishment.

   b. Objective 1b: Establish Upland Habitat
      - Metric: For each monitoring year, the project area should maintain or increase the overall coverage of upland vegetation. There should be no significant signs of herbivory or invasive species establishment.
2. **Monitoring Goal 2**: Stability of Marsh Terraces
   a. Objective 2: Marsh Terrace Structures
      - Metric: For each monitoring year, the terrace structures should show no significant signs of damage, deterioration or extreme settlement.
3. **Monitoring Goal 3**: Establishment of a Sustainable SAV Community
   a. Objective 3: Establish SAV Communities

- Metric: For each monitoring year, the SAV planting areas should maintain or increase the overall coverage of SAV vegetation. There should be no significant signs of herbivory or invasive species establishment.

MONITORING PLAN

The monitoring plan includes stakeholders, a schedule for the annual monitoring inspections, the monitoring strategy/sampling plan, and approach for addressing any needs for maintenance.

Monitoring Stakeholders

An Environmental Scientist from Dewberry Engineers Inc. will perform the annual monitoring inspections and provide a copy of the monitoring report to the City of Virginia Beach, USACE, VDEQ, VMRC, and the City of Virginia Beach Wetlands Board as necessary. As owners of the project, the City of Virginia Beach will review monitoring recommendations and perform corrective actions as necessary.

Annual Inspection Schedule

Monitoring inspections should be conducted annually, during the peak growing season, which is defined by VMRC as between June and August. To enable consistent tracking of project performance from year to year, annual monitoring inspections will be conducted prior to the end of the growing season in September of each year, with annual reports to be submitted to regulatory stakeholders prior to November 30th [or an annual date defined in the permit conditions] of each year. The following outlines the monitoring inspection schedule and deliverables.

Phase 1 Post-Construction As-Built Report (Date: Prior to December 31st, 2025)

To serve as a baseline for the post-construction annual monitoring, an as-built report for the Phase 1 terraces will be completed following the construction of each phase of terraces and submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following.

- Coordinates and diagrams of established transects, as well as site photographs from photo stations 1-40 as defined in the Methods section.
- Final location of all planted vegetation (upland plantings, high marsh plantings and low marsh plantings).
- Final grade topographic surveys (plan, profile, and cross sections).
- Discussion of the project design versus as-built conditions.

Phase 2 Post-Construction As-Built Report (Date: Prior to December 31st, 2026)

To serve as a baseline for the post-construction annual monitoring, an as-built report for the Phase 2 terraces will be completed following the construction of each phase of terraces and submitted to the

City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following.

- Coordinates and diagrams of established transects, as well as site photographs from photo stations 41-80 as defined in the Methods section.
- Final location of all planted vegetation (upland plantings, high marsh plantings and low marsh plantings).
- Final location and extent of SAV plantings.
- Final grade topographic surveys (plan, profile, and cross sections).
- Discussion of the project design versus as-built conditions.

Year 1a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2026)

At the end of the first full growing season following planting of the Phase 1 terraces, a Year 1a monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 40 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 1 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion; it is anticipated that the wetland planting contractor will provide a one-year post construction maintenance and guarantee period for the wetland plantings.

Year 1b/2a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2027)

At the end of the first full growing season following planting of the Phase 2 terraces following planting, and the second full growing season of the Phase 1 terraces, a Year 1b/2a monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 1 conditions (for Phase 2 terraces) and to Year 2 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).

- Estimated percent cover and change in coverage from planted conditions to Year 1 conditions for SAV planting quadrants
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion; it is anticipated that the wetland planting contractor will provide a one-year post construction maintenance and guarantee period for the wetland plantings.

Year 2b/3a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2028)

At the end of the second full growing season of the Phase 2 terraces following planting, and the third full growing season of the Phase 1 terraces, a Year 2b/3a monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 2 conditions (for Phase 2 terraces) and to Year 3 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- Estimated percent cover and change in coverage from planted conditions to Year 2 conditions for SAV planting quadrants
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

Year 3b/4a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2029)

At the end of the third full growing season of the Phase 2 terraces following planting, and the fourth full growing season of the Phase 1 terraces, a Year 3b/4a monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 3 conditions (for Phase 2 terraces) and to Year 4 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).

- Estimated percent cover and change in coverage from planted conditions to Year 3 conditions for SAV planting quadrants
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

Year 4b/5a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2030)

At the end of the fourth full growing season of the Phase 2 terraces following planting, and the fifth full growing season of the Phase 1 terraces, a Year 4b/Final (Year 5a) monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 4 conditions (for Phase 2 terraces) and to Year 5 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- Estimated percent cover and change in coverage from planted conditions to Year 4 conditions for SAV planting quadrants
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

Year 5b Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2031)

At the end of the fifth full growing season of the Phase 2 terraces following planting, a Final (Year 5b) monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 41 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 5 conditions (for Phase 2 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- Estimated percent cover and change in coverage from planted conditions to Year 5 conditions for SAV planting quadrants

- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

Monitoring Strategy

The monitoring strategy consists of established transects with photo stations and quadrants that cover the area between transects. This approach enables monitoring of the four primary features of the living shoreline: uplands, low-marsh plantings, high-marsh plantings, and SAV*.

*Note: The planting scheme for SAV has not yet been established but it is anticipated that some SAV will be planted along the submerged portions of the marsh terraces. If more suitable planting locations are determined to be between terraces, separate transects will be established and sampled to track SAV survival apart from the proposed terrace transects.

Transects/Photo Points

A total of eighty (80) transects will be established across the project site, with 10 transects located along each of 8 terraces. Transects will span perpendicular to the length of each terrace from the ridge to the edge of the planted/vegetated area. See Figures 3 and 4 for graphic depictions of the proposed transect locations and layouts. Terraces were selected using a random stratified method to ensure representative terraces in each location within the project area (North Interior, North Exterior, South Interior, South Exterior), and of each planting scheme, were represented in the proposed monitoring plan. The selected terraces are as follows:

- North Interior: T-110, T-113
- North Exterior: T-100, T-106
- South Interior: T-124, T-131
- South Exterior: T-123, T-140

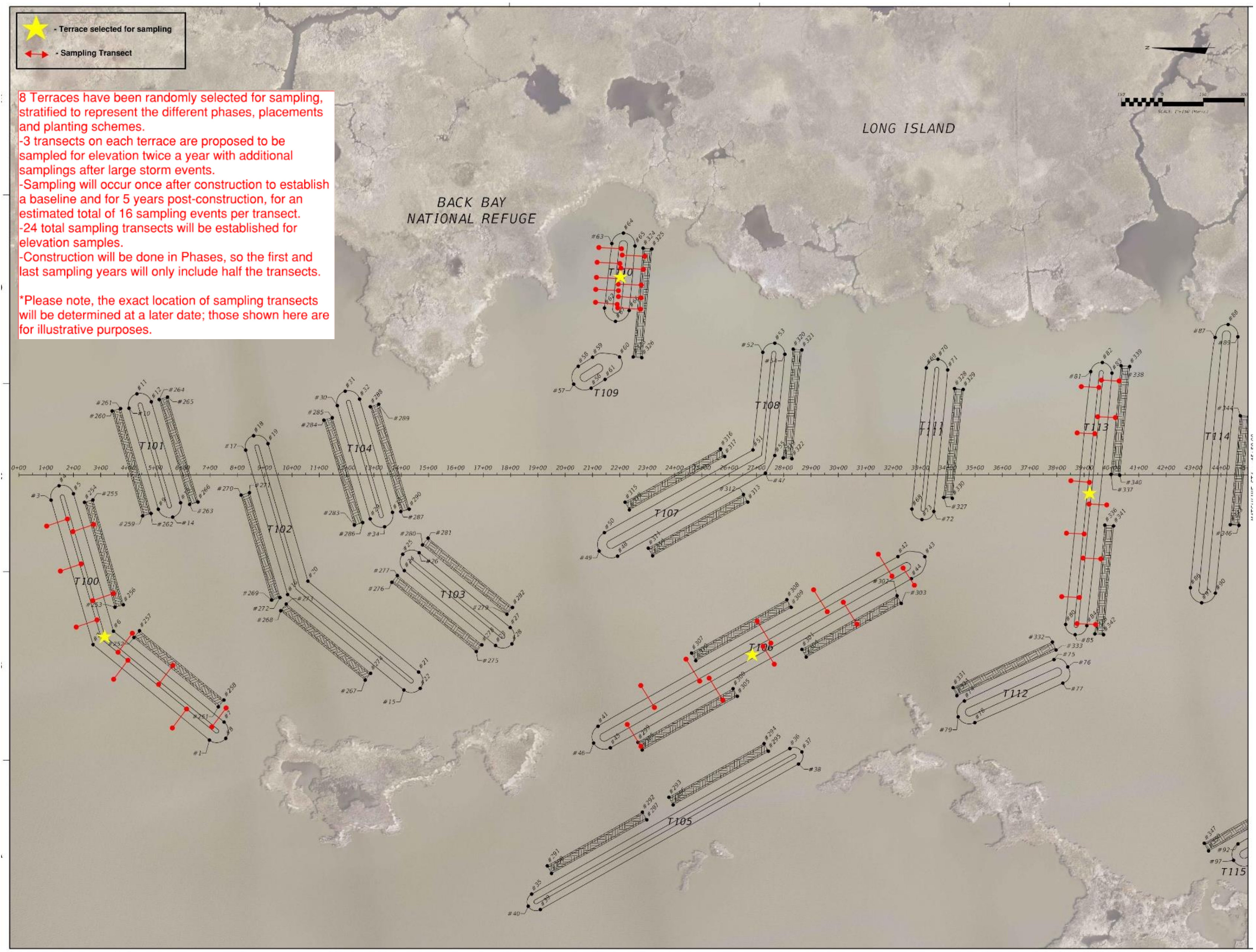

Figure 3: Monitoring design site plan – North Terraces

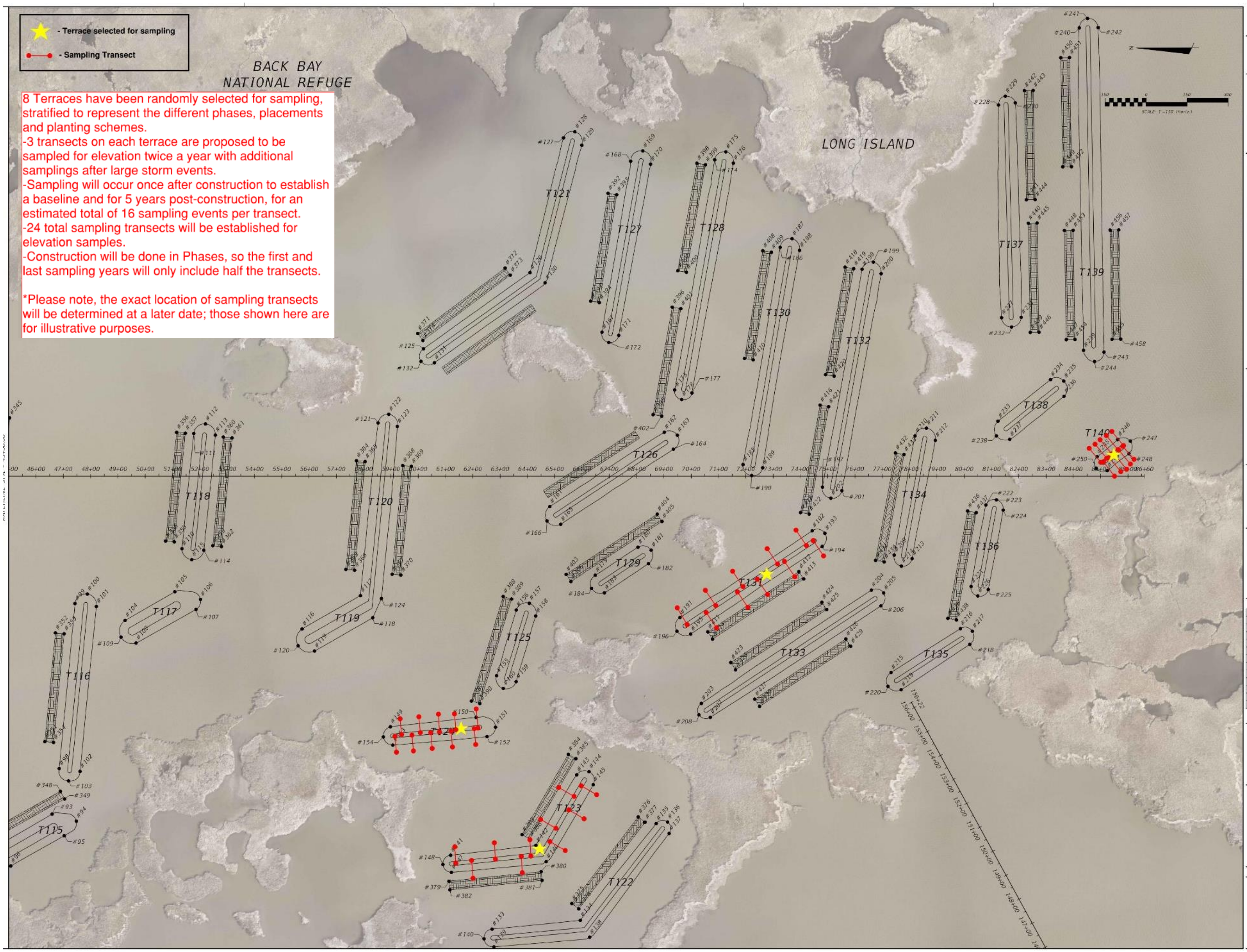

Figure 4: Monitoring design site plan – South Terraces

Permanent photo stations will be established at each quadrant along each transect to capture the design features/established habitats and vegetation. Figure 5 shows the general proposed locations (indicated by the red arrows/labels) for each quadrant and photograph station along each transect. Photos were shot from each photo location on [DATE]. These photos will be collected annually and compiled in Appendix B.

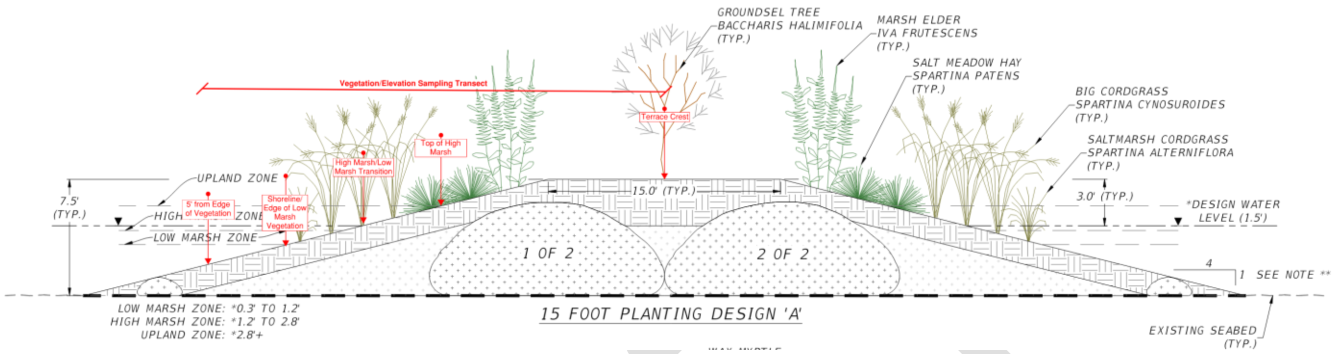

Figure 5: Photo station layout example

Quadrants

To estimate percent cover of vegetation, four (4) quadrants along each of ten (10) transects will be established on the eight selected terraces to allow for estimates of habitat coverage and planting survival. Estimates of coverage and survival were compared to post-construction conditions to evaluate changes.

Further, the following guiding questions were established to monitor overall project performance, presence of invasive species, and identify any needs for maintenance:

1. Are there specific problem areas where plants are dying or appear unhealthy?
2. Were any signs of herbivory observed?
3. Are there any undesirable plant species present?
4. Condition of the terrace structures: Is there any observed settlement, dislodged stone, significant debris etc.?
5. If an updated survey was conducted, are there any significant changes in the profile of the marsh terraces?
6. Does the upland portion of each terrace show any significant signs of erosion or loss of vegetation?

MONITORING RESULTS

Table 2: Low Marsh Vegetation Percent Cover Monitoring Results (Example Table – Terrace 1).

		Estimated Percent Coverage						Percent Change in Coverage (from Baseline)				
Terrace/ Transect	Photo Station Reference	Baseline (2024)	Year 1 (2025)	Year 2 (2026)	Year 3 (2027)	Year 4 (2028)	Year 5 (2029)	Baseline to Year 1	Baseline to Year 2	Baseline to Year 3	Baseline to Year 4	Baseline to Year 5
1 - 1	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 2	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 3	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 4	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 5	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 6	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 7	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 8	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 9	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 10	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
Overall		**Choose an item.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**

Table 3: High Marsh Vegetation Percent Cover Monitoring Results (Example Table – Terrace 1).

		Estimated Percent Coverage						Percent Change in Coverage (from Baseline)				
Terrace/ Transect	Photo Station Reference	Baseline (2024)	Year 1 (2025)	Year 2 (2026)	Year 3 (2027)	Year 4 (2028)	Year 5 (2029)	Baseline to Year 1	Baseline to Year 2	Baseline to Year 3	Baseline to Year 4	Baseline to Year 5
1 - 1	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 2	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 3	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 4	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 5	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 6	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 7	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 8	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 9	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 10	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
Overall		**Choose an item.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**

Table 4: General Observations for Wetland Planting Areas on the Marsh Terraces (Example Table – Terrace 1)

Monitoring Questions	Terrace/Transect									
	1 - 1	1 - 2	1 - 3	1 - 4	1 - 5	1 - 6	1 - 7	1 - 8	1 - 9	1 - 10
Are there specific problem areas where plants are dying or appear unhealthy?	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.
Were any herbivory issues observed?	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.
Are there any undesirable plant species present?	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.
If updated survey was conducted, are there any significant changes in the profile of the living shoreline system?	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.

Table 5: General Observations for the Unplanted Structural Components of the Marsh Terraces (Example Table – Terrace 1)

	Terrace/Transect									
Monitoring Questions	**1 - 1**	**1 - 2**	**1 - 3**	**1 - 4**	**1 - 5**	**1 - 6**	**1 - 7**	**1 - 8**	**1 - 9**	**1 - 10**
Are there any structural issues with the planted terrace structures (e.g. observed settlement, loss of topsoil, etc.)?	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.
Is there any observed growth in SAV on or adjacent to the marsh terraces?	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.

Are there any structural issues with the rock armoring on the terraces (e.g. observed settlement, dislodged stone, significant debris, etc.)?	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.

MAINTENANCE RECOMMENDATIONS

The following table outlines the recommendations for maintenance, including estimated quantities and specific guidance, based on the results of the [YEAR] monitoring results.

Table 6: Maintenance Recommendations Checklist

Design Feature/ Monitoring Objective	Maintenance Elements	Location & Estimated Quantity	Specific Guidance
Terrace Upland and Wetland Habitats and Wetland Soils – Monitoring Objectives 1a/1b	☐ Replace plants	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Add new plants	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Remove debris	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Remove invasive vegetation	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Add sand to eroding areas	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Replace waterfowl barrier	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.

Design Feature/ Monitoring Objective	Maintenance Elements	Location & Estimated Quantity	Specific Guidance
Terrace Structures & Stone Armoring, Monitoring Objective 2a/2b	☐ Re-place dislodged stones	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Add additional stone to address settlement	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Remove debris	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Repair sand cores or other structural elements	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
SAV Establishment, Monitoring Objective 3	☐ Replace plants	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Add new plants	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.

APPENDIX A: AS-BUILT PLANS

[Page left intentionally blank; as-built plans will be included in the Year 1 monitoring report]

APPENDIX B: MONITORING PHOTOGRAPHS

Table 7: Terrace 1 Transect 1 Photographs

Photograph from Photo Location 1A	Photograph from Photo Location 1B
Photograph from Photo Location 1C	Additional photos of any problem areas.

Table 8: Terrace 1 Transect 2 Photographs

Photograph from Photo Location 2A	Photograph from Photo Location 2B
Photograph from Photo Location 2C	Additional photos of any problem areas.

Table 9: Terrace 1 Transect 3 Photographs

Photograph from Photo Location 3A	Photograph from Photo Location 3B
Photograph from Photo Location 3C	Additional photos of any problem areas.

Table 10: Terrace 1 Transect 4 Photographs

Photograph from Photo Location 4A	Photograph from Photo Location 4B
Photograph from Photo Location 4C	Additional photos of any problem areas.

Table 11: Terrace 1 Transect 5 Photographs

Photograph from Photo Location 5A	Photograph from Photo Location 5B
Photograph from Photo Location 5C	Additional photos of any problem areas.

Table 12: Terrace 1 Transect 6 Photographs

Photograph from Photo Location 6A	Photograph from Photo Location 6B
Photograph from Photo Location 6C	Additional photos of any problem areas.

Table 13: Terrace 1 Transect 7 Photographs

Photograph from Photo Location 7A	Photograph from Photo Location 7B
Photograph from Photo Location 7C	Additional photos of any problem areas.

Table 14: Terrace 1 Transect 7 Photographs

Photograph from Photo Location 7A	Photograph from Photo Location 7B
Photograph from Photo Location 7C	Additional photos of any problem areas.

Table 15: Terrace 1 Transect 8 Photographs

Photograph from Photo Location 8A	Photograph from Photo Location 8B
Photograph from Photo Location 8C	Additional photos of any problem areas.

Table 16: Terrace 1 Transect 9 Photographs

Photograph from Photo Location 9A	Photograph from Photo Location 9B
Additional photos of any problem areas.	

Table 17: Terrace 1 Transect 10 Photographs

Photograph from Photo Location 9A	Photograph from Photo Location 9B
Photograph from Photo Location 9C	Additional photos of any problem areas.

Dewberry®

2023 Virginia Community Flood Preparedness Fund

Marsh Restoration in Back Bay, Virginia Beach

CITY OF VIRGINIA BEACH

Table of Contents

Appendix A – Application Form

Applicants must have prior approval from the Department to submit <u>applications, forms, and supporting documents by mail in lieu of the WebGrants portal.</u>

Appendix A: Application Form for Grant and Loan Requests for All Categories

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Virginia Department of Conservation and Recreation
Virginia Community Flood Preparedness Fund Grant Program

Name of Local Government:

Category Being Applied for (check one):

☐ **Capacity Building/Planning**

☑ **Project**

☐ **Study**

NFIP/DCR Community Identification Number (CID) 515531

Name of Authorized Official and Title: Toni Utterback, Stormwater Engineering Center Administrator

Signature of Authorized Official: Katie E Shannon for Toni Utterback

Mailing Address (1): 2875 Sabre Street, Suite 250

Mailing Address (2): __________

City: Virginia Beach **State:** Virginia **Zip:** 23452

Telephone Number: (757) 385-8746 **Cell Phone Number:** (____) ________

Email Address: TPUtterback@vbgov.com

Contact and Title (If different from authorized official): C.J. Bodnar, Technical Services Program Manager

Type text here

Mailing Address (1): 2875 Sabre Street, Suite 250

Mailing Address (2): ____

City: Virginia Beach **State:** Virginia **Zip:** 23452

Telephone Number: (757) 385-8430 **Cell Phone Number:** (____) ________________

Email Address: CBodnar@vbgov.com

Is the proposal in this application intended to benefit a low-income geographic area as defined in the Part 1 Definitions? Yes ____ No ✓

Categories (select applicable activities that will be included in the project and used for scoring criterion):

Capacity Building and Planning Grants

☐ Floodplain Staff Capacity.

☐ Resilience Plan Development

- ☐ Revisions to existing resilience plans and modifications to existing comprehensive and hazard mitigation plans.
- ☐ Resource assessments, planning, strategies, and development.
  - Policy management and/or development.
  - Stakeholder engagement and strategies.

☐ Other: ____

Study Grants (Check All that Apply)

☐ Studies to aid in updating floodplain ordinances to maintain compliance with the NFIP, or to incorporate higher standards that may reduce the risk of flood damage. This must include establishing processes for implementing the ordinance, including but not limited to, permitting, record retention, violations, and variances. This may include revising a floodplain ordinance when the community is getting new Flood Insurance Rate Maps (FIRMs), updating a floodplain ordinance to include floodplain setbacks, freeboard, or other

higher standards, RiskMAP public noticing requirements, or correcting issues identified in a Corrective Action Plan.

- ☐ Revising other land use ordinances to incorporate flood protection and mitigation goals, standards, and practices.
- ☐ Conducting hydrologic and hydraulic (H&H) studies of floodplains. *Changes to the base flood, as demonstrated by the H&H must be submitted to FEMA within 6 months of the data becoming available.*
- ☐ Studies and Data Collection of Statewide and Regional Significance.
- ☐ Revisions to existing resilience plans and modifications to existing comprehensive and hazard.
- ☐ Other relevant flood prevention and protection project or study.

Project Grants and Loans (Check All that Apply – Hybrid Solutions will include items from both the "Nature-Based" and "Other" categories)

Nature-based solutions

- ☐ Acquisition of property (or interests therein) and/or structures for purposes of allowing floodwater inundation, strategic retreat of existing land uses from areas vulnerable to flooding; the conservation or enhancement of natural flood resilience resources; or acquisition of structures, provided the acquired property will be protected in perpetuity from further development, <u>and where the flood mitigation benefits will be achieved as a part of the same project as the property acquisition.</u>
- ☑ Wetland restoration.
- ☐ Floodplain restoration.
- ☐ Construction of swales and settling ponds.
- ☑ Living shorelines and vegetated buffers.
- ☐ Permanent conservation of undeveloped lands identified as having flood resilience value by *ConserveVirginia* Floodplain and Flooding Resilience layer or a similar data driven analytic tool, or the acquisition of developed land for future conservation.
- ☐ Dam removal.
- ☐ Stream bank restoration or stabilization.
- ☐ Restoration of floodplains to natural and beneficial function.

Other Projects

- ☐ Structural floodwalls, levees, berms, flood gates, structural conveyances.
- ☐ Storm water system upgrades.
- ☐ Medium and large-scale Low Impact Development (LID) in urban areas.

- ☐ Developing flood warning and response systems, which may include gauge installation, to notify residents of potential emergency flooding events.
- ☐ Dam restoration.
- ☐ Beneficial reuse of dredge materials for flood mitigation purposes
- ☐ Removal or relocation of structures from flood-prone areas where the land will not be returned to open space.
- ☐ Acquisition of property (or interests therein) and/or structures for purposes of allowing floodwater inundation, strategic retreat of existing land uses from areas vulnerable to flooding; the conservation or enhancement of natural flood resilience resources; or acquisition of structures, provided the acquired property will be protected in perpetuity from further development, <u>and where the flood mitigation benefits will **not be** achieved as a part of the same project as the property acquisition.</u>
- ☐ Other project identified in a DCR-approved Resilience Plan.

Location of Project or Activity (Include Maps): Bonney Cove in Back Bay, Virginia Beach

NFIP Community Identification Number (CID#) : 515531

Is Project Located in an NFIP Participating Community? ☑ Yes ☐ No

Is Project Located in a Special Flood Hazard Area? ☑ Yes ☐ No

Flood Zone(s) (If Applicable): Zone VE (EL 5 Feet), Zone AE (EL 4 Feet), Zone Open Water

Flood Insurance Rate Map Number(s) (If Applicable): 5155310215G and 5155310220G

Total Cost of Project: $53,378,490

Total Amount Requested $5,000,000

Amount Requested as Grant $5,000,000

Amount Requested as Project Loan (not including short-term loans for up-front costs) ____________________

Amount Requested as Short-Term loan for Up-Front Costs (not to exceed 20% of amount requested as Grant) __________________________

For projects, planning, capacity building, and studies in low-income geographic areas: Are you requesting that match be waived? □ Yes □ No

<u>Additional Information for Loan Requests</u>
Requested Loan Security: ______________________________

(General Obligation, Lease, Revenue, Special Fund Revenue, and/or Moral obligation from other government entity)

Desired loan term: __________________________________

Since the date of your latest financial statements, did the applicant issue any new debt? ______
(If yes, provide details)

Is there any pending or potential litigation by or against the applicant? ______________

Attach five years of current audited financial statements (FY18-22) or refer to website if posted
(Not necessary for existing VRA borrowers)

Attach FY2024 adopted budget or refer to website

Attach current Capital Improvement Plan

Attach adopted Financial Policies

Attach a list of the ten largest employers in the Applicant's jurisdiction.

Attach a list of the ten largest taxpayers in the Applicant's jurisdiction

Appendix B: Budget Form

Appendix B: Budget Narrative Template

Applicant Name: Community Flood Preparedness Fund & Resilient Virginia Revolving Loan Fund Detailed Budget Narrative Period of Performance: June 2024 through June 2027 Submission Date: November 12, 2023									
								Grand Total State Funding Request	$ 5,000,000
								Grand Total Local Share of Project	$ 38,356,966
			National Fish and Wildlife Foundation Grants					Federal Funding (if applicable)	$ 10,021,524
								Project Grand Total	$ 53,378,490
								Locality Cost Match	% 71.85
Breakout By Cost Type	Personnel	Fringe	Travel	Equipment	Supplies	Contracts	Indirect Costs	Other Costs	Total
Federal Share (if applicable)								10,021,524	10,021,524
Local Share								37,330,166	37,330,166
State Share								5,000,000	5,000,000
Pre-Award/Startup								276,800	276,800
Maintenance								750,000	750,000
Total	$	$	$	$	$	$	$	$53,378,490	$ 53,378,490

1. Federal Share represents National Fish and Wildlife Foundation (NFWF) Grants. NFWF is not a federal agency.
2. Local Share represents the total project cost less design and implementation (monitoring and initial maintenance) costs.
3. State Share represents the CFPF grant request.
4. Pre-Award costs represent project design costs.
5. Maintenance costs represent implementation (monitoring and initial maintenance costs).

Scope of Work Narrative

Introduction

The City of Virginia Beach ("City") is pleased to submit the Marsh Restoration in Back Bay project for consideration under the Flood Prevention and Protection Projects category in the 2023 Virginia Community Flood Preparedness Fund. The City has made significant investments in the study of historical flooding data, current and future hydrology, and the projected increase in flood frequency due to changing rainfall patterns and sea level rise. These studies culminated in Virginia Beach's Resilience Plan, socialized as "Sea Level Wise,"[1] which includes a conceptual suite of projects focused on flood control and resilience. The Virginia Beach Resilience Plan leverages four overarching adaptation strategies to identify actionable projects for each of the City's four unique major watersheds. This project represents the first adaptation project to advance to construction to implement the City's Resilience Plan.

The adaptation strategy for the Southern Rivers Watershed, which includes Back Bay, is presented in Figure 1. The strategy focuses on employing natural mitigation methods, an integrated system of defense structures, and complementary measures, such as land-use strategies. Collectively these approaches are designed to strategically reduce flow into and within Back Bay and improve flood storage and overall coastal resiliency. Marsh restoration was identified as a key resilience-building strategy as part of an extensive evaluation of structural and non-structural alternatives. Marsh restoration provides multiple benefits of flood risk reduction, enhanced habitat, and improved water quality.

As part of the Virginia Coastal Resilience Master Planning Framework, a precursor to the first phase of the Virginia Coastal Resilience Master Plan (CRMP), the Commonwealth of Virginia identified guiding principles for a statewide resilience strategy. One of these guiding principles is recognizing the importance of protecting and enhancing natural infrastructure and prioritizing nature-based infrastructure.[2] The City's marsh restoration project aligns with this principle and was highlighted as an exemplary nature-based project in the CRMP (refer to pages 178-179).[3]

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[1] City of Virginia Beach (2020). Virginia Beach Sea Level Wise Adaptation Strategy (Website).

[2] Office of Governor Ralph S. Northam Commonwealth of Virginia. (2020). Virginia Coastal Resilience Master Planning Framework (PDF).

[3] Office of Governor Ralph S. Northam Commonwealth of Virginia. (2021). Virginia Coastal Resilience Master Plan Phase 1 (PDF).

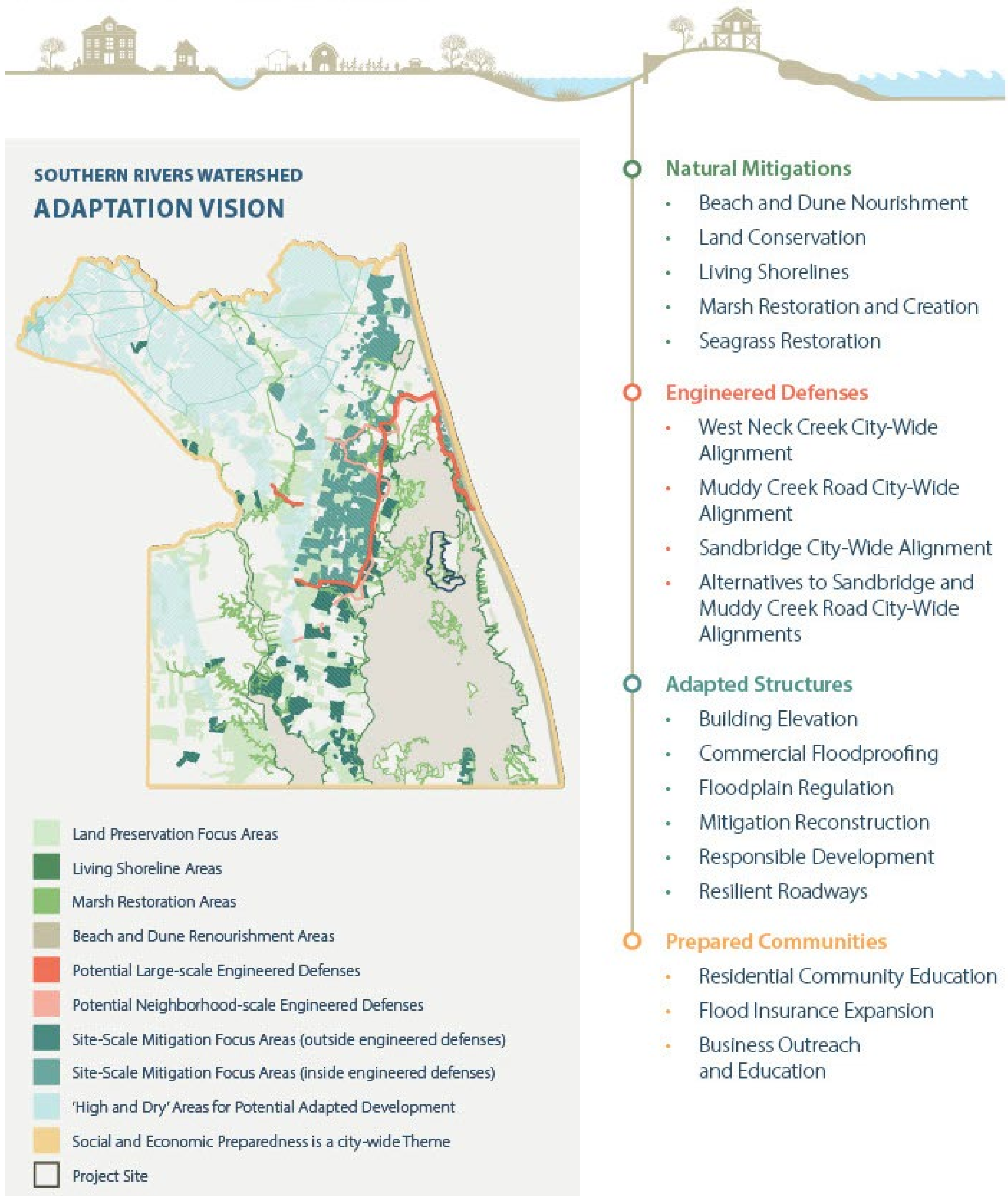

Figure 1: Adaptation Vision for the Southern Rivers Watershed.

Hydraulic modeling analysis identified Bonney Cove as a location where marsh restoration has the potential to reduce the propagation of floodwater through key pathways within Back Bay (Figure 2). The City prioritized this project as the first to advance to construction due to its significant benefits to community and habitat resilience.

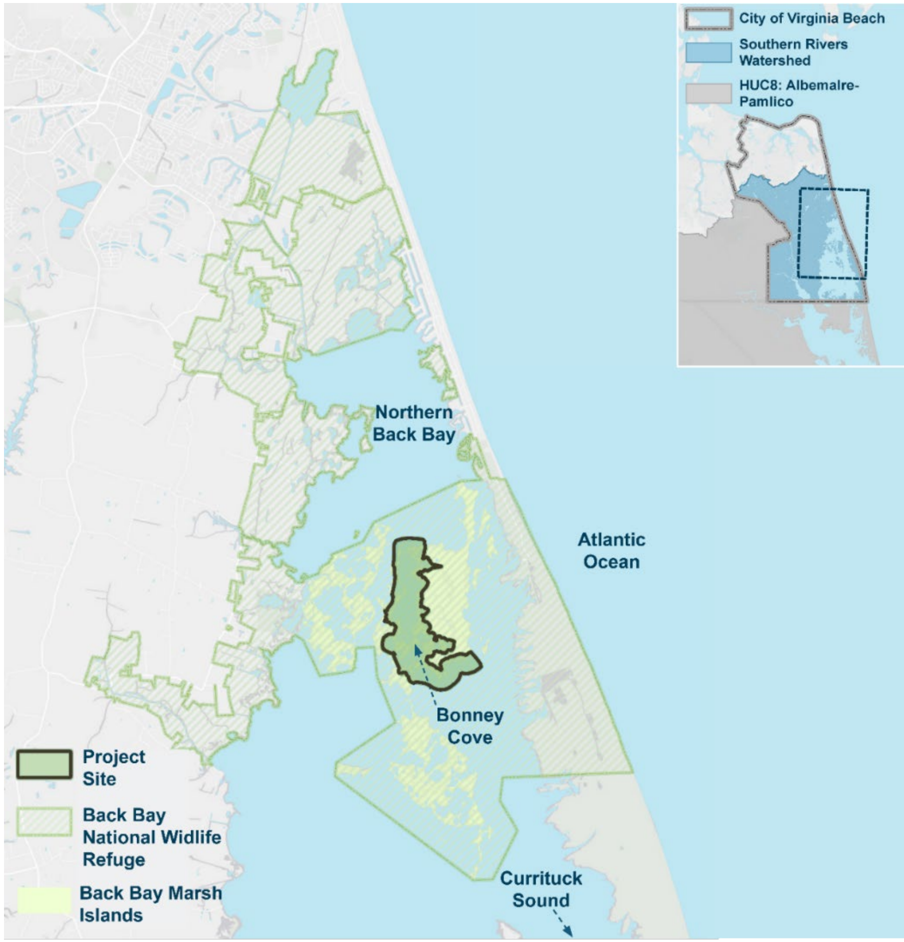

Figure 2: Project site location map.

This project represents a collaborative effort between the City's Department of Public Works alongside other City departments, public constituents, local nonprofits, and state and federal agencies. In selecting the project location and developing the design approach, the City has coordinated closely with the Back Bay National Wildlife Refuge (BBNWR), part of the U.S. Fish and Wildlife Service (USFWS), and the Virginia Department of Wildlife Resources (VDWR). Environmental organizations committed to stewardship of Back Bay have also contributed input throughout the design process, including the Back Bay Restoration Foundation (BBRF), Friends of Back Bay, the Back Bay National Wildlife Refuge Society, and the Albemarle-Pamlico National Estuary Partnership (APNEP). Project field investigations involved local support from Old Dominion University (ODU) and others, and outside expertise from Louisiana. The National Fish and Wildlife Foundation (NFWF) provided grant funding under the National Coastal Resilience Fund (NCRF) to support design, permitting, and environmental assessments. Broad support of the project is demonstrated by contributions from the organizations noted above along with other stakeholders engaged in the restoration effort.

Needs and Problems

Specific Problem Being Solved – Habitat Degradation and "Wind Tide" Flooding

Marshes are vital to the Southern Rivers Watershed for the ecological and flood reduction benefits they provide. The Southern Rivers Watershed contains 90% of the City's land area under an elevation of three feet, making this area particularly susceptible to flood impacts. As illustrated in Figure 3, sustained southerly winds push water up from the Albemarle-Pamlico Sound through the Currituck Sound and into Back Bay, creating a phenomenon referred to locally as "wind tide flooding". Marsh habitat loss has contributed to the opening of a secondary channel in Bonney Cove that has increased water flow during wind tide and other flood events to areas with high community exposure.

Within today's marsh system, it takes between two to five days of sustained southerly winds to cause flooding, depending on the wind speed and direction. Over the last four years, more than five wind tide flooding events have occurred in this area. The increasing frequency of flooding events is primarily attributed to a foot of relative sea level rise in the last 50 years and degradation of marsh and seagrass habitat.

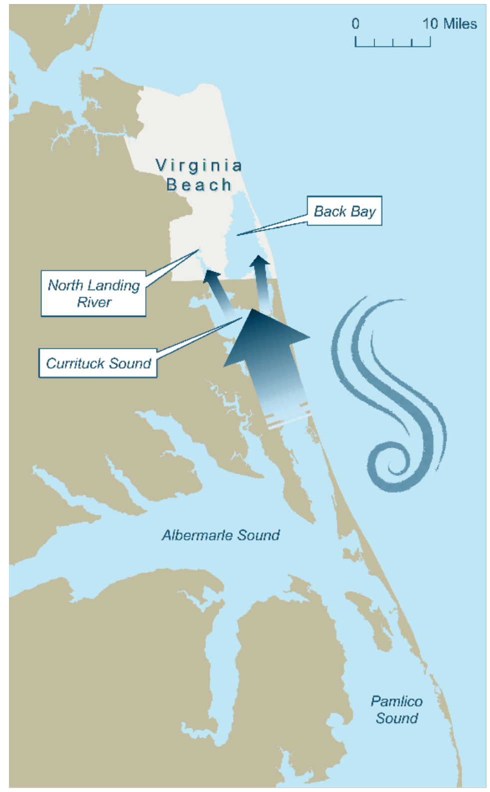

Figure 3: Flood pathways in the Southern Rivers Watershed.

This marsh restoration project aims to address the challenges of habitat degradation and "wind tide" flooding by stabilizing two critically eroding marsh islands, decreasing turbidity to promote the growth of aquatic vegetation, and providing flood risk reduction benefits through increased friction and wave attenuation.

Factors Contributing to the Identified Problem

This growing flood risk in the Southern Rivers Watershed can be attributed mainly to the reduced friction in the water column from the increased water depth and eroded vegetation, which allows water to move more quickly through key hydraulic pathways. Another term for this is "fetch", which is defined as the open water distance over which a given wind can blow and generate higher waves without obstruction. Unmitigated, the continued loss of these marsh island systems and aquatic vegetation is expected to result in more frequent and intense wind tide flooding events.

Emergent Marsh Degradation

Approximately 50% of former marshland at the site (260 acres) has eroded into open water leading to the opening of a wide secondary channel ("Bonney Cove") that is about two miles

long and half a mile wide (Figure 4). The southern exposed edge of the adjacent marsh islands is exposed to approximately 1.5 miles of fetch in the predominant wind direction.

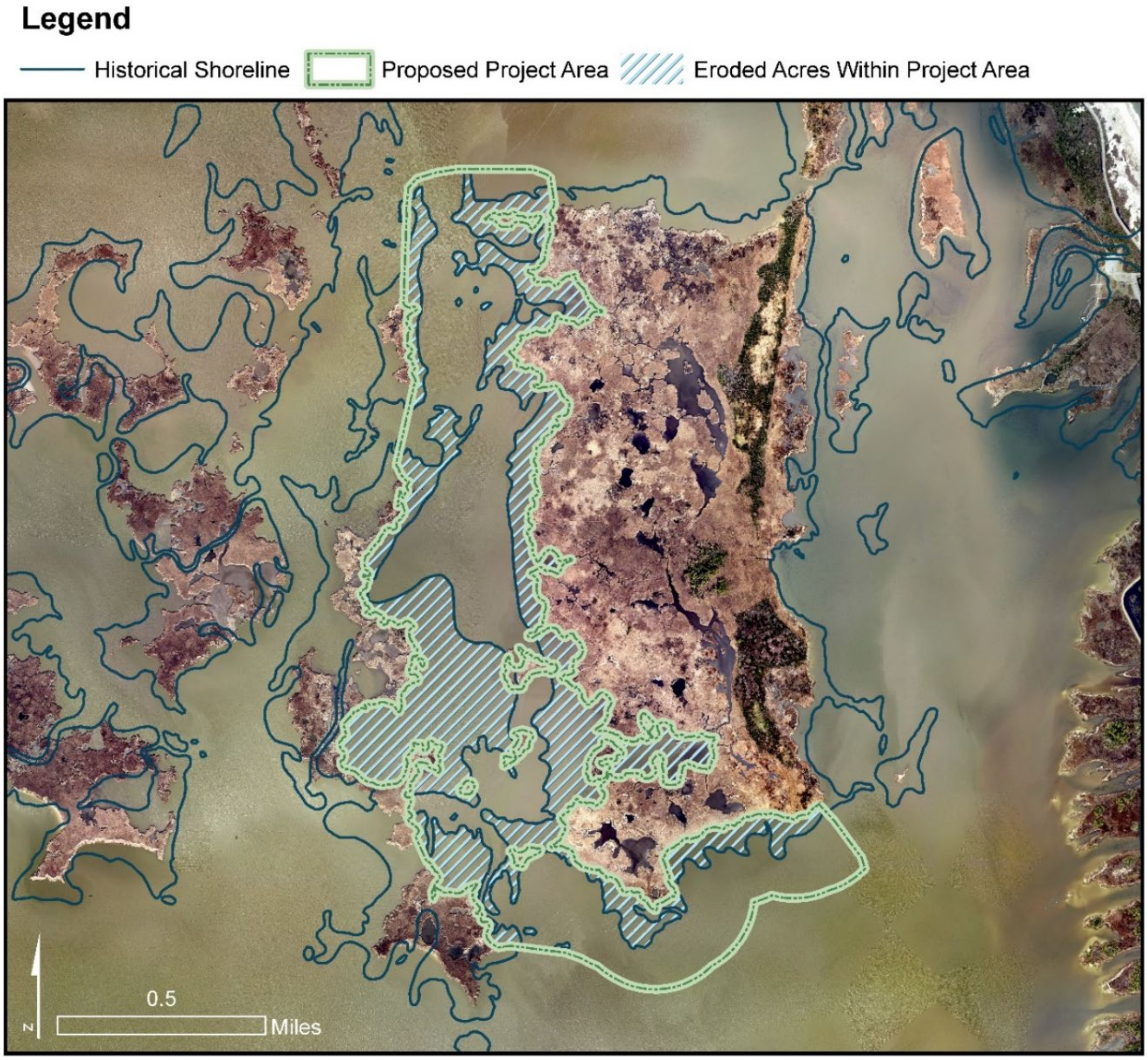

Figure 4: Historical marsh erosion within the project area.

Submerged Aquatic Vegetation (SAV) Loss

SAV used to be abundant at the site (around 45% coverage, overall) but is now extremely sparse, ranging from 0% to 10% coverage across the site, on average. Field studies conducted by the VDWR show that wind-driven waves and high flow velocities are the primary drivers of this loss, particularly in the last 5 years as shown in Figure 5.

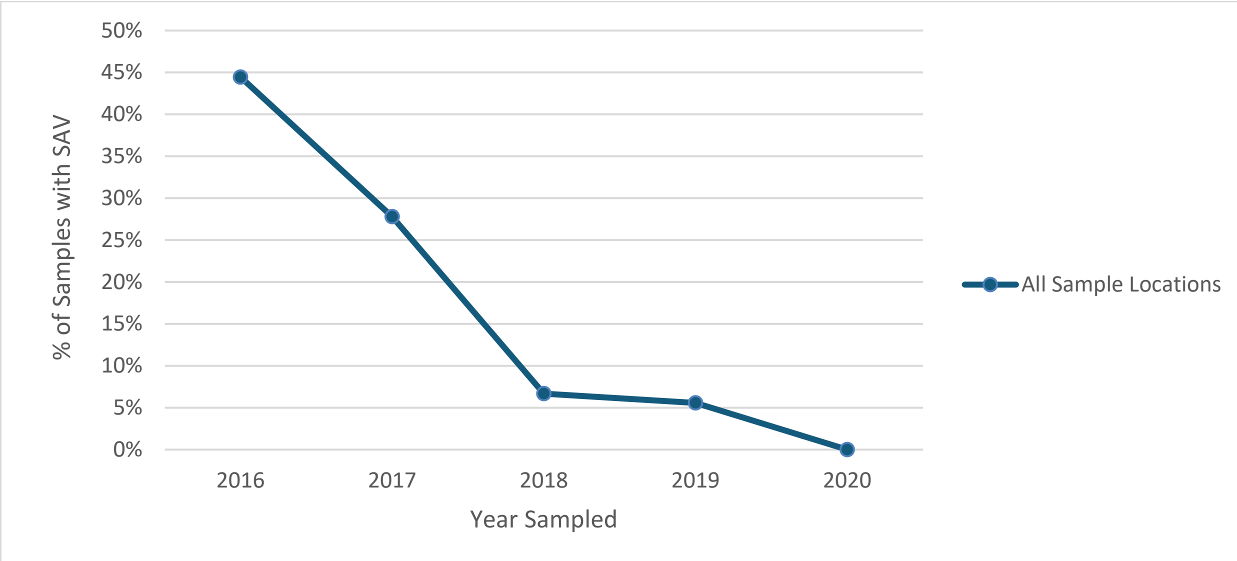

Figure 5: SAV sampling data from VDWR within the project vicinity.

Why is the Project Needed Locally/Regionally?

Pilot Project

The City's design concept for the marsh restoration project leverages "marsh terracing," an innovative coastal engineering technique widely used in Texas and Louisiana to convert shallow subtidal bottom to marsh. This technique has not yet been implemented along the U.S. East Coast and has not yet been implemented in the Mid-Atlantic region. Through the export of proven expertise from successful marsh terraces, this project would lay the foundation for future projects in the region, Virginia, and other states along the East Coast. The project would document detailed cost estimates, demonstrate effective construction practices for large-scale marsh creation projects, identify best sources for local/regional materials, and establish partnerships with permitting officials at various levels of government. The City has outlined a preliminary sequencing plan for marsh island restoration projects in Back Bay to strategically close hydraulic pathways and address priority restoration areas as shown in Figure 6. Some of these projects would require coordination with the State of North Carolina to realize its broader resilience efforts.

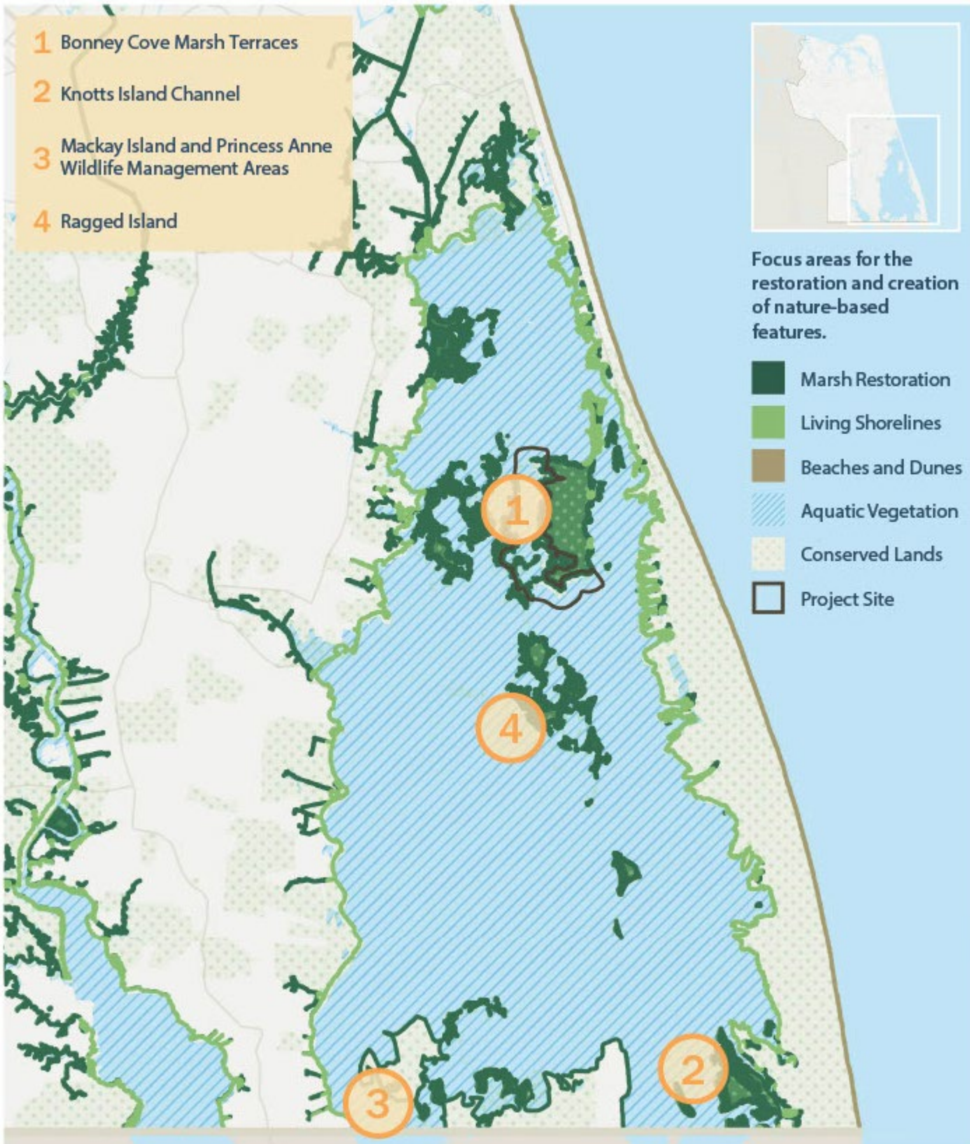

Figure 6: Preliminary Sequencing Restoration Plan.

Virginia Coastal Resilience Master Plan Exemplary Project

The CRMP impact assessment shows a high vulnerability of nature-based features to coastal flood hazards that is consistent with the City's analysis. In the Hampton Roads region, the CRMP impact assessment estimates a decrease from 40,600 acres to 2,940 acres of tidal wetlands by 2080, representing a 93% decline in tidal wetlands.[4] Back Bay was identified as a hotspot for tidal wetland loss, emphasizing the critical location of the City's marsh restoration effort. Specifically, the Virginia CRMP impact assessment shows that portions of tidal wetlands within the project area have "High" and "Very High" impact levels, which indicates areas of tidal marsh

[4] Office of Governor Ralph S. Northam Commonwealth of Virginia and Virginia Department of Conservation and Recreation (2021). Virginia Coastal Resilience Master Plan Phase 1 (PDF).

that are anticipated to be lost through inundation causing conversion to open water (Figure 7).

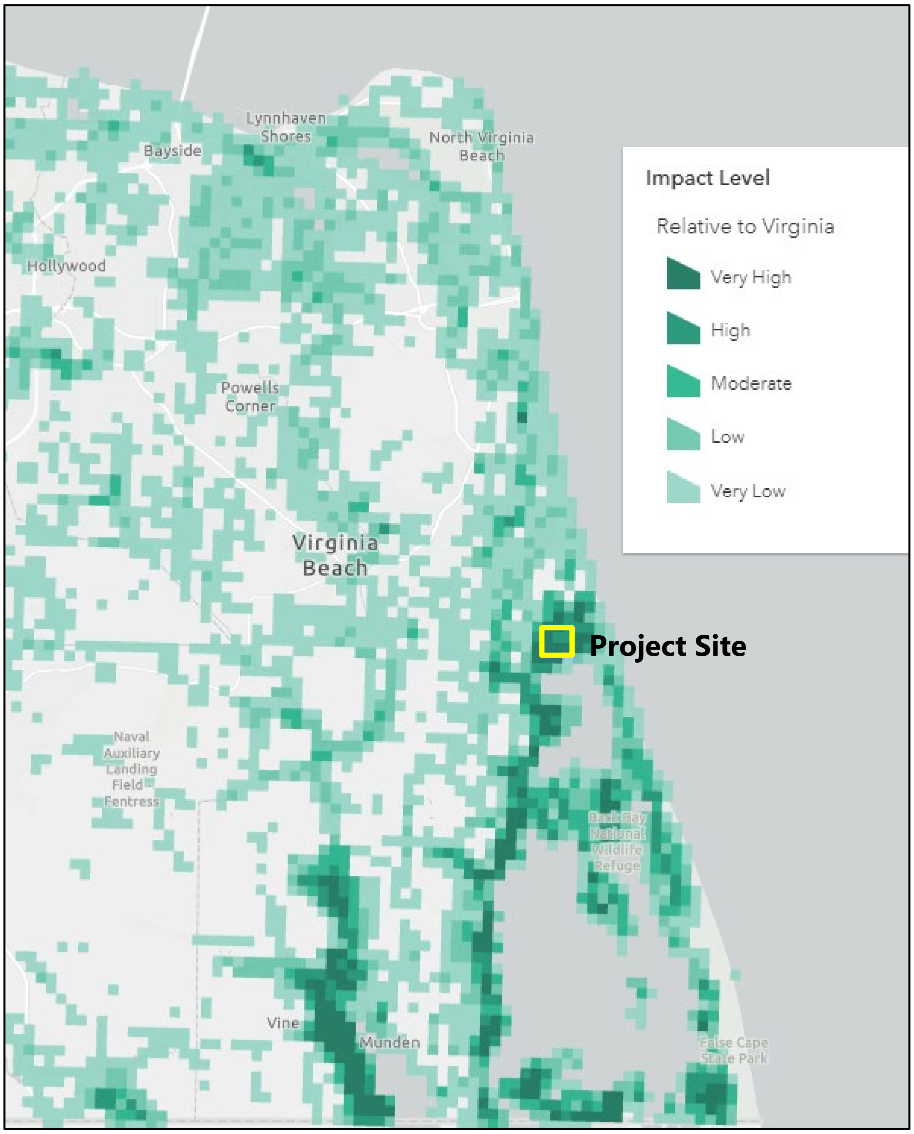

Figure 7: Virginia CRMP Impact Assessment for Tidal Wetlands.

Currituck Sound Coalition High Priority Area

In coordination with Audubon North Carolina, the Currituck Sounds Coalition designated the project site as a High Priority Area for restoring and enhancing vulnerable and degraded marshes with "high flood risk reduction benefits and habitat value" as shown in Figure 8[5].

[5] Audubon North Carolina. (2021). Currituck Sound Coalition Marsh Conservation Plan. (PDF)

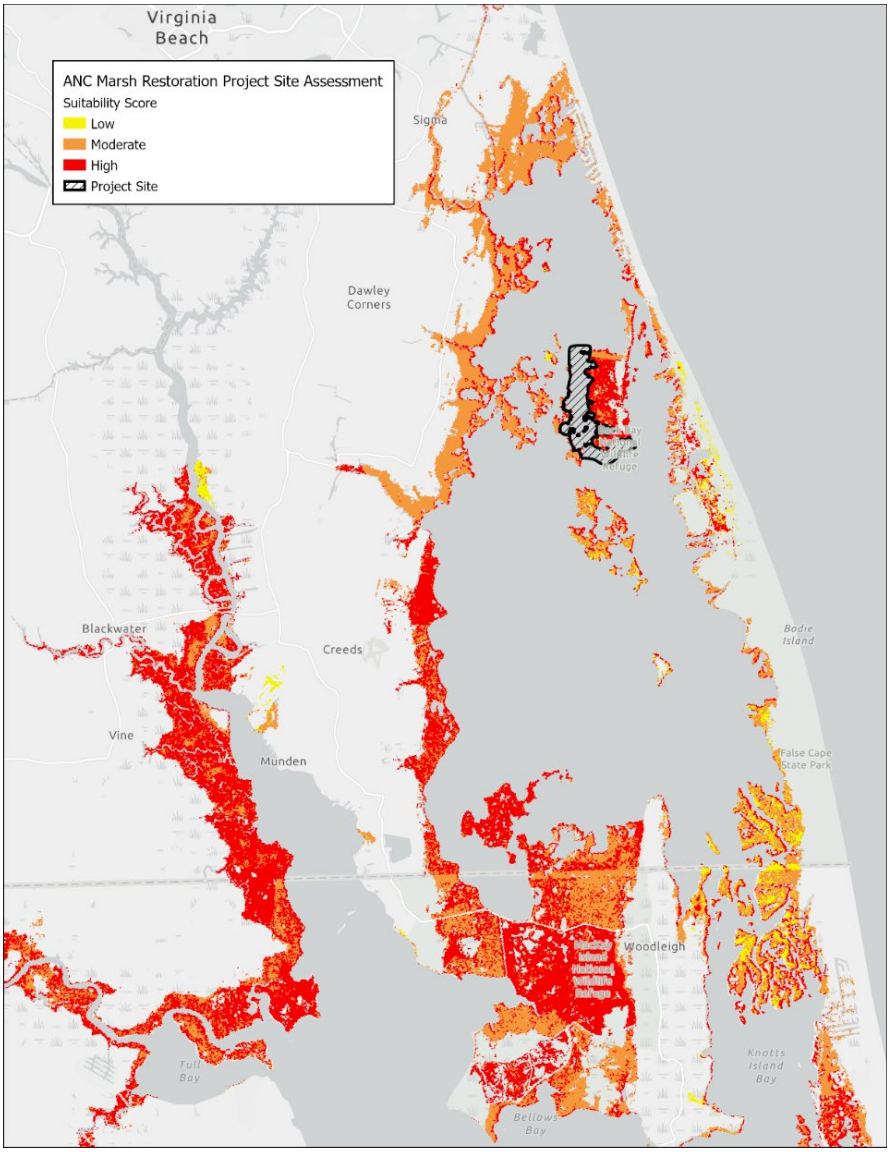

Figure 8: Audubon North Carolina Marsh Restoration Project Site Assessment

Ecological Core for Flood Resilience

The Virginia Department of Conservation and Recreation Natural Heritage Data Explorer provides data from ConserveVirginia v3.0 and other data to support conservation planning. The following map in Figure 9 displays Ecological Cores and the Floodplains and Flooding Resilience Category layer (blue polygon) from ConserveVirginia. The project area contains "High" (C3) and "General" (C5) Ecological Cores and is within the boundaries of the Floodplain and Flooding Resilience area.

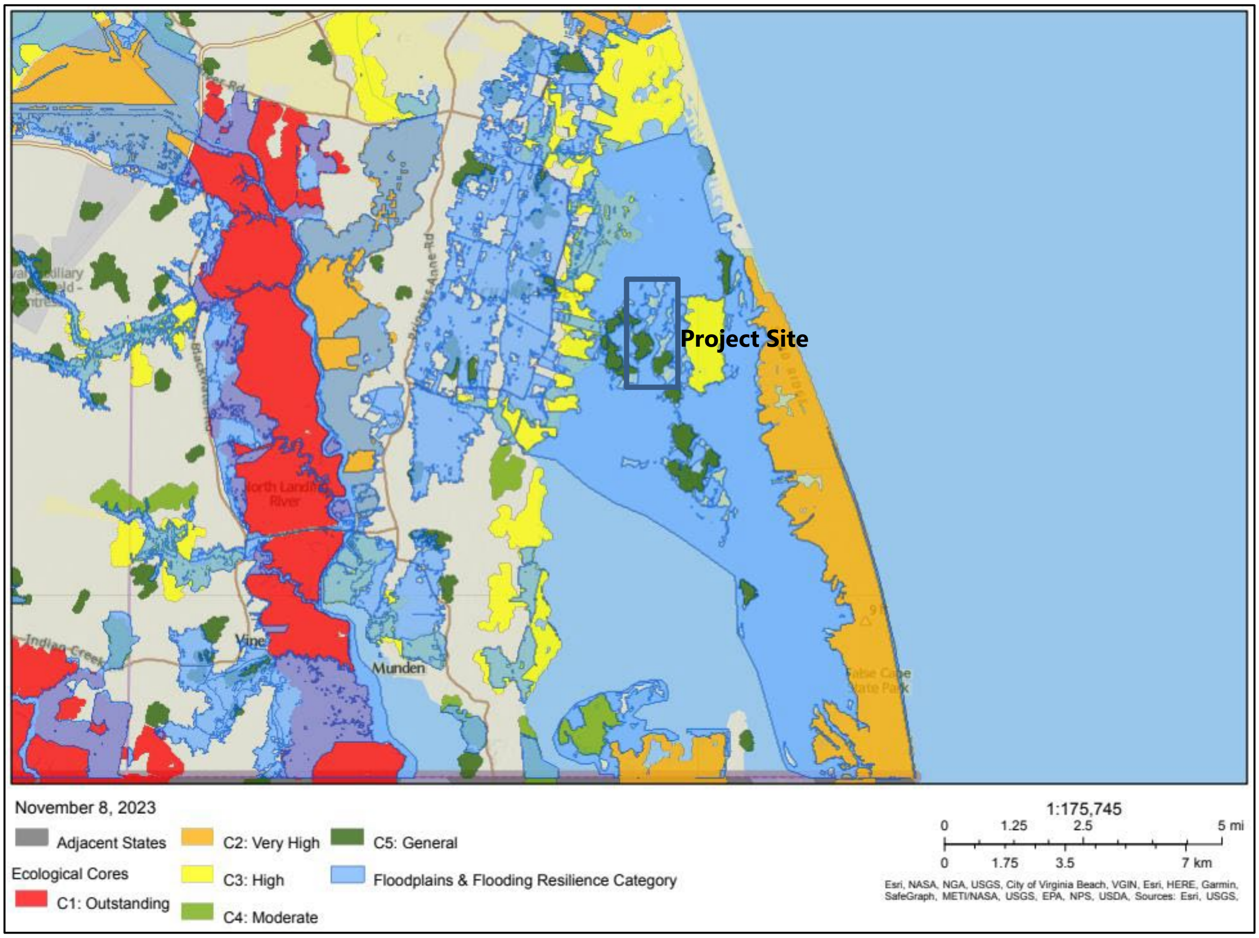

Figure 9: Virginia Natural Heritage Data Explorer Ecological Cores and ConserveVirginia Data.

The safety threats, or environmental concerns related to flood risk.

The City's risk assessment forecasts that approximately 70% of the remaining marsh (730 acres) surrounding the project site will convert to open water with three feet of sea level rise if unmitigated. Fragmentation of this adjacent marsh would result in about eight miles of fetch acting on the southern extent of the site in the predominant wind direction. Without these central marsh islands, the northern shorelines of Back Bay would be exposed to 12 miles of fetch from the Knotts Island Channel at the Virginia-North Carolina boundary. This condition would leave the fringing marshes highly vulnerable to accelerated erosion.

How does the project decrease the risk to public safety through flood risk reduction?

Construction of the forty-one individual marsh terraces, totaling 27,000 linear feet (a 51-acre footprint), across Bonney Cove offers a nature-based technique that will stabilize and protect the marsh island in the center of the bay and reduce erosion of the fringing marsh systems to the north. Numerical modeling was leveraged to quantify specific erosion reduction benefits of the project for wave heights and flow velocities:

- **Wave Height Reduction**: The marsh terraces are expected to reduce wave heights within the project site by approximately 45%. This reduction is consistent with other field studies, which have found that average wave heights within two terraced sites were 37% to 48% lower than those observed at the reference site (Brasher 2015). Wave energy reduction is anticipated to increase the potential for sediment deposition on the terraces' leeward side, leading to the growth of new emergent marsh and reducing erosion of adjacent marsh. Approximately five miles of marsh island shoreline around Bonney Cove will benefit directly from the erosion reduction associated with the computed wave attenuation.
- **Flow Velocity Reduction**: The marsh terraces reduce flow velocity within the project area. This reduction in velocity will reduce bottom shear stress, decrease turbidity, increase light penetration into the water column and promote the growth of SAV. Reducing bottom shear stress will make conditions more suitable for SAV growth between the terraces. Field studies of marsh terraces in Texas and Louisiana document an approximately 45% to 56% reduction in turbidity and the emergence of SAV in the years following terrace construction (Brasher 2015).
- **Wind Shear Stress Reduction**: Although not included as a parameter within the numerical modeling effort, the bald cypress trees planted on the terraces within the middle of the site are expected to reduce wind speed within the project site. This will further reduce wind-generated waves within the project site on the terraces' leeward and windward sides. Research shows that trees that grow to at least 30 feet at maturity result in lower wind speeds of up to 60 to 150 ft on the windward side and up to 900 ft on the leeward side (USDA).

How does the project protect or conserve natural resources?

The proposed project aims to restore marsh island communities in Bonney Cove that have historically provided environmental and flood reduction benefits to the communities in northern Back Bay. As illustrated in Figure 10, when an intact marsh begins to fragment and convert to open water, fetch increases and enables greater wave energy, increasing marsh erosion rates, and ultimately accelerating conversion to an ever-expanding body of open water. Strategic marsh restoration and creation in Bonney Cove would help mitigate the cycle of marsh island erosion and loss of SAV currently occurring in Back Bay, thereby protecting the remaining marsh islands and reducing fetch and wave energy.

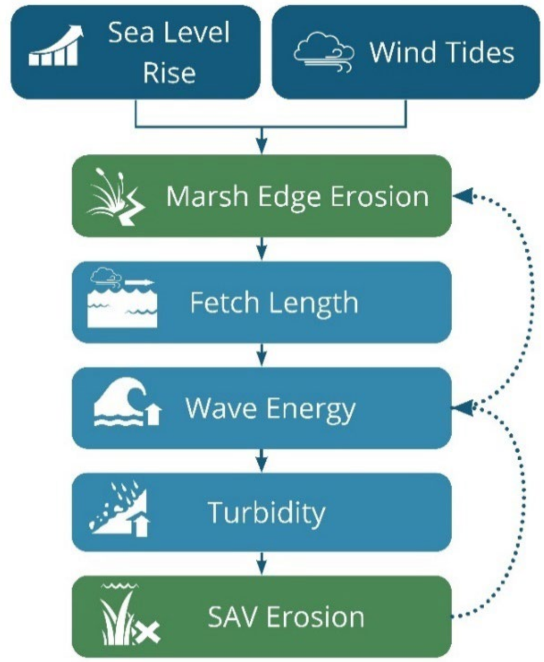

Figure 10: Cycle of marsh erosion, SAV loss, and increased wind-driven flooding.

The primary objective of this project is to create a sustainable coastal marsh island system in Back Bay through reclamation of historically lost marsh habitat and protection of existing marsh complexes from erosion. This restoration effort aims to provide multiple benefits of reduced flood impacts, enhanced fish and wildlife habitat, and improved water quality. The project is designed to achieve the following outcomes:

- Decrease turbidity to create conditions that promote the growth of emergent vegetation and aquatic grasses;
- Maximize habitat value for ecologically important fish and wildlife populations (e.g. Largemouth Bass, Bluegill, Yellow Perch, Striped Bass, Blueback Herring, Alewife, American Eel, etc.); and,
- Reduce fetch, wave heights, and flow velocities to mitigate erosion of fringing marsh systems that provide a buffer for the low-lying neighborhoods and roads that experience frequent flooding in northern Back Bay.

The City selected marsh terracing as the preferred restoration approach because the design is compatible with Back Bay's shallow bottom and the historical loss of habitat. Marsh terraces are narrow, man-made islands placed in shallow open water to restore previous marsh environments. Typically arranged in a chevron pattern, the overall field of marsh terraces dissipates waves, decreases turbidity, and slows down the moving water. The resulting calmer water conditions allow more sunlight to penetrate to the shallow bottom, promoting the establishment and growth of marsh seagrass and ultimately improving habitat quality for fish and wildlife. Further, as opposed to one continuous marsh platform, marsh terraces maximize habitat for a variety of fish and wildlife species, as illustrated in Figure 11.

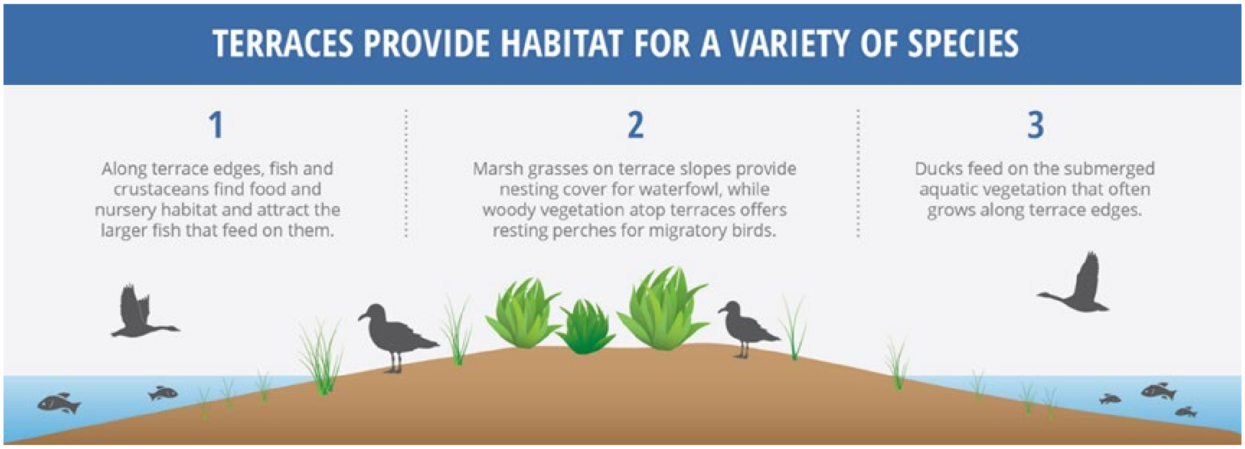

Figure 11: Conceptual diagram of marsh terraces.

Groups to be targeted who might directly benefit from this flood risk reduction effort.

The northern Back Bay communities adjacent to the project area and interested stakeholders have been engaged in the planning effort through public meetings. These meetings provided an opportunity for the community to provide feedback on the 30% and 95% designs and artistic renderings. We anticipate the project to benefit properties and infrastructure assets in northern Back Bay, including the following:

- **Reduce erosion rates along approximately 8 miles of shoreline by reducing wind and wave energy north of the project site.** Most of the properties along this reach of shoreline are not protected by traditional erosion risk reduction measures, such as bulkheads. Maintaining a naturalized shoreline while protecting fringe marsh is a priority of the City and its project partners. This approach will ensure that these marsh systems can migrate landward in response to sea level rise.
- **Reduce flood risk to commercial and residential properties north of the project site.** There are approximately 70 commercial and 2,350 residential structures within the two census block groups surrounding the project site. Around 635 of those structures are vulnerable to flooding during a 50-year event today. With three feet of sea level rise, approximately 2,060 structures are expected to be vulnerable to flooding during a 50-year return period event, representing about 85% of the residential structures within the project vicinity. These numbers underscore the importance of implementing the proposed project alongside complimentary flood risk reduction projects.
- **Reduce the magnitude and duration of flooding along critical access roads and critical facilities.** In addition to Muddy Creek Road, two other critical access roads are anticipated to benefit from delayed flooding. This includes Shipps Cabin Road (intersecting with Muddy Creek Road) and Sandpiper Road, which runs parallel to the eastern bank of Back Bay and provides ingress/egress out of the Sandbridge community (Figure 12).

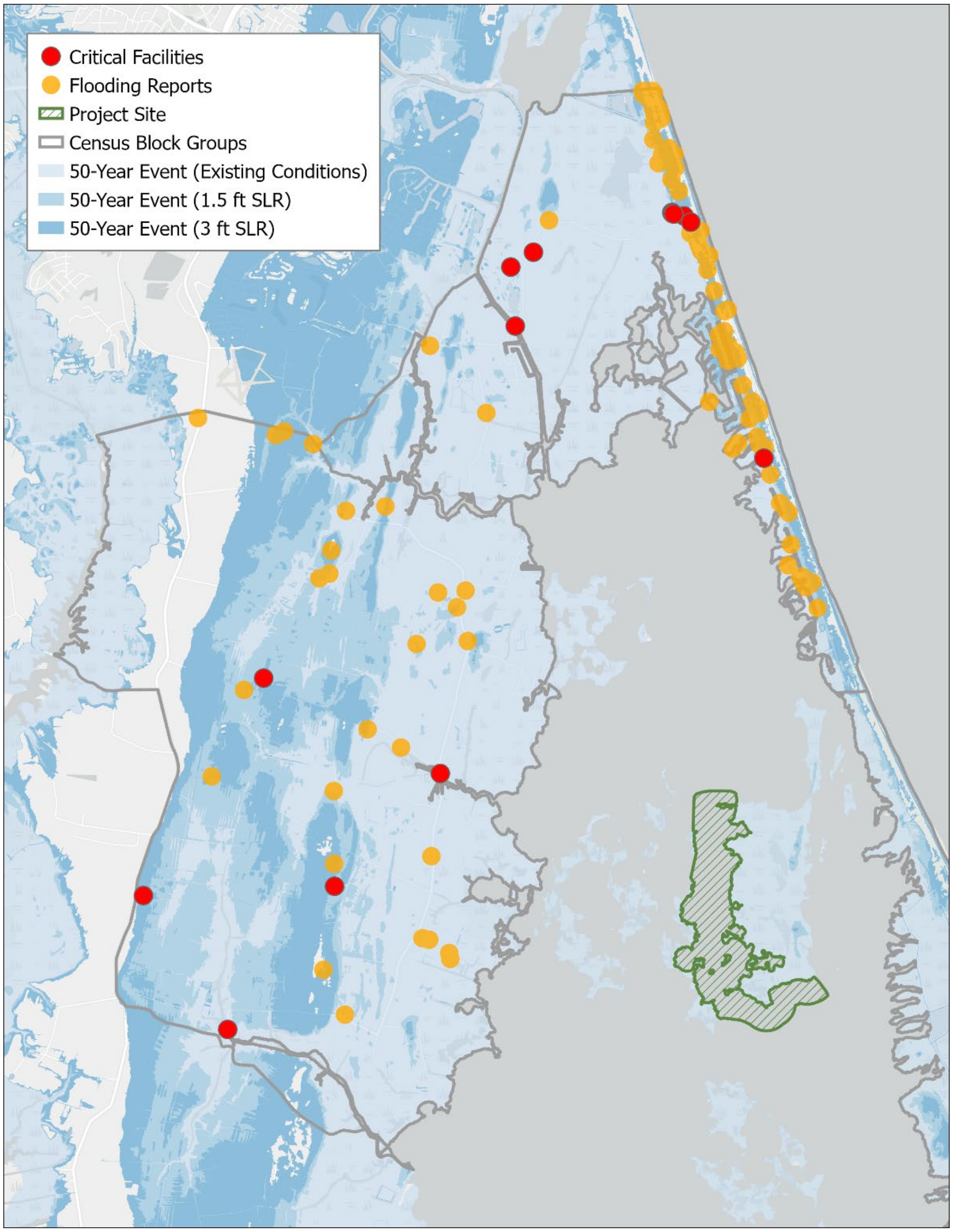

Figure 12: Critical facilities and flooding reports within project vicinity.

What would happen (or not happen) if the applicant does not receive funding?

If this project does not advance from design to construction, erosion of the adjacent marsh would continue to occur, resulting in fragmented habitat lacking the capacity to reduce wave action and slow water velocities. It is anticipated that wind-driven flooding events will continue to increase in frequency, resulting in increasing flooding of the low-lying properties and roadways surrounding northern Back Bay.

Alternatives Analysis

The proposed project offers the best approach for addressing the needs and problem statement outlined in this Scope of Work narrative. The project would result in the creation of 46.5 acres of marsh terraces, which would produce a net gain of approximately 16 acres of low/high marsh habitat by the end of the project construction compared to the No Action Alternative. The integrated system of marsh terrace ridges and perimeter rock armoring would stabilize the two critically eroding marsh islands (Long Island to the east, and a series of smaller unnamed islands to the west) from continued degradation. The tall terrace design improves the functionality and resiliency of the marsh system while also providing diversified habitat for fish and wildlife in the form of increased marsh edge as sea level rises. Numerical modeling of the preferred alternative demonstrated that the project would decrease wave heights and decrease the overall flow velocity of water moving through the project site, reducing water exchange in Back Bay during flooding events, encouraging sediment deposition, mitigating wave effects and consequent erosion, and result in localized water quality benefits. The proposed terraces would not only create a platform for vegetation growth within the marsh, but also reduce wave fetch in these large open water areas. The reduction in wave energy would lead to improved water clarity to promote the growth of SAV in the area between the terraces (approximately 310 acres).

Dredging in between the terraces to obtain sediment for the terrace cap would ensure no invasive vegetation is introduced into Back Bay, which is a high priority of the USFWS and VRMC. The dredging areas would also create valuable fish habitat to attract signature Back Bay fish and wildlife populations such as Largemouth Bass. The proposed dredging areas in between the terraces was evaluated and not anticipated to increase erosion of the adjacent marsh system. Furthermore, dredging in-situ material for building terraces is a widely accepted approach in Gulf Coast region marsh creation/terracing projects, as determined through conversations with project owners in Louisiana. Some terrace cap material will also be obtained from the Nimmo VII-A project. Through export of proven expertise from successful marsh terracing projects, this project would lay the foundation for future similar projects in the region through the development of detailed cost estimates, identification of best sources for local/regional materials, and establishment of partnerships with permitting officials at various levels of government.

Goals and Objectives

The overarching goal of this project is to construct the City's first nature-based adaptation project in the Southern Rivers Watershed and one of the CRMP's exemplary nature-based projects. This project aims to stabilize two critically eroding marsh islands from further degradation, decrease turbidity to promote the growth of aquatic vegetation, and provide flood risk reduction benefits through increased friction and wave attenuation. Table 1 below provides a high-level overview of the specific objectives established to solve the problem/need identified – specifically habitat degradation and wind tide flooding along with measure(s) of success. A more detailed description of these objectives is provided in the Supporting Documentation section.

Table 1: Overview of Project Objectives.

Objectives	Description	Measure(s) of Success	Timing of Measures
Objective 1	Create a Construction Access and Staging Area	a. Secured permits for construction. b. Contractor Selection. c. Construction of Staging Area.	a. December 2023 b. April-May 2023 c. June 2023 -February 2024
Objective 2	Restore Marsh and Aquatic Vegetation	a. Secured permits for construction. b. Restoration of 46.5 acres of habitat.	a. December 2023 b. March - October 2025 and March – October 2026
Objective 3	Engage Stakeholders and Disseminate Effective Practices	Number of people meaningfully engaged in the process of the project within the agreement period.	Continuous through period of performance.

Work Plan

Current Status and Ongoing Activities

The marsh terrace project design is progressing and will be ready for construction in the CFPF grant timeline. Table 2 summarizes ongoing tasks related to the project and an anticipated schedule for completion.

Table 2: Completed, ongoing, and anticipated activities leading up to construction.

Activity	Description	Schedule
Stakeholder Scoping Workshop	In November 2020, the City hosted a virtual workshop to receive initial input from project stakeholders.	Completed (Fall 2020)
Site Characterization and Vegetation Survey	In fall 2020, a site characterization and vegetation survey within Bonney Cove was conducted under a USFWS Special Use Permit (SUP). The purpose of the survey was to document existing emergent marsh and submerged aquatic vegetation (SAV) species composition and percent coverage within the proposed project area. MAP Environmental, Inc. conducted a literature review of marsh terracing projects in the Gulf Coast region to identify effective practices for project planning and design.	Completed (Fall 2020)
Bathymetric Survey	An updated bathymetric survey of Bonney Cove, also covered under a USFWS SUP, was completed in March 2021. This data serves as an input to identify appropriate design elevations to determine quantities of materials necessary to build the proposed marsh terraces and for numerical modeling of project alternatives.	Completed (Spring 2021)
Geotechnical Investigation	A geotechnical investigation of Bonney Cove was conducted in the spring of 2021. The permitted survey, (Virginia Marine Resources Commission (VMRC) Permit No. 2020-2286, U.S. Army Corps of Engineers (USACE) Permit No. 2020-02439, and USFWS SUP) included the collection of 10 soil borings in locations that avoided aquatic vegetation habitat. The soil samples were retrieved by drilling with a specialized airboat-mounted drill rig which was essential for drilling in shallow areas as it avoids disruption to bottom habitat. The soil samples were analyzed to determine the suitability and physical characteristics of the soils within the project area. Additional soil analysis was conducted to determine the suitability of Back Bay sediments for building components of the marsh terraces.	Completed (Spring 2021)

Activity	Description	Schedule
Water Quality and Hydrodynamic Survey	ODU conducted a water quality and hydrodynamic survey of Bonney Cove in the spring of 2021. The USFWS permitted survey collected water samples and deployment/retrieval of hydrodynamic sensors (pressure sensors, acoustic Doppler current profilers, and optical backscatter sensors) at three sampling points in Bonney Cove. Sensor equipment was deployed for two one-month periods (3/10/2021 – 4/12/2021 and 5/19/2021 – 6/8/2021). The water level, wave, and current data served as an input to the numerical model calibration. The water quality parameters (including pH, salinity, temperature, dissolved oxygen, chlorophyll, and turbidity) will serve as a reference to compare pre-and post-construction water quality conditions.	Completed (Summer 2021)
30% Design	Dewberry leveraged the field-collected data to establish design criteria for the project to ensure that it will be resilient in the face of changing future conditions during wind-tide events. Artistic design renderings were developed to enable stakeholders to visualize the implemented project.	Completed (Fall 2021)
Public Engagement – 30% Design	The City held a public information meeting on October 14, 2021, at Creeds Elementary School. The project team delivered a 10-minute presentation of the proposed project followed by an open-format discussion where participants reviewed the preliminary (30%) designs and artistic renderings and submitted comments regarding environmental and community impacts.	Completed (Fall 2021)
Numerical Modeling	Numerical modeling has been completed to evaluate the proposed project's impact on water levels, wave heights, and flow velocities within and surrounding the project area. Potential water quality impacts were also evaluated. The numerical modeling effort involved the development of an XBeach model, which is a nearshore model that accounts for wave-vegetation interactions based on field-derived drag coefficients.	Completed (Winter 2021)
Environmental Assessment and Scoping	In coordination with the USFWS and with technical assistance from Dewberry, the City evaluated the potential environmental impacts of the project. The draft environmental assessment document was distributed to key stakeholders with jurisdictional authority or a vested interest in the project for review and comment.	Completed (Summer 2023)

Activity	Description	Schedule
60% Design	After numerical modeling and stakeholder review of the 30% design, the engineering design plans were advanced from 30% to 60%.	Completed (Spring 2023)
95% Design and Public Engagement	The engineering design team prepared 95% engineering design plans to address comments on the 60% plan set. The City held a second public information meeting from 6:00 – 7:30 p.m. on July 13, 2023, at the Senior Resource Center in Virginia Beach where the project team delivered a 10-minute presentation of the proposed project followed by an open-format discussion where participants reviewed the 95% designs, updated artistic renderings, and submitted comments.	Completed (Fall 2023)
Construction Permit Applications Submitted	The City submitted the Joint Permit Applications for the proposed project, including the initial post-construction monitoring plan, to VMRC and the USACE in August 2023.	Completed (Summer 2023)
Modeling of Potential Adverse Impacts	In response to public concerns, the City performed additional numerical modeling of both northerly and southerly wind events and reviewed water level responses at locations in Back Bay for any potential adverse impacts. No adverse impacts were found for either type of event.	Completed (Fall 2023)
Publication of Frequently Asked Questions	The City will be publishing findings for the potential adverse impacts modeling, along with other responses to public concerns raised at the question in a Frequently Asked Questions webpage in November 2023.	In Progress (Fall 2023)
100% Design	The engineering design team prepared and submitted the 100% engineering design plans to the City for review. The plans will be finalized on receipt of any comments from the permitting process, anticipated to occur by end of 2023.	In Progress (Fall 2023)
Contractor Procurement	The engineering team will provide final plans, specifications, and construction estimates (PS&E). The City will prepare the bid Request for Proposal (RFP), provide Bid Packages, and review bids obtained, and select a construction contractor.	Planned (Winter 2023 - Spring 2024

What are the major activities and tasks?

The key activities and tasks to be competed under the agreement period are summarized in Table 3. Please refer to the Supporting Documentation section for a more detailed description of these activities and tasks.

Table 3: Overview of Activities and Tasks.

Activities	Description	Tasks
Activity 1	Construction Staging Area Preparation and Construction	1. Mobilize equipment 2. Stabilize road, establish construction staging area, abutments, install pre-engineered bridge, construct ramp to water and slurry basins. 3. Establish traffic flagging stations. 4. Install pipe and booster stations.
Activity 2	Marsh Terrace Construction	1. Construct 41 terraces (2-phased approach). 2. Demobilize equipment.
Activity 3	Stakeholder Engagement	1. Develop project marketing materials. 2. Attend and document engagement activities.

Who is responsible for completing the activities and tasks?

Responsibility for completing the project's activities and tasks lies with a collaborative effort led by the City's Department of Public Works. To ensure the successful execution of the project, the City has assembled a diverse team of consultants, advisors and subject matter experts. For a comprehensive understanding of the specific roles and responsibilities of each entity involved in carrying out the proposed scope of work, please refer to the *Supporting Documentation – Approach, Milestones, and Deliverables – Project Partner*s section of this report, which provides a detailed description of how each team member contributes to the project's overall success.

What is the timeframe for accomplishing activities and tasks?

An overview of the planned project timeline is shown in Figure 13. Grant activities will initiated in Summer 2024 with construction of the staging area and material acquisition. Please refer to the *Supporting Documentation – Approach, Milestones, and Deliverables –Milestone Schedule* section of this report for a detailed outline for each activity and associated deliverables.

Figure 13. Timeline overview for project implementation.

Identify the required partners to ensure success and where they are represented in the workplan.

A diverse team of consultants, advisors, and subject matter experts, led by the City's Department of Public Works, has been assembled to complete the project's activities and tasks. Please refer to the *Supporting Documentation – Approach, Milestones, and Deliverables – Project Partner*s section of this report for a detailed description of each team member's role, responsibilities, and contribution to the project's overall success.

Deliverables

An overview of the project deliverables is provided in Table 4. Please refer to the *Supporting Documentation – Approach, Milestones, and Deliverables* section of this report for more detail.

Table 4: Summary of Deliverables.

Activities	Deliverables
Activity 1: Construction Staging Area Preparation and Construction	1. Material acquisition. 2. Progression and completion of the construction staging area, with daily inspections to monitor progress. 3. Documented progress and completion through quarterly reports to DCR.
Activity 2: Marsh Terrace Construction	1. Progression and completion of the 2025 and 2026 construction phases, including plantings, with daily inspections to monitor progress. 2. Demobilization and removal of equipment from construction staging area. 3. Documented progress and completion through quarterly reports to DCR.
Activity 3: Stakeholder Engagement and Lessons-Learned Dissemination	1. Project marketing materials. 2. Records documenting number of stakeholders engaged during the outreach activities.

Maintenance plan tied to the identified viability of the project. Plan for sustaining the project after the agreement period (if applicable)

The City has developed a draft Annual Monitoring Plan and Post-Construction Monitoring Report that was submitted along with the Joint Permit Application for the project. See Attachment 5 for a copy of the draft report.

Project maintenance will be addressed by the City of Virginia Beach's Public Works Stormwater Operations Group. Any maintenance issues identified by the monitoring effort or other observers will be flagged to the Operations Group to address. The City intends to maintain the construction staging area to support future project maintenance needs. After completion of the monitoring program, the City will perform inspections every 2-5 years and make any repairs needed for the life of the project.

Evaluation

Indicators of Success

Indicators of success for this project have been identified during the development of the monitoring plan. Three (3) indicators of success were defined in relation to the primary objectives of the project (as defined elsewhere in this document), and include:

- The establishment of a sustainable coastal marsh island system.
- Stability of the marsh terrace structures.
- Establishment of a sustainable SAV community.

What data will be collected and how will it be used to measure success?

Data collection for the project has been detailed in the proposed monitoring plan and includes two sets of data: one set associated with as-built surveys to establish baseline reference conditions for subsequent monitoring efforts, and monitoring data to assess the success of the project in meeting the indicators defined above. Baseline and monitoring data will be compiled in an annual report and distributed to permitting agencies, and stakeholders as appropriate, to fulfill monitoring requirements and ensure success criteria are being met and maintenance needs are addressed.

Baseline data, which is proposed to be collected after the completion of each of two phases of terrace installation, will include the following data:

- Coordinates and diagrams of established transects, as well as site photographs from photo stations established along each sampling transect, as defined in the Methods section of the monitoring plan.
- Final location of all planted vegetation (upland plantings, high marsh plantings and low marsh plantings).
- Final location and extent of SAV plantings.
- Final grade topographic surveys (plan, profile, and cross sections).
- Discussion of the project design versus as-built conditions.

Monitoring data will be collected at the end of the full growing season during each monitoring year and include the following:

- Site photographs from photo stations defined in the Methods section of the monitoring report.
- Estimated percent cover and change in coverage from the as-built conditions to sampling year conditions for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- Estimated percent cover and change in coverage from planted conditions to sampling year conditions for SAV planting quadrants

- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

This monitoring data will be used to define success by tracking the establishment of the proposed vegetative communities on and between the proposed marsh terraces as well as the structural integrity of the marsh terrace structures themselves. Vegetation cover thresholds for each year will be defined to ensure planted communities are appropriately established on each marsh terrace. Acceptable measures of deviation will be defined for structural elements to ensure design requirements are met. Maintenance and mitigation measures defined in the monitoring plan will be implemented as required if success criteria are not met during any particular monitoring year.

How was cost effectiveness evaluated and measured against the expected outcomes?

Through a BCA approach using FEMA methods and ecosystem service valuations, a BCR of 1.17 was calculated for the project. This BCR is greater than 1, indicating the project can be considered cost-effective. The project also provides an additional $9.2M in value over the current estimated project costs.

A description of the BCA analysis and methods is provided in the following Benefit Cost Analysis Section.

What products, services, meetings, outreach efforts etc. will be conducted and how will success be measured?

The City is firmly dedicated to fostering meaningful engagement with project partners and external stakeholders throughout the project, with the goal of raising awareness about the project's approach and its benefits and enhancing the likelihood of its successful adoption in other areas within the region and the state.

Activity 4, titled "Stakeholder Engagement and Lessons-Learned Dissemination," provides a comprehensive outline of the City's outreach strategy, encompassing proposed deliverables and outreach endeavors. This strategic plan entails the development of project marketing materials, along with the facilitation of presentations and meetings with local and regional stakeholders, as well as participation in state and national-level conferences.

To gauge the effectiveness of our efforts, the City will employ metrics to track and document the number of individuals engaged throughout the project. This information will be regularly communicated to DCR to serve as a key performance indicator for project success.

For a more detailed breakdown of the tasks and deliverables associated with Activity 4, please refer to the Supporting Documentation section of this application.

Project Progress Monitoring Plan

The City's Project Progress Monitoring Plan is designed to guarantee the seamless and effective execution of the project. We have established a robust internal system to oversee the entire project lifecycle, ensuring that all key stakeholders are aligned with the project's objectives, activities, deliverables, and schedule.

The process commences with a kickoff meeting involving all project partners, where we collectively set the stage for the project. During this meeting, we thoroughly review the project's objectives and scope, ensuring that everyone is on the same page. This initial step is instrumental in fostering a shared understanding of the project's vision and goals among all involved parties.

In addition to the kickoff meeting, we place a strong emphasis on quality assurance and control. We meticulously assess each contractor's quality management system to ensure that well-defined procedures are in place to maintain the highest standards of quality throughout the project. This dedication to quality is paramount to delivering a successful project that meets the City's standards and the expectations of our stakeholders.

The City is committed to ongoing and transparent communication with our design and construction contractors, as well as our advisory stakeholders. Regular meetings will be held to monitor progress, address any potential challenges, and ensure the project adheres to the proposed milestone schedule and deliverables as outlined in this grant application. This proactive approach to project monitoring allows us to stay on track, identify and address issues promptly, and uphold our commitment to the successful completion of the project.

Supporting Documentation

Project Information

The following sections provide details regarding the project site and highlight the impacted population, residential and commercial structures, and critical facilities. This section also provides an overview of the historical, existing, and projected flood conditions in and around the project site.

Population

As shown in Figure 14, two census block groups (518100454.121 and 518100464.001) adjacent to Back Bay are within the extent of the anticipated project benefits. The total population of these two block groups is 3,531.[6] The residential population has grown approximately 1.8% in the past two decades. The median household income in 2021 dollars is $99,078. There are approximately 2,500 residential housing units, of which 43.1% are owner-occupied, 11.4% are renter-occupied, and 45.5% are vacant. The high percentage of vacant housing units can likely be attributed to seasonal rentals within the Sandbridge Resort Area. The race and ethnicity demographics of the community are 94.4% White, 1.4% Black, 3.4% Hispanic, and less than 1% Asian and American Indian.

[6] Population, household income, housing units, and demographic data obtained from Esri ArcGIS Community Analyst (2022). Esri forecasts for 2021 based on U.S. Census Bureau 2010 data.

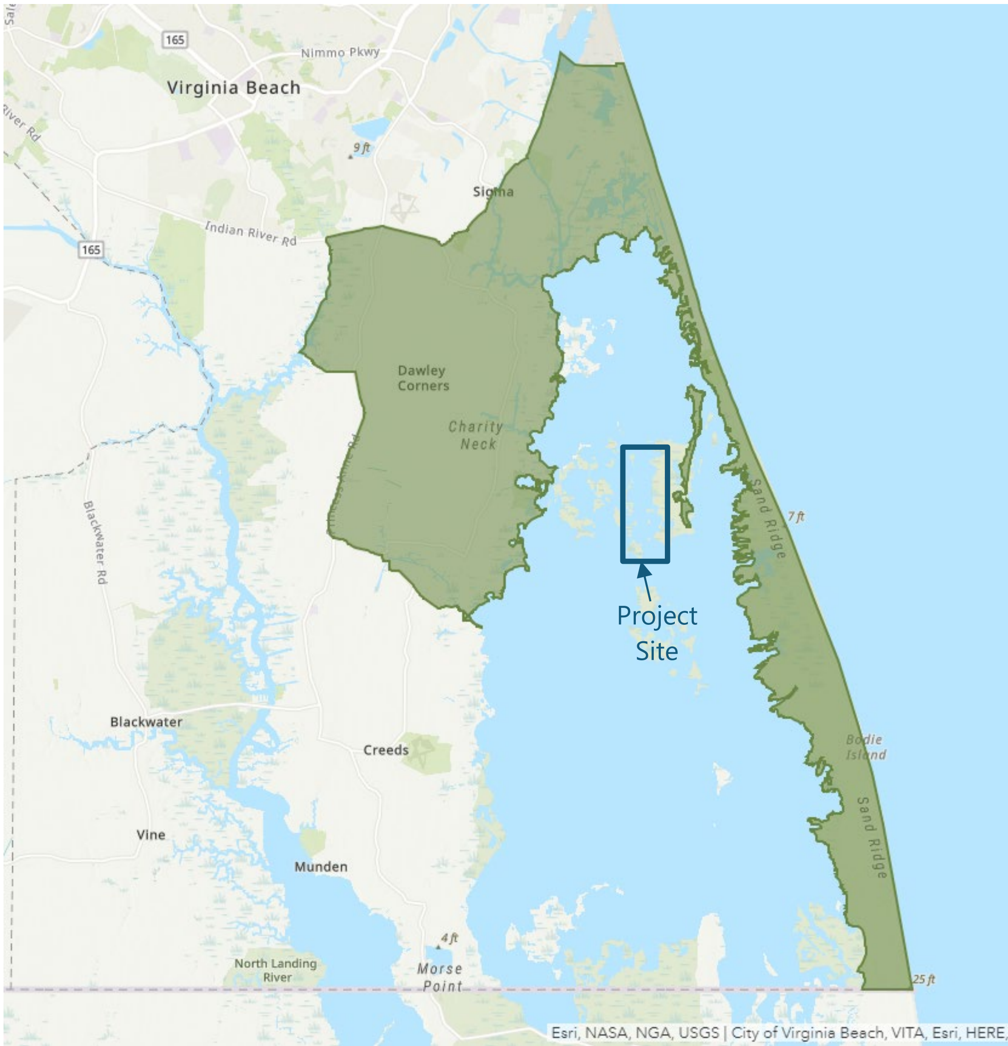

Figure 14: Census block groups selected for population estimates.

Historic Flooding Data and Hydrologic Studies Projecting Flood Frequency

Historical and Existing Flood Data

The project is located within a Federal Emergency Management Agency (FEMA) mapped Special Flood Hazard Area (SFHA), as shown in Figure 15 and Figure 16. Based on the City's current flood maps (effective January 16, 2015), the project site's flood zones are VE, AE, and Open Water. Portions of the site are within Otherwise Protected areas.

The following maps provide an overview of the existing flood hazards for the project area, including the northern boundary (Figure 15) and southern boundary (Figure 16). Based on the City's current flood maps (effective January 16, 2015), the project site contains VE and AE flood zones and Open Water.

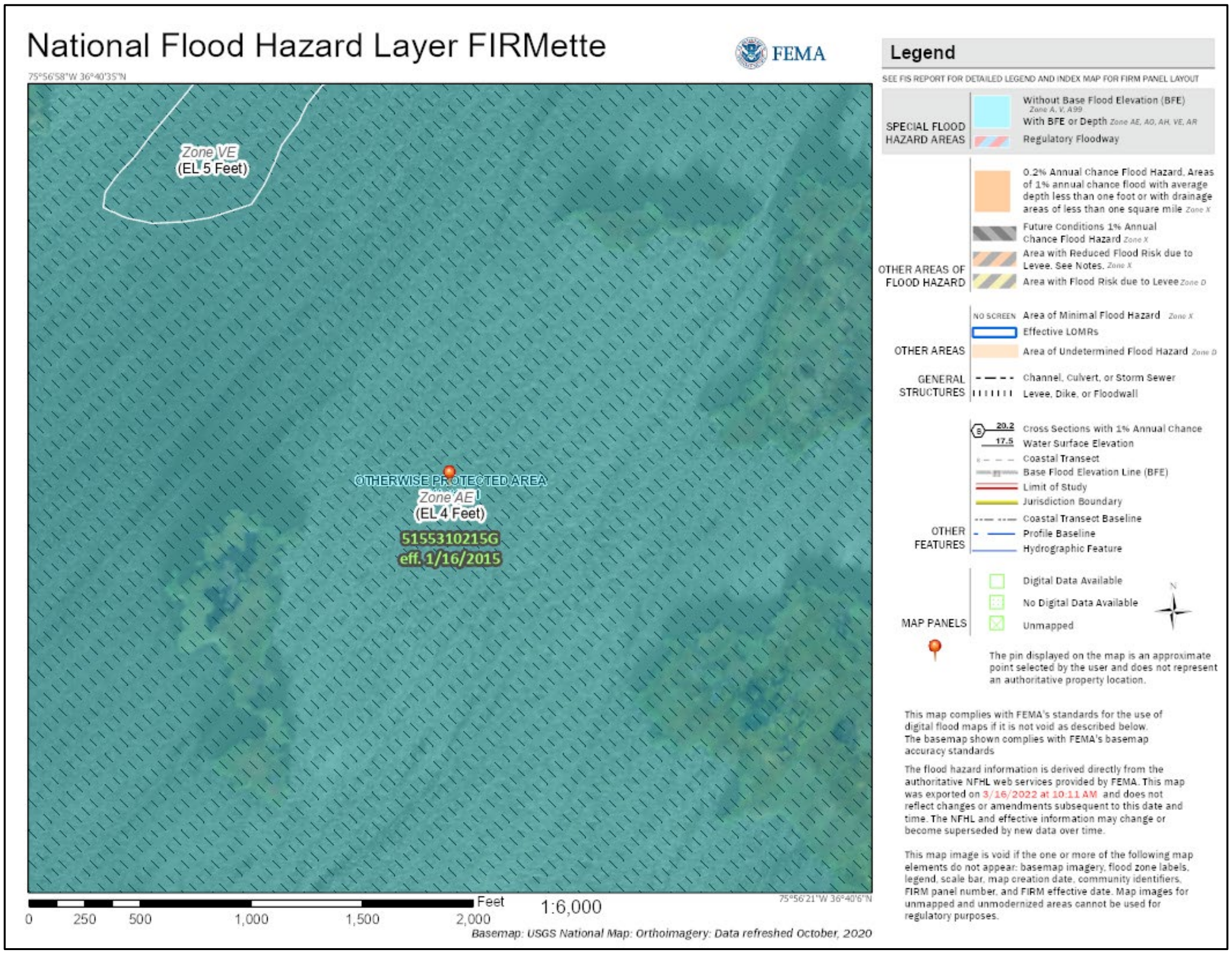

Figure 15: FIRMette for the project area (northern boundary).

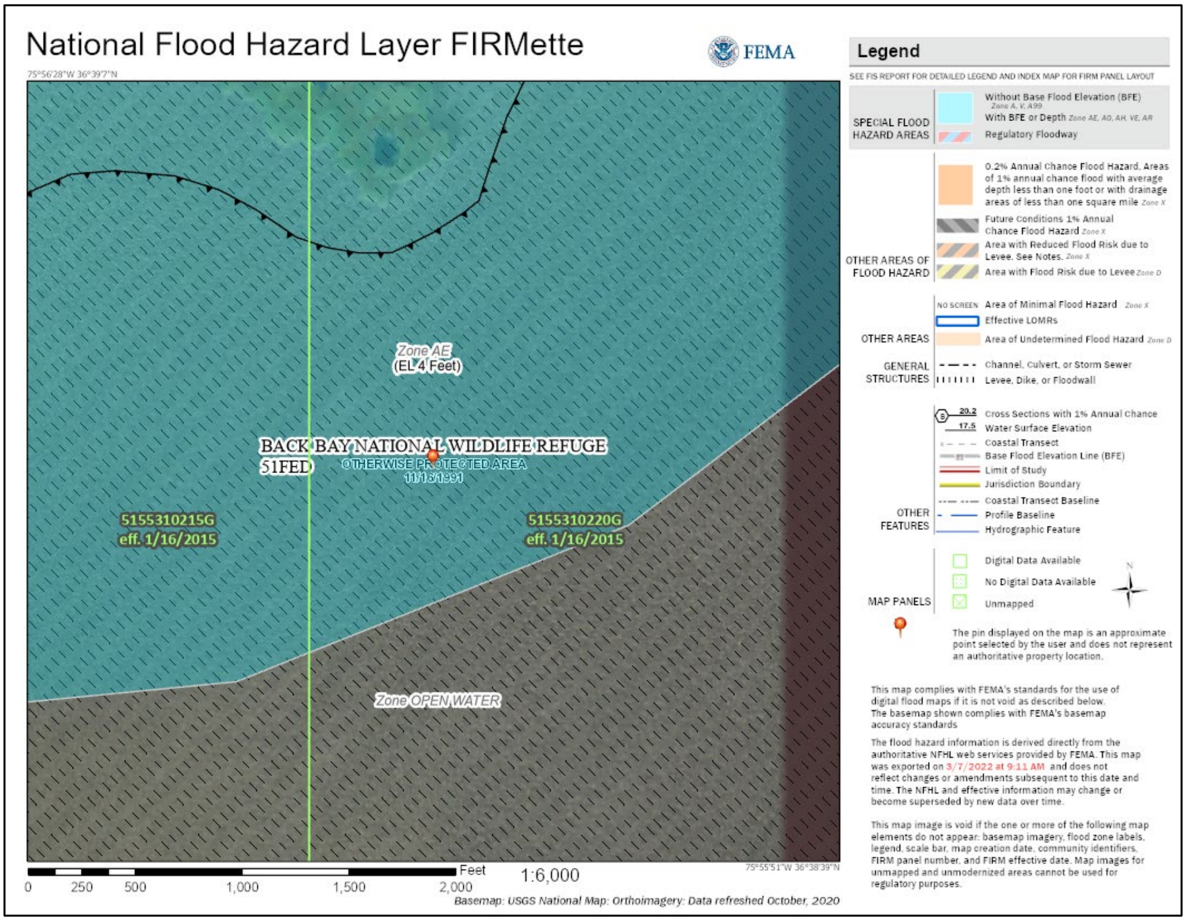

Figure 16: FIRMette for the project area (southern boundary).

The City maintains records of where residents report flood issues and what type of flooding is causing the issue. Residents regularly report flood issues through a hotline, which are then recorded in a flood event database. The census block groups adjacent to the project area reported 111 flood issues associated with heavy rain or high tide between 2001 and 2019. Critical facilities and flood incidences are relatively concentrated in the Sandbridge Resort Area.

Projected Flood Frequency

The USFWS, the City, and other stakeholders have made significant investments in detailed assessments, sophisticated computer models, and water level gauges to better understand historical and future wind tide flooding. Figure 17 displays the projected flood pathways under the 10-year and 100-year storm event under a 3 feet sea level rise scenario surrounding the project site.

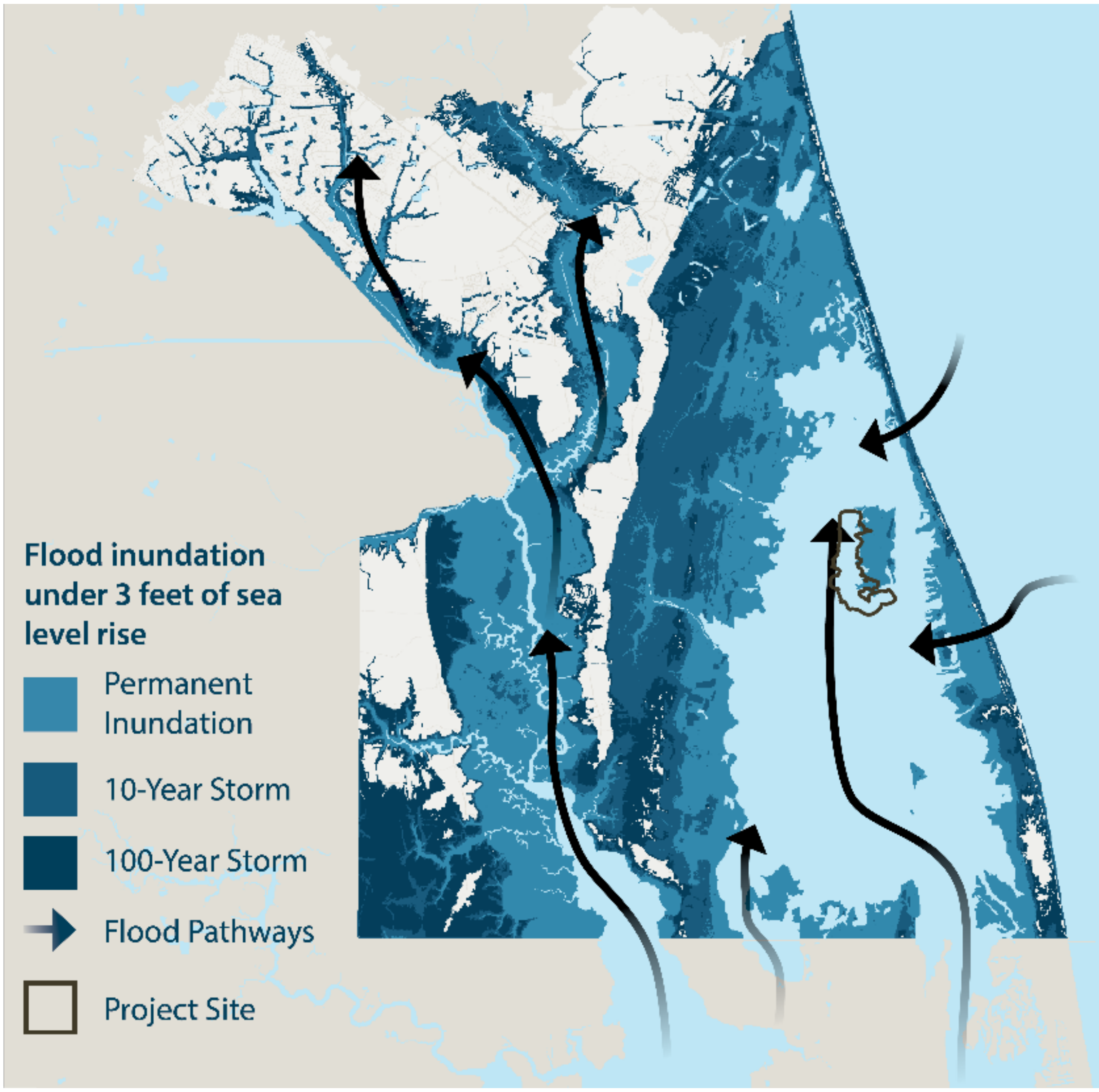

Figure 17: Flood pathways into the Southern Rivers Watershed with 3 feet of sea level rise.

Numerical modeling also shows that as sea levels continue to rise, a shorter duration wind event will produce more wind-induced flooding in less time. The three lines in Figure 18 represent the water level response to a sustained 15-mph wind for each sea level rise scenario. With the existing marsh system today (blue line), it takes approximately five days of sustained southerly wind to cause flooding. With 1.5 feet (yellow line) and 3 feet (red line) of sea level rise, the peak water level could be reached two to three days sooner, respectively. Model simulations showed that marsh island creation across Back Bay would help delay the onset of flooding by several days, which would allow the City and residents more preparation time[7].

[7] City of Virginia Beach. (2018). Analysis of Marsh Response to Sea Level Rise (PDF).

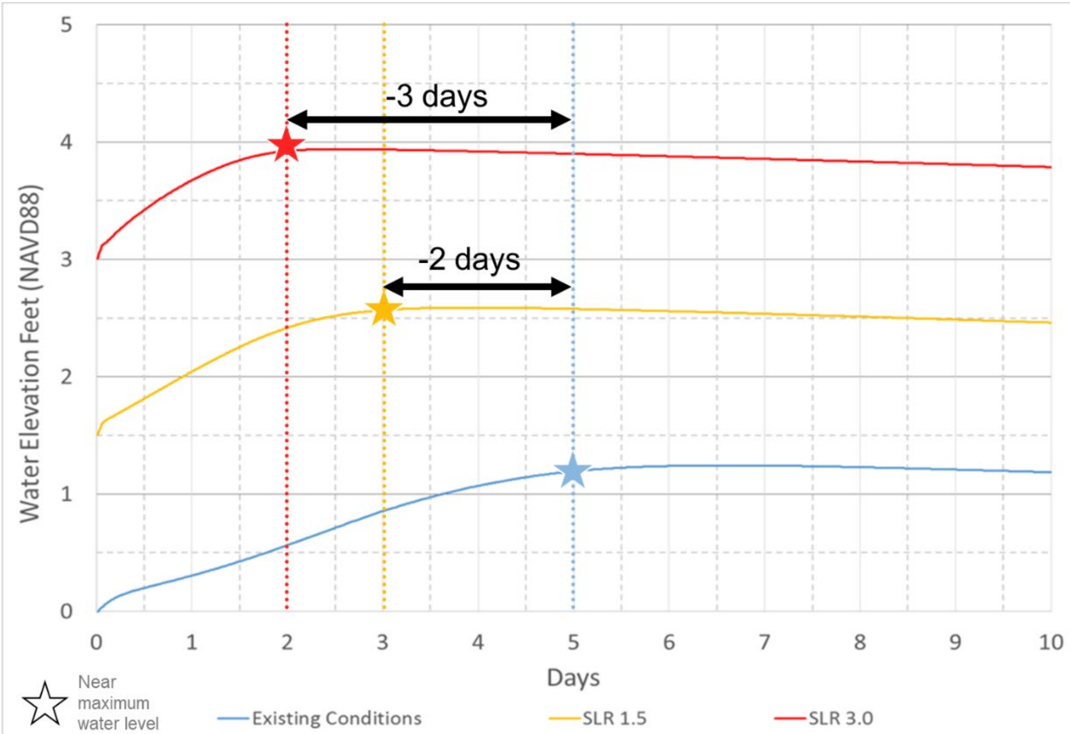

Figure 18: Water-level response under sustained 15-mph southerly wind.

The City analyzed future marsh conditions using the Sea Level Affecting Marshes Model (SLAMM).[7] Figure 19 illustrates areas likely to experience accelerated degradation of marsh in Back Bay due to rising water levels. If no action is taken, substantial marsh loss is projected in Bonney Cove under 3 feet of sea level rise. Within a 1-mile radius of Bonney Cove, the City's SLAMM model predicts that approximately 730 additional acres could be eroded into open water in response to sea level rise. This represents more than a 70% reduction as compared to the existing marsh system surrounding Bonney Cove today. It is also presumed that open water areas would continue to experience high levels of turbidity, which will continue to negatively affect SAV communities in Back Bay.

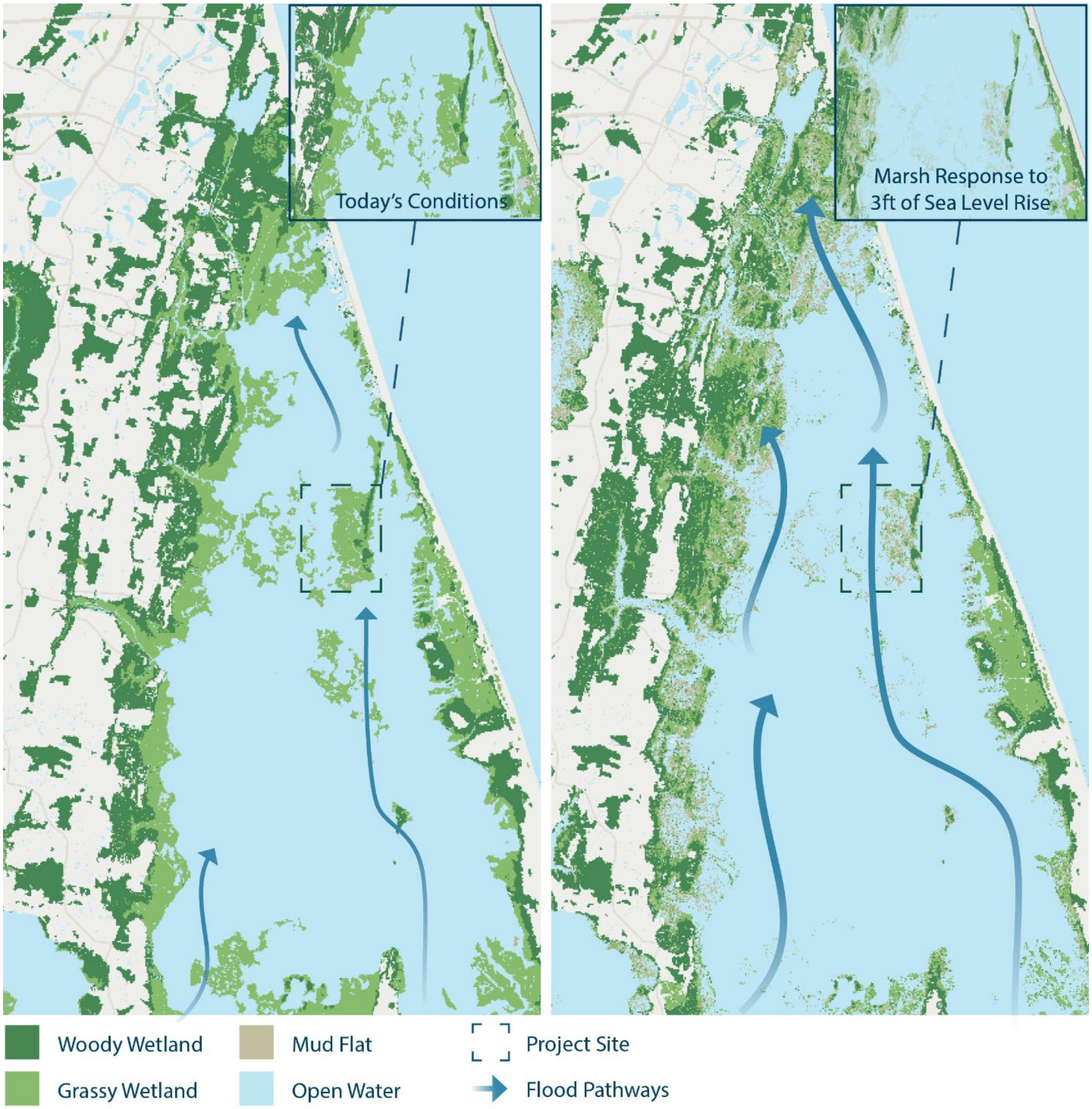

Figure 19: Comparison of current marsh conditions to future marsh conditions with 3 feet of sea level rise.

The proposed project site in Bonney Cove has a predominant south-southwest wind direction, which contributes to significant wave generation in the large unobstructed open-water areas and provides a continuous source of scouring and erosion in those areas. Marsh loss is likely to continue in the project area, creating a negative feedback cycle as continued fragmentation of the marsh would further deteriorate the remaining stands of healthy marsh and increase fetch. Today, the site faces low to medium fetch exposure, but in the future, the site could experience high to very high fetch exposure, as defined by the Virginia Institute of Marine Science (VIMS)

Shoreline Design Guidelines for Shore Protection in Virginia's Estuarine Environments.[8] Projections of increasing fetch at the site, along with the transects used for the wind fetch analysis, are summarized in Figure 20.

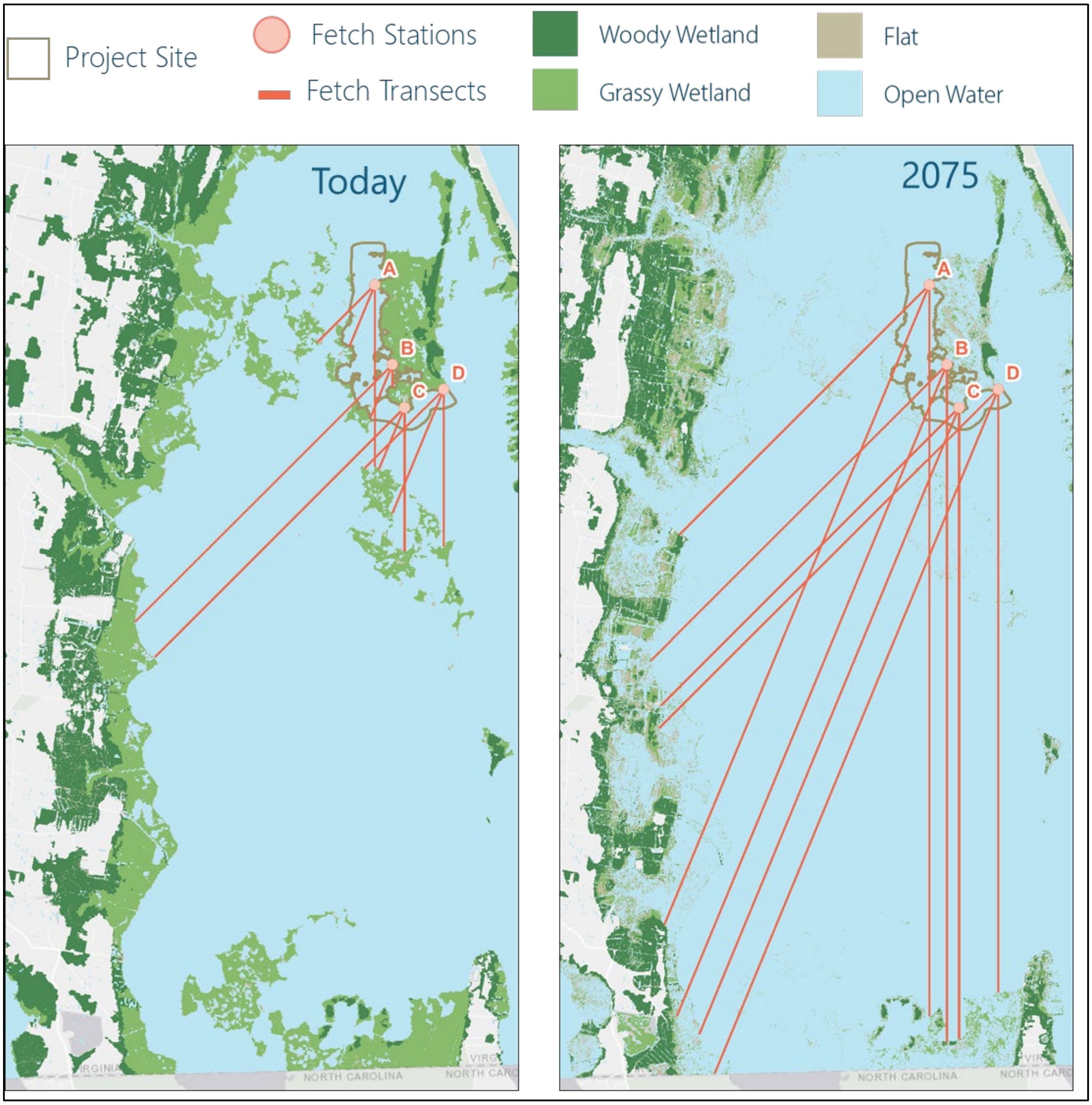

Figure 20: Wind fetch analysis of project area.

The following table displays specific values of fetch distances and classifications that correspond with the transects displayed in Figure 20 above.

[8] Virginia Institute of Marine Science. (2010). Living Shoreline Design Guidelines for Shore Protection in Virginia's Estuarine Environments; Version 1.2 (PDF).

Table 5: Measurements of fetch transects referenced in Figure 20.

Fetch Transect	Length, Miles (Today)	Classification	Length, Miles (3 feet SLR)	Classification
A-SW	0.9	Low	3.7	High
A-SSW	0.7	Low	7.3	Very High
A-S	1.9	Medium	7.7	Very High
B-SW	3.8	Medium	4.4	High
B-SSW	0.6	Low	7.4	Very High
B-S	0.2	Very Low	7.2	Very High
C-SW	3.7	Medium	4.4	High
C-SSW	0.7	Low	7.2	Very High
C-S	1.5	Medium	6.7	Very High
D-SW	1.2	Medium	5.1	Very High
D-SSW	1.4	Medium	7.8	Very High
D-S	1.7	Medium	6.4	Very High

No Adverse Impact

The City conducted additional hydraulic numerical modeling to identify any potential adverse impacts in response to concerns raised during a public meeting in July 2023. The City utilized a Danish Hydraulic Institute MIKE FLOOD model developed for stormwater master planning activities in Lower Southern Rivers Watershed of Virginia Beach. This model encompasses the entirety of Back Bay and extends into North Carolina’s Currituck Sound. Model performance has been validated against observations from multiple flood events.

The effort looked at water level and velocities in response to a historical southerly wind tide flood in May 2017 and a northerly wind event associated with Tropical Storm Ophelia in September 2022. These events were ran with model grids depicting with- and without project conditions, considering the 100% project design specifications. The northerly wind event was

included to address concerns from residents of Knott's Island, at the southern end of Back Bay. Both the terrace field and the construction staging area were included in the with-project condition. The modeling found that there were no increases in water levels to areas within Back Bay or to Knotts Island. Negligible changes in water velocity (0.2 ft/s or less) were observed in the channel to the west of the terrace field. No increases in water levels were observed in the area of the construction staging area.

Local Government to Provide its Share of the Cost

The City of Virginia Beach is fully prepared to cover the cost share of the proposed project, as highlighted in the attached budget narrative, "Amount of Cash Funds Available." The funding for the grant match is contained within the City budget.

Benefit-Cost Analysis

FEMA recognizes the economic value of restoration projects and has provided ecosystem service economic valuations for benefit cost considerations. The approach and values used here are consistent with FEMA Benefit-Cost-Assessment (BCA) toolkit approaches and ecosystem service valuations published in "FEMA Ecosystem Service Value Updates, June 2022[9]." The 2022 FEMA guidance provides methods and values for various nature-based projects, including coastal wetlands. The valuations recognize ecosystem services for coastal wetlands including aesthetic value, climate regulation (carbon sequestration), flood and storm hazard reduction, habitat, recreation/tourism, water filtration and supply benefits of coastal wetland features.

Feasibility and Effectives Criteria

The project meets FEMA's Feasibility and Effectives Criteria for a Coastal Wetland as defined in the 2022 guidance, including:

- Land cover associated with the project is a "Estuarine and Marine Wetland" as classified for NWI for remaining marsh within and adjacent to the study area. The area of the project is also a historical marsh.
- The project demonstrates "ecosystem restoration" by using the terrace approach to recover degraded, damaged, and destroyed wetlands and submerged aquatic vegetation in the Back Bay ecosystem.
- The project meetings EPA concepts of restoration through direct creation of marshes (the terraces themselves) and enhancement of the ecosystem (reduction of water turbidity to enhance growth of submerged aquatic vegetation).
- The project will result in notable increased health and function of the local ecosystem in the "after mitigation" scenario through reduction of wave heights, water flow, and significantly decreased turbidity within the project area, as well as reduction of wave heights to adjacent areas.

[9] FEMA Ecosystem Service Value Updates, June 2022 (PDF).

- The project approach was aligned with established principles and techniques on wetland restoration, as outlined in the Coastal Wetlands and Tidal Flats section of the International Guidelines on Natural and Nature-base Features for Flood Risk Management10.

Design Life

As mentioned, the project useful life is 30-years. The FEMA 2022 guidance allows 50-years a typical lifespan; however, as stated in the project description, the elevation of the terraces was set based on a 30-year design life and estimated settlement.

Ecosystem Services Valuation

- The 2022 guidance values ecosystem services for coastal wetlands at $8,955 in 2021 U.S. dollars (USD), per acre, per year.
- The project will restore 46.5 acres of intertidal and upland marsh through direct creation of the marsh terraces. The project will also promote the growth of SAV in between the terraces, an area estimated at 310 acres. This provide for a total project benefit area of (46.5 + 310) = 356.5 acres.
- Project benefits occur over a period of time into the future; while most of the project costs are incurred up front and in the present. FEMA conducts its BCAs on a net present value basis, meaning the present value of the benefits gained from the project over the life of the project are compared to the total project cost to establish the BCR. Because project benefits accumulate over time, project benefits are calculated on an average annual basis ("annualized") and then multiplied by a Present Value Coefficient (PVC) to determine the present value of the annualized benefits.
- The present value coefficient is calculate as follows:

$$PVC = \left[\frac{1-(1-r)^{-T}}{r}\right]$$

  where *r* is the discount rate and *T* is the useful life of the project. The CFPF 2023 Grant Manual does not specify a discount rate for the benefits calculation; therefore, the latest FEMA program grant guidance was reviewed. For the 2023 FEMA Building Resilient Infrastructure and Communities (BRIC) and Floodplain Mitigation Assistance Grant Program (FMA) cycles FEMA has established a set discount rate of 3%[11]. The 3% discount rate provides for a PVC of 19.60 for a 30-year lifecycle for the project.
- Project benefits were calculated by:

$$Benefits = PVC \times Project\ Area \times Coastal\ Wetland\ Benefits$$

- The benefit cost ratio (BCR) was calculated as:

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[10] International Guidelines on Natural and Nature-Based Features for Flood Risk Management - Engineering With Nature (dren.mil)

[11] FEMA Fact Sheet. Notice of Funding Opportunity for Fiscal Year 2023 Building Resilient Infrastructure and Communities Program (PDF).

$$BCR = \frac{Benefits}{Costs}.$$

A summary of the calculated values is provided in the below table:

Table 6. Summary of BCA parameters and results.

Project Area	Benefits (acre / year, 2021 USD)	Project Lifespan	Benefits, 3% discount rate	Project Cost	BCR, 3% discount rate
356.5	8,954	30	$62,566,588	$53,378,490	1.17

The calculated BCR for the project was 1.17, based on the FEMA ecosystem services valuation approach. This BCR is greater than 1, indicating the project can be considered cost-effective. The project also provides an additional $9.19M in value over the project cost.

Local Floodplain Management Regulations

The City recognizes the vital importance of floodplains in the natural movement of water through the community. Appendix K of the Virginia Beach Code of Ordinances regulates development in the community's floodplains. The City requires that a permit is obtained for any construction or development in the Special Flood Hazard Area. For more information and details regarding the City's floodplain management and ordinances, please refer to the following:

- Link to current floodplain ordinance: Virginia Beach Floodplain Ordinance.

In addition, a copy of the current floodplain ordinance has been included in *Part IV, Section E5*. For further information regarding the City's hazard mitigation and comprehensive planning, please refer to the following:

- Link to current hazard mitigation plan: Regional Hazard Mitigation Planning.
- Link to current comprehensive plan: Virginia Beach Comprehensive Planning.

Other Necessary Information to Establish Project Priority

Repetitive Loss and/or Severe Repetitive Loss Properties

The repetitive loss database shows 113 repetitive loss and severe repetitive loss properties within the two census block groups (518100454.121 and 518100464.001) associated with the project area.

Residential and/or Commercial Structures

A detailed economic flood loss assessment presented in the City's Resilience Plan showed that approximately 45% of the entire future risk exposure in the City is concentrated in the Southern Rivers watershed. Of that risk, 65% is concentrated in three communities north of Back Bay

(Figure 21).[12] Under a "no action" scenario, average annualized flood losses would increase from $974 thousand, representing present day conditions, to $6 million with 1.5 feet of sea level rise as anticipated by 2050. This figure equals an increase of six times present day conditions. With 3 feet of sea level rise as anticipated by 2080, annualized losses are expected to drastically increase to $80 million, more than 80 times today's conditions.

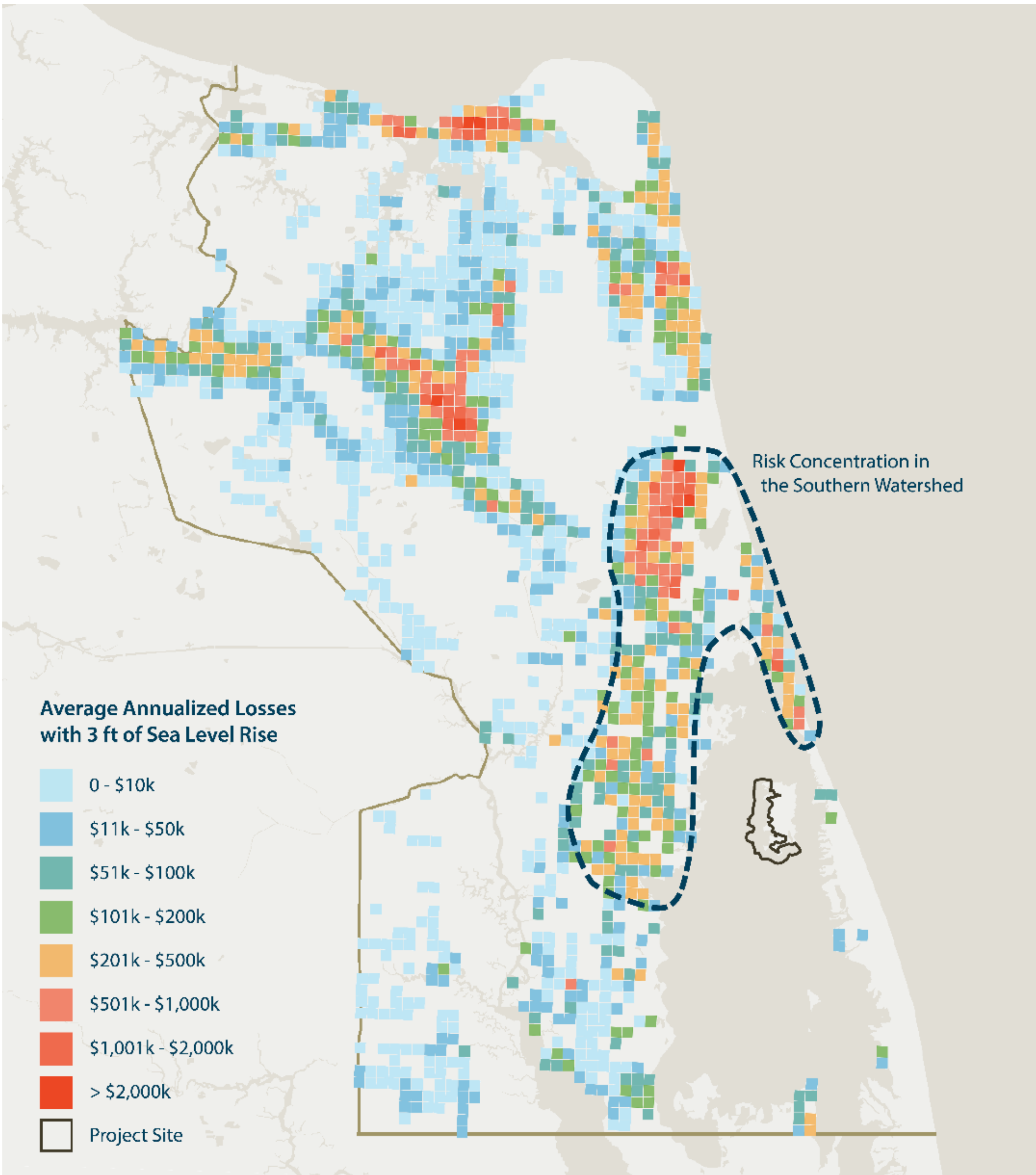

Figure 21: Concentration of average annualized losses estimated with 3 feet of sea level rise under a "no action" scenario presented in the City's Resilience Plan.

[12] City of Virginia Beach. (2020). Coastal Flooding and Economic Loss Analysis (PDF).

Within the two census block groups adjacent to Back Bay near the project area, there are approximately 70 commercial structures and 2,350 residential structures. Of those structures, approximately 635 structures are vulnerable to flooding during a 50-year event today. With 3 feet of sea level rise, approximately 2,060 structures are expected to be vulnerable during a 50-year event, representing approximately 85% of the residential structures within the project vicinity. These numbers underscore the importance of implementing the proposed project alongside complimentary flood risk reduction projects.

Critical Facilities

The two census block groups near the project site include 10 critical facilities. Table 7 summarizes critical facilities by type, total number, and the number of facilities exposed to the 50-year storm scenario under current and future "no action" scenarios. Under current 50-year storm conditions, 2 communication facilities and 1 electric power station would be exposed to flooding. With 3 feet of sea level rise, the number of critical facilities exposed to flooding increases to 9 total facilities.

Table 7: Summary of critical facilities located in the selected census block groups and flood hazard exposure to the 50-year storm event under current conditions and with 1.5 feet and 3 feet of sea level rise.

Type of Facility	Number of Facilities	Current 50-year storm	50-year storm with 1.5 feet sea level rise	50-year storm with 3 feet sea level rise
Communication	3	2 (66%)	2 (66%)	3 (100%)
Electric Power	1	1 (100%)	1 (100%)	1 (100%)
Fire Station	1	0	0	0
Potable Water	2	0	2 (100%)	2 (100%)
School	1	0	0	1 (100%)
Wastewater Treatment	2	0	0	2 (100%)

Need for Assistance

The City of Virginia Beach has invested significant time, money, and staff resources in understanding, communicating, and planning for the threats of sea level rise and recurrent flooding to the community. The City is ready to begin the implementation of adaptation measures, and the marsh terrace project is the first project to advance to construction from the City's Resilience Plan. The project represents the first step in restoring Back Bay and the larger Albemarle-Pamlico estuary, and serves as a pilot for additional restoration projects. Virginia Beach understands that flood mitigation costs are substantial and is seeking funds to support project implementation alongside dedicated resources procured by the City. The City's

Department of Public Works Stormwater Engineering Center has closely coordinated with the City's Department of Planning & Community Development throughout the design and permitting process. The Department of Public Works will oversee the construction of the marsh terrace project, including providing construction inspectors to monitor that the project is built to the City's design standards and technical specifications. Additionally, the City has access to necessary software, including AutoCAD and ArcGIS Desktop, and support from consultants to augment the City's technical capabilities.

Examples of City staff who will support the project include the following:

- Program Manager for the Technical Services Division of the Stormwater Engineering Center.
- Project Manager for Green Infrastructure Projects for the Technical Services Division of the Stormwater Engineering Center.
- Environmental Planner / Certified Floodplain Manager from the Wetlands & Shoreline Construction Team of the Planning Administration Division of the Department of Planning & Community Development.
- Planning Evaluation Coordinator from the Chesapeake Bay Preservation Area & Southern Rivers Watershed Team of the Planning Administration Division of the Department of Planning & Community Development.
- Full-time Construction Inspector assigned exclusively to this project from the City's Construction Bureau or under contract with the City Public Works Engineering Division.
- Grant Coordinator from the City's Public Works Engineering Division.

Additional staffing will be provided as needed to ensure project success.

This project benefits communities in northern Back Bay with a high concentration of flood losses (as shown in Figure 21). These communities contribute significantly to Virginia Beach's rural economy, including agriculture, forestry, fishing, hunting, and eco-tourism. In Hampton Roads, these industries contribute a combined $100 million in gross domestic product.[13] Protection of vulnerable natural infrastructure, such as the marshes in Back Bay, is critical to ensuring these industries can continue to thrive within the region.

Alternatives

Several other alternatives were considered but not advanced due to technical and environmental limitations. These alternatives are briefly summarized below.

[13] Office of Governor Ralph S. Northam Commonwealth of Virginia and Virginia Department of Conservation and Recreation. (2021). Virginia Coastal Resilience Master Plan Phase 1 (PDF); data referenced sourced from the US Bureau of Economic Analysis. (2019).

Alternative 1 - No Action Alternative

Under this alternative, no action would be taken to restore marsh habitat in the shallow open water channel of Bonney Cove. Erosion of the adjacent marsh would continue to occur, resulting in fragmented habitat lacking the capacity to reduce wave action and slow water velocities. It is anticipated that wind-driven flooding events will continue to increase in frequency, resulting in increasing flooding of the low-lying properties and roadways surrounding northern Back Bay.

Alternative 2 - Alternative Terrace Configuration Design(s)

Several configuration alternatives for the terraces were considered during the design process. These included four alternative layouts with different spacing and terrace top widths:

- **Alternative 2a** (Figure 22): Terraces would be spaced at approximately 300-foot intervals and have a top width of 15 feet. Between the base of the terraces, there would be approximately 220 feet for potential establishment of SAV habitat.
- **Alternative 2b** (Figure 23): Terraces would be spaced at approximately 300-foot intervals and have a top width of 30 feet. Between the base of the terraces, there would be approximately 200 feet for potential establishment of SAV habitat.
- **Alternative 2c** (Figure 24): Terraces would be spaced at approximately 600-foot intervals and have a top width of 15 feet. Between the base of the terraces, there would be approximately 520 feet for potential establishment of SAV habitat.
- **Alternative 2d** (Figure 25): Terraces would be spaced at approximately 600-foot intervals and have a top width of 30 feet. Between the base of the terraces, there would be approximately 500 feet for potential establishment of SAV habitat.

A common feature across all of these design alternatives was a breakwater that spanned the entire length of the southern extent of Long Island and a northern breakwater that spanned the northern exposed section of the project site.

Alternative 2a and 2b were eliminated due to constructability concerns regarding the quantity of sediment that would be required and due to the limited amount of room for SAV establishment in between the terraces (approximately 220- and 200- feet of potential SAV habitat between terraces for Alternative 2a and 2b, respectively).

Alternatives 2c and 2d were discussed extensively amongst the project team; however, it was ultimately determined that they did not maximize the opportunity for species diversity (by including both smaller and larger terraces). These alternatives were combined to form the preferred alternative presented in this document. Additional refinements that were made to these alternatives include the removal of the perimeter breakwater, as the proposed design elevation evaluated in the geotechnical analysis revealed stability issues with these large features.

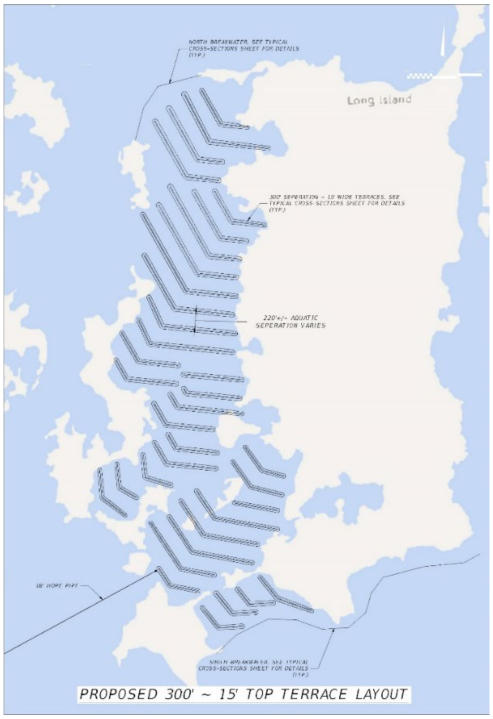

Figure 22: Alternative 2a.

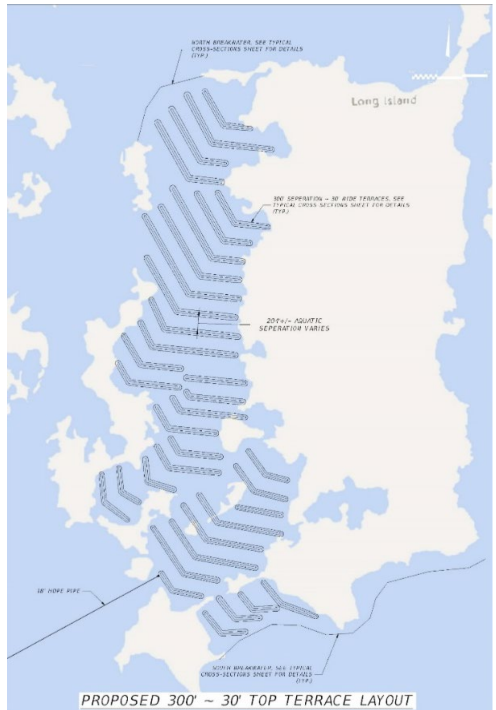

Figure 23: Alternative 2b.

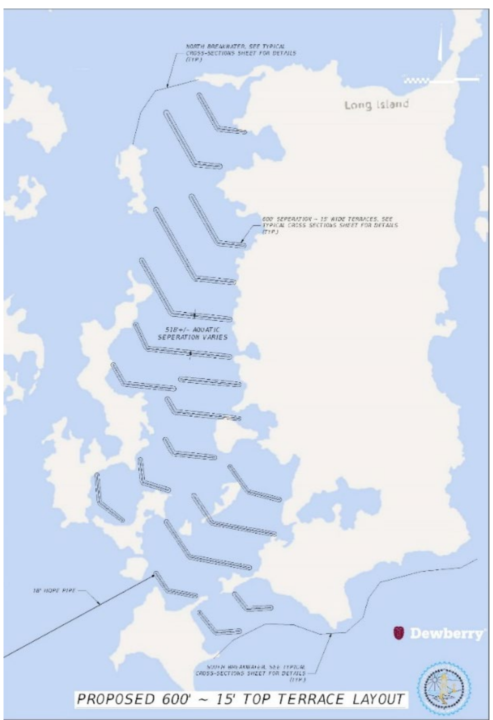

Figure 24: Alternative 2c.

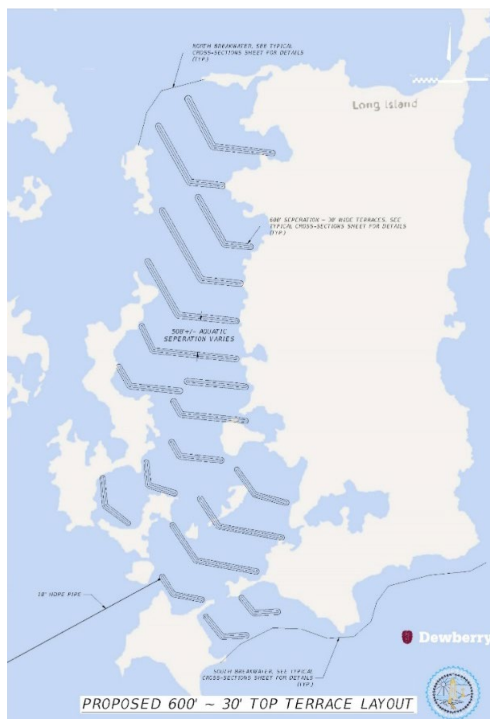

Figure 25: Alternative 2d.

Alternative Terrace Core Material Sources and Transportation – Alternative 3

In the proposed alternative with sand cores, a no-dredging alternative was considered. However, in order to successfully complete the project and establish the vegetation desired, material would need to be sourced, blended, transported, and placed. The City helped identify two potential borrow sources of material: Bow Creek Golf Course (Figure 26) and the Whitehurst Dredged Material Management Area (DMMA) (Figure 27).

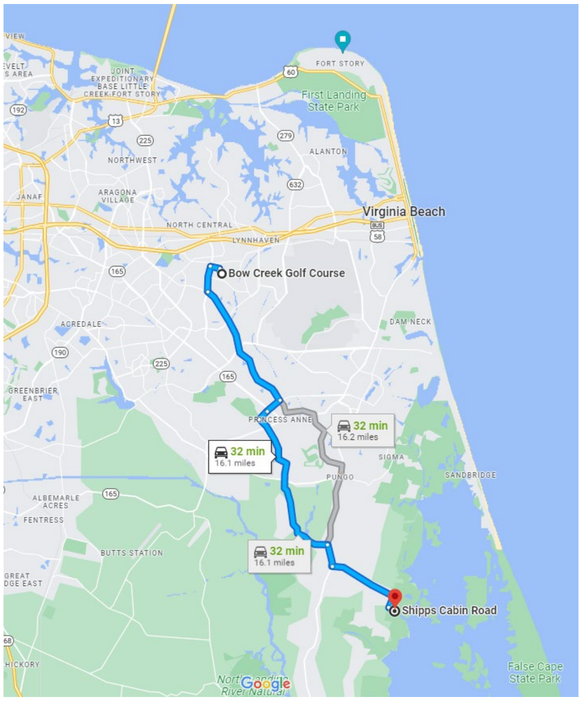

Figure 26: Distance from Bow Creek Golf Course to the proposed Shipps Cabin staging area.

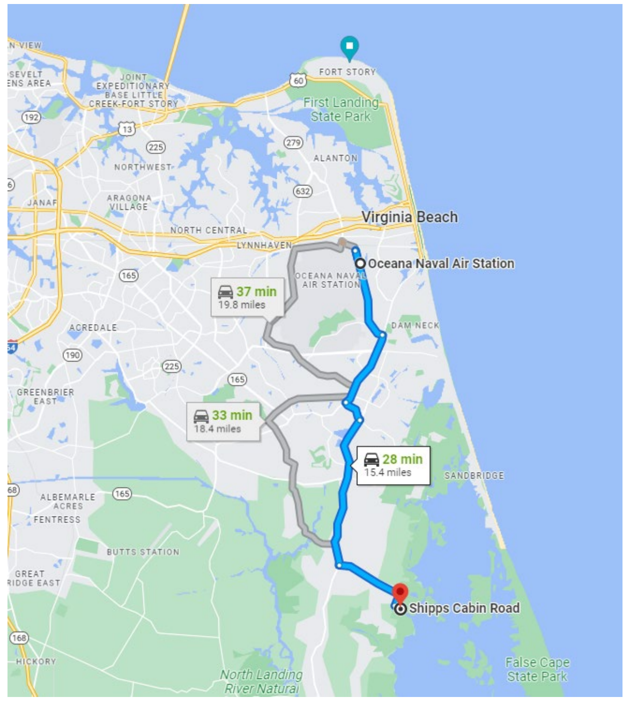

Figure 27: Distance from Whitehurst DMMA to the proposed Shipps Cabin staging area.

Bow Creek Golf Course: Bow Creek Golf Course is located approximately 16 miles from the proposed Shipps Cabin staging area. In the next few years, The Bow Creek Golf Course is scheduled to be converted into a Stormwater Park as one of 21 projects funded by the City's Stormwater Flood Protection Program. Large quantities of materials will be removed from the site for use within the City. The material from Bow Creek would need to be excavated, screened, and tested for foreign seeds and contaminants. Most likely, this material would have to be processed before it could be loaded again on dump trucks and hauled approximately 16 miles to a potential staging area where it would be loaded again on shallow draft barges.

Whitehurst DMMA: The Whitehurst DMMA is a similar distance to the proposed Shipps Cabin Road Construction Staging Area. The material at Whitehurst may not have to be processed as much; however, it would need to be tested for foreign seeds and contaminants. Because of the organic components in this soil and the need for the material to establish vegetation on the terraces, this material is not able to be hydraulically blended and pumped to the site. Therefore, this material would need to be loaded on shallow draft barges and then

placed by mechanical means. Further, the amount of material needed to cap the proposed terraces is approximately 110,000 cubic yards which equates to roughly 5,500 quad-axle dump trucks traveling city streets and damaging other infrastructure.

Barging of all materials was considered. Dewberry conducted meetings, site investigations, and talked with both industry leaders in maritime construction and locals who know the water in Back Bay. A typical 35-foot by 95-foot construction barge drafts approximately 7 feet. This type of barge is not able to be trucked to the landing site, nor is it able to be brought into Back Bay. There are truckable barges, but again the drafts of those barges can be in the 4 to 5 feet range when loaded and would require dredging a channel for access. Shallow draft barges can be used in Back Bay that only draft 1 to 3 feet, and they would need to be off-loaded from a staging site. To bring any materials such as stone, sandy fill, or terrace cap material by barge around Knotts Island is not feasible. The actual channel into the southern point of Back Bay has a height restriction due to the causeway serving Knotts Island.

Continuous Marsh Platform – Alternative 4

A continuous marsh platform to fill in the areas of historical marsh would help to restore this eroded habitat but would not provide conditions suitable for SAV establishment or optimize the wave/flow velocity attenuation through the project area. Furthermore, for a single marsh platform across Bonney Cove, the amount of material required would be more than 3 or 4 million cubic yards of material. To achieve that volume of material by dredging, significant areas of existing SAV present in Back Bay would need to be impacted. As the geotechnical report indicated, the existing material of the project site and surrounding areas is not capable of supporting itself in a constructed arrangement and would slough off back into the water. Further, providing this amount of material without dredging would require bringing external sediment sources into Back Bay, which could introduce invasive species. Finally, while the platform will reclaim marshland, it is not anticipated to establish extensive areas appropriate for SAV reestablishment and would eliminate deeper water areas preferred by some endemic wildlife species.

Goals and Objectives

The overarching goal of this project is to construct the City's first nature-based adaptation project in the Southern Rivers Watershed and one of the CRMP's exemplary nature-based projects. This project aims to stabilize two critically eroding marsh islands from further degradation, decrease turbidity to promote the growth of aquatic vegetation and provide flood risk reduction benefits through increased friction and wave attenuation. The following section summarizes the objectives through which this goal will be realized.

Objective 1 – Create a Construction Access and Staging Area

The project's first objective is to employ a construction approach that is compatible with the shallow nature of Back Bay and the large quantity of material required to build the marsh terraces. The engineering team performed a constructability review of suitable landing sites to

stage construction operations for the terraces. A property located at the end of Shipps Cabin Road (Figure 28) was identified as the preferred staging and construction access location for the following reasons:

- Shipps Cabin Road Construction Staging Area Proximity to site (2 miles).
- Shipps Cabin Road Construction Staging Area Proximity to sand borrow sources.
- Shipps Cabin Road between Muddy Creek Road and the Construction Staging Area is in disrepair and was identified as an opportunity to improve the condition of the road as part of the construction activities.

Figure 28: Proposed Construction Access.

On completion of the project, the City plans to retain the staging area for future monitoring and maintenance needs for the project. This future use is consistent with the sentiments of local stakeholders, as communicated during public engagement meetings for the study.

Expected Benefits:

- Enables constructability of the marsh terraces.
- Enable access to the project for post-construction monitoring and future marsh restoration projects.

Objective 2 – Restore Marsh and Aquatic Vegetation

The second objective of the project is to restore marsh and aquatic vegetation for habitat and flood resilience. Specifically, the City's construction of the marsh terraces will result in the restoration of approximately 46 acres of habitat within Back Bay, consisting of:

- 10 acres of low marsh habitat; low marsh plantings would include Big Cordgrass (*Spartina cynosuroides*) and Saltmarsh Cordgrass (*Spartina alterniflora*).
- 6 acres of high marsh habitat; high marsh plantings would include Black Needlerush (*Juncus roemerianus*) and Salt Meadow Hay (*Spartina patens*).
- 14 acres of upland vegetated habitat; upland vegetation would include Arrow-leaf Tearthumb (*Persicaria sagittate*), Groundsel Tree (*Baccharis halimifolia*), Wax Myrtle (*Myrica cerifera*), and Bald Cypress (*Taxodium distichum*).
- 16 acres of submerged terrace habitat anticipated to create suitable conditions for the emergence of SAV.

Additionally, approximately 310 acres of open water SAV habitat would remain between the proposed marsh terraces, and it is anticipated that construction of the terraces would create conditions within the project area favorable to the re-establishment of SAV populations.

Expected Benefits:

- Reduce wave heights, flow velocities, and wind sheer stress within the project area to protect marsh islands from continued erosion.
- Restore the natural buffer that helps protect low-lying neighborhoods and critical access roads from wind-driven flooding.
- Improved water quality by removing excess nutrients.
- Lowered transport of suspended sediment and prevention of resuspension of fine sediments in the water.
- Reduced flow velocity and absorbing wave/wind energy to reduce shoreline erosion.
- Creation of habitat (nursery and feeding areas) for fish (such as Largemouth Bass, Bluegill Yellow Perch, Striped, Blueback Herring, Alewife, and American Eel), migratory waterfowl (such as the Canvasback Duck [*Aythya vallisineria*]), and other aquatic animals.

Objective 3 – Engage Stakeholders and Disseminate Effective Practices

The City is committed to continued meaningful engagement with project partners and external stakeholders throughout the restoration and monitoring phases to ensure transferability to other sites in the region and state.

Expected Benefits:

- Ensure that the lessons from this project can be transferred and scaled to other sites in the state or region.

Approach, Milestones, and Deliverables

The following approach, milestones, and deliverables lay out a plan of action. The milestone schedule follows in *Section B: Milestone Schedule*.

Approach & Deliverables

Activity 1 – Construction Staging Area Preparation and Construction

Activity 1 involves preparing the Shipps Cabin Road property as a construction staging area. Construction activities will include stabilization of the road, laying geotextile to stabilize the ground under the construction staging area, filling with material for the construction staging area, adding fencing, creating bridge abutments and installing a temporary bridge and ramp for waterfront construction access, construction of slurry basins, and establishment of traffic flagging stations.

In the final step, the contractor will install pipe to pump the slurry material from the Shipps Cabin staging area to Bonney Cove. The pipe will be floated with subaqueous tie-downs at channels and certain points of access to maintain boat crossings. Those subaqueous locations will be marked by a buoy every 10 feet and temporary signage as reasonable. The contractor will install two booster stations along the alignment, one approximately half-way between the landing and Bonney Cove, and one at the edge of Bonney Cove. These booster stations will consist of a pontoon-mounted diesel engine pump capable of moving the sand slurry from the construction staging area to the site. It is estimated that 150 CY per hour of sand slurry would be pumped through the pipe in a 60:40 ratio. Additional booster stations may be required for manifolding and supplying slurry stations to individual terraces.

Relevant Objective(s): Objective 1

Deliverables:

- Conduct daily inspections to monitor construction progress of the Shipps Cabin Road Construction Staging Area preparation.

Assumptions:

- It is anticipated that the Shipps Cabin Road Construction Staging Area construction activities can occur simultaneously with material production in Year 1 (2024).

Activity 2 – Marsh Terrace Construction

Once the Shipps Cabin Construction Staging Area preparation is complete, marsh terrace construction activities can commence. The contractor will construct the terraces according to the 100% Final PS&E documents. The most recent engineering designs and design report are available upon request; they are not included as an attachment to this proposal due to file size. Figure 29 shows the overall layout of the terraces, and Figure 30 and Figure 31 show the project renderings. Terrace construction will begin in the northern extent of the project site at Terrace #100, noted in Figure 29, and the contractor will work south towards Terrace #140. The contractor will complete each terrace (including installation of plants) before moving onto the next.

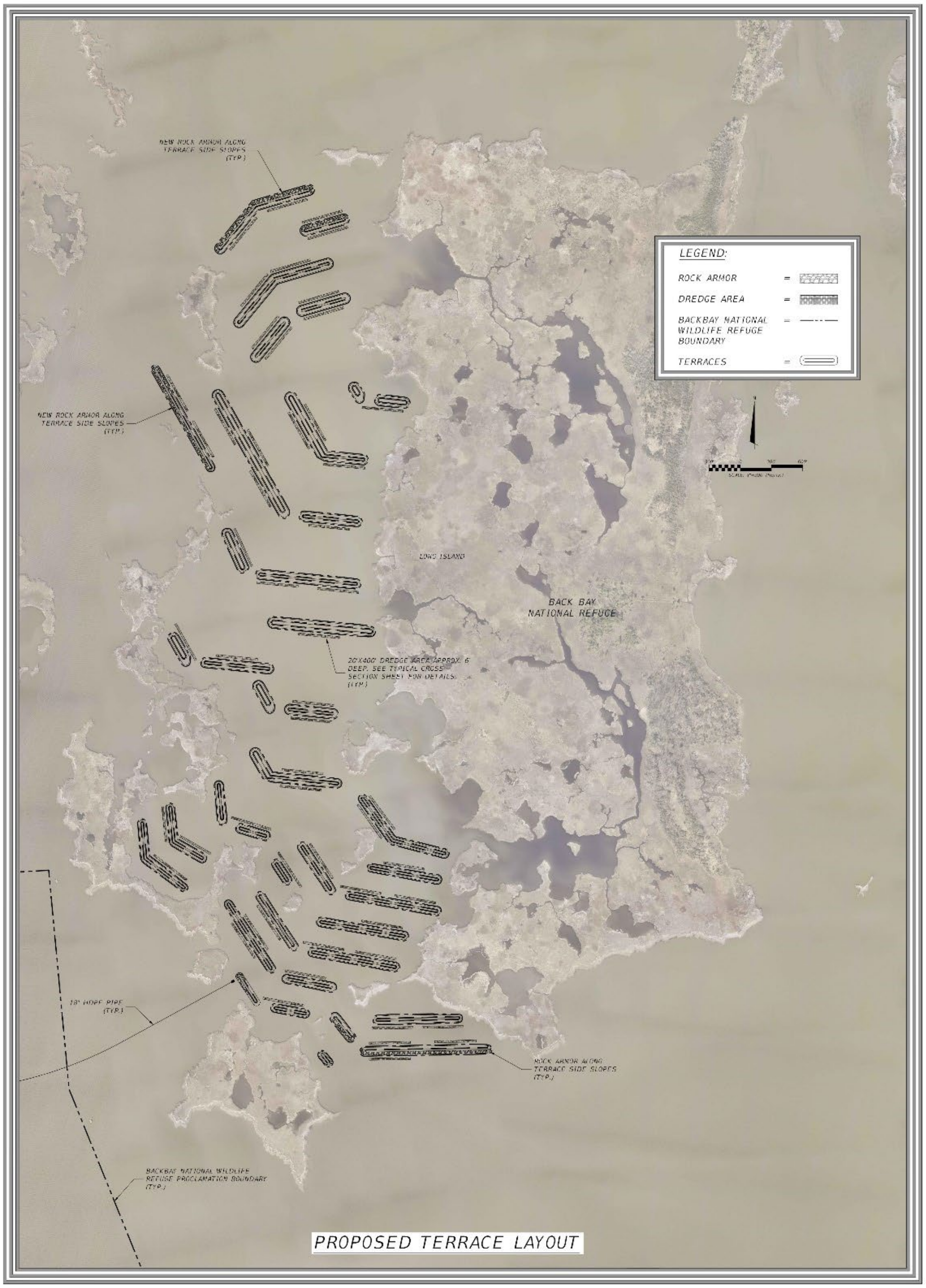

Figure 29: Marsh terrace layout across Bonney Cove.

Figure 30: Marsh terrace design rendering.

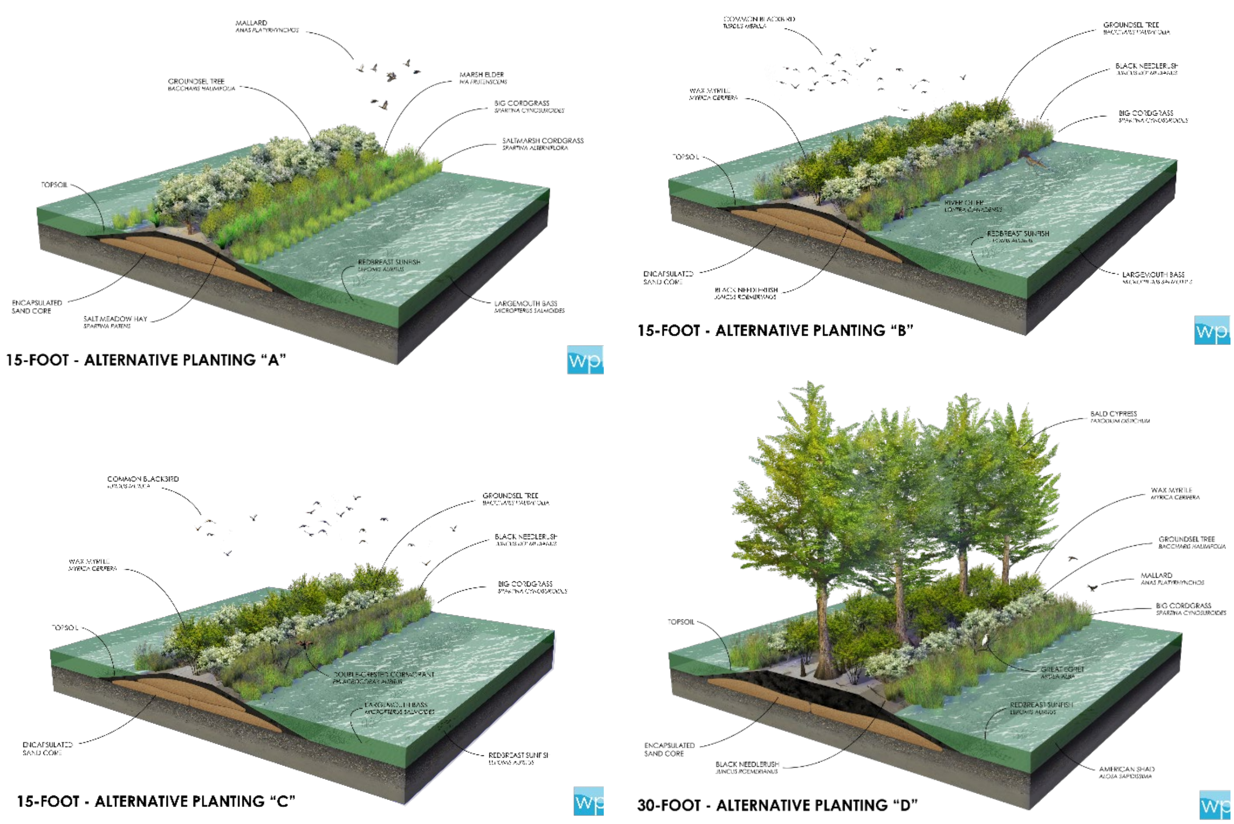

Figure 31: Marsh terrace cross-section design renderings.

The following section provides a high-level description of the proposed design and

construction approach.

Terrace Orientation:

The orientation of the terraces will be perpendicular to the predominant wind direction (south-southwest) to maximize wave energy reduction. The terraces in the northern extent of the project site will be angled perpendicular to a north-northwest wind direction. The terraces would be segmented in a chevron pattern (duck-wing pattern) to provide the most favorable fish and swimming crustacean (termed "nekton") habitat while also allowing adequate circulation to promote sedimentation and maintaining navigability throughout the project area. The terraces would not be connected to the adjacent marsh; this gap, or physical open water barrier, is intended to deter the invasion of Common Reed (*Phragmites australis*) stands from adjacent marshes.

Spacing:

The terraces would be spaced at approximately 300-foot intervals in the northern and southern quarters, and then 600-foot or greater intervals in the center. This arrangement aims to lessen the open water and subsequent wave action at the northern and southern ends of the site and allow adequate construction space for marine-based construction equipment.

Terrace Elevation and Width:

To achieve a sustainable marsh elevation throughout the project life, the marsh terraces would initially be built to a higher elevation during construction and allowed to settle to the desired target elevation over time. Taller terraces improve the functionality and resiliency of the system while also providing diversified habitat for fish and wildlife. The goal is that, by the end of the 30-year design life and with 1.5 feet of relative sea level rise, the terraces will be at or above the elevation of a moderate wind tide event (when Back Bay water levels are anticipated to reach +3.0 feet NAVD88 over the design water level). This threshold was determined to ensure the terraces would not be fully overtopped during a future wind tide event and maintain resiliency to anticipated sea level rise. The 1.5 feet sea level rise scenario is consistent with the near-term planning scenarios identified in the City's Resilience Plan to represent conditions from 2035 to 2050 and adopted by the Hampton Roads Planning District Commission (HRPDC) as part of resolution number 2018-01.

The terraces would have a top width of 15 or 30 feet and be built to an elevation of +4.5 to +5.0 feet NAVD88, depending on the width of the crest, underlying soils, and local bottom depth, with side slopes of 4 horizontal to 1 vertical (4H:1V). The +4.5- to +5.0-foot elevation is calculated based on a target elevation of +3.0 feet NAVD88 or higher at the end of the project's 30-year design life and an estimated settlement of approximately 1 to 2 feet, depending on where the terrace is located. The geotechnical investigation revealed that terraces in the site's southern portion are expected to experience greater settlement than those to the north.

Terrace Composition:

The terraces would consist of a sand-filled core that is encapsulated by a high-strength blend of woven and non-woven geotextile fabrics. The sand for this material will come from nearby offsite sources and be pumped through the 1-inch diameter pipe described in Activity 2. Once the cores are in place, long-reach excavators would travel along the tops of the terraces and begin to shape the cross slopes. Existing adjacent material devoid of SAV would be mechanically dredged and placed over the sand-filled cores. The marsh terraces would be covered with 1 to 3 feet of suitable fill, depending on crest widths, and then planted with native emergent and brackish plant species to stabilize the terraces and provide wind-driven flood reduction benefits.

Relevant Objective(s): Objective 2

Deliverables:

- Conduct daily inspections to monitor construction progress of the marsh terraces.

Assumptions:

- It is anticipated that construction of the terraces will occur in two phases over two years from 2025 through 2026, with the following assumptions:
    - Construction activities are not permitted within BBNWR from October 31 through February 28, annually, to limit disturbance to wintering waterfowl and migration during those months.

Activity 3 – Stakeholder Engagement and Lessons-Learned Dissemination

As the first large scale terracing project on the Atlantic coast, the City recognizes the importance of documenting lessons learned and effective practices during each of the proposed activities: contractor procurement, construction, and post-construction monitoring. The City plans to develop a set of project marketing materials (PowerPoint presentations, StoryMap, information flyers, etc.) to cover key topics, such as:

- Lessons learned during contractor procurement, construction, and post-construction monitoring.
- Effective practices for contractor procurement, bid development, and evaluation. This project is expected to require a highly specialized contractor given the complexity of the project, very shallow water depths, and distance of the site from available construction access and staging areas.
- Guidance for identifying the best sources for local and regional materials for building the terraces and developing a project construction schedule with enough lead time for producing the quantity of material needed for large-scale marsh creation projects.
- Effective practices for developing a post-construction monitoring plan for marsh terraces that a) aligns with permitting, grant, and other requirements and b) enables quantification of project benefits and areas for improvement.

- Effective practices for communicating project benefits based on a combination of field data collection, numerical modeling, and post-construction monitoring.

The City plans to leverage the materials to facilitate dissemination to key stakeholders to increase likelihood of transferability of the approach to other areas in the region and state. The City's plan for engagement is summarized in the following table. In addition to these efforts, the City is committed to collaborating with DCR to identify any additional opportunities to help socialize the project's innovative design and lessons learned.

Table 8: Summary of opportunities for City, regional, state, and national stakeholder engagement; expected benefits.

	Description of Proposed Outreach Activities

CITY	• Facilitate internal municipal awareness, coordination, and approval to gain budgetary approval for funding to expand the approach to other sites in Back Bay (such as "The Great Narrows", Mackay Island and Princess Anne Wildlife Management Areas, and Ragged Island) through presentations to the:
	  o Virginia Beach City Council
	  o City Manager Working Group for SLR and Recurrent Flooding, comprised of representatives from all City departments, to facilitate awareness, coordination, and action to advance the project to the restoration phase.
	• City of Virginia Beach Management Leadership Team (MLT), which includes the City Manager, Deputy City Managers, and Department heads from across the City.

REGION	• Collaborate with the National Audubon Society and Albemarle-Pamlico National Estuarine Partnership (APNEP) to:
	  o Highlight the marsh terrace project as a success story in the next iteration of the Currituck Sound Coalition Marsh Conservation Plan.
	  o Explore opportunities for marsh terrace projects in the Knotts Island Channel, a key flood pathway into Back Bay, as well as other locations in the Currituck and Albemarle-Pamlico Sound.
	• Share lessons learned to regional and state stakeholders, improving knowledge-based, awareness, and capacity for future efforts through presentations to:
	  o Hampton Roads Adaptation Forum – a regional dialogue for academics, non-profits, consultants, and municipalities committed to resilience measures.
	  o The Hampton Roads Planning District Commission (HRPDC) Coastal Resiliency Committee .
	  o Regional conferences on green infrastructure, coastal resilience, and SLR adaptation.
	• Collaborate with Wetlands Watch, a regional non-profit organization committed to the protection of wetlands using nature-based solutions, to socialize the project and disseminate lessons learned.

	Description of Proposed Outreach Activities
STATE	• Continue to coordinate with the Virginia Department of Conservation and Recreation (DCR) to: o Promote the project as a success story for the State Coastal Master Plan (CRMP), which highlighted the project as an "exemplary" resilience project that aligns with the Commonwealth's objective to protect and enhance the state's natural infrastructure. o Incorporate project updates and lessons learned on the CRMP website is an excellent mechanism for dissemination to all coastal Planning District Commissions (PDCs)/Regional Commissions (RCs) across the state. • Continue to collaborate with The Nature Conservancy (TNC), a national player in guiding the implementation of nature-based strategies, to help disseminate lessons learned on project implementation. The City has engaged in early discussions with TNC about partnering to host a state-level workshop that would draw from the network of TNC's local and regional chapters • Presentations at state-level conferences on water resources, floodplain management, and resilience, such as hosted by Resilient Virginia and Virginia Lakes and Watersheds Association.
NATION	• Disseminate lessons learned/effective practices through presentations at 1-2 relevant national conferences such as Restore America's Estuaries, Association of State Floodplain Managers, or the American Shore and Beach Preservation Association, etc. • Leverage working relationships and existing contract work with the U.S. Army Corps of Engineers and partners to integrate lessons learned into the International Natural and Nature-Based Feature Design Guidelines to promote consideration of marsh terraces within similar Back Bay environments (for example, in North Carolina, Maryland, New Jersey, and New York).

Relevant Objective(s): Objective 3

Deliverables:

- Project marketing materials.
- Records documenting number of stakeholders engaged during outreach activities.

Activities Not Included Under this Grant

Submerged Aquatic Vegetation Transplant Plan: The City will evaluate opportunities for restoring native submerged aquatic vegetation populations in Back Bay, such as Wild Celery (*Vallisneria americana*), through consultations with subject matter experts. After terrace construction, the City will formulate a plan for planting submerged aquatic vegetation in between the terraces in coordination with identified partners and the construction contractor.

Post-Construction Monitoring: Post-construction monitoring and inspections will occur for a minimum of five (5) years following construction. Given the period of performance for the CFPF grant, post-construction monitoring activities have not been included in this application.

Milestone Schedule

The scope of work proposed in this grant application are scheduled to occur between June 2024 and June 2027. Work activities are anticipated to complete in December 2026; however, the proposed schedule extends through June 2027 for contingency. The project's expected progression is shown in the following milestone schedule, noting deliverables for each milestone:

2024 Activities

- *1st Quarter **(pre-grant period activities):***
  - 100% Final PS&E
  - Submit Bid Documents
- *2nd Quarter (pre-grant period activities):*
  - Final Bid Coordination/Acceptance
  - Construction NTP
- ***Begin Year 1 Grant Activities – 2nd Quarter 2024:***
  - Mobilization for Shipps Cabin Road Construction Staging Area
  - Initiation of Marsh Terrace Material Production
- *3rd Quarter:*
  - Construction NTP and Mobilization for Slurry Basin Installation
- *4th Quarter:*
  - Completion of Shipps Cabin Road Construction Staging Area and Slurry Basin Construction

2025

- *1st Quarter*
  - Completion of Marsh Terrace Material Production
  - Construction Mobilization for Marsh Terraces (beginning on March 1, 2025)
  - Oversight, Management, and Inspection Services of Slurry Basin Installation
- ***Begin Year 2 Grant Activities - 2nd Quarter 2025***
  - Construction of Marsh Terraces #100 – 105
- *3rd Quarter*
  - Construction of Marsh Terraces #106 – 114
- *4th Quarter*
  - Construction of Marsh Terraces #115 – 119
  - Marsh Terrace Construction Demobilization (to accommodate break in construction period from October 31, 2025 – February 28, 2026)

2026

- *1st Quarter*
  - Construction Re-Mobilization for Marsh Terraces (beginning on March 1, 2026)
- ***Begin Year 3 Grant Activities - 2nd Quarter 2026***

- Construction of Marsh Terraces #120 – 134
- *3rd Quarter*
    - Construction of Marsh Terraces #135 – 140
- *4th Quarter*
    - Shipps Cabin Road Construction Staging Area Final Improvements & Demobilization

2027

- *1st and 2nd Quarter*
    - *Contingency for any delays experienced through end of 2026*

End Year 3 Grant Activities

Project Partners

The following table highlights the specific project partners, their roles, and their capabilities concerning the proposed project.

Table 9: Potential Project Partners.

Entity	Role	Description
U.S. Fish and Wildlife Service, Back Bay National Wildlife Refuge	Project Partner / Advisor / Adjacent Land Owner	BBNWR owns the land adjacent to the project footprint and monitors migratory bird hunting within Presidential Proclamation boundaries. BBNWR has coordinated with the City on project design and will continue to be involved during project construction as a stakeholder and advisor.
Virginia Department of Wildlife Resources	Project Advisory / Stakeholder	The City has coordinated closely with VDWR on project design. Furthermore, VDWR has been monitoring SAV distribution in Back Bay for decades and will be a critical partner for identifying native seagrass species and techniques for restoration based on extensive experience from previous SAV restoration projects in Back Bay.
Virginia Beach Department of Planning & Community Development	Permit Compliance	The City's Department of Public Works has been in close coordination with the City's Department of Planning & Community Development throughout the design and permitting process. Continued involvement and coordination during construction and post-construction monitoring is anticipated.
Dewberry	Engineering Contractor	Engineering consultant to support the City with contractor procurement and construction administration.
To be Determined	Construction Contractors	Construction contractor for the Shipps Cabin Road Construction Staging Area and marsh terrace construction activities.

Entity	Role	Description
Friends of Back Bay	Project Advisory / Stakeholder	Friends of Back Bay was formed in the 1980s to lead efforts to expand and conserve BBNWR, including securing millions in funding to support the Refuge's expansion. The City has coordinated with the BBNWR Society throughout the design and permitting process and will continue this coordination through construction and post-construction monitoring.
Back Bay National Wildlife Refuge Society	Project Advisory / Stakeholder	The Back Bay National Wildlife Refuge Society (BBNWR Society) is an independent, 501(c)(3) non-profit group dedicated to supporting the mission of the USFWS National Wildlife Refuge System and specifically promoting awareness of the BBNWR through education and participation. The City has coordinated with BBNWR Society throughout the design and permitting process and will continue this coordination through construction and post-construction monitoring.
Back Bay Restoration Foundation	Project Advisory / Stakeholder	Back Bay Restoration Foundation (BBRF) is an independent, 501(c)(3) non-profit group focusing on growing concerns about issues such as recurrent flooding, sea level rise, and development in the Southern Rivers Watershed. The group aims to serve as an advocate for the Bay and surrounding residents. The City has coordinated with BBRF throughout the design and permitting process and will continue this coordination through construction and post-construction monitoring.

Relationship to Other Projects

This project represents the first nature-based project in the Southern Rivers Watershed to advance to design and construction to implement the City's Wise Resilience Plan. The project is also an aspect of the Stormwater Green Infrastructure aspect of the City's Flood Protection Plan. The City has received a $3M award from the CFPF to support another project in the Stormwater Green Infrastructure element of the Flood Protection Program – the Elizabeth River Wetland and Floodplain Restoration Project (Round 1 CFPF Grant Awards).

The City has also received two NFWF NRCF grants from the Marsh Restoration in Back Bay project. Approximately $135,000 in NFWF NRCF funding was awarded in 2020 for the previous phase (design and permitting) for the project. The City continues to meet the obligations and period of performance of this NFWF grant. In 2022, the NFWF NRCF awarded $9,886,400 to support construction activities.

In its Resilience Plan, Virginia Beach identifies an adaptation approach for the Southern Rivers Watershed that emphasizes natural mitigation methods and integrated systems of defenses. As a natural mitigation strategy, the marsh terrace project aims to serve as a first line of defense during flood events, reducing wind-driven fetch, wave energy, and flow velocities to protect the important marsh buffer surrounding the shorelines of Back Bay. Other projects are also needed to provide multi-layered flood protection to northern Back Bay communities (Figure 32). Several

of these projects are highlighted below. It should be noted that the projects described below are either not yet funded or will be funded in the future through the City's Capital Improvement Program.

Figure 32: Southern Rivers Watershed Adaptation Vision.

Marsh island restoration serves as a critical first line of defense of the multi-layered protection system in the Southern Rivers Watershed. The following map (Figure 33) shows the structural adaptation projects proposed for the Southern Rivers Watershed, including the Muddy Creek Road and Sandbridge flood defense systems. The City's numerical modeling shows that, if implemented, there is potential for small increases in flooding outside of these structural protection systems.[14] This emphasizes the need for complimentary measures, including the marsh terrace project, land acquisition, and conservation efforts, to mitigate this residual risk.

[14] City of Virginia Beach (2020). City-wide Structural Alternatives for Coastal Flood Protection (PDF).

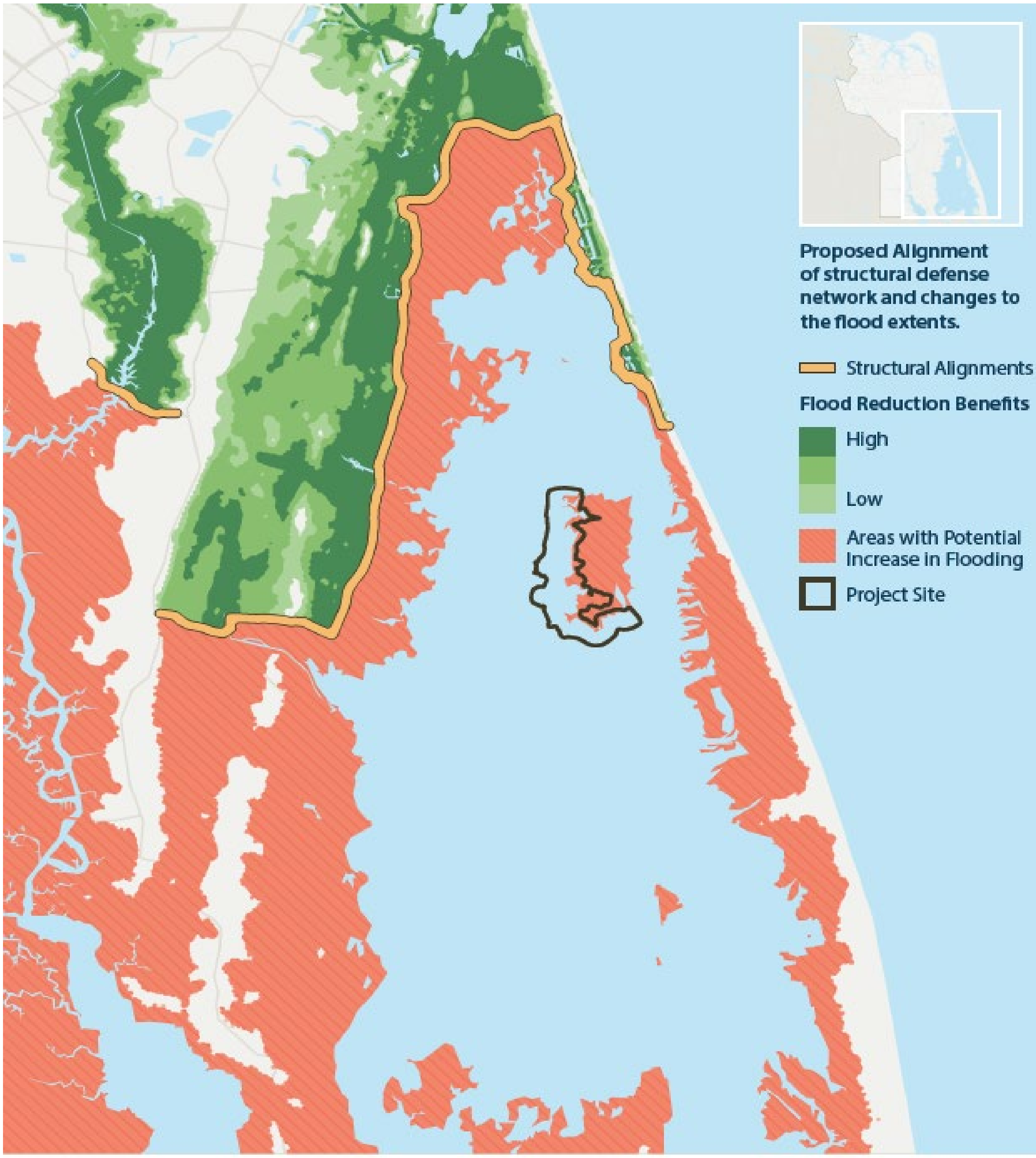

Figure 33: Structural adaptation projects proposed for the Southern Rivers Watershed, including the Muddy Creek Road and Sandridge flood defense systems.

Backside of Sandbridge Flood Defense System

Protection of the Sandbridge resort community from increasing coastal flood hazards would require a complex and expensive structural protection system because of the manufactured land configuration on the backside of Sandbridge. The proposed protection system includes elevating Sandbridge Road and constructing a network of seawalls, levees, and gates along the Back Bay shoreline of Sandbridge. This project does not have designated funding at this time.

Hell Point Creek Flood Defense System

As part of the integrated Sandbridge City-Wide flood defense network, a storm surge barrier across Hell Point Creek could block flood waters originating from Back Bay. Sandbridge Road would also need to be raised to ensure floodwaters could not flank the system. This project does not have designated funding at this time.

Sandbridge/New Bridge Intersection Improvements

Road and shoulder improvements are planned to increase safety at the New Bridge Road/Sandbridge Road intersection and reduce the need for road closures due to flooding from the adjacent Ashville Creek.

Muddy Creek Road Flood Defense System

Muddy Creek Road provides access to important rural and agricultural communities and Back Bay and the Wildlife Refuge. Muddy Creek Road is one of the lowest-lying roadways in all of Virginia Beach and frequently floods. This City-Wide Structural Alternative Flood Protection analysis identified this roadway as a critical location to provide flood protection. The proposed system, known as the Muddy Creek Road Alignment, would transform much of Muddy Creek Road into a levee, with the road on the top. The City's numerical modeling effort shows that the Muddy Creek Road Flood Defense System could potentially increase flood risk to the east of Muddy Creek Road, as shown in Figure 33. Therefore, the implementation of nature-based strategies suitable to the low-lying shorelines of Back Bay is essential to mitigate these impacts. This project does not have designated funding at this time.

Voluntary Acquisition Program

Virginia Beach City Council has recently funded a $2.0 million City-wide voluntary acquisition program to encourage flood-prone property owners to apply for a buyout. Parcels acquired by the City, in the Southern Rivers Watershed, would then be converted to open space to serve as flood storage and a marsh migration buffer.

Stormwater Master Plan

The City Council initiated an update of the City's Stormwater Master Plan in 2014. This effort is interchanging information with aspects of the City's Resilience Plan to account for the impact of sea level rise on the stormwater system's performance. Specific stormwater drainage improvement projects are included within the Lower Southern Rivers Watershed Drainage Basin.

Virginia Coastal Resilience Master Plan

The CRMP highlighted the marsh terrace project as an exemplary nature-based resilience project. The CRMP emphasizes Virginia Beach's strategic use of multiple funding streams to implement a large-scale nature-based project. DCR’s contribution to the project’s construction could be highlighted as a success story for implementation of the CRMP.

Audubon North Carolina Currituck Sound Coalition Marsh Conservation Plan

In coordination with Audubon North Carolina, the Currituck Sounds Coalition identified marsh restoration priorities based on criteria for siting restoration projects, including vulnerability to sea level rise, historic increase in surface water, and distance to hardened shorelines. This assessment identified Virginia Beach's marsh terrace project site as a high-priority area for restoration. There is an opportunity to highlight this project as a success story in the next iteration of the Audubon's Marsh Conservation Plan, which is slated to be updated every three years.

Maintenance Plan

Standard maintenance measures have been defined as part of the draft Annual Monitoring Plan and Post-Construction Monitoring Report developed for this project. See Attachment 5 for a copy of the draft report.

Subsequent to the monitoring period, project maintenance will be addressed by the City's Public Works Stormwater Operations Group, who will also respond to any maintenance issues identified by the monitoring effort or other observers. The City intends to maintain the construction staging area to support future project maintenance needs. The City will perform inspections every 2-5 years and make any repairs needed for the life of the project after completion of the initial monitoring program.

As described by the draft Annual Monitoring Plan and Post-Construction Monitoring Report, maintenance measures include the replacement of plantings (including upland, marsh and SAV plantings), the removal of debris from the terraces, the removal of invasive vegetation identified in the planting areas, the addition of sediment to eroding areas of the terraces, and the replacement of waterfowl barriers as necessary. In addition, structural maintenance measures that might be identified and prescribed during monitoring efforts include replacement of dislodged stones, addition of stone to address structure settlement, and general repair of sand cores or other structural elements. As proposed, these measures would become conditions of the wetland permits required for this project, in addition to standard commitments and requirements defined by the permitting agencies.

In addition to the commitments made in the monitoring plan, and those anticipated to be defined during the permitting process, it is the assumption that the placement of the proposed marsh terrace structures in state waters (subaqueous bottoms) will require the City to maintain the marsh terraces in perpetuity. As previously defined through coordination with VMRC, the City would obtain a compensable interest in the property that has been filled on top of state-owned subaqueous bottomlands (i.e. the terraces). As such, the City would be responsible for maintaining the proposed marsh terraces structures to ensure they fulfill their intended functions, as defined in the objectives and indicators of success previously defined in this proposal.

Criteria

The project receives a total score of **65 Points**. An explanation of how the project meets each

of the applicable scoring criteria contained in Appendix D is provided below.

Eligible Project (Type)

Category/Points: Wetland/floodplain restoration, Living shorelines and vegetated buffers (25 Points)

Explanation: Marsh terraces are considered a type of wetland restoration or a component of a living shoreline project:

- Wetland Restoration: Wetland restoration aims to reestablish or enhance natural wetland ecosystems. Marsh terraces can be constructed in areas where wetlands have been degraded or lost, and they help to recreation or support wetland functions. They provide habitat for various species, improve water quality, and can contribute to the overall health and resilience of a wetland ecosystem.
- Living Shoreline Project: Living shorelines are designed to protect shorelines from erosion while also promoting ecological and environmental benefits. Marsh terraces are often used as a component of living shoreline projects. They can serve as a buffer against wave action, stabilize shorelines, and create suitable habitat for marsh and aquatic species.

Social Vulnerability Index Score

Category/Points: Low Social Vulnerability (0 Points)

Explanation: Based on the Virginia Flood Risk Information System (VFRIS) Social Vulnerability Index Layer, the Social Vulnerability Index scores of the communities located in the two census block groups adjacent to Back Bay near the project site are -1.07 and -0.43 (an average of -0.75), which falls into the Low Social Vulnerability category.

Community Scale Benefits

Category/Points: More than one census block group (30 Points)

Explanation: As documented in the *Supporting Documentation - Project Information – Population* section of this document, the project is anticipated to benefit two census block groups (518100454.121 and 518100464.001).

Expected Lifespan of Project

Category/Points: Over 20 Years (10 Points)

Explanation: As documented in the *Supporting Documentation – Approach, Milestones, and Deliverables – Activity 3 (Marsh Terrace Construction)* section, the marsh terraces have a 30-year design life.

Budget Narrative

The following budget narrative details the proposed project expenditures. See Appendix B for completed budget spreadsheet.

Estimated Total Project Cost

The current estimated total project cost is **$53,378,490.** This estimate includes design, site acquisition for the construction staging area, construction, inspections and support, implementation, and contingencies, as shown in the below table. The design engineer's opinion of probable cost for construction is provided

Project Activity	Capital Improvement Program Estimate
Design	$276,800
Site Acquisition	$50,000
Construction	$41,839,900
Inspections and Support	$5,609,200
Implementation	$750,000
Contingencies	$4,852,590
Total:	$53,378,490

Funds Requested from the Fund

The City is requesting a total of **$5,000,000.00** in funding from the CFPF Round 4. These funds will support contractual services of the engineering consultant and construction contractor to execute Activity 2 (Construction Staging Area Preparation and Construction) and Activity 3 (Marsh Terrace Construction). No support is requested for City personnel.

These funds will be used to support ongoing construction activities through 2024-2026. Example activities include contractor construction services, mobilization/demobilization, construction staging area construction, slurry pipe installation, portions of the terrace materials, and waterfowl barriers. Construction costs are based on a detailed estimate from the design engineer that includes detailed breakdown of estimated quantities and costs from the 95% design package using industry standards for the anticipated aspects of the project construction. The City has withheld the detailed estimate as it provides information that would affect bidding on the construction.

Amount of Funds Available

The City as prime recipient is providing a cash match of $38,356,966 from funds fully programmed and available from the City's Flood Protection Program Capital Improvement Program to support the project. The Flood Protection Program is supported by a related bond referendum that provided $567.5M to fund more than 40 projects identified for Phase 1 of the Program. The program is tightly managed by the City, an independent contractor, and has a resident oversight board. The City is fully confident these funds will be available for constructing this project.

The City's dedicated funds will provide cash match to cover contractual services to support Activity 1 (Construction Staging Area Preparation and Construction), Activity 2 (Marsh Terrace Construction), Activity 3 (Stakeholder Engagement and Dissemination), and all related City support and direct overhead costs related for the project.

The National Fish and Wildlife Foundation is also supporting the project through two grant awards from the National Coastal Resilience Fund. This includes an initial award of $135,124 in 2020 for design and a second award of $9,886,400 in 2022 to support construction. The 2022 grant funds are dedicated to purchasing the native vegetation and a portion of the materials needed to build the marsh terraces.

A summary of project costs, funds available, and funds requested is provided below:

Item	Amount
Project Cost:	$53,378,490.00
Funding Sources Available	
NFWF Grant:	$10,021,524.00
CFPF Grant Request:	$5,000,000
City Funds Available:	$38,356,96600
Total Project Funding:	**$53,378,490.00**

Authorization to Request for Funding

Please refer to *attachment* for the documentation authorizing the funding request.

Attachment 1: Virginia Beach Resilience Plan DCR Approval

Matthew J. Strickler
Secretary of Natural Resources

Clyde E. Cristman
Director

COMMONWEALTH of VIRGINIA
DEPARTMENT OF CONSERVATION AND RECREATION

Rochelle Altholz
Deputy Director of Administration and Finance

Russell W. Baxter
Deputy Director of Dam Safety & Floodplain Management and Soil & Water Conservation

Nathan Burrell
Deputy Director of Government and Community Relations

Thomas L. Smith
Deputy Director of Operations

July 20, 2021

Toni Utterback, P.E.
Department of Public Works
2875 Sabre Street, Suite 250
Virginia Beach, VA 23452

RE: Virginia Beach Resilience Plan Second Submission - CFPF

Dear Ms. Utterback:

Thank you for the resubmission of the Sea Level Wise Adaptation Plan for City of Virginia Beach. After careful review and consideration, the Virginia Department of Conservation and Recreation has deemed the Plan complete and meets all the criteria outlined in the June 2021 Community Flood Preparedness Grant Manual. This approval will remain in effect for a period of three years, ending on July 31, 2024.

The following elements were evaluated as part of this review:

1. **Element 1: It is project-based with projects focused on flood control and resilience. DCR RESPONSE**

    a. Project-based: Four watersheds—each with a defined geographic area, analysis of community social and environmental characteristics, types of flooding, and a tailored flood resilience strategy with <u>discrete projects identified</u>.

Projects focused on flood control and resilience include:

Neighborhood	Flood Control Project
Elizabeth River	City-wide alignment, living shoreline, marsh restoration, land conservation
Lynnhaven	Chesapeake Bay alignment, Lesner Bridge Neighborhood alignment (East & West), beach & dune nourishment, ecological revetments, shellfish reef restoration, seagrass restoration
Oceanfront	Atlantic Oceanfront alignment, Rudee Heights alignment
Southern Rivers	West Neck Creek city-wide alignment, Muddy Creek Road city-wide alignment, Sandbridge city-wide alignment

**additional projects listed within the Sea Level Wise Adaptation Strategy.*

2. **Element 2: It incorporates nature-based infrastructure to the maximum extent possible. DCR RESPONSE**

   a. Nature-based infrastructure: Flood mitigation projects throughout the city incorporate nature-based solutions and were identified for maximum use within specific watersheds.

3. **Element 3: It includes considerations of all parts of a locality regardless of socioeconomics or race. DCR RESPONSE**
   a. All parts of a locality: Locality divided into four watersheds, covering the entirety of the jurisdictional boundary.
   b. Social vulnerability: Social implications of flood hazards and analysis of populations at-risk documented.
   c. Demographic Analysis: Demographic and Population Vulnerability Analysis conducted by Dewberry and incorporated into the Plan.

4. **Element 4: It includes coordination with other local and inter-jurisdictional projects, plans, and activities and has a clearly articulated timeline or phasing for plan implementation. DCR RESPONSE**
   a. Coordination with other projects, plans, and activities: Contains the planning processes and frameworks which outline local and regional plans used by the City and address resilience; and how they have been integrated for flood adaptation planning.
   b. Clearly articulated timeline or phasing for plan implementation: Program phases clearly articulated and described in detail—Impact assessment, Adaptation research, Strategy development, and Long-term implementation.

5. **Element 5: Is based on the best available science, and incorporates climate change, sea level rise, storm surge (where appropriate), and current flood maps.**
   a. Technically backed water-resources analysis, sea level rise projections, storm surge, and climate change incorporated into strategic approach.

VA DCR looks forward to working with you as you work to make Virginia Beach a more resilient community. If you have questions or need additional assistance, please contact us at cfpf@dcr.virginia.gov. Again, thank you for your interest in the Community Flood Preparedness Fund.

Sincerely,

Wendy Howard Cooper, Director
Dam Safety and Floodplain Management

cc: Darryl Glover, DCR

Attachment 2: Authorization to request funding from the Fund from governing body or chief executive of the local government

City of Virginia Beach

DEPARTMENT OF BUDGET AND MANAGEMENT SERVICES
(757) 385-8234
(757) 385-1857 FAX

VBgov.com
MUNICIPAL CENTER
BUILDING 1, 3RD FLOOR
2401 COURTHOUSE DRIVE
VIRGINIA BEACH, VA 23456-9001

INTER-OFFICE MEMORANDUM

DATE: November 1, 2023

TO: Patrick A. Duhaney, City Manager

FROM: Stuart McCrery, Budget and Policy Analyst KJ for SM

SUBJECT: Application for Virginia Community Flood Preparedness Fund Grant

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The Department of Public Works is requesting permission to apply for the Virginia Community Flood Preparedness Fund Grant from the Virginia Department of Conservation and Recreation. The Virginia Community Flood Preparedness Fund was established in the 2020 session of the General Assembly. Money in this fund comes from the auction of carbon allowances through the Regional Greenhouse Gas Initiative. It was established to provide support to localities across Virginia to reduce the impacts of flooding, including flooding driven by climate change.

Public Works is requesting a total of $5,000,000 to construct marsh terraces in Back Bay to promote wetland restoration and mitigate frequent flooding. The City has already made significant investments into this project through CIP project 100551 "Stormwater Green Infrastructure."

This grant also requires a local match of 30% for projects that implement nature-based solutions; however, the City has more than met this requirement through its current appropriations to CIP project 1000551 "Stormwater Green Infrastructure" which currently total over $49 million from the Referendum and other grant awards.

Budget & Management Services recommends this grant application for approval. Please indicate approval or disapproval below. Applications are due by November 12, 2023.

11/1/2023

Approve (Date) Disapprove (Date)

Attachment 3: Virginia Beach Floodplain Administrator Support Letter

City of Virginia Beach

VBgov.com

DEPARTMENT OF PLANNING & COMMUNITY DEVELOPMENT
PHONE (757) 385-4621
FAX (757) 385-5667
VA Relay Number TTY: 711

2875 SABRE STREET, SUITE 500
VIRGINIA BEACH, VA 23452-7385

November 7, 2023

Division of Dam Safety and Floodplain Management
600 East Main Street, 24th Floor
Richmond, Virginia 23219

RE: Community Flood Preparedness Fund – Marsh Terrace Creation, Back Bay

The proposed project is located in both open water and a Federal Emergency Management Agency (FEMA) mapped Special Flood Hazard Area (SFHA). Hydraulic modeling analysis identified Bonney Cove as a location where marsh restoration has the potential to reduce the propagation of floodwater through key pathways within Back Bay. This project aims to stabilize two critically eroding marsh islands that serve as a key flood pathway into northern Back Bay, promote the growth of aquatic vegetation, and provide flood risk reduction benefits to communities in the surrounding area. Within the two census block groups that would benefit from this project, there are 113 repetitive loss and severe repetitive loss properties.

If I can provide any further information or assistance, please call me at 757-385-4621, or e-mail me at wmcnamar@vbgov.com.

Sincerely,

Whitney McNamara

Whitney McNamara, CFM
Floodplain Administrator and CRS Coordinator

Attachment 4: Letters of Support

Back Bay Restoration Foundation

PO Box 57041 • Virginia Beach, Virginia • 23457• 757-818-4829

November 6, 2023

Department of Conservation and Recreation
Dam Safety and Floodplain Management
600 E. Main St., 24th Floor
Richmond, VA 23219

Re: Virginia Community Flood Preparedness Fund Grant

Grantors:

The Back Bay Restoration Foundation (BBRF), is a 35 year-old non-profit watershed organization, founded in 1986 by a group of local citizens concerned about deterioration of the Back Bay watershed visible then through decreases in Submerged Aquatic Vegetation (SAV), fish, and waterfowl. BBRF is the only voice solely dedicated to conserving and improving Virginia Beach's two Southern Watersheds; namely, the Back Bay and North Landing River watersheds. Our efforts focus on education, stewardship and outreach to conserve the largest watersheds in Virginia Beach. We team with other non-profits, and city, state and federal agencies to work toward best solutions for the future of the Back Bay and North Landing River watersheds. BBRF strives to raise awareness, addressing issues that negatively affect these watersheds such as sea level rise, land subsidence and land use changes.

Back Bay is a historical, nationally significant, watershed. With the Back Bay National Wildlife Refuge (NWR) and significant State conservation lands at its core, the watershed was recognized as an Aquatic Resource of National Importance (ARNI) in 2008 by both the US Fish and Wildlife Service and the US Army Corps of Engineers. Back Bay is a wind-tidal oligohaline estuary and is located at the northern tip of the Albemarle/Pamlico estuarine system, the second largest estuarine complex in the United States. The Albemarle/Pamlico estuarine system was designated as an Estuary of National Significance in 1987 and selected to be studied as part of the Environmental Protection Agency's National Estuary Program. Back Bay is a shallow-water aquatic ecosystem with an average depth of four feet. Winds can influence the water depth by as much as three feet.

BBRF supports the City of Virginia Beach's application for Round 4 of VADCR's Community Flood Preparedness Fund. We were strong advocates of the City's successful applications to the National Fish and Wildlife Foundation (NFWF), and have seen what they accomplished with the initial NFWF funding they received. With the combined funding of NFWF, the City of Virginia Beach, and this application for DCR funding, their project of creating a Marsh Terrace Network to Achieve Restoration and Flood Resilience has overachieved by any measure. From community engagement and the NEPA process to conceptual and preliminary designs as described in the recent Army Corps Public Notice, the City has been productive and completely transparent.

As noted above, the City's community engagement and partnerships with organizations like ours has been transparent and resulted in broad support. Although the current project is localized in its first application, we expect the results will significantly mitigate SLR, land subsidence and wind tides in Back Bay. Similarly, this restoration will provide the biotic building blocks to maintain the watershed's national importance for wildlife. The innovative designs proposed will inform future projects at the landscape level. Although innovative, we believe the project is technically sound based on BBRF's 35 years of experience in habitat restoration.

Please feel free to contact us for further information.

Jared Brandwein

Executive Director
Back Bay Restoration Foundation

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Back Bay National Wildlife Refuge
1324 Sandpiper Road
Virginia Beach, VA 23456

October 30, 2023

Wendy Howard Cooper
Division of Dam Safety and Floodplain Management
600 East Main Street, 24th Floor
Richmond, Virginia 23219

Dear Ms. Cooper,

The City of Virginia Beach is proposing to install marsh terraces in the waters of Back Bay adjacent to Back Bay National Wildlife Refuge. This project is expected to reduce wave energy and thus decrease the speed of erosion of remaining islands in the project area, many of which are managed by the U.S. Fish and Wildlife Service and provide habitat for migratory birds and other species. Additionally, the addition of multiple vegetative structures added to the bay will supplement habitat and provide nesting grounds for multiple species.

The mission of the U.S. Fish and Wildlife Service is *working with others to conserve, protect, and enhance fish, wildlife, plants, and their habitats for the continuing benefit of the American people*. Although much work is conducted on federal property to achieve this mission, the Service equally coordinates with external partners to further mutual goals. The proposed marsh terrace project is an excellent example of local and federal government coordination, and we support the City of Virginia Beach's proposed project.

Megan Reed
Refuge Manager

October 26, 2023

Wendy Howard Cooper
Virginia Dept. of Conservation and Recreation
Division of Dam Safety and Floodplain Management
600 E. Main St., 24th Floor
Richmond, VA 23219

Dear Wendy,

The Albemarle-Pamlico National Estuary Partnership (APNEP) strongly endorses the City of Virginia Beach and partners' application to Round 4 of The Virginia Community Flood Preparedness Fund (CFPF). The proposal is to support construction of the Back Bay Marsh Terrace Restoration Project.

APNEP relies on regional partnerships and collaboration to implement our 2012-2022 Comprehensive Conservation & Management Plan (CCMP) within the waterways of our congressionally designated "estuary of national significance." The proposed partnership between the City of Virginia Beach and the U.S. Fish and Wildlife Service will also advance our 2020 Memorandum of Understanding between Virginia and North Carolina to protect the ecosystem resources in the shared waterways between our two states. The project also addresses a "high priority" area for restoring and enhancing vulnerable marshes with high flood risk reduction benefits and habitat value, as identified by Audubon's Currituck Sound Coalition Marsh Conservation Plan released in 2021.

The marsh terrace project employs the use of natural features to build resilience to flooding in the Back Bay watershed. The project offers coastal resilience and habitat protection and conservation co-benefits including preserving marsh islands, restoring Submerged Aquatic Vegetation, migratory bird and fish habitat, reducing flow that could exacerbate wind tide flooding in local communities, and filling a gap in prior applied research on predominantly fresh water coastal lagoons. These features support the following CCMP actions:

- A2.3: Support research on adapting to impacts associated with climate change and sea level rise.
- C3.2: Develop and implement a coordinated wetland restoration strategy.
- C3.3: Develop and implement a submerged aquatic vegetation (SAV) restoration strategy.
- D3.3: Provide assistance to state, regional, and local governments to incorporate climate change and sea level rise considerations into their planning processes.

In closing, we strongly support the full funding of the City of Virginia Beach's proposal to Round 4 of The Virginia Community Flood Preparedness Fund (CFPF). Please contact Steve Anderson, Partnership Coordinator, at (919) 707-8743 with questions.

Sincerely,

W. Crowell

William L. Crowell, Jr., Ph.D., AICP, CEE
Director

Attachment 5: Copy of the Current Floodplain Ordinance

ORD-3685

AN ORDINANCE TO AMEND SECTIONS 1.1, 1.2, 1.3, 1.8, 2.1, 2.2, 2.3, 2.4, 2.8, 2.11, 3.1, 4.1, 4.2, 4.3, 4.4, 4.6, 4.8, 4.9, 4.10, 5.1, 6.1, AND 6.3 OF APPENDIX K, FLOODPLAIN ORDINANCE OF THE CITY CODE PERTAINING TO HOUSEKEEPING THE DELETION OF PUBLIC WORKS REQUIREMENTS AND THE ADDITION OF A COASTAL A ZONE AND A COASTAL HIGH HAZARD ZONE

Sections Amended: 1.1, 1.2, 1.3, 1.8, 2.1, 2.2, 2.3, 2.4, 2.8, 2.11, 3.1, 4.1, 4.2, 4.3, 4.4, 4.6, 4.8, 4.9, 4.10, 5.1, 6.1, and 6.3 of Appendix K, Floodplain Ordinance

WHEREAS, the public necessity, convenience, general welfare and good zoning practice so require;

BE IT ORDAINED BY THE CITY COUNCIL OF THE CITY OF VIRGINIA BEACH, VIRGINIA:

That Sections 1.1, 1.2, 1.3, 1.8, 2.1, 2.2, 2.3, 2.4, 2.8, 2.11, 3.1, 4.1, 4.2, 4.3, 4.4, 4.6, 4.8, 4.9, 4.10, 5.1, 6.1, and 6.3 of Appendix K, Floodplain Ordinance is hereby amended and reordained to read as follows:

APPENDIX K FLOODPLAIN ORDINANCE

ARTICLE I. GENERAL PROVISIONS

Sec. 1.1. Statutory authorization and purpose.

A. This ordinance is adopted pursuant to the authority granted to localities by Code of Virginia § ~~10.1-600 et seq~~ 15.2-984.

B. The city council finds the purpose of these provisions is to prevent the loss of life and property, the creation of health and safety hazards, the disruption of commerce and governmental services, the extraordinary and unnecessary expenditure of public funds for flood protection and relief, and the impairment of the tax base by:

1. Regulating uses, activities, and development that, alone or in combination with other existing or future uses, activities, and development, will cause unacceptable increases in flood heights, velocities, and frequencies;

2. Restricting or prohibiting certain uses, activities, and development from locating within districts subject to flooding;
3. Requiring all uses, activities, and developments that do occur in flood-prone districts be protected or flood-proofed against flooding and flood damage;

4. Protecting individuals from buying land and structures that are unsuited for intended purposes because of flood hazards; and

5. Acknowledging that the tide data over the last one hundred (100) years shows that Virginia Beach is facing an increased danger of flooding caused by both sea level rise and subsidence and has adopted the Sea Level Wise Adaptation Report as part of the Comprehensive Plan.

Sec. 1.2. Applicability.

These provisions shall apply to all privately and publicly owned lands within the jurisdiction of the City of Virginia Beach and identified as areas ~~of special flood hazard~~ at risk of flooding by the City of Virginia Beach or shown ~~according to~~ on the Flood Insurance Rate Map (FIRM) or included on the flood insurance study (FIS) that ~~is~~ are provided to the City of Virginia Beach by the Federal Emergency Management Agency (FEMA) and dated January 16, 2015 ~~or identified as floodplains subject to special restrictions in section 4.10 of this ordinance~~.

Sec. 1.3. Definitions.

. . . .

City manager. The City Manager of the City of Virginia Beach, or his designees.

Design Flood Elevation (regulatory flood protection elevation). The base flood elevation plus the freeboard required by this ordinance.

. . . .

Recreational vehicle. A vehicle that is:

1. Built on a single chassis;
2. Four hundred (400) square feet or less when measured at the largest horizontal projection;
3. Designed to be self-propelled or permanently towable by a light duty truck; and
4. Designed primarily not for use as a permanent dwelling but as temporary living quarters for recreational camping, travel, or seasonal use.

~~*Regulatory flood protection elevation (design flood elevation)*. The base flood elevation plus the freeboard required by this ordinance.~~

. . . .

Sec. 1.8. Penalty for violations.

Any person who fails to comply with any of the requirements or provisions of this ordinance or directions of the ~~d~~Directors of ~~p~~Planning ~~or public works~~ or any authorized employee of the City of Virginia Beach shall be guilty of the appropriate violation and subject to the penalties therefore. Any violation of the provision of this ordinance shall be punishable by a fine of not more than one hundred dollars ($100.00). Each person shall be deemed guilty of a separate offense for each and every day or portion thereof during which any violation of any of the provisions of this ordinance is committed.

The Virginia Uniform Statewide Building Code (VA USBC) addresses building code violations and the associated penalties in ~~section 104 and section 115~~ VA USBC § 104 and § 115. Violations and associated penalties of the Zoning Ordinance for the City of Virginia Beach are addressed in § 104 of the Zoning Ordinance.

In addition to the above penalties, all other actions are hereby reserved, including an action in equity for the proper enforcement of this ordinance. The imposition of a fine or penalty for any violation of, or noncompliance with, this ordinance shall not excuse the violation or noncompliance or permit it to continue, and all such persons shall be required to correct or remedy such violations within a reasonable time. Any structure constructed, reconstructed, enlarged, altered, or relocated in noncompliance with this ordinance may be declared by the City of Virginia Beach to be a public nuisance and abatable as such. Flood insurance may be withheld from structures constructed in violation of this ordinance.

ARTICLE II. ADMINISTRATION

Sec. 2.1. Designation of the floodplain administrator.

The City Manager of the City of Virginia Beach is hereby appointed the floodplain administrator to administer and implement this ordinance. The floodplain administrator has delegated the duties and responsibilities set forth in this ordinance to the ~~departments of public works and planning, as specified below~~ Department of Planning and Community Development.

Sec. 2.2. Duties and responsibilities of the ~~department of public works~~ floodplain administrator or his designee.

The duties and responsibilities of the ~~department of public works~~ floodplain administrator of his designee shall include but are not limited to:

A. Interpreting floodplain boundaries and providing available base flood elevation and flood hazard information;

B. Verifying that applicants proposing an alteration of a watercourse have notified adjacent communities, the department of conservation and recreation (division of dam safety and floodplain management), and other appropriate agencies (Virginia Department of Environmental Quality (VADEQ), United States Army Corps of Engineers (USACE), etc.) and have submitted copies of such notifications to FEMA;

C. Advising applicants for new construction or substantial improvement of structures that are located within an area of the coastal barrier resources system established by the Coastal Barrier Resources Act that Federal flood insurance is not available on such structures; areas subject to this limitation are shown on FIRMs as coastal barrier resource system areas or otherwise protected areas;

D. Submitting to FEMA, or requiring applicants to submit to FEMA, data and information necessary to maintain FIRMs, including hydrologic and hydraulic engineering analyses prepared by or for the city, within six (6) months after such data and information becomes available if the analyses indicate changes in base flood elevations;

E. Maintaining and permanently keeping records that are necessary for the administration of these regulations, including:

1. ~~flood~~ Flood insurance studies, FIRMs (including historic studies and maps and current effective studies and maps) and letters of map change; and

2. Documentation supporting issuance and denial of permits, Elevation Certificates, documentation of the elevation (in relation to the datum on the FIRM) to which structures have been floodproofed, inspection records, other required design certifications, variances, and records of enforcement actions taken to correct violations of these regulations.

F. Notifying FEMA when the corporate boundaries of the City of Virginia Beach have been modified and:

1. Providing a map that clearly delineates the new corporate boundaries or the new area for which the authority to regulate pursuant to this ordinance has either been assumed or relinquished through annexation; and

2. If the FIRM for any annexed area includes SFHAs that have flood zones with regulatory requirements that are not set forth in this

ordinance, prepare amendments to this ordinance to adopt the FIRM and appropriate requirements, and submit the amendments to the city council for adoption; such adoption shall take place at the same time as or prior to the date of annexation and a copy of the amended ordinance shall be provided to the department of conservation and recreation (division of dam safety and floodplain management) and FEMA.

G. Upon the request of FEMA, completing and submitting a report concerning participation in the NFIP, which may request information regarding the number of buildings in the SFHA, the number of permits issued for development in the SFHA, and the number of variances issued for development in the SFHA.

H. Reviewing applications for permits to determine whether proposed activities will be located in the SFHA;

I. Reviewing applications to determine whether proposed activities will be reasonably safe from flooding and requiring new construction and substantial improvements to meet the requirements of this ordinance;

J. Reviewing applications to determine whether all necessary permits have been obtained from the federal, state, or local agencies from which prior or concurrent approval is required; in particular, permits from state agencies for any construction, reconstruction, repair, or alteration of a dam, reservoir, or waterway obstruction (including bridges, culverts, structures), any alteration of a watercourse, or any change of the course, current, or cross section of a stream or body of water, including any change to the SFHAs of free-flowing non-tidal waters of the state;

K. Approving applications and issuing permits to develop in flood hazard areas if the provisions of this ordinance have been met, or disapproving applications if the provisions of this ordinance have not been met;

L. Granting administrative variances pursuant to section 6.1 of this ordinance;

M. Inspecting, or causing to be inspected, buildings, structures, and other development for which permits have been issued to determine compliance with this ordinance or to determine if non-compliance has occurred or violations have been committed;

N. Reviewing elevation certificates and requiring incomplete or deficient certificates to be corrected;

O. Maintaining and permanently keeping documentation supporting the issuance and denial of permits, elevation certificates, documentation of the elevation (in relation to the datum on the FIRM) to which structures have been flood proofed, and other required design certifications, variances, and records of enforcement actions taken to correct violations of this ordinance;

P. Enforcing the provisions of this ordinance, investigating violations, issuing notices of violations or stop work orders, and requiring permit holders to take corrective action;

Q. Advising the city council regarding the intent of this ordinance and, for each application for a variance, preparing a staff report and recommendation; and

R. Administering the requirements related to proposed work on existing buildings:

1. Making determinations as to whether buildings and structures that are located in flood hazard areas and that are damaged by any cause have been substantially damaged; and

2. Making reasonable efforts to notify owners of substantially damaged structures of the need to obtain a permit to repair, rehabilitate, or reconstruct, and prohibit the non-compliant repair of substantially damaged buildings except for temporary emergency protective measures necessary to secure a property or stabilize a building or structure to prevent additional damage.

S. Undertaking, as determined appropriate by the floodplain administrator due to the circumstances, other actions that may include but are not limited to: issuing press releases, public service announcements, and other public information materials related to permit requests and repair of damaged structures; coordinating with other federal, state, and local agencies to assist with substantial damage determinations; providing owners of damaged structures information related to the proper repair of damaged structures in SFHAs; and assisting property owners with documentation necessary to file claims for increased cost of compliance coverage under National Flood Insurance Program (NFIP) flood insurance policies; and

T. It is the duty of the city floodplain administrator to take into account flood, mudslide, and flood-related erosion hazards, to the extent that they are known, in all official actions relating to land management and use throughout the entire jurisdictional area of the city, whether or not those

hazards have been specifically delineated geographically (e.g., via mapping or surveying).

~~Sec. 2.3. Duties and responsibilities of the department of planning.~~ Reserved.

~~The duties and responsibilities of the department of planning shall include but are not limited to:~~

~~A. Reviewing applications for permits to determine whether proposed activities will be located in the SFHA;~~

~~B. Reviewing applications to determine whether proposed activities will be reasonably safe from flooding and requiring new construction and substantial improvements to meet the requirements of this ordinance;~~

~~C. Reviewing applications to determine whether all necessary permits have been obtained from the federal, state, or local agencies from which prior or concurrent approval is required; in particular, permits from state agencies for any construction, reconstruction, repair, or alteration of a dam, reservoir, or waterway obstruction (including bridges, culverts, structures), any alteration of a watercourse, or any change of the course, current, or cross section of a stream or body of water, including any change to the SFHAs of free-flowing non-tidal waters of the state;~~

~~D. Approving applications and issuing permits to develop in flood hazard areas if the provisions of this ordinance have been met, or disapproving applications if the provisions of this ordinance have not been met;~~

~~E. Granting administrative variances pursuant to section 6.1 of this ordinance;~~

~~F. Inspecting, or causing to be inspected, buildings, structures, and other development for which permits have been issued to determine compliance with this ordinance or to determine if non-compliance has occurred or violations have been committed;~~

~~G. Reviewing elevation certificates and requiring incomplete or deficient certificates to be corrected;~~

~~H. Maintaining and permanently keeping documentation supporting the issuance and denial of permits, elevation certificates, documentation of the elevation (in relation to the datum on the FIRM) to which structures have been flood proofed, and other required design certifications, variances, and records of enforcement actions taken to correct violations of this ordinance;~~

~~I. Enforcing the provisions of this ordinance, investigating violations, issuing notices of violations or stop work orders, and requiring permit holders to take corrective action;~~

~~J. Advising the city council regarding the intent of this ordinance and, for each application for a variance, preparing a staff report and recommendation; and~~

~~K. Administering the requirements related to proposed work on existing buildings:~~

~~1. Making determinations as to whether buildings and structures that are located in flood hazard areas and that are damaged by any cause have been substantially damaged; and~~
~~2. Making reasonable efforts to notify owners of substantially damaged structures of the need to obtain a permit to repair, rehabilitate, or reconstruct, and prohibit the non-compliant repair of substantially damaged buildings except for temporary emergency protective measures necessary to secure a property or stabilize a building or structure to prevent additional damage.~~

~~Sec. 2.4. Shared duties and responsibilities.~~ <u>Reserved.</u>

~~The duties and responsibilities shared by the departments of public works and Planning shall include but are not limited to:~~

~~A. Undertaking, as determined appropriate by the floodplain administrator due to the circumstances, other actions that may include but are not limited to: issuing press releases, public service announcements, and other public information materials related to permit requests and repair of damaged structures; coordinating with other federal, state, and local agencies to assist with substantial damage determinations; providing owners of damaged structures information related to the proper repair of damaged structures in SFHAs; and assisting property owners with documentation necessary to file claims for increased cost of compliance coverage under National Flood Insurance Program (NFIP) flood insurance policies; and~~

~~B. It is the duty of the city floodplain administrator to take into account flood, mudslide, and flood-related erosion hazards, to the extent that they are known, in all official actions relating to land management and use throughout the entire jurisdictional area of the city, whether or not those hazards have been specifically delineated geographically (e.g., via mapping or surveying).~~

. . . .

Sec. 2.8. Interpretation of district boundaries.

Initial interpretations of the boundaries of the floodplain districts shall be made by the floodplain administrator. Should a dispute arise concerning the boundaries of any of the districts~~, the city council shall make the necessary determination. The person questioning or contesting the location of the district boundary shall be given a reasonable opportunity to present his case to the city council and to submit his own technical evidence if he so desires~~ a surveyor shall provide either an elevation certificate or recent survey showing topographic elevations and delineating the Special Flood Hazard Area.

. . . .

Sec. 2.11. Appeals to decisions made by the floodplain administrator.

It is further provided that any decision of the floodplain administrator or his designee may be modified, reversed, or affirmed by the city council upon appeal by any aggrieved party to such decision, if such appeal is filed with the floodplain administrator within thirty (30) days of such decision through the application for a Floodplain Variance outlined in Section VI of this ordinance.

ARTICLE III. ESTABLISHMENT OF FLOODPLAIN DISTRICTS

Sec. 3.1. Description of floodplain districts.

A. Special flood hazard areas (SFHA). The SFHAs shall include land in the floodplain subject to a one (1) percent or greater chance of being flooded in any given year. The basis for the delineation of these districts shall be the FIS and the FIRM for the City of Virginia Beach prepared by FEMA, Federal Insurance Administration, dated January 16, 2015, and any subsequent revisions or amendments thereto.

The boundaries of the SFHAs are established as shown on the FIRM, which is declared to be a part of this ordinance and shall be kept on file at the City of Virginia Beach Department of ~~Public Works~~ Planning and Community Development, and include the following districts:

1. The Floodway District is in an AE Zone and is delineated, for the purposes of this ordinance, using the criterion that certain areas within the floodplain must be capable of carrying the waters of the one (1) percent annual chance flood without increasing the water surface elevation of that flood more than one (1) foot at any point. The areas included in this district are specifically defined in Table 7 of the above-referenced FIS and shown on the accompanying FIRM.

2. The AE or AH Zones on the FIRM accompanying the FIS shall be those areas for which one (1) percent annual chance flood elevations have been provided and the floodway has not been delineated.

3. The A Zone on the FIRM accompanying the FIS shall be those areas for which no detailed flood profiles or elevations are provided, but the one (1) percent annual chance floodplain boundary has been approximated.

4. The AO Zone on the FIRM accompanying the FIS shall be those areas of shallow flooding identified as AO on the FIRM.

5. ~~Reserved.~~ The Coastal A Zone on the FIRM accompanying the FIS shall be those areas labeled as AE and are located seaward of the limit of moderate wave action (LiMWA) line.

6. The VE or V Zones on FIRMs accompanying the FIS shall be those areas that are known as coastal high hazard areas, extending from offshore to the inland limit of a primary frontal dune along an open coast and any other area subject to high velocity wave action from storm or seismic sources.

B. ~~Floodplain subject to special restrictions~~ *Local Flood Hazard Areas*. The City of Virginia Beach may identify and regulate local flood hazard or ponding areas that are not delineated on the FIRM. These areas are ~~identified in section 4.10 and may be delineated on a map using best available topographic data and locally derived information such as flood of record, historic high water marks, or approximate study methodologies~~ identified as follows:~~.~~

a. *Other areas of flood risk*. The X and the X(Shaded) Zone on the FIRM where the City of Virginia Beach Stormwater Master Plan has identified areas, outside SFHAs delineated on the FIRM, that area susceptible to flooding. The most recent updated version of the modeling shall be used to identify areas that are likely to experience flooding.

b. *Floodplain Subject to Special Restrictions*. The Floodplain Subject to Special Restrictions is identified in section 4.10 and includes areas in the southern part of the city which are characterized by wind tides, low topography, and poorly draining soils.

ARTICLE IV. FLOODPLAIN DISTRICT PROVISIONS

Sec. 4.1. Permit and application requirements.

. . . .

B. Site plans and permit applications. All applications for development within any floodplain district and all building permits issued within ~~the~~ any floodplain district shall incorporate the following information:

1. For any addition, conversion of any non-habitable space to habitable space, or the construction or installation of a new accessory structure that requires a building permit.

   a. A physical survey, performed after the effective date of the FIRM that:

      i. accurately depicts current improvements on the property;
      ii. provides a flood zone determination and BFE or flood depth at the stie; and
      iii. delineates the location of the flood zones on the property.

   b. For structures located in the SFHA delineated on the FIRM, a current elevation certificate sealed by a licensed design professional.

2. For new construction and any substantial improvement of the principal structure:

   a. a proposed site plan sealed by a registered design professional that provides:

      ~~1~~i. The elevation of the base flood at the site;

      ~~2~~ii. The elevation of the lowest floor (including basement) or, in V Zones, the lowest horizontal structural member;

      ~~3~~iii. For structures to be flood-proofed (non-residential only), the elevation to which the structure will be flood-proofed; and

      4iv. Topographic information showing existing and proposed ground elevations.

Sec. 4.2. General standards.

. . . .

5. Electrical, heating, ventilation, plumbing, air conditioning equipment, and other service facilities, including duct work, shall be designed and/or ~~located so as to prevent water from entering or accumulating within the components during conditions of flooding~~ or above the design flood elevation.

6. New and replacement water supply systems shall be designed to minimize or eliminate infiltration of flood waters into the system.

7. New and replacement sanitary sewage systems shall be designed to minimize or eliminate infiltration of flood waters into the systems and discharges from the systems into flood waters.

8. On-site waste disposal systems shall be located and constructed to avoid impairment to them or contamination from them during flooding.

9. No use shall be permitted if such use will increase the amounts of potentially damaging materials, including those likely to be injurious to health, that might be transported in floods.

10. For properties located in SFHAs delineated on the FIRM, an elevation certificate and, if applicable, a flood-proofing certificate shall be provided to the Floodplain Administrator prior to any foundation inspection, final inspections, and the issuance of any certificates of occupancy, in order to assure compliance with these floodplain regulations.

11. Prior to any proposed alteration or relocation of any channels or of any watercourse or stream within the city, a permit shall be obtained from the USACE, VADEQ, the Virginia Marine Resources Commission, and the Wetlands Board through the joint permit application process. Furthermore, notification of the proposal shall be given by the applicant to all affected adjacent jurisdictions, the department of conservation and recreation (division of dam safety and floodplain management), other required agencies, and FEMA.

12. The flood carrying capacity within an altered or relocated portion of any watercourse shall be maintained.

~~B. In all SFHAs, the following additional provisions shall apply:~~

~~1. Prior to any proposed alteration or relocation of any channels or of any watercourse or stream, within the city a permit shall be obtained from the USACE, VADEQ, the Virginia Marine Resources Commission, and the Wetlands Board through the joint permit application process. Furthermore, notification of the proposal shall be given by the applicant to all affected adjacent jurisdictions, the department of conservation and recreation (division of dam safety and floodplain management), other required agencies, and FEMA.~~

~~2. The flood carrying capacity within an altered or relocated portion of any watercourse shall be maintained.~~

~~3. Sand dunes, barrier beaches, and other natural protective barriers shall remain intact to provide protection against wind, waves, and erosion drainage. Any person who desires to use or alter any coastal primary sand dune, other than for the purpose of conducting the activities specified in section 1602 of the Zoning Ordinance of the City of Virginia Beach, shall first obtain a permit from the USACE, VADEQ, the Virginia Marine Resources Commission, and the Wetlands Board through the joint permit application process.~~

Sec. 4.3. Elevation and construction requirements.

In all ~~SFHAs where base flood elevations have been provided in the FIS or generated by a licensed professional in accordance with section 4.6 of this ordinance~~ floodplain districts, with the exception of Coastal A and Coastal High Hazard (VE) zones, the following provisions shall apply:

A. Residential construction requirements. ~~New construction or substantial improvement of any residential structure or manufactured home in Zones AE, AH, and A with detailed base flood elevations shall have the lowest floor, including basement, elevated to a minimum of two (2) feet above the base flood level.~~ The lowest flood, including basement, shall be set to the higher of the following:

i. A minimum of two (2) feet above the base flood elevation established on the most recent FIRM or by the most recent FIS or,

ii. A minimum of one (1) foot above the 100-year HGL elevation measured at the nearest existing or proposed public drainage structure or BMP, in the City Stormwater Master Plan.

B. Non-residential construction requirements. New construction or substantial improvement of any commercial, industrial, or non-residential building or manufactured home shall have the lowest floor, including basement, elevated as ~~minimum of two (2) feet above the base flood level~~ established in Section 4.3 A of this ordinance. Buildings ~~located in AE or AH Zones~~ may be flood-proofed in lieu of being elevated provided that all areas of the building components below the ~~elevation corresponding to the base flood elevation plus a minimum of two (2) feet freeboard~~ design flood elevation are watertight with walls substantially impermeable to the passage of water, and use structural components having the capability of resisting hydrostatic and hydrodynamic loads and the effect of buoyancy. A professional engineer or architect licensed by the Commonwealth of Virginia shall certify that the standards of this subsection are satisfied. Such certification, including the specific elevation (in relation to NAVD88) to which such structures are flood proofed, shall be maintained by the building official.

C. ~~Space below the lowest floor requirements. In Zones A, AE, AH, and AO, f~~Fully enclosed areas of new construction or substantially improved existing structures that are below the ~~regulatory~~ design flood protection elevation shall:

1. Not be designed or used for human habitation, but shall only be used for parking of vehicles, building access, or limited storage of maintenance equipment used in connection with the premises. Access to the enclosed area shall be the minimum necessary to allow for parking of vehicles (garage door), limited storage of maintenance equipment (standard exterior door), or entry to the living area (stairway or elevator).

2. Be constructed entirely of flood resistant materials below the ~~regulatory~~ design flood ~~protection~~ elevation.

3. Space below the lowest floor of SFHAs delineated on the FIRM shall ~~I~~include measures to automatically equalize hydrostatic flood forces on walls by allowing for the entry and exit of floodwaters. To meet this requirement, the openings shall either be certified by a professional engineer or architect licensed by the Commonwealth of Virginia or meet or exceed the following minimum design criteria:

. . . .

Sec. 4.4. Floodway requirements.

. . . .

B. The placement of new or replacement manufactured homes (mobile homes) is prohibited.

~~C.~~ ~~The following uses and structures may be permitted in the floodway district, subject to the requirements of articles III, IV, V, and VI of this ordinance:~~

~~1.~~ ~~Public and private outdoor recreational facilities;~~

~~2.~~ ~~Agricultural uses, including farming, grazing, and the raising of poultry or livestock; provided, that poultry or livestock shall not be housed within five hundred (500) feet of any residential, apartment, or hotel district;~~

~~3.~~ ~~Open uses, such as public and private roadways, off street parking, or loading and unloading areas related to uses in adjoining districts;~~

4. ~~Commercial mining, soil removal, and sand pits subject to regulations applicable to extractive industries as set forth in the conditional use provisions of the Zoning Ordinance of the City of Virginia Beach;~~

5. ~~Public improvements, such as dams, levees and channel improvements, and utilities installations and substations, including temporary storage of materials, except flammable, toxic or noxious materials, and temporary location of maintenance installations; and~~

6. ~~Uses and structures customarily accessory and clearly incidental and subordinate to uses listed above, including in connection with agricultural uses; roadside stands for the sale of agricultural products produced on the premises; provided that:~~

   a. ~~Only one (1) such stand shall be permitted per lot;~~

   b. ~~No such stand shall exceed five hundred (500) square feet in floor area; and~~

   c. ~~No such stand on the street frontage shall be erected within twenty (20) feet of the property line.~~

. . . .

Sec. 4.6. A Zone requirements.

. . . .

B. The floodplain administrator reserves the right to require a hydrologic and hydraulic analysis for any development and to determine the base flood elevation. When such base flood elevation data is utilized, the lowest floor shall be elevated to minimum of two (2) feet above the base flood level. During the permitting process, the floodplain administrator shall obtain:

   1. The elevation of the lowest floor (including the basement) of all new and substantially improved structures; and

   2. If the structure has been flood-proofed in accordance with the requirements of this ordinance, the elevation (in relation to NAVD88) to which the structure has been flood-proofed.

~~C.~~ ~~When the data is not available from any source, the lowest floor of the structure shall be elevated to not less than two (2) feet above the highest adjacent grade.~~

Sec. 4.8. ~~Reserved~~ X and X(Shaded) Zone requirements. (Other Areas of Flood Risk).

A. *Residential construction requirements*. The lowest floor, including basements, shall be set to a minimum of one (1) foot above the 100-year HGL elevation measured at the nearest existing or proposed public drainage structure or BMP, in the City Stormwater Master Plan.

B. *Non-residential construction requirements*. New construction or substantial improvement of any commercial, industrial, or non-residential building or manufactured home shall have the lowest floor, including basement, elevated as established in Section 4.8 A of this ordinance above. Buildings may be flood-proofed in lieu of being elevated provided that all areas of the building components below the design flood elevation are watertight with walls substantially impermeable to the passage of water, and use structural components having the capability of resisting hydrostatic and hydrodynamic loads and the effect of buoyancy. A professional engineer or architect licensed by the Commonwealth of Virginia shall certify that the standards of this subsection area satisfied. Such certification, including the specific elevation (in relation to NAVD88) to which such structures are flood proofed, shall be maintained by the building official.

Sec. 4.9. – Coastal High Hazard (~~V and~~ VE Zone) requirements.

The following provisions shall apply within ~~V and VE Zones~~ Coastal A Zones and Coastal High Hazard Areas:

A. All new construction and substantial improvements, including to manufactured homes, shall be elevated on pilings or columns so that:

1. The bottom of the lowest horizontal structural member of the lowest floor (excluding the pilings or columns) is elevated to a minimum of ~~two~~ three (~~2~~3) feet above the base flood ~~level~~ elevation; and

2. The pile or column foundation and structure attached thereto is anchored to resist flotation, collapse, and lateral movement due to the effects of wind and water loads acting simultaneously on all building components. Wind and water loading values shall each have a one (1) percent chance of being equaled or exceeded in any given year.

B. A professional engineer or architect licensed by the Commonwealth of Virginia shall develop or review the structural design, specifications, and plans for the construction and shall certify that the design and methods of construction to be used are in accordance with accepted standards of practice for meeting the provisions of article IV, section 4.6 A. A V Zone

Design Certificate shall be submitted to Permits and Inspections with plans for a building permit.

. . . .

I. ~~The man-made alteration of sand dunes, which would increase potential flood damage, is prohibited.~~ Sand dunes, barrier beaches, and other natural protective barriers shall remain intact to provide protection against wind, waves, and erosion drainage. Any person who desires to use or alter any coastal primary sand dune or beaches, other than for the purpose of conducting the activities specified in Article 1600, Section 1602 of the Zoning Ordinance of the City of Virginia Beach, shall first obtain a permit, or authorization, from the USACE, VADEQ, the Virginia Marine Resources Commission, and the Wetlands Board through the joint permit application process.

J. Manufactured homes are prohibited.

Sec. 4.10. Floodplain subject to special restrictions.

A. All ~~FIRM delineated~~ SFHAs that ultimately drain to Back Bay or the Currituck Sound ~~located in the following areas~~ shall be identified as a floodplain subject to special restrictions~~:~~.

~~1. North Landing River and its tributaries south of Lynnhaven Parkway;~~

~~2. West Neck Creek and its tributaries south of Shipps Corner Road, London Bridge Road, and the portion of Dam Neck Road east of its intersection with London Bridge Road; and~~

~~3. Bays, creeks, lakes, guts, coves, wetlands, marshes and swamps and their tributaries comprising the Back Bay and Small Coastal South watersheds south of South Birdneck Road and east of Princess Anne Road and General Booth Boulevard.~~

B. The following provisions shall apply within the floodplain subject to special restrictions:

1. Notwithstanding any provision of this ordinance to the contrary, no filling shall be permitted, including filling with material excavated from the same floodplain except for:

a. The purpose of public roadway or other similar public works construction undertaken by the Department of Public Works or Virginia Department of Transportation, or their agent for

construction. This construction includes flood protection and flood mitigation projects;

b. The maintenance, alteration, or relocation of bona fide agricultural ditches, swales, or agricultural pathways or those ditches required for proper lot drainage;

c. For shoreline stabilization or maintenance projects, such as riprap revetment, bulkheads, or other treatment used to stabilize and protect the banks of waterways, the city manager or his designee may approve the placement of fill provided the following criteria are met:

i. A joint permit application is submitted;

ii. The alignment of the stabilization structure is along the escarpment or in line with adjacent stabilization structures; ~~and~~

iii. If there is an existing shoreline stabilization structure, any proposed replacement structure shall be no more than six (6) inches higher than the existing structure; and

~~iii~~iv. Fill must be the minimum necessary to support the stabilization project.

2. The city manager, or his designee, may approve the placement of fill provided that the following criteria are met:

a. Proposed fill within the floodplain:

i. Shall be mitigated to result in no decrease in flood storage volume on the site;

ii. Shall be mitigated entirely on the same site that will incur the fill;

iii. Shall be contiguous to the existing floodplain that is being filled; and

iv. Shall be limited to the smallest amount of area and volume possible to correct irregularities within the boundary of the project.

b. The combined areas of fill and mitigation shall not exceed five (5) percent of the total area within the floodplain located on the site that will incur the fill.

3. Residential dwelling structures shall not be located within the floodplains subject to special restrictions on lots created after October 23, 2001. Residential dwelling structures located in ~~local flood hazard areas as of~~ a SFHA and constructed prior to October 23, 2001 may be expanded with attached additions to a total footprint of less than one thousand (1,000) square feet; such additions shall also comply with the requirements set forth in article V of this ordinance.

. . . .

ARTICLE V. EXISTING STRUCTURES IN FLOODPLAIN AREAS

Sec. 5.1. Existing structures.

A structure or use of a structure or premises that lawfully existed prior to the adoption of this ordinance, but which is not in conformity with this ordinance, may be continued subject to the following conditions:

A. Any existing structures in the floodway area shall not be expanded or enlarged unless it has been demonstrated through hydrologic and hydraulic analyses performed in accordance with standard engineering practices that the proposed expansion or enlargement would not result in any increase in the base flood elevation.

B. Any modification, alteration, repair, reconstruction, or improvement of any kind to a structure and/or use located in any floodplain ~~areas~~ district to an extent or amount of less than fifty (50) percent of its market value shall conform to the VA USBC and meet the freeboard height in effect at the start of construction for the original structure.

C. Any modification, alteration, repair, reconstruction, or improvement of any kind to a structure and/or use, in any floodplain ~~area~~ district to an extent or amount of fifty (50) percent or more of its market value shall be undertaken only in full compliance with this ordinance and shall require the entire structure to conform to the VA USBC.

ARTICLE VI. VARIANCES AND APPEALS

Sec. 6.1. Administrative variances.

The floodplain administrator shall approve or deny an application requesting an administrative variance after receipt of a complete application. Administrative variances may only be granted for the following uses, development, or redevelopment:

A. As defined in section 4.10, floodplains subject to special restrictions, for filling only.

B. Any structure or use sustaining damage not caused by flood to an extent or amount of fifty (50) percent or more of its market value to allow the structure to be rebuilt to the freeboard height in effect at the start of construction for the original structure. If the structure is a pre-FIRM structure, full compliance with the current VAUSBC freeboard above the base flood elevation is required. Structures that are utilizing an approved land management plan for their on-site waste disposal may be allowed to continue the use of the land management plan as long as it is approved by the city and the health department, even for damage or destruction resulting from flood.

C. As defined in section 4.8 B, X and X(Shaded) Zone requirements. (Other Areas of Flood Risk), and 4.3 A(ii) when the required finished floor is higher than the BFE plus two feet of freeboard, where the floodplain administrator, in consultation with the Development Services Center, has determined that the proposed stormwater engineering design will approximately mitigate any impacts to the finished floor of the nonresidential development.

Sec. 6.3. Application process.

A. Applications for variances from the requirements of this ordinance shall be made to the city council and filed with the director of planning. The fee for such applications shall be ~~six hundred fifty dollars~~ seven hundred eighty ($~~650~~780.00). Such fee shall include all costs of notifications and advertising. Except in cases in which such fee is waived, the director shall not accept any application not accompanied by payment of the required fee. The procedure for the advertising, hearing and determination of applications for floodplain variances shall be in accordance with the requirements pertaining to applications for subdivision variances, as set forth in section 9.4 of the subdivision ordinance. In cases in which a variance application is filed by reason of a natural disaster that is the subject of a federal declaration of emergency, application and associated advertising fees shall be waived and such application shall be given expedited processing to the maximum practical extent.

B. All applications shall be accompanied by the following:

1. A separate map, on a 1″ = 100′ or greater scale, identifying all proposed land disturbance, including fill and mitigation areas, and the limits of the existing and proposed SFHAs, tidal and non-tidal wetlands, Southern Rivers Watershed Management Area Buffer, and CBPA Resource Protection Area Buffer; and

2. A preliminary floodplain study addressing the physical and environmental characteristics of the floodplain located on adjoining properties and in the general area. Such study shall be sufficient to show that the variance, if granted, will meet the standards defined in section 6.~~3~~4 and in addition thereto, shall:

   a. Contain supporting data and calculations required for a Preliminary Stormwater Engineering Analysis as appropriate~~, given the preliminary nature of the floodplain study~~;

   b. Comply with the Public Works Design Standards Manual; and

   c. Be certified by a professional engineer, architect, surveyor, landscape architect or practitioner of a related field having a valid license issued by the Commonwealth of Virginia or who is exempt from licensure pursuant to applicable provisions of the Virginia Code.

Adopted by the Council of the City of Virginia Beach, Virginia, on the 1st day of February, 2022.

Attachment 6: Copy of Monitoring/Maintenance Plan

Dewberry

[DRAFT] Annual Monitoring Plan and Post-Construction Monitoring Report

Marsh Restoration in Back Bay, Virginia Beach, VA

Prepared by: Dewberry Engineers, Inc.

[July 6, 2023]

[REPORT VERSION [DRAFT]]

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INTRODUCTION

This project is intended to implement one of the nature-based projects proposed in Virginia Beach's "Sea Level Wise" (SLW) Adaptation Strategy[1] adopted by the Virginia Beach City Council in June 2020. The SLW Adaptation Strategy presents a holistic framework for addressing flood risks across the City, consisting of four general strategies – natural mitigations, engineered defenses, adapted structures, and prepared communities. These strategies were applied to each major watershed in the City and tailored to their unique characteristics and risk profiles. The adaptation vision for the Lower Southern Rivers Drainage Basin, where the proposed project is located, focuses on employing natural mitigation methodologies to strategically reduce flow into and within Back Bay, along with an integrated system of defense structures and complementary adaptation measures, such as land-use strategies, to improve flood storage and overall coastal resiliency. The Bonney Cove area of Back Bay, where the project site is proposed, is particularly suitable for the use of nature-based strategies given the low elevations of marshlands and documented historic degradation of habitat. Participants at the 'near-neighbor' public engagement meetings held during the SLW Adaptation Strategy development were supportive of these types of strategies.

The City has several dedicated Capital Improvement Program (CIP) initiatives for the Lower Southern Rivers Drainage Basin for implementation of these strategies. The City's Stormwater Green Infrastructure CIP has obligated approximately $421,700 in contracts to support field investigations, environmental assessments, and engineering designs of the project – a true indication of the City's commitment to nature-based approaches and the critical first step in a broader effort. During the General Election on November 2, 2021, Virginia Beach residents voted to authorize $567.5 million dollars in debt to fund the design and construction of 21 Phase 1 projects in the citywide Flood Protection Program. [2] The Back Bay Marsh Terrace project is included under the Stormwater Green Infrastructure Master Project.[3] Other Southern Watershed projects that received funding under the Flood Protection Program include the West Neck Creek Bridge City-Wide Sea Level Rise Strategy, the Pungo Ferry Road Improvements, and the Sandbridge/New Bridge Intersection Improvements projects.

Outside of this project, the Virginia Beach City Council has recently funded a $5.2 million dollar voluntary acquisition program to encourage flood-prone properties to apply for a buyout to enable the City to convert parcels to open space to serve as flood storage and a marsh migration buffer. The City's

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[1] City of Virginia Beach Sea Level Wise Adaptation Strategy webpage: https://www.vbgov.com/government/departments/public-works/comp-sea-level-rise/Pages/default.aspx

[2] City of Virginia Beach Flood Protection Program webpage: https://www.vbgov.com/government/departments/public-works/flood-protection-program/Pages/Flood-Protection-Program.aspx.

[3] Stormwater Green Infrastructure Page: https://www.vbgov.com/government/departments/public-works/flood-protection-program/Pages/Stormwater-Green-Infrastructure-.aspx

Stormwater Green Infrastructure CIP is also supporting the implementation of other natural and nature-based projects across the City, including a wetland and floodplain restoration project along the Eastern Branch of the Elizabeth River.

An assessment of restoration opportunities in the City's Lower Southern Rivers Drainage Basin with dual flood reduction and habitat restoration benefits identified the Bonney Cove area as a potential project site for several reasons. The Bonney Cove site has experienced significant historical ecological degradation. Historical shoreline data from 1869 indicates approximately 50% of present-day open water in Bonney Cove (260 acres) was previously marsh (Figure 1). Loss of the marsh island habitat within Bonney Cove has resulted in the opening of a secondary channel allowing increased flow exchange between the upper and lower bays. In comparison to shore-adjacent restoration, off-shore marsh restoration leveraging hydraulic modeling identified Bonney Cove as a location where marsh restoration has the potential to reduce the propagation of floodwaters through key pathways within Back Bay. The United States Fish and Wildlife Service (USFWS) and the Virginia Department of Wildlife Resources (VDWR) also identified Bonney Cove as a restoration priority as this area serves as an ideal location for Submerged Aquatic Vegetation (SAV) reestablishment and vital habitat for migratory birds and fish.

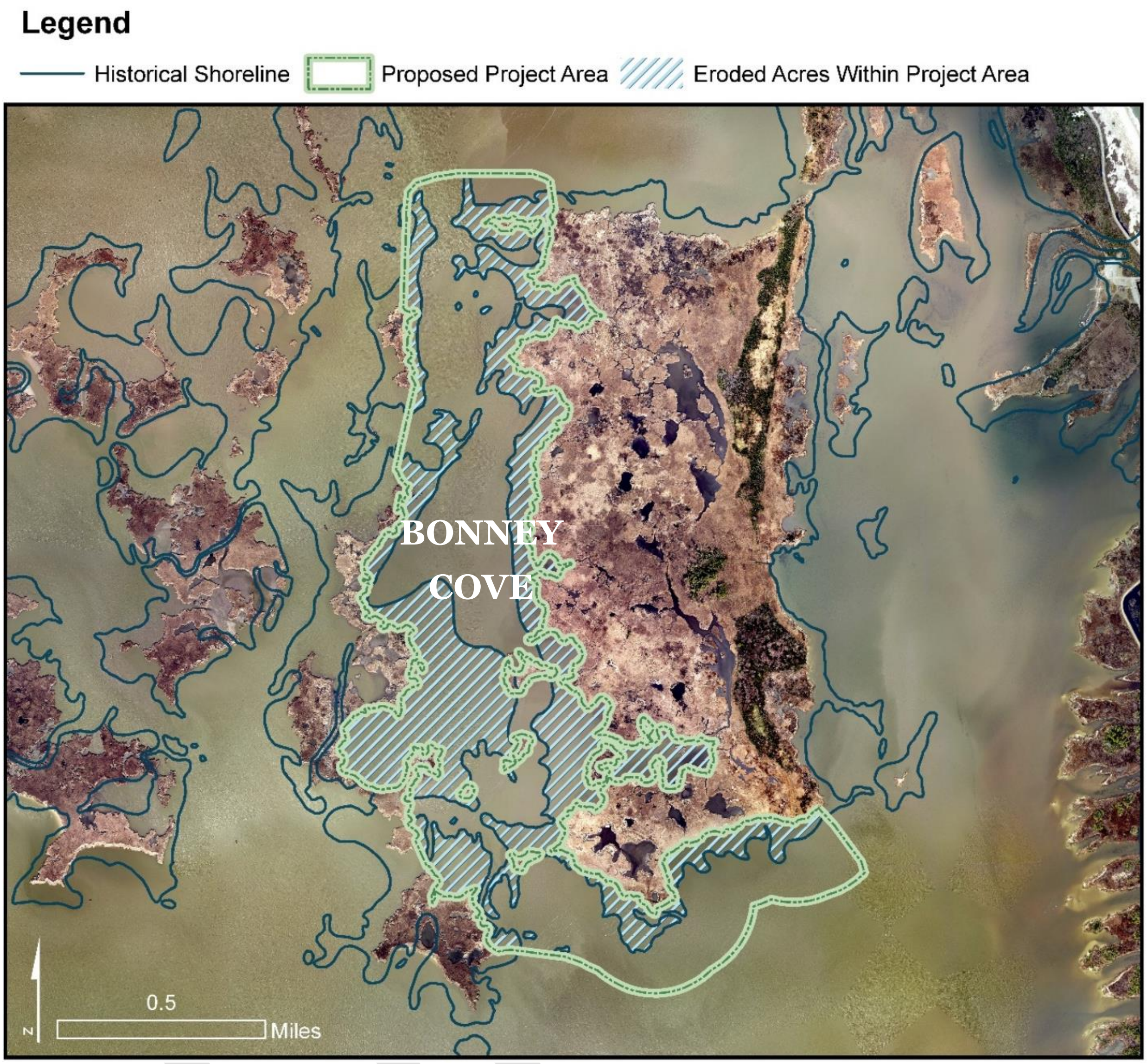

Figure 1: Historical marsh erosion within the project area.

The project is situated within the Bonney Cove area of Back Bay, spanning the western and southern lengths of Long Island, as shown in Figure 1.

Project Background

Marsh island restoration through terracing was identified as a particularly viable solution given Back Bay's shallow bottom and the historical loss of habitat. The marsh terraces are narrow man-made islands that will be arranged across areas that were historically marsh but are now shallow open water. A series of these islands, or terraces, are typically arranged in a chevron pattern. The overall field of terraces dissipates waves and slows down water moving through the area. In turn, the calmer water allows more sunlight to penetrate to the shallow bottom, promoting establishment and growth of marsh

and SAV habitats. Further, as opposed to one continuous marsh platform, marsh terraces maximize habitat for a variety of fish and wildlife species.

The Preferred Alternative includes the creation of 41 individual marsh terraces totaling approximately 25,000 linear feet (or an approximately 47-acre footprint) across Bonney Cove. These 47 acres of terraces are comprised of approximately 13 acres of emergent (low and high marsh) vegetated habitat, 14 acres of upland vegetated habitat, and 16 acres of submerged terrace habitat. Approximately 310 acres of suitable SAV habitat will remain in between the terraces.

Terrace Construction and Orientation

Terrace construction will begin in the northern extent of the project site, and the contractor will work towards the southern extent of the site. The contractor will complete each terrace, including installing plants, before moving to the next. Marsh terrace construction will occur over two years (2025 to 2026) and will pause annually between October 31st and March 1st to limit disturbance to wintering waterfowl and migration, in accommodation of BBNWR's requirement. Approximately 20 terraces will be constructed in 2025 ("Phase 1"), and 21 terraces will be constructed in 2026 ("Phase 2"). The following sections summarize the proposed design and construction approach.

Terraces will be generally oriented perpendicular to the predominant wind direction (south-southwest) to maximize wave energy reduction. The terraces will be segmented in a chevron (duck-wing) pattern to create the most favorable fish and swimming crustacean (termed "nekton") habitat, facilitate adequate circulation, and maintain navigability throughout the project area. The terraces will not be connected to the adjacent marsh to maintain a physical open water barrier to deter the invasion of Common Reed (*Phragmites australis*) stands.

The terraces will be spaced at approximately 300-foot intervals in the northern and southern quarters and span 15 feet in width, and at least 600-foot intervals in the center and span 30 feet in width. This arrangement will lessen the amount of open water and subsequent wave action at the northern and southern ends of the site and provide space for marine-based construction equipment. The design team reviewed the final spacing layout of the terraces to ensure navigability of a watercraft through the project site which will be required for post-construction monitoring, any needed maintenance, as well as community recreational access.

The terraces would consist of a sand filled core encapsulated by a high-strength blend of woven and non-woven geotextile fabrics ("geobags"). The sand for this material would need to come from offsite sources. Back Bay is too shallow to accommodate conventional barges for material placement. To avoid extensive impacts to the bottom of the bay, the slurry basin will pump sand for the project from the proposed Shipps Cabin Road staging area to Bonney Cove. The slurry pipeline will consist of approximately 10,424 linear feet of 12" diameter HDPE fused/welded pipeline that will be assembled on land and floated into its proposed alignment within Back Bay. The pipe would be marked by floats

every 5 feet and temporary signage as reasonable. It is anticipated the pipeline will be submerged to the bottom of the bay at channel crossings and adjacent to a duck hunting cabin adjacent to the alignment. By establishing a floating pipeline, it will limit disturbances to the subaqueous bottomlands along the alignment and allow for the retraction of the pipeline during the winter inactive periods and inclement weather events. Booster stations would be placed approximately every mile. These booster stations would consist of a pontoon mounted diesel engine pump capable of moving the sand slurry from the laydown area to the site. Given the distance to the site, four or five of these booster stations are anticipated to be necessary to create the sand cores of the terrace. It is estimated that 450 Gallons Per Minute (GPM) of sand slurry would be pumped through the pipe.

Once the cores are in place, long reach excavators would travel along the tops of the terraces and begin to shape the cross slopes. Appropriate materials for establishing vegetation atop the terraces will be primarily sourced from materials dredged during the Sandbridge Road Nimmo Parkway Phase VII-A project located immediately north of Back Bay (VMRC 15-1564, USACE IP NAO-2015-00151). Materials will be tested and screened to remove organics prior to application to the terraces. As needed, dredging sites adjacent to the proposed terrace locations that are confirmed to be devoid of SAV will be utilized to provide supplemental soil materials to top the proposed terraces[4]. It was determined that the in-situ bay sediment would be suitable for vegetation growth. The marsh terraces would be covered with 1 to 3 feet of suitable fill, depending on crest widths. Jute netting will cover the topsoil to control erosion and promote vegetation establishment. Coir logs will be places along the terrace slope controls to further promote vegetation establishment along the slope.

SAV Plantings

The City has partnered with Virginia Polytechnic Institute and State University ("Virginia Tech") to evaluate opportunities for restoring populations of native Wild Celery (*Vallisneria americana*) in Back Bay. The Virginia Tech research team has developed an innovative technique to grow Wild Celery in an aquaculture center that results in larger, mature plants that can better withstand Back Bay's turbidity. Once transplanted, plants are surrounded by cages to prevent predation. These founder colonies can be used for propagation throughout Back Bay. After terrace construction, the City will transplant Wild Celery in an area adjacent to the site. This founder colony will be used to strategically transplant Wild Celery in between the terraces for 5 years after construction (2026 – 2029) with the ultimate goal of establishing 10 acres of SAV vegetation in between the marsh terraces.

[4] The 60% preliminary design showed preliminary siting of these dredge areas based on avoidance of existing SAV habitat; however, pre-construction surveys of SAV would be required to re-delineate these dredging areas.

Terrace Plantings – Upland and Marsh Vegetation

The terraces' intertidal perimeter will be planted with appropriate emergent estuarine plant species (e.g., Saltmarsh Cordgrass [*Spartina alterniflora*] and Salt Meadow Hay [*Spartina patens*]) and brackish plant species (e.g., Big Cordgrass [*Spartina cynosuroides*]). These plants will be installed as soon as possible after construction to stabilize planting areas and protect the terrace from erosion. In addition to emergent grass, woody growth (i.e., shrubs and trees) within the terrace crest will be incorporated to protect the terraces' surfaces from rain and wind erosion and hold the landform together through substantial root systems.

Appropriate native species were identified based on the review of the reference marshes surrounding the project site and a review of water levels in Back Bay. Since the Bay's water levels are not affected by lunar tides and instead by wind-driven fluctuations, the project team evaluated average water elevations at the U.S. Geological Survey (USGS) Beggars Bridge Creek Gauge (Gauge ID 0204300267) from 2016 – 2021 to determine ranges of inundation to achieve functional marsh elevations throughout the project life, defined as:

- *Mean Low Water (MLW)*: the average low water at the site (10th Percentile: -0.62 ft NAVD88)
- *Mean High Water (MHW)*: the average high water at the site (95th Percentile: 1.22 ft NAVD88)
- *Mean Tide Level (MTL)*: halfway between MLW and MHW (0.3 ft NAVD88)
- *Upper Limit of Wetlands (ULW)*: approximately 1.5 times the mean tide range at the site (2.76 ft NAVD88)

These elevations were correlated to suitability for low marsh, high marsh, and upland species, as shown in Table 1.

Table 1: Proposed planting elevation zones.

Planting Zone	Definition	Elevation Range	Elevation (feet NAVD88)	Percentage of record where water reaches these elevations
Low Marsh	Marsh that is flooded frequently but exposed sometimes	MTL - MHW	0.3 – 1.2 ft	48%
High Marsh	Marsh that is generally only flooded during higher-than average water conditions	MHW – ULW	1.2 to 2.8 ft	7%
Upland Habitat	Habitat that is rarely flooded, only during extreme conditions	> ULW	> 2.8 ft	0%

Five planting schemas were identified to provide the highest possible environmental benefit in terms of erosion control, habitat diversity, and fetch reduction. The wider (30-foot) terraces will be planted with Bald Cypress (*Taxodium districhum*) trees capable of withstanding rising water levels. The full list of species and quantities is provided in the 95% design plan set.

The final engineered design component is the strategic placement of rock on the exposed perimeter terraces on the project site's north, west, and southern extents. The need for the rock armor was determined through analysis of wind data both from NOAA and ASCE-7-10 50-year return period anticipated 3-second gust values. These values were used to calculate fetch-generated waves at the project site. The calculations performed confirmed that armored protection would be required to protect the proposed terraces from the forces created by wave action. The stone sizes required for these features (Class II rip rap) were calculated following the procedures laid out in the USACE Coastal Engineering Manual (CEM) and Virginia Institute of Marine Science (VIMS) Living Shoreline Design Guidelines for Shore Protection in Virginia's Estuarine Environments. Two calculation methods, Hudson (1974) and Van Der Meer (1988), from the CEM were utilized to evaluate the range of acceptable rock armor for the exposed perimeter. These two methods calculate the armor stone size based on several design inputs including initial wave height, allowable damage level, revetment slope, and breaking versus non-breaking waves. The two methods often result in corresponding values that are used by the engineer to make an experienced determination on the final rock armor sizing. The rock armor will serve as a nature-based design element by acting as a substrate for the Wild Celery grass that has proven to be successful for SAV establishment in Back Bay (see Figure 2).

Figure 2: Example Back Bay SAV experiment; photo courtesy of Virginia Tech.

Monitoring Goals and Objectives

Annual post-construction monitoring of the site is required by the Virginia Marine Resource Commission (VMRC) (TBD) Permit (VMRC #XXXX-XXXX) and the U.S. Army Corps of Engineers (USACE) Individual Permit (NOA-20XX-XXXXX). [Insert details of the relevant permits and permit conditions]. The following goals, objectives, and metrics were established to enable consistent tracking of the primary living shoreline project components across each monitoring year.

1. **Monitoring Goal 1**: Establishment of a Sustainable Coastal Marsh Island System
   a. Objective 1a: Establish Emergent Marsh Habitat
      - Metric: For each monitoring year, the project area should maintain or increase the overall coverage of emergent marsh vegetation. There should be no significant signs of herbivory or invasive species establishment.

   b. Objective 1b: Establish Upland Habitat
      - Metric: For each monitoring year, the project area should maintain or increase the overall coverage of upland vegetation. There should be no significant signs of herbivory or invasive species establishment.
2. **Monitoring Goal 2**: Stability of Marsh Terraces
   a. Objective 2: Marsh Terrace Structures
      - Metric: For each monitoring year, the terrace structures should show no significant signs of damage, deterioration or extreme settlement.
3. **Monitoring Goal 3**: Establishment of a Sustainable SAV Community
   a. Objective 3: Establish SAV Communities

- Metric: For each monitoring year, the SAV planting areas should maintain or increase the overall coverage of SAV vegetation. There should be no significant signs of herbivory or invasive species establishment.

MONITORING PLAN

The monitoring plan includes stakeholders, a schedule for the annual monitoring inspections, the monitoring strategy/sampling plan, and approach for addressing any needs for maintenance.

Monitoring Stakeholders

An Environmental Scientist from Dewberry Engineers Inc. will perform the annual monitoring inspections and provide a copy of the monitoring report to the City of Virginia Beach, USACE, VDEQ, VMRC, and the City of Virginia Beach Wetlands Board as necessary. As owners of the project, the City of Virginia Beach will review monitoring recommendations and perform corrective actions as necessary.

Annual Inspection Schedule

Monitoring inspections should be conducted annually, during the peak growing season, which is defined by VMRC as between June and August. To enable consistent tracking of project performance from year to year, annual monitoring inspections will be conducted prior to the end of the growing season in September of each year, with annual reports to be submitted to regulatory stakeholders prior to November 30th [or an annual date defined in the permit conditions] of each year. The following outlines the monitoring inspection schedule and deliverables.

Phase 1 Post-Construction As-Built Report (Date: Prior to December 31st, 2025)

To serve as a baseline for the post-construction annual monitoring, an as-built report for the Phase 1 terraces will be completed following the construction of each phase of terraces and submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following.

- Coordinates and diagrams of established transects, as well as site photographs from photo stations 1-40 as defined in the Methods section.
- Final location of all planted vegetation (upland plantings, high marsh plantings and low marsh plantings).
- Final grade topographic surveys (plan, profile, and cross sections).
- Discussion of the project design versus as-built conditions.

Phase 2 Post-Construction As-Built Report (Date: Prior to December 31st, 2026)

To serve as a baseline for the post-construction annual monitoring, an as-built report for the Phase 2 terraces will be completed following the construction of each phase of terraces and submitted to the

City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following.

- Coordinates and diagrams of established transects, as well as site photographs from photo stations 41-80 as defined in the Methods section.
- Final location of all planted vegetation (upland plantings, high marsh plantings and low marsh plantings).
- Final location and extent of SAV plantings.
- Final grade topographic surveys (plan, profile, and cross sections).
- Discussion of the project design versus as-built conditions.

Year 1a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2026)

At the end of the first full growing season following planting of the Phase 1 terraces, a Year 1a monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 40 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 1 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion; it is anticipated that the wetland planting contractor will provide a one-year post construction maintenance and guarantee period for the wetland plantings.

Year 1b/2a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2027)

At the end of the first full growing season following planting of the Phase 2 terraces following planting, and the second full growing season of the Phase 1 terraces, a Year 1b/2a monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 1 conditions (for Phase 2 terraces) and to Year 2 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).

- Estimated percent cover and change in coverage from planted conditions to Year 1 conditions for SAV planting quadrants
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion; it is anticipated that the wetland planting contractor will provide a one-year post construction maintenance and guarantee period for the wetland plantings.

Year 2b/3a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2028)

At the end of the second full growing season of the Phase 2 terraces following planting, and the third full growing season of the Phase 1 terraces, a Year 2b/3a monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 2 conditions (for Phase 2 terraces) and to Year 3 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- Estimated percent cover and change in coverage from planted conditions to Year 2 conditions for SAV planting quadrants
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

Year 3b/4a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2029)

At the end of the third full growing season of the Phase 2 terraces following planting, and the fourth full growing season of the Phase 1 terraces, a Year 3b/4a monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 3 conditions (for Phase 2 terraces) and to Year 4 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).

- Estimated percent cover and change in coverage from planted conditions to Year 3 conditions for SAV planting quadrants
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

Year 4b/5a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2030)

At the end of the fourth full growing season of the Phase 2 terraces following planting, and the fifth full growing season of the Phase 1 terraces, a Year 4b/Final (Year 5a) monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 4 conditions (for Phase 2 terraces) and to Year 5 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- Estimated percent cover and change in coverage from planted conditions to Year 4 conditions for SAV planting quadrants
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

Year 5b Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2031)

At the end of the fifth full growing season of the Phase 2 terraces following planting, a Final (Year 5b) monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 41 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 5 conditions (for Phase 2 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- Estimated percent cover and change in coverage from planted conditions to Year 5 conditions for SAV planting quadrants

- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

Monitoring Strategy

The monitoring strategy consists of established transects with photo stations and quadrants that cover the area between transects. This approach enables monitoring of the four primary features of the living shoreline: uplands, low-marsh plantings, high-marsh plantings, and SAV*.

*Note: The planting scheme for SAV has not yet been established but it is anticipated that some SAV will be planted along the submerged portions of the marsh terraces. If more suitable planting locations are determined to be between terraces, separate transects will be established and sampled to track SAV survival apart from the proposed terrace transects.

Transects/Photo Points

A total of eighty (80) transects will be established across the project site, with 10 transects located along each of 8 terraces. Transects will span perpendicular to the length of each terrace from the ridge to the edge of the planted/vegetated area. See Figures 3 and 4 for graphic depictions of the proposed transect locations and layouts. Terraces were selected using a random stratified method to ensure representative terraces in each location within the project area (North Interior, North Exterior, South Interior, South Exterior), and of each planting scheme, were represented in the proposed monitoring plan. The selected terraces are as follows:

- North Interior: T-110, T-113
- North Exterior: T-100, T-106
- South Interior: T-124, T-131
- South Exterior: T-123, T-140

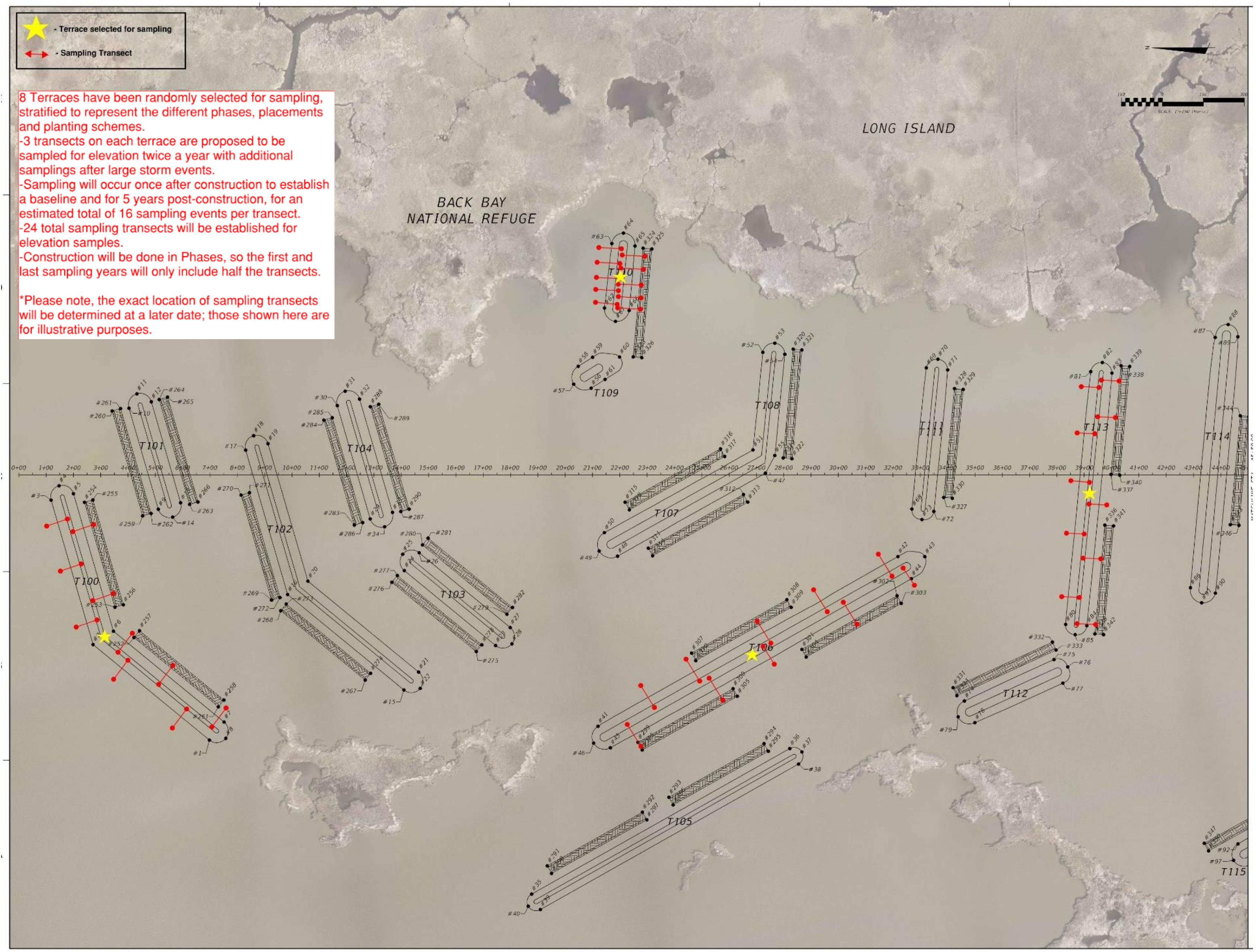

Figure 3: Monitoring design site plan – North Terraces

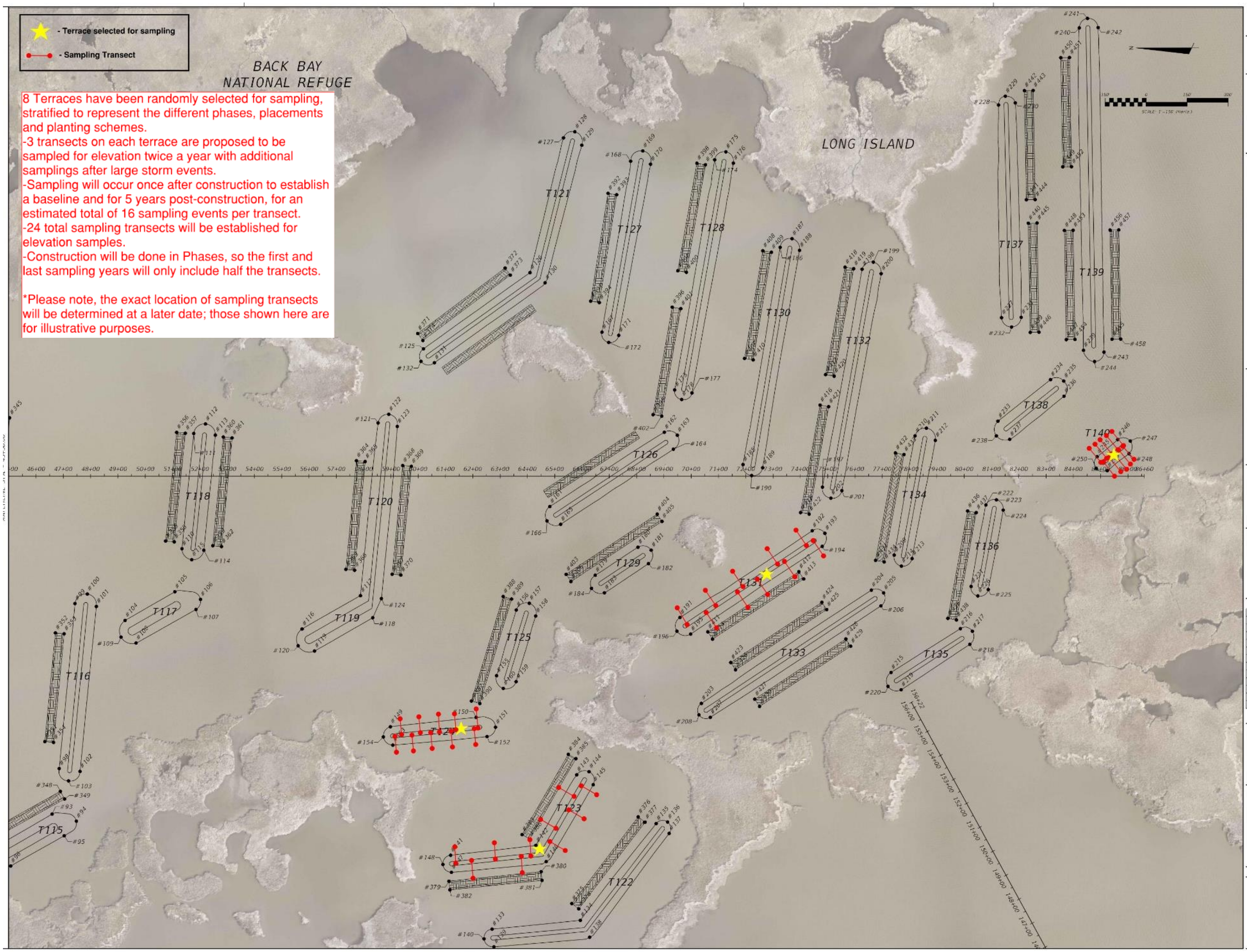

Figure 4: Monitoring design site plan – South Terraces

Permanent photo stations will be established at each quadrant along each transect to capture the design features/established habitats and vegetation. Figure 5 shows the general proposed locations (indicated by the red arrows/labels) for each quadrant and photograph station along each transect. Photos were shot from each photo location on [DATE]. These photos will be collected annually and compiled in Appendix B.

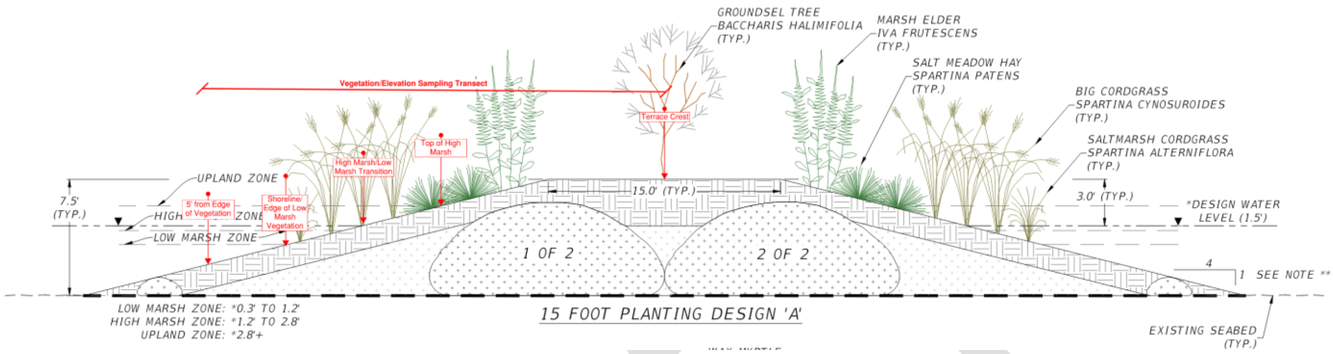

Figure 5: Photo station layout example

Quadrants

To estimate percent cover of vegetation, four (4) quadrants along each of ten (10) transects will be established on the eight selected terraces to allow for estimates of habitat coverage and planting survival. Estimates of coverage and survival were compared to post-construction conditions to evaluate changes.

Further, the following guiding questions were established to monitor overall project performance, presence of invasive species, and identify any needs for maintenance:

1. Are there specific problem areas where plants are dying or appear unhealthy?
2. Were any signs of herbivory observed?
3. Are there any undesirable plant species present?
4. Condition of the terrace structures: Is there any observed settlement, dislodged stone, significant debris etc.?
5. If an updated survey was conducted, are there any significant changes in the profile of the marsh terraces?
6. Does the upland portion of each terrace show any significant signs of erosion or loss of vegetation?

MONITORING RESULTS

Table 2: Low Marsh Vegetation Percent Cover Monitoring Results (Example Table – Terrace 1).

		Estimated Percent Coverage						Percent Change in Coverage (from Baseline)				
Terrace/ Transect	Photo Station Reference	Baseline (2024)	Year 1 (2025)	Year 2 (2026)	Year 3 (2027)	Year 4 (2028)	Year 5 (2029)	Baseline to Year 1	Baseline to Year 2	Baseline to Year 3	Baseline to Year 4	Baseline to Year 5
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1 - 4	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 5	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
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Overall		Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.

Table 3: High Marsh Vegetation Percent Cover Monitoring Results (Example Table – Terrace 1).

		Estimated Percent Coverage						Percent Change in Coverage (from Baseline)				
Terrace/ Transect	Photo Station Reference	Baseline (2024)	Year 1 (2025)	Year 2 (2026)	Year 3 (2027)	Year 4 (2028)	Year 5 (2029)	Baseline to Year 1	Baseline to Year 2	Baseline to Year 3	Baseline to Year 4	Baseline to Year 5
1 - 1	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 2	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
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1 - 4	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 5	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 6	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 7	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 8	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 9	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 10	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
Overall		**Choose an item.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**

Table 4: General Observations for Wetland Planting Areas on the Marsh Terraces (Example Table – Terrace 1)

Monitoring Questions	Terrace/Transect									
	1 - 1	1 - 2	1 - 3	1 - 4	1 - 5	1 - 6	1 - 7	1 - 8	1 - 9	1 - 10
Are there specific problem areas where plants are dying or appear unhealthy?	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.
Were any herbivory issues observed?	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.
Are there any undesirable plant species present?	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.
If updated survey was conducted, are there any significant changes in the profile of the living shoreline system?	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.

Table 5: General Observations for the Unplanted Structural Components of the Marsh Terraces (Example Table – Terrace 1)

Terrace/Transect										
Monitoring Questions	**1 - 1**	**1 - 2**	**1 - 3**	**1 - 4**	**1 - 5**	**1 - 6**	**1 - 7**	**1 - 8**	**1 - 9**	**1 - 10**
Are there any structural issues with the planted terrace structures (e.g. observed settlement, loss of topsoil, etc.)?	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☒ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.
Is there any observed growth in SAV on or adjacent to the marsh terraces?	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☒ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.

Are there any structural issues with the rock armoring on the terraces (e.g. observed settlement, dislodged stone, significant debris, etc.)?	YES ☐ NO ☒ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☒ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.

MAINTENANCE RECOMMENDATIONS

The following table outlines the recommendations for maintenance, including estimated quantities and specific guidance, based on the results of the [YEAR] monitoring results.

Table 6: Maintenance Recommendations Checklist

Design Feature/ Monitoring Objective	Maintenance Elements	Location & Estimated Quantity	Specific Guidance
Terrace Upland and Wetland Habitats and Wetland Soils – Monitoring Objectives 1a/1b	☐ Replace plants	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Add new plants	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Remove debris	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Remove invasive vegetation	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Add sand to eroding areas	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Replace waterfowl barrier	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.

Design Feature/ Monitoring Objective	Maintenance Elements	Location & Estimated Quantity	Specific Guidance
Terrace Structures & Stone Armoring, Monitoring Objective 2a/2b	☐ Re-place dislodged stones	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Add additional stone to address settlement	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Remove debris	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Repair sand cores or other structural elements	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
SAV Establishment, Monitoring Objective 3	☐ Replace plants	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Add new plants	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.

APPENDIX A: AS-BUILT PLANS

[Page left intentionally blank; as-built plans will be included in the Year 1 monitoring report]

APPENDIX B: MONITORING PHOTOGRAPHS

Table 7: Terrace 1 Transect 1 Photographs

Photograph from Photo Location 1A	Photograph from Photo Location 1B
Photograph from Photo Location 1C	Additional photos of any problem areas.

Table 8: Terrace 1 Transect 2 Photographs

Photograph from Photo Location 2A	Photograph from Photo Location 2B
Photograph from Photo Location 2C	Additional photos of any problem areas.

Table 9: Terrace 1 Transect 3 Photographs

Photograph from Photo Location 3A	Photograph from Photo Location 3B
Photograph from Photo Location 3C	Additional photos of any problem areas.

Table 10: Terrace 1 Transect 4 Photographs

Photograph from Photo Location 4A	Photograph from Photo Location 4B
Photograph from Photo Location 4C	Additional photos of any problem areas.

Table 11: Terrace 1 Transect 5 Photographs

Photograph from Photo Location 5A	Photograph from Photo Location 5B
Photograph from Photo Location 5C	Additional photos of any problem areas.

Table 12: Terrace 1 Transect 6 Photographs

Photograph from Photo Location 6A	Photograph from Photo Location 6B
Photograph from Photo Location 6C	Additional photos of any problem areas.

Table 13: Terrace 1 Transect 7 Photographs

Photograph from Photo Location 7A	Photograph from Photo Location 7B
Photograph from Photo Location 7C	Additional photos of any problem areas.

Table 14: Terrace 1 Transect 7 Photographs

Photograph from Photo Location 7A	Photograph from Photo Location 7B
Photograph from Photo Location 7C	Additional photos of any problem areas.

Table 15: Terrace 1 Transect 8 Photographs

Photograph from Photo Location 8A	Photograph from Photo Location 8B
Photograph from Photo Location 8C	Additional photos of any problem areas.

Table 16: Terrace 1 Transect 9 Photographs

Photograph from Photo Location 9A	Photograph from Photo Location 9B
Photograph from Photo Location 9C	Additional photos of any problem areas.

Table 17: Terrace 1 Transect 10 Photographs

Photograph from Photo Location 9A	Photograph from Photo Location 9B
Photograph from Photo Location 9C	Additional photos of any problem areas.

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[DRAFT] Annual Monitoring Plan and Post-Construction Monitoring Report

Marsh Restoration in Back Bay, Virginia Beach, VA

Prepared by: Dewberry Engineers, Inc.

[July 6, 2023]

[REPORT VERSION [DRAFT]]

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INTRODUCTION

This project is intended to implement one of the nature-based projects proposed in Virginia Beach's "Sea Level Wise" (SLW) Adaptation Strategy[1] adopted by the Virginia Beach City Council in June 2020. The SLW Adaptation Strategy presents a holistic framework for addressing flood risks across the City, consisting of four general strategies – natural mitigations, engineered defenses, adapted structures, and prepared communities. These strategies were applied to each major watershed in the City and tailored to their unique characteristics and risk profiles. The adaptation vision for the Lower Southern Rivers Drainage Basin, where the proposed project is located, focuses on employing natural mitigation methodologies to strategically reduce flow into and within Back Bay, along with an integrated system of defense structures and complementary adaptation measures, such as land-use strategies, to improve flood storage and overall coastal resiliency. The Bonney Cove area of Back Bay, where the project site is proposed, is particularly suitable for the use of nature-based strategies given the low elevations of marshlands and documented historic degradation of habitat. Participants at the 'near-neighbor' public engagement meetings held during the SLW Adaptation Strategy development were supportive of these types of strategies.

The City has several dedicated Capital Improvement Program (CIP) initiatives for the Lower Southern Rivers Drainage Basin for implementation of these strategies. The City's Stormwater Green Infrastructure CIP has obligated approximately $421,700 in contracts to support field investigations, environmental assessments, and engineering designs of the project – a true indication of the City's commitment to nature-based approaches and the critical first step in a broader effort. During the General Election on November 2, 2021, Virginia Beach residents voted to authorize $567.5 million dollars in debt to fund the design and construction of 21 Phase 1 projects in the citywide Flood Protection Program. [2] The Back Bay Marsh Terrace project is included under the Stormwater Green Infrastructure Master Project.[3] Other Southern Watershed projects that received funding under the Flood Protection Program include the West Neck Creek Bridge City-Wide Sea Level Rise Strategy, the Pungo Ferry Road Improvements, and the Sandbridge/New Bridge Intersection Improvements projects.

Outside of this project, the Virginia Beach City Council has recently funded a $5.2 million dollar voluntary acquisition program to encourage flood-prone properties to apply for a buyout to enable the City to convert parcels to open space to serve as flood storage and a marsh migration buffer. The City's

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[1] City of Virginia Beach Sea Level Wise Adaptation Strategy webpage: https://www.vbgov.com/government/departments/public-works/comp-sea-level-rise/Pages/default.aspx

[2] City of Virginia Beach Flood Protection Program webpage: https://www.vbgov.com/government/departments/public-works/flood-protection-program/Pages/Flood-Protection-Program.aspx.

[3] Stormwater Green Infrastructure Page: https://www.vbgov.com/government/departments/public-works/flood-protection-program/Pages/Stormwater-Green-Infrastructure-.aspx

Stormwater Green Infrastructure CIP is also supporting the implementation of other natural and nature-based projects across the City, including a wetland and floodplain restoration project along the Eastern Branch of the Elizabeth River.

An assessment of restoration opportunities in the City's Lower Southern Rivers Drainage Basin with dual flood reduction and habitat restoration benefits identified the Bonney Cove area as a potential project site for several reasons. The Bonney Cove site has experienced significant historical ecological degradation. Historical shoreline data from 1869 indicates approximately 50% of present-day open water in Bonney Cove (260 acres) was previously marsh (Figure 1). Loss of the marsh island habitat within Bonney Cove has resulted in the opening of a secondary channel allowing increased flow exchange between the upper and lower bays. In comparison to shore-adjacent restoration, off-shore marsh restoration leveraging hydraulic modeling identified Bonney Cove as a location where marsh restoration has the potential to reduce the propagation of floodwaters through key pathways within Back Bay. The United States Fish and Wildlife Service (USFWS) and the Virginia Department of Wildlife Resources (VDWR) also identified Bonney Cove as a restoration priority as this area serves as an ideal location for Submerged Aquatic Vegetation (SAV) reestablishment and vital habitat for migratory birds and fish.

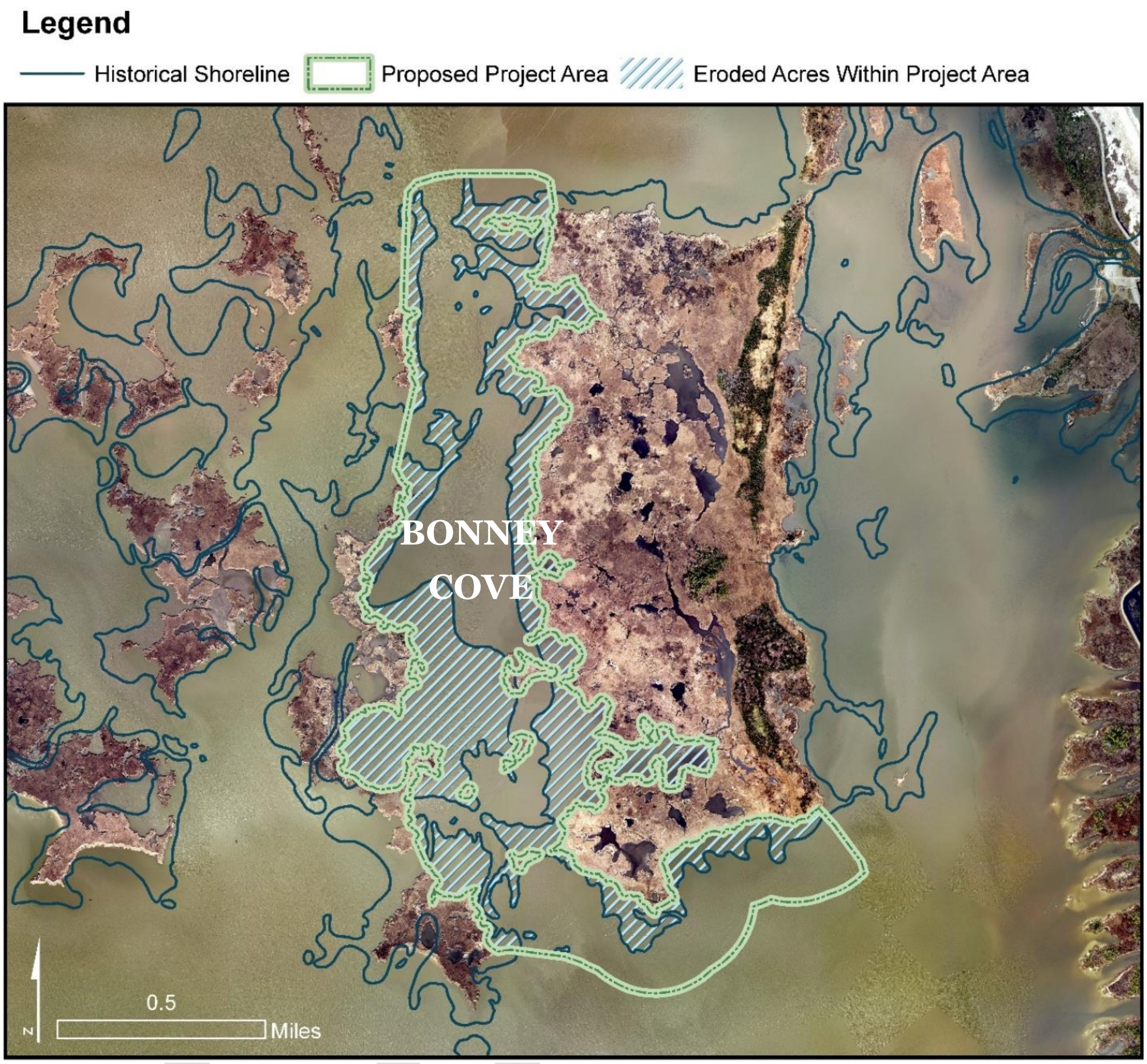

Figure 1: Historical marsh erosion within the project area.

The project is situated within the Bonney Cove area of Back Bay, spanning the western and southern lengths of Long Island, as shown in Figure 1.

Project Background

Marsh island restoration through terracing was identified as a particularly viable solution given Back Bay's shallow bottom and the historical loss of habitat. The marsh terraces are narrow man-made islands that will be arranged across areas that were historically marsh but are now shallow open water. A series of these islands, or terraces, are typically arranged in a chevron pattern. The overall field of terraces dissipates waves and slows down water moving through the area. In turn, the calmer water allows more sunlight to penetrate to the shallow bottom, promoting establishment and growth of marsh

and SAV habitats. Further, as opposed to one continuous marsh platform, marsh terraces maximize habitat for a variety of fish and wildlife species.

The Preferred Alternative includes the creation of 41 individual marsh terraces totaling approximately 25,000 linear feet (or an approximately 47-acre footprint) across Bonney Cove. These 47 acres of terraces are comprised of approximately 13 acres of emergent (low and high marsh) vegetated habitat, 14 acres of upland vegetated habitat, and 16 acres of submerged terrace habitat. Approximately 310 acres of suitable SAV habitat will remain in between the terraces.

Terrace Construction and Orientation

Terrace construction will begin in the northern extent of the project site, and the contractor will work towards the southern extent of the site. The contractor will complete each terrace, including installing plants, before moving to the next. Marsh terrace construction will occur over two years (2025 to 2026) and will pause annually between October 31st and March 1st to limit disturbance to wintering waterfowl and migration, in accommodation of BBNWR's requirement. Approximately 20 terraces will be constructed in 2025 ("Phase 1"), and 21 terraces will be constructed in 2026 ("Phase 2"). The following sections summarize the proposed design and construction approach.

Terraces will be generally oriented perpendicular to the predominant wind direction (south-southwest) to maximize wave energy reduction. The terraces will be segmented in a chevron (duck-wing) pattern to create the most favorable fish and swimming crustacean (termed "nekton") habitat, facilitate adequate circulation, and maintain navigability throughout the project area. The terraces will not be connected to the adjacent marsh to maintain a physical open water barrier to deter the invasion of Common Reed (*Phragmites australis*) stands.

The terraces will be spaced at approximately 300-foot intervals in the northern and southern quarters and span 15 feet in width, and at least 600-foot intervals in the center and span 30 feet in width. This arrangement will lessen the amount of open water and subsequent wave action at the northern and southern ends of the site and provide space for marine-based construction equipment. The design team reviewed the final spacing layout of the terraces to ensure navigability of a watercraft through the project site which will be required for post-construction monitoring, any needed maintenance, as well as community recreational access.

The terraces would consist of a sand filled core encapsulated by a high-strength blend of woven and non-woven geotextile fabrics ("geobags"). The sand for this material would need to come from offsite sources. Back Bay is too shallow to accommodate conventional barges for material placement. To avoid extensive impacts to the bottom of the bay, the slurry basin will pump sand for the project from the proposed Shipps Cabin Road staging area to Bonney Cove. The slurry pipeline will consist of approximately 10,424 linear feet of 12" diameter HDPE fused/welded pipeline that will be assembled on land and floated into its proposed alignment within Back Bay. The pipe would be marked by floats

every 5 feet and temporary signage as reasonable. It is anticipated the pipeline will be submerged to the bottom of the bay at channel crossings and adjacent to a duck hunting cabin adjacent to the alignment. By establishing a floating pipeline, it will limit disturbances to the subaqueous bottomlands along the alignment and allow for the retraction of the pipeline during the winter inactive periods and inclement weather events. Booster stations would be placed approximately every mile. These booster stations would consist of a pontoon mounted diesel engine pump capable of moving the sand slurry from the laydown area to the site. Given the distance to the site, four or five of these booster stations are anticipated to be necessary to create the sand cores of the terrace. It is estimated that 450 Gallons Per Minute (GPM) of sand slurry would be pumped through the pipe.

Once the cores are in place, long reach excavators would travel along the tops of the terraces and begin to shape the cross slopes. Appropriate materials for establishing vegetation atop the terraces will be primarily sourced from materials dredged during the Sandbridge Road Nimmo Parkway Phase VII-A project located immediately north of Back Bay (VMRC 15-1564, USACE IP NAO-2015-00151). Materials will be tested and screened to remove organics prior to application to the terraces. As needed, dredging sites adjacent to the proposed terrace locations that are confirmed to be devoid of SAV will be utilized to provide supplemental soil materials to top the proposed terraces[4]. It was determined that the in-situ bay sediment would be suitable for vegetation growth. The marsh terraces would be covered with 1 to 3 feet of suitable fill, depending on crest widths. Jute netting will cover the topsoil to control erosion and promote vegetation establishment. Coir logs will be places along the terrace slope controls to further promote vegetation establishment along the slope.

SAV Plantings

The City has partnered with Virginia Polytechnic Institute and State University ("Virginia Tech") to evaluate opportunities for restoring populations of native Wild Celery (*Vallisneria americana*) in Back Bay. The Virginia Tech research team has developed an innovative technique to grow Wild Celery in an aquaculture center that results in larger, mature plants that can better withstand Back Bay's turbidity. Once transplanted, plants are surrounded by cages to prevent predation. These founder colonies can be used for propagation throughout Back Bay. After terrace construction, the City will transplant Wild Celery in an area adjacent to the site. This founder colony will be used to strategically transplant Wild Celery in between the terraces for 5 years after construction (2026 – 2029) with the ultimate goal of establishing 10 acres of SAV vegetation in between the marsh terraces.

[4] The 60% preliminary design showed preliminary siting of these dredge areas based on avoidance of existing SAV habitat; however, pre-construction surveys of SAV would be required to re-delineate these dredging areas.

Terrace Plantings – Upland and Marsh Vegetation

The terraces' intertidal perimeter will be planted with appropriate emergent estuarine plant species (e.g., Saltmarsh Cordgrass [*Spartina alterniflora*] and Salt Meadow Hay [*Spartina patens*]) and brackish plant species (e.g., Big Cordgrass [*Spartina cynosuroides*]). These plants will be installed as soon as possible after construction to stabilize planting areas and protect the terrace from erosion. In addition to emergent grass, woody growth (i.e., shrubs and trees) within the terrace crest will be incorporated to protect the terraces' surfaces from rain and wind erosion and hold the landform together through substantial root systems.

Appropriate native species were identified based on the review of the reference marshes surrounding the project site and a review of water levels in Back Bay. Since the Bay's water levels are not affected by lunar tides and instead by wind-driven fluctuations, the project team evaluated average water elevations at the U.S. Geological Survey (USGS) Beggars Bridge Creek Gauge (Gauge ID 0204300267) from 2016 – 2021 to determine ranges of inundation to achieve functional marsh elevations throughout the project life, defined as:

- *Mean Low Water (MLW)*: the average low water at the site (10th Percentile: -0.62 ft NAVD88)
- *Mean High Water (MHW)*: the average high water at the site (95th Percentile: 1.22 ft NAVD88)
- *Mean Tide Level (MTL)*: halfway between MLW and MHW (0.3 ft NAVD88)
- *Upper Limit of Wetlands (ULW)*: approximately 1.5 times the mean tide range at the site (2.76 ft NAVD88)

These elevations were correlated to suitability for low marsh, high marsh, and upland species, as shown in Table 1.

Table 1: Proposed planting elevation zones.

Planting Zone	Definition	Elevation Range	Elevation (feet NAVD88)	Percentage of record where water reaches these elevations
Low Marsh	Marsh that is flooded frequently but exposed sometimes	MTL - MHW	0.3 – 1.2 ft	48%
High Marsh	Marsh that is generally only flooded during higher-than average water conditions	MHW – ULW	1.2 to 2.8 ft	7%
Upland Habitat	Habitat that is rarely flooded, only during extreme conditions	> ULW	> 2.8 ft	0%

Five planting schemas were identified to provide the highest possible environmental benefit in terms of erosion control, habitat diversity, and fetch reduction. The wider (30-foot) terraces will be planted with Bald Cypress (*Taxodium districhum*) trees capable of withstanding rising water levels. The full list of species and quantities is provided in the 95% design plan set.

The final engineered design component is the strategic placement of rock on the exposed perimeter terraces on the project site's north, west, and southern extents. The need for the rock armor was determined through analysis of wind data both from NOAA and ASCE-7-10 50-year return period anticipated 3-second gust values. These values were used to calculate fetch-generated waves at the project site. The calculations performed confirmed that armored protection would be required to protect the proposed terraces from the forces created by wave action. The stone sizes required for these features (Class II rip rap) were calculated following the procedures laid out in the USACE Coastal Engineering Manual (CEM) and Virginia Institute of Marine Science (VIMS) Living Shoreline Design Guidelines for Shore Protection in Virginia's Estuarine Environments. Two calculation methods, Hudson (1974) and Van Der Meer (1988), from the CEM were utilized to evaluate the range of acceptable rock armor for the exposed perimeter. These two methods calculate the armor stone size based on several design inputs including initial wave height, allowable damage level, revetment slope, and breaking versus non-breaking waves. The two methods often result in corresponding values that are used by the engineer to make an experienced determination on the final rock armor sizing. The rock armor will serve as a nature-based design element by acting as a substrate for the Wild Celery grass that has proven to be successful for SAV establishment in Back Bay (see Figure 2).

Figure 2: Example Back Bay SAV experiment; photo courtesy of Virginia Tech.

Monitoring Goals and Objectives

Annual post-construction monitoring of the site is required by the Virginia Marine Resource Commission (VMRC) (TBD) Permit (VMRC #XXXX-XXXX) and the U.S. Army Corps of Engineers (USACE) Individual Permit (NOA-20XX-XXXXX). [Insert details of the relevant permits and permit conditions]. The following goals, objectives, and metrics were established to enable consistent tracking of the primary living shoreline project components across each monitoring year.

1. **Monitoring Goal 1**: Establishment of a Sustainable Coastal Marsh Island System
   a. Objective 1a: Establish Emergent Marsh Habitat
      - Metric: For each monitoring year, the project area should maintain or increase the overall coverage of emergent marsh vegetation. There should be no significant signs of herbivory or invasive species establishment.

   b. Objective 1b: Establish Upland Habitat
      - Metric: For each monitoring year, the project area should maintain or increase the overall coverage of upland vegetation. There should be no significant signs of herbivory or invasive species establishment.
2. **Monitoring Goal 2**: Stability of Marsh Terraces
   a. Objective 2: Marsh Terrace Structures
      - Metric: For each monitoring year, the terrace structures should show no significant signs of damage, deterioration or extreme settlement.
3. **Monitoring Goal 3**: Establishment of a Sustainable SAV Community
   a. Objective 3: Establish SAV Communities

- Metric: For each monitoring year, the SAV planting areas should maintain or increase the overall coverage of SAV vegetation. There should be no significant signs of herbivory or invasive species establishment.

MONITORING PLAN

The monitoring plan includes stakeholders, a schedule for the annual monitoring inspections, the monitoring strategy/sampling plan, and approach for addressing any needs for maintenance.

Monitoring Stakeholders

An Environmental Scientist from Dewberry Engineers Inc. will perform the annual monitoring inspections and provide a copy of the monitoring report to the City of Virginia Beach, USACE, VDEQ, VMRC, and the City of Virginia Beach Wetlands Board as necessary. As owners of the project, the City of Virginia Beach will review monitoring recommendations and perform corrective actions as necessary.

Annual Inspection Schedule

Monitoring inspections should be conducted annually, during the peak growing season, which is defined by VMRC as between June and August. To enable consistent tracking of project performance from year to year, annual monitoring inspections will be conducted prior to the end of the growing season in September of each year, with annual reports to be submitted to regulatory stakeholders prior to November 30th [or an annual date defined in the permit conditions] of each year. The following outlines the monitoring inspection schedule and deliverables.

Phase 1 Post-Construction As-Built Report (Date: Prior to December 31st, 2025)

To serve as a baseline for the post-construction annual monitoring, an as-built report for the Phase 1 terraces will be completed following the construction of each phase of terraces and submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following.

- Coordinates and diagrams of established transects, as well as site photographs from photo stations 1-40 as defined in the Methods section.
- Final location of all planted vegetation (upland plantings, high marsh plantings and low marsh plantings).
- Final grade topographic surveys (plan, profile, and cross sections).
- Discussion of the project design versus as-built conditions.

Phase 2 Post-Construction As-Built Report (Date: Prior to December 31st, 2026)

To serve as a baseline for the post-construction annual monitoring, an as-built report for the Phase 2 terraces will be completed following the construction of each phase of terraces and submitted to the

City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following.

- Coordinates and diagrams of established transects, as well as site photographs from photo stations 41-80 as defined in the Methods section.
- Final location of all planted vegetation (upland plantings, high marsh plantings and low marsh plantings).
- Final location and extent of SAV plantings.
- Final grade topographic surveys (plan, profile, and cross sections).
- Discussion of the project design versus as-built conditions.

Year 1a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2026)

At the end of the first full growing season following planting of the Phase 1 terraces, a Year 1a monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 40 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 1 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion; it is anticipated that the wetland planting contractor will provide a one-year post construction maintenance and guarantee period for the wetland plantings.

Year 1b/2a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2027)

At the end of the first full growing season following planting of the Phase 2 terraces following planting, and the second full growing season of the Phase 1 terraces, a Year 1b/2a monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 1 conditions (for Phase 2 terraces) and to Year 2 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).

- Estimated percent cover and change in coverage from planted conditions to Year 1 conditions for SAV planting quadrants
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion; it is anticipated that the wetland planting contractor will provide a one-year post construction maintenance and guarantee period for the wetland plantings.

Year 2b/3a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2028)

At the end of the second full growing season of the Phase 2 terraces following planting, and the third full growing season of the Phase 1 terraces, a Year 2b/3a monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 2 conditions (for Phase 2 terraces) and to Year 3 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- Estimated percent cover and change in coverage from planted conditions to Year 2 conditions for SAV planting quadrants
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

Year 3b/4a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2029)

At the end of the third full growing season of the Phase 2 terraces following planting, and the fourth full growing season of the Phase 1 terraces, a Year 3b/4a monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 3 conditions (for Phase 2 terraces) and to Year 4 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).

- Estimated percent cover and change in coverage from planted conditions to Year 3 conditions for SAV planting quadrants
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

Year 4b/5a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2030)

At the end of the fourth full growing season of the Phase 2 terraces following planting, and the fifth full growing season of the Phase 1 terraces, a Year 4b/Final (Year 5a) monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 4 conditions (for Phase 2 terraces) and to Year 5 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- Estimated percent cover and change in coverage from planted conditions to Year 4 conditions for SAV planting quadrants
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

Year 5b Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2031)

At the end of the fifth full growing season of the Phase 2 terraces following planting, a Final (Year 5b) monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 41 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 5 conditions (for Phase 2 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- Estimated percent cover and change in coverage from planted conditions to Year 5 conditions for SAV planting quadrants

- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

Monitoring Strategy

The monitoring strategy consists of established transects with photo stations and quadrants that cover the area between transects. This approach enables monitoring of the four primary features of the living shoreline: uplands, low-marsh plantings, high-marsh plantings, and SAV*.

*Note: The planting scheme for SAV has not yet been established but it is anticipated that some SAV will be planted along the submerged portions of the marsh terraces. If more suitable planting locations are determined to be between terraces, separate transects will be established and sampled to track SAV survival apart from the proposed terrace transects.

Transects/Photo Points

A total of eighty (80) transects will be established across the project site, with 10 transects located along each of 8 terraces. Transects will span perpendicular to the length of each terrace from the ridge to the edge of the planted/vegetated area. See Figures 3 and 4 for graphic depictions of the proposed transect locations and layouts. Terraces were selected using a random stratified method to ensure representative terraces in each location within the project area (North Interior, North Exterior, South Interior, South Exterior), and of each planting scheme, were represented in the proposed monitoring plan. The selected terraces are as follows:

- North Interior: T-110, T-113
- North Exterior: T-100, T-106
- South Interior: T-124, T-131
- South Exterior: T-123, T-140

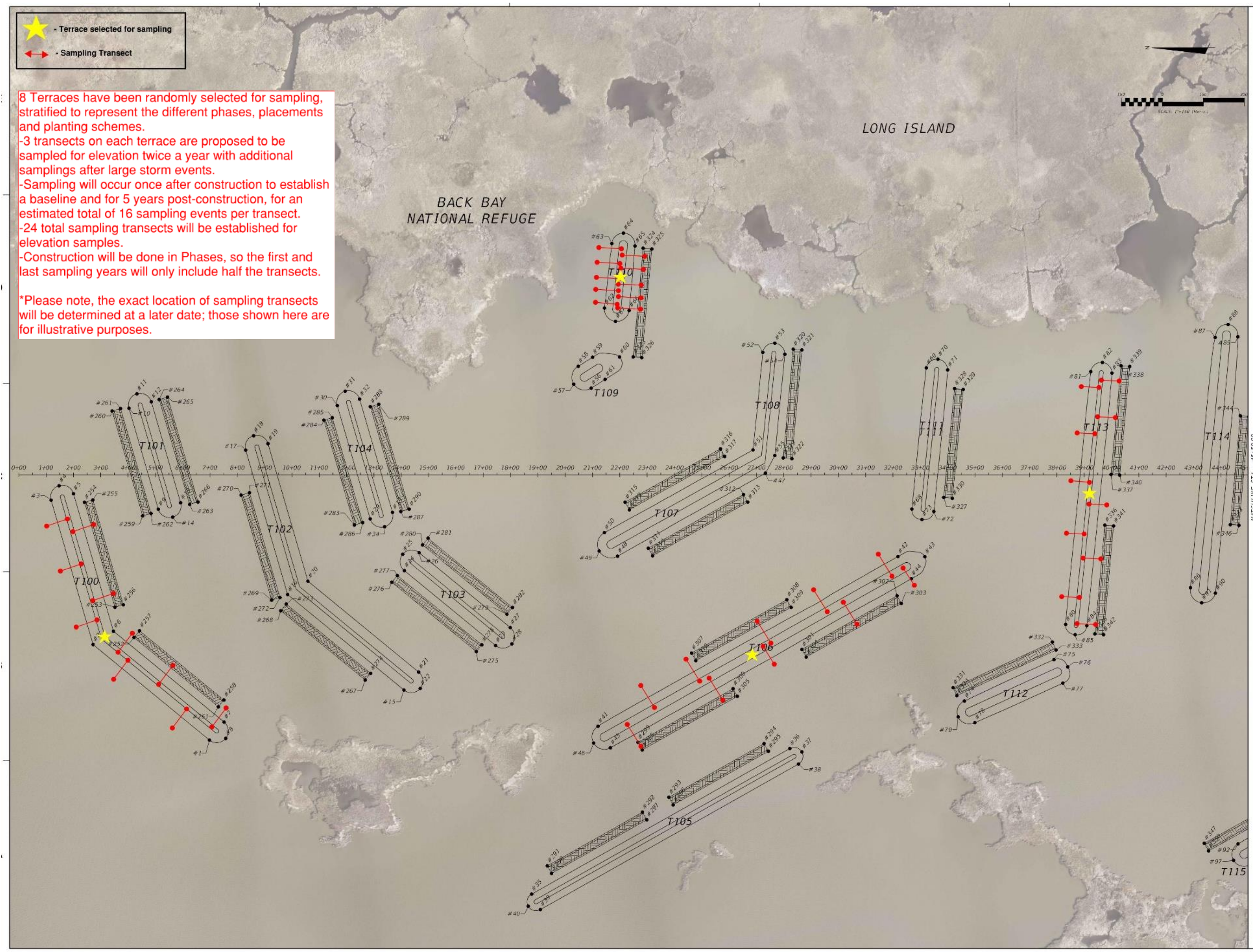

Figure 3: Monitoring design site plan – North Terraces

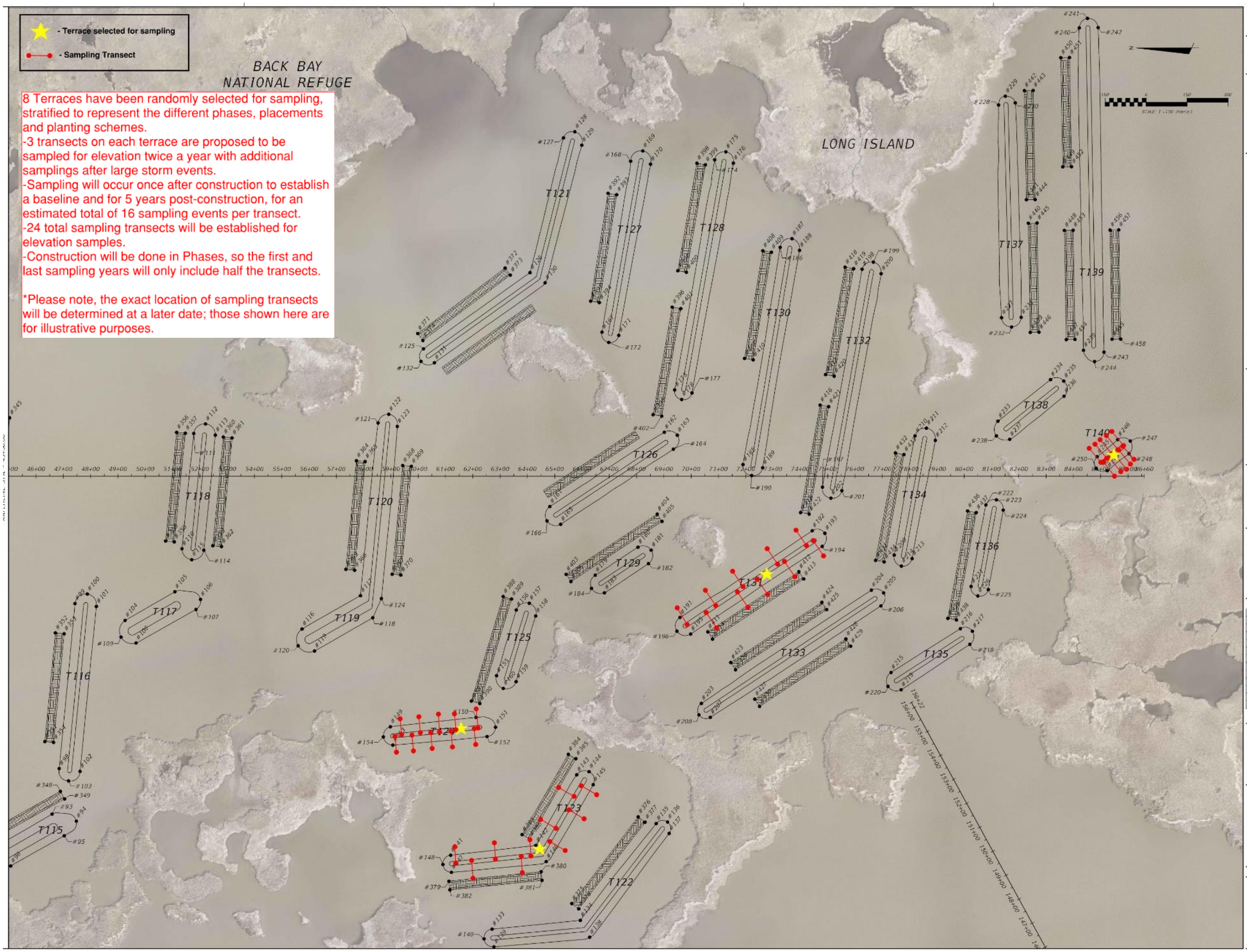

Figure 4: Monitoring design site plan – South Terraces

Permanent photo stations will be established at each quadrant along each transect to capture the design features/established habitats and vegetation. Figure 5 shows the general proposed locations (indicated by the red arrows/labels) for each quadrant and photograph station along each transect. Photos were shot from each photo location on [DATE]. These photos will be collected annually and compiled in Appendix B.

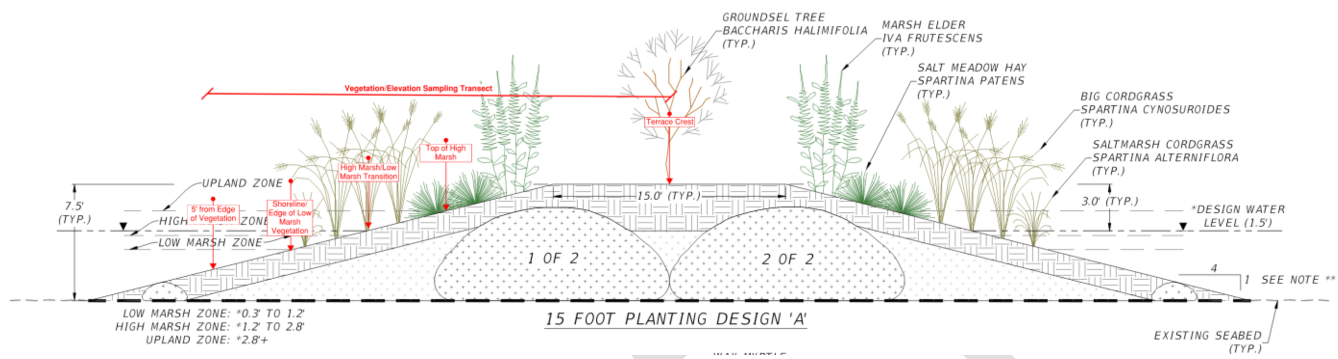

Figure 5: Photo station layout example

Quadrants

To estimate percent cover of vegetation, four (4) quadrants along each of ten (10) transects will be established on the eight selected terraces to allow for estimates of habitat coverage and planting survival. Estimates of coverage and survival were compared to post-construction conditions to evaluate changes.

Further, the following guiding questions were established to monitor overall project performance, presence of invasive species, and identify any needs for maintenance:

1. Are there specific problem areas where plants are dying or appear unhealthy?
2. Were any signs of herbivory observed?
3. Are there any undesirable plant species present?
4. Condition of the terrace structures: Is there any observed settlement, dislodged stone, significant debris etc.?
5. If an updated survey was conducted, are there any significant changes in the profile of the marsh terraces?
6. Does the upland portion of each terrace show any significant signs of erosion or loss of vegetation?

MONITORING RESULTS

Table 2: Low Marsh Vegetation Percent Cover Monitoring Results (Example Table – Terrace 1).

		Estimated Percent Coverage						Percent Change in Coverage (from Baseline)				
Terrace/ Transect	Photo Station Reference	Baseline (2024)	Year 1 (2025)	Year 2 (2026)	Year 3 (2027)	Year 4 (2028)	Year 5 (2029)	Baseline to Year 1	Baseline to Year 2	Baseline to Year 3	Baseline to Year 4	Baseline to Year 5
1 - 1	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 2	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 3	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 4	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 5	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 6	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 7	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 8	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 9	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 10	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
Overall		**Choose an item.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**

Table 3: High Marsh Vegetation Percent Cover Monitoring Results (Example Table – Terrace 1).

		Estimated Percent Coverage						Percent Change in Coverage (from Baseline)				
Terrace/ Transect	Photo Station Reference	Baseline (2024)	Year 1 (2025)	Year 2 (2026)	Year 3 (2027)	Year 4 (2028)	Year 5 (2029)	Baseline to Year 1	Baseline to Year 2	Baseline to Year 3	Baseline to Year 4	Baseline to Year 5
1 - 1	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 2	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 3	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 4	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 5	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 6	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 7	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 8	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 9	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 10	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
Overall		**Choose an item.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**

Table 4: General Observations for Wetland Planting Areas on the Marsh Terraces (Example Table – Terrace 1)

Monitoring Questions	Terrace/Transect									
	1 - 1	1 - 2	1 - 3	1 - 4	1 - 5	1 - 6	1 - 7	1 - 8	1 - 9	1 - 10
Are there specific problem areas where plants are dying or appear unhealthy?	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.
Were any herbivory issues observed?	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.
Are there any undesirable plant species present?	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.
If updated survey was conducted, are there any significant changes in the profile of the living shoreline system?	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.

Table 5: General Observations for the Unplanted Structural Components of the Marsh Terraces (Example Table – Terrace 1)

Terrace/Transect										
Monitoring Questions	**1 - 1**	**1 - 2**	**1 - 3**	**1 - 4**	**1 - 5**	**1 - 6**	**1 - 7**	**1 - 8**	**1 - 9**	**1 - 10**
Are there any structural issues with the planted terrace structures (e.g. observed settlement, loss of topsoil, etc.)?	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☒ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.
Is there any observed growth in SAV on or adjacent to the marsh terraces?	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☒ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.

Are there any structural issues with the rock armoring on the terraces (e.g. observed settlement, dislodged stone, significant debris, etc.)?	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.

MAINTENANCE RECOMMENDATIONS

The following table outlines the recommendations for maintenance, including estimated quantities and specific guidance, based on the results of the [YEAR] monitoring results.

Table 6: Maintenance Recommendations Checklist

Design Feature/ Monitoring Objective	Maintenance Elements	Location & Estimated Quantity	Specific Guidance
Terrace Upland and Wetland Habitats and Wetland Soils – Monitoring Objectives 1a/1b	☐ Replace plants	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Add new plants	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Remove debris	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Remove invasive vegetation	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Add sand to eroding areas	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Replace waterfowl barrier	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.

Design Feature/ Monitoring Objective	Maintenance Elements	Location & Estimated Quantity	Specific Guidance
Terrace Structures & Stone Armoring, Monitoring Objective 2a/2b	☐ Re-place dislodged stones	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Add additional stone to address settlement	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Remove debris	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Repair sand cores or other structural elements	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
SAV Establishment, Monitoring Objective 3	☐ Replace plants	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Add new plants	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.

APPENDIX A: AS-BUILT PLANS

[Page left intentionally blank; as-built plans will be included in the Year 1 monitoring report]

APPENDIX B: MONITORING PHOTOGRAPHS

Table 7: Terrace 1 Transect 1 Photographs

Photograph from Photo Location 1A	Photograph from Photo Location 1B
Photograph from Photo Location 1C	Additional photos of any problem areas.

Table 8: Terrace 1 Transect 2 Photographs

Photograph from Photo Location 2A	Photograph from Photo Location 2B
Photograph from Photo Location 2C	Additional photos of any problem areas.

Table 9: Terrace 1 Transect 3 Photographs

Photograph from Photo Location 3A	Photograph from Photo Location 3B
Photograph from Photo Location 3C	Additional photos of any problem areas.

Table 10: Terrace 1 Transect 4 Photographs

Photograph from Photo Location 4A	Photograph from Photo Location 4B
Photograph from Photo Location 4C	Additional photos of any problem areas.

Table 11: Terrace 1 Transect 5 Photographs

Photograph from Photo Location 5A	Photograph from Photo Location 5B
Photograph from Photo Location 5C	Additional photos of any problem areas.

Table 12: Terrace 1 Transect 6 Photographs

Photograph from Photo Location 6A	Photograph from Photo Location 6B
Photograph from Photo Location 6C	Additional photos of any problem areas.

Table 13: Terrace 1 Transect 7 Photographs

Photograph from Photo Location 7A	Photograph from Photo Location 7B
Photograph from Photo Location 7C	Additional photos of any problem areas.

Table 14: Terrace 1 Transect 7 Photographs

Photograph from Photo Location 7A	Photograph from Photo Location 7B
Photograph from Photo Location 7C	Additional photos of any problem areas.

Table 15: Terrace 1 Transect 8 Photographs

Photograph from Photo Location 8A	Photograph from Photo Location 8B
Photograph from Photo Location 8C	Additional photos of any problem areas.

Table 16: Terrace 1 Transect 9 Photographs

Photograph from Photo Location 9A	Photograph from Photo Location 9B
Photograph from Photo Location 9C	Additional photos of any problem areas.

Table 17: Terrace 1 Transect 10 Photographs

Photograph from Photo Location 9A	Photograph from Photo Location 9B
Photograph from Photo Location 9C	Additional photos of any problem areas.

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2023 Virginia Community Flood Preparedness Fund

Marsh Restoration in Back Bay, Virginia Beach

CITY OF
VIRGINIA
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Table of Contents

Appendix A – Application Form

Applicants must have prior approval from the Department to submit applications, forms, and supporting documents by mail in lieu of the WebGrants portal.

Appendix A: Application Form for Grant and Loan Requests for All Categories

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Virginia Department of Conservation and Recreation
Virginia Community Flood Preparedness Fund Grant Program

Name of Local Government:

Category Being Applied for (check one):

☐ **Capacity Building/Planning**

☑ **Project**

☐ **Study**

NFIP/DCR Community Identification Number (CID) 515531

Name of Authorized Official and Title: Toni Utterback, Stormwater Engineering Center Administrator

Signature of Authorized Official: Katie E Shannon for Toni Utterback

Mailing Address (1): 2875 Sabre Street, Suite 250

Mailing Address (2): ______

City: Virginia Beach **State:** Virginia **Zip:** 23452

Telephone Number: (757) 385-8746 **Cell Phone Number:** (____) ______

Email Address: TPUtterback@vbgov.com

Contact and Title (If different from authorized official): C.J. Bodnar, Technical Services Program Manager

Type text here

Mailing Address (1): 2875 Sabre Street, Suite 250

Mailing Address (2): ____________________

City: Virginia Beach **State:** Virginia **Zip:** 23452

Telephone Number: (757) 385-8430 **Cell Phone Number:** (____) ________________

Email Address: CBodnar@vbgov.com

Is the proposal in this application intended to benefit a low-income geographic area as defined in the Part 1 Definitions? Yes ____ No ✓

Categories (select applicable activities that will be included in the project and used for scoring criterion):

Capacity Building and Planning Grants

☐ Floodplain Staff Capacity.

☐ Resilience Plan Development

- ☐ Revisions to existing resilience plans and modifications to existing comprehensive and hazard mitigation plans.
- ☐ Resource assessments, planning, strategies, and development.
  - Policy management and/or development.
  - Stakeholder engagement and strategies.

☐ Other: ____________________

Study Grants (Check All that Apply)

☐ Studies to aid in updating floodplain ordinances to maintain compliance with the NFIP, or to incorporate higher standards that may reduce the risk of flood damage. This must include establishing processes for implementing the ordinance, including but not limited to, permitting, record retention, violations, and variances. This may include revising a floodplain ordinance when the community is getting new Flood Insurance Rate Maps (FIRMs), updating a floodplain ordinance to include floodplain setbacks, freeboard, or other

higher standards, RiskMAP public noticing requirements, or correcting issues identified in a Corrective Action Plan.

- ☐ Revising other land use ordinances to incorporate flood protection and mitigation goals, standards, and practices.
- ☐ Conducting hydrologic and hydraulic (H&H) studies of floodplains. *Changes to the base flood, as demonstrated by the H&H must be submitted to FEMA within 6 months of the data becoming available.*
- ☐ Studies and Data Collection of Statewide and Regional Significance.
- ☐ Revisions to existing resilience plans and modifications to existing comprehensive and hazard.
- ☐ Other relevant flood prevention and protection project or study.

Project Grants and Loans (Check All that Apply – Hybrid Solutions will include items from both the "Nature-Based" and "Other" categories)

Nature-based solutions

- ☐ Acquisition of property (or interests therein) and/or structures for purposes of allowing floodwater inundation, strategic retreat of existing land uses from areas vulnerable to flooding; the conservation or enhancement of natural flood resilience resources; or acquisition of structures, provided the acquired property will be protected in perpetuity from further development, <u>and where the flood mitigation benefits will be achieved as a part of the same project as the property acquisition.</u>
- ☑ Wetland restoration.
- ☐ Floodplain restoration.
- ☐ Construction of swales and settling ponds.
- ☑ Living shorelines and vegetated buffers.
- ☐ Permanent conservation of undeveloped lands identified as having flood resilience value by *ConserveVirginia* Floodplain and Flooding Resilience layer or a similar data driven analytic tool, or the acquisition of developed land for future conservation.
- ☐ Dam removal.
- ☐ Stream bank restoration or stabilization.
- ☐ Restoration of floodplains to natural and beneficial function.

Other Projects

- ☐ Structural floodwalls, levees, berms, flood gates, structural conveyances.
- ☐ Storm water system upgrades.
- ☐ Medium and large-scale Low Impact Development (LID) in urban areas.

- Developing flood warning and response systems, which may include gauge installation, to notify residents of potential emergency flooding events.
- Dam restoration.
- Beneficial reuse of dredge materials for flood mitigation purposes
- Removal or relocation of structures from flood-prone areas where the land will not be returned to open space.
- Acquisition of property (or interests therein) and/or structures for purposes of allowing floodwater inundation, strategic retreat of existing land uses from areas vulnerable to flooding; the conservation or enhancement of natural flood resilience resources; or acquisition of structures, provided the acquired property will be protected in perpetuity from further development, <u>and where the flood mitigation benefits will **not be** achieved as a part of the same project as the property acquisition.</u>
- Other project identified in a DCR-approved Resilience Plan.

Location of Project or Activity (Include Maps): Bonney Cove in Back Bay, Virginia Beach

NFIP Community Identification Number (CID#) : 515531

Is Project Located in an NFIP Participating Community? ☑ Yes ☐ No

Is Project Located in a Special Flood Hazard Area? ☑ Yes ☐ No

Flood Zone(s) (If Applicable): Zone VE (EL 5 Feet), Zone AE (EL 4 Feet), Zone Open Water

Flood Insurance Rate Map Number(s) (If Applicable): 5155310215G and 5155310220G

Total Cost of Project: $53,378,490

Total Amount Requested $5,000,000

Amount Requested as Grant $5,000,000

Amount Requested as Project Loan (not including short-term loans for up-front costs) ____________________

Amount Requested as Short-Term loan for Up-Front Costs (not to exceed 20% of amount requested as Grant) _________________________

For projects, planning, capacity building, and studies in low-income geographic areas: Are you requesting that match be waived? □ Yes □ No

<u>Additional Information for Loan Requests</u>
Requested Loan Security: _____________________________

(General Obligation, Lease, Revenue, Special Fund Revenue, and/or Moral obligation from other government entity)

Desired loan term: _________________________________

Since the date of your latest financial statements, did the applicant issue any new debt? ______
(If yes, provide details)

Is there any pending or potential litigation by or against the applicant? ______________

Attach five years of current audited financial statements (FY18-22) or refer to website if posted
(Not necessary for existing VRA borrowers)

Attach FY2024 adopted budget or refer to website

Attach current Capital Improvement Plan

Attach adopted Financial Policies

Attach a list of the ten largest employers in the Applicant's jurisdiction.

Attach a list of the ten largest taxpayers in the Applicant's jurisdiction

Appendix B: Budget Form

Appendix B: Budget Narrative Template

Applicant Name: Community Flood Preparedness Fund & Resilient Virginia Revolving Loan Fund Detailed Budget Narrative Period of Performance: June 2024 through June 2027 Submission Date: November 12, 2023									
								Grand Total State Funding Request	$ 5,000,000
								Grand Total Local Share of Project	$ 38,356,966
			National Fish and Wildlife Foundation Grants					Federal Funding (if applicable)	$ 10,021,524
								Project Grand Total	$ 53,378,490
								Locality Cost Match	% 71.85
Breakout By Cost Type	Personnel	Fringe	Travel	Equipment	Supplies	Contracts	Indirect Costs	Other Costs	Total
Federal Share (if applicable)								10,021,524	10,021,524
Local Share								37,330,166	37,330,166
State Share								5,000,000	5,000,000
Pre-Award/Startup								276,800	276,800
Maintenance								750,000	750,000
Total	$	$	$	$	$	$	$	$53,378,490	$ 53,378,490

1. Federal Share represents National Fish and Wildlife Foundation (NFWF) Grants. NFWF is not a federal agency.
2. Local Share represents the total project cost less design and implementation (monitoring and initial maintenance) costs.
3. State Share represents the CFPF grant request.
4. Pre-Award costs represent project design costs.
5. Maintenance costs represent implementation (monitoring and initial maintenance costs).

Scope of Work Narrative

Introduction

The City of Virginia Beach ("City") is pleased to submit the Marsh Restoration in Back Bay project for consideration under the Flood Prevention and Protection Projects category in the 2023 Virginia Community Flood Preparedness Fund. The City has made significant investments in the study of historical flooding data, current and future hydrology, and the projected increase in flood frequency due to changing rainfall patterns and sea level rise. These studies culminated in Virginia Beach's Resilience Plan, socialized as "Sea Level Wise,"[1] which includes a conceptual suite of projects focused on flood control and resilience. The Virginia Beach Resilience Plan leverages four overarching adaptation strategies to identify actionable projects for each of the City's four unique major watersheds. This project represents the first adaptation project to advance to construction to implement the City's Resilience Plan.

The adaptation strategy for the Southern Rivers Watershed, which includes Back Bay, is presented in Figure 1. The strategy focuses on employing natural mitigation methods, an integrated system of defense structures, and complementary measures, such as land-use strategies. Collectively these approaches are designed to strategically reduce flow into and within Back Bay and improve flood storage and overall coastal resiliency. Marsh restoration was identified as a key resilience-building strategy as part of an extensive evaluation of structural and non-structural alternatives. Marsh restoration provides multiple benefits of flood risk reduction, enhanced habitat, and improved water quality.

As part of the Virginia Coastal Resilience Master Planning Framework, a precursor to the first phase of the Virginia Coastal Resilience Master Plan (CRMP), the Commonwealth of Virginia identified guiding principles for a statewide resilience strategy. One of these guiding principles is recognizing the importance of protecting and enhancing natural infrastructure and prioritizing nature-based infrastructure.[2] The City's marsh restoration project aligns with this principle and was highlighted as an exemplary nature-based project in the CRMP (refer to pages 178-179).[3]

[1] City of Virginia Beach (2020). Virginia Beach Sea Level Wise Adaptation Strategy (Website).
[2] Office of Governor Ralph S. Northam Commonwealth of Virginia. (2020). Virginia Coastal Resilience Master Planning Framework (PDF).
[3] Office of Governor Ralph S. Northam Commonwealth of Virginia. (2021). Virginia Coastal Resilience Master Plan Phase 1 (PDF).

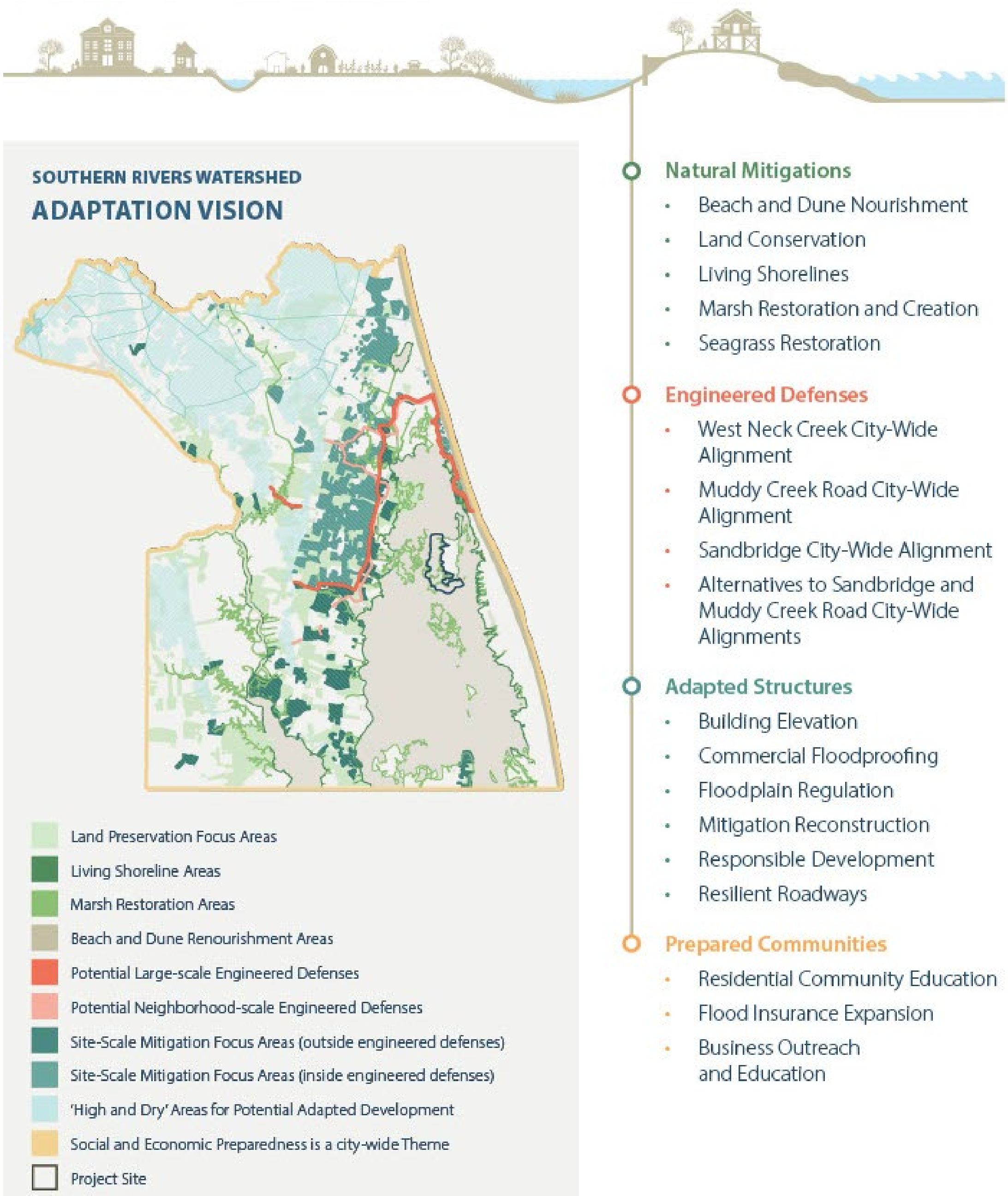

Figure 1: Adaptation Vision for the Southern Rivers Watershed.

Hydraulic modeling analysis identified Bonney Cove as a location where marsh restoration has the potential to reduce the propagation of floodwater through key pathways within Back Bay (Figure 2). The City prioritized this project as the first to advance to construction due to its significant benefits to community and habitat resilience.

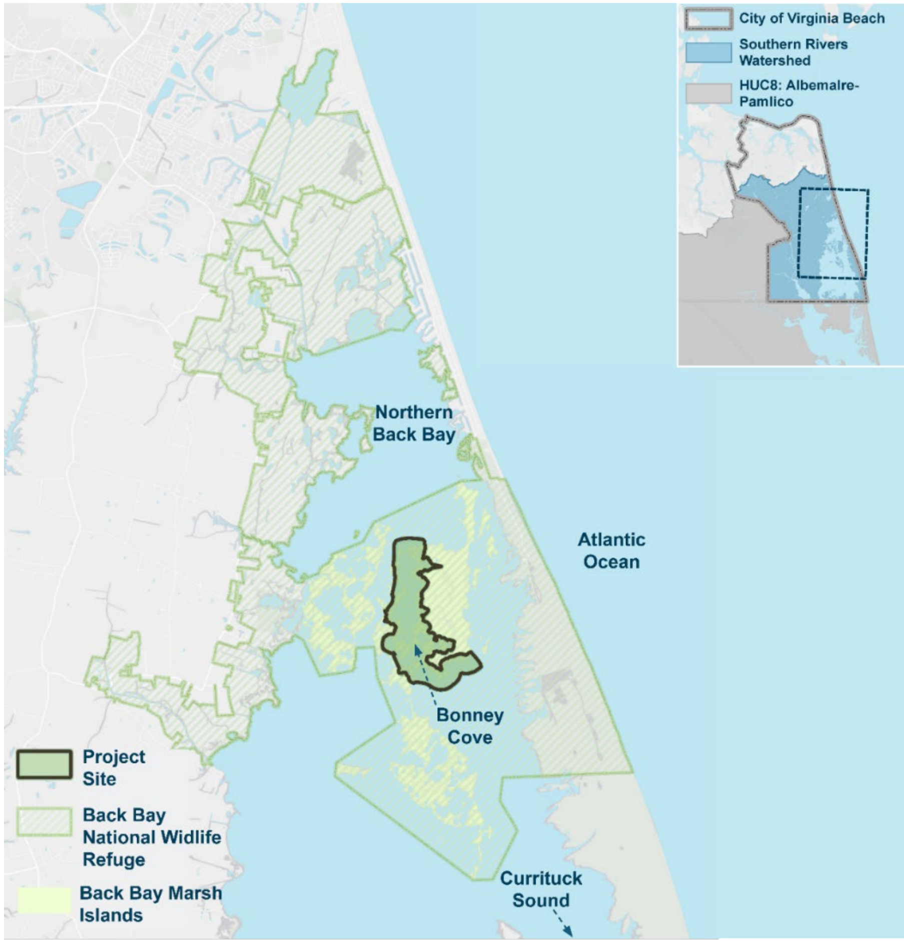

Figure 2: Project site location map.

This project represents a collaborative effort between the City's Department of Public Works alongside other City departments, public constituents, local nonprofits, and state and federal agencies. In selecting the project location and developing the design approach, the City has coordinated closely with the Back Bay National Wildlife Refuge (BBNWR), part of the U.S. Fish and Wildlife Service (USFWS), and the Virginia Department of Wildlife Resources (VDWR). Environmental organizations committed to stewardship of Back Bay have also contributed input throughout the design process, including the Back Bay Restoration Foundation (BBRF), Friends of Back Bay, the Back Bay National Wildlife Refuge Society, and the Albemarle-Pamlico National Estuary Partnership (APNEP). Project field investigations involved local support from Old Dominion University (ODU) and others, and outside expertise from Louisiana. The National Fish and Wildlife Foundation (NFWF) provided grant funding under the National Coastal Resilience Fund (NCRF) to support design, permitting, and environmental assessments. Broad support of the project is demonstrated by contributions from the organizations noted above along with other stakeholders engaged in the restoration effort.

Needs and Problems

Specific Problem Being Solved – Habitat Degradation and "Wind Tide" Flooding

Marshes are vital to the Southern Rivers Watershed for the ecological and flood reduction benefits they provide. The Southern Rivers Watershed contains 90% of the City's land area under an elevation of three feet, making this area particularly susceptible to flood impacts. As illustrated in Figure 3, sustained southerly winds push water up from the Albemarle-Pamlico Sound through the Currituck Sound and into Back Bay, creating a phenomenon referred to locally as "wind tide flooding". Marsh habitat loss has contributed to the opening of a secondary channel in Bonney Cove that has increased water flow during wind tide and other flood events to areas with high community exposure.

Within today's marsh system, it takes between two to five days of sustained southerly winds to cause flooding, depending on the wind speed and direction. Over the last four years, more than five wind tide flooding events have occurred in this area. The increasing frequency of flooding events is primarily attributed to a foot of relative sea level rise in the last 50 years and degradation of marsh and seagrass habitat.

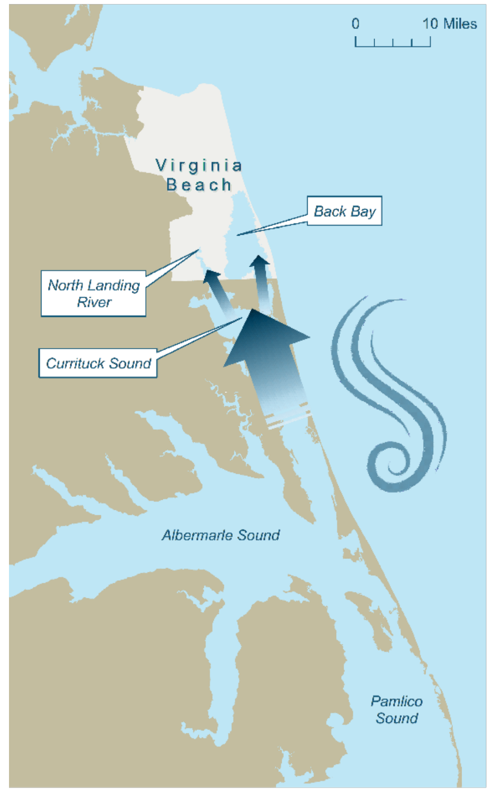

Figure 3: Flood pathways in the Southern Rivers Watershed.

This marsh restoration project aims to address the challenges of habitat degradation and "wind tide" flooding by stabilizing two critically eroding marsh islands, decreasing turbidity to promote the growth of aquatic vegetation, and providing flood risk reduction benefits through increased friction and wave attenuation.

Factors Contributing to the Identified Problem

This growing flood risk in the Southern Rivers Watershed can be attributed mainly to the reduced friction in the water column from the increased water depth and eroded vegetation, which allows water to move more quickly through key hydraulic pathways. Another term for this is "fetch", which is defined as the open water distance over which a given wind can blow and generate higher waves without obstruction. Unmitigated, the continued loss of these marsh island systems and aquatic vegetation is expected to result in more frequent and intense wind tide flooding events.

Emergent Marsh Degradation

Approximately 50% of former marshland at the site (260 acres) has eroded into open water leading to the opening of a wide secondary channel ("Bonney Cove") that is about two miles

long and half a mile wide (Figure 4). The southern exposed edge of the adjacent marsh islands is exposed to approximately 1.5 miles of fetch in the predominant wind direction.

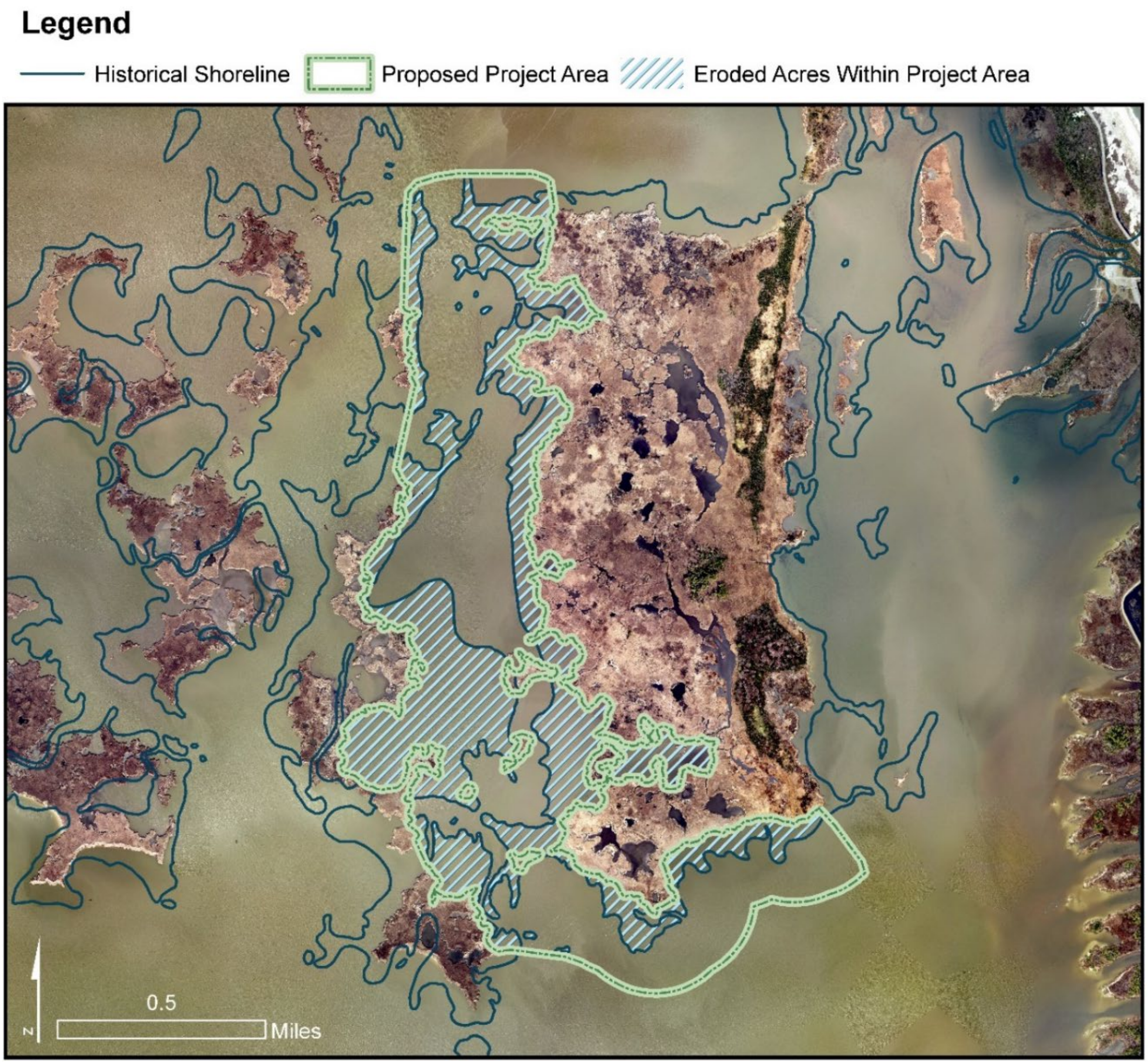

Figure 4: Historical marsh erosion within the project area.

Submerged Aquatic Vegetation (SAV) Loss

SAV used to be abundant at the site (around 45% coverage, overall) but is now extremely sparse, ranging from 0% to 10% coverage across the site, on average. Field studies conducted by the VDWR show that wind-driven waves and high flow velocities are the primary drivers of this loss, particularly in the last 5 years as shown in Figure 5.

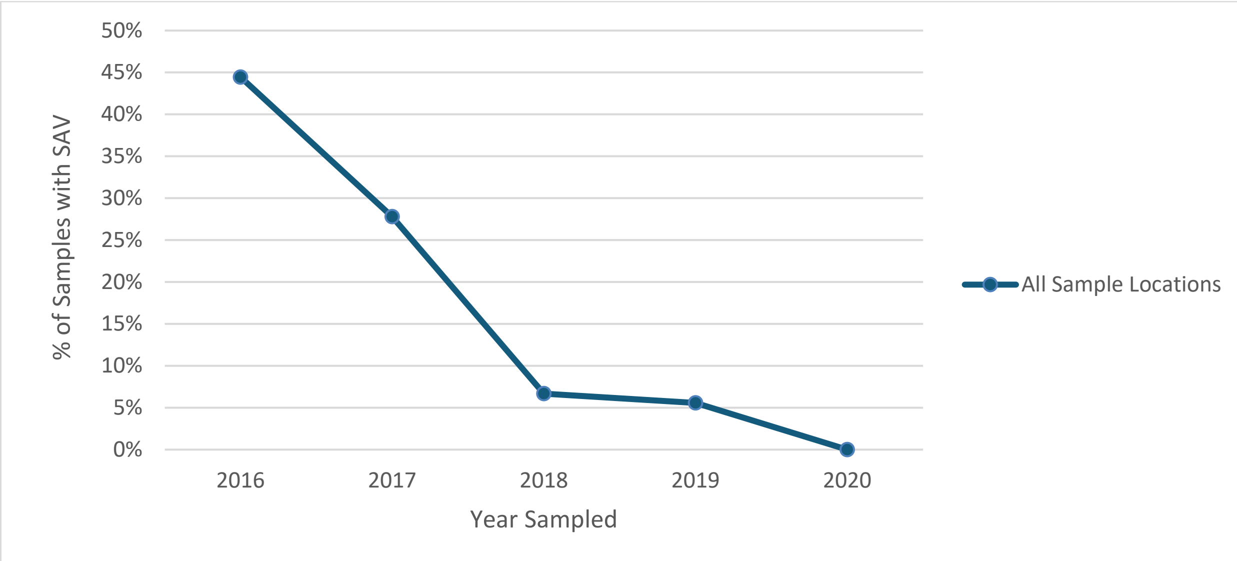

Figure 5: SAV sampling data from VDWR within the project vicinity.

Why is the Project Needed Locally/Regionally?

Pilot Project

The City's design concept for the marsh restoration project leverages "marsh terracing," an innovative coastal engineering technique widely used in Texas and Louisiana to convert shallow subtidal bottom to marsh. This technique has not yet been implemented along the U.S. East Coast and has not yet been implemented in the Mid-Atlantic region. Through the export of proven expertise from successful marsh terraces, this project would lay the foundation for future projects in the region, Virginia, and other states along the East Coast. The project would document detailed cost estimates, demonstrate effective construction practices for large-scale marsh creation projects, identify best sources for local/regional materials, and establish partnerships with permitting officials at various levels of government. The City has outlined a preliminary sequencing plan for marsh island restoration projects in Back Bay to strategically close hydraulic pathways and address priority restoration areas as shown in Figure 6. Some of these projects would require coordination with the State of North Carolina to realize its broader resilience efforts.

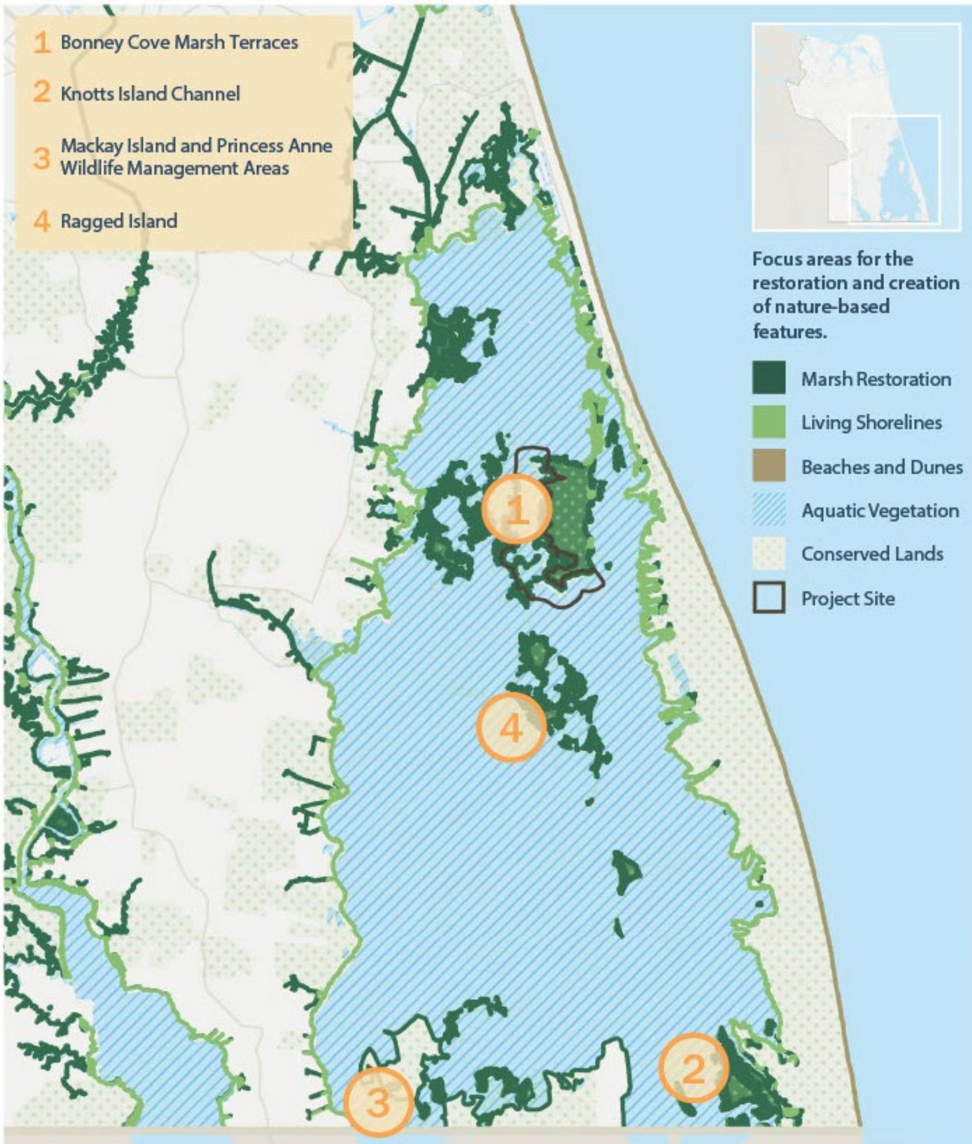

Figure 6: Preliminary Sequencing Restoration Plan.

Virginia Coastal Resilience Master Plan Exemplary Project

The CRMP impact assessment shows a high vulnerability of nature-based features to coastal flood hazards that is consistent with the City's analysis. In the Hampton Roads region, the CRMP impact assessment estimates a decrease from 40,600 acres to 2,940 acres of tidal wetlands by 2080, representing a 93% decline in tidal wetlands.[4] Back Bay was identified as a hotspot for tidal wetland loss, emphasizing the critical location of the City's marsh restoration effort. Specifically, the Virginia CRMP impact assessment shows that portions of tidal wetlands within the project area have "High" and "Very High" impact levels, which indicates areas of tidal marsh

[4] Office of Governor Ralph S. Northam Commonwealth of Virginia and Virginia Department of Conservation and Recreation (2021). Virginia Coastal Resilience Master Plan Phase 1 (PDF).

that are anticipated to be lost through inundation causing conversion to open water (Figure 7).

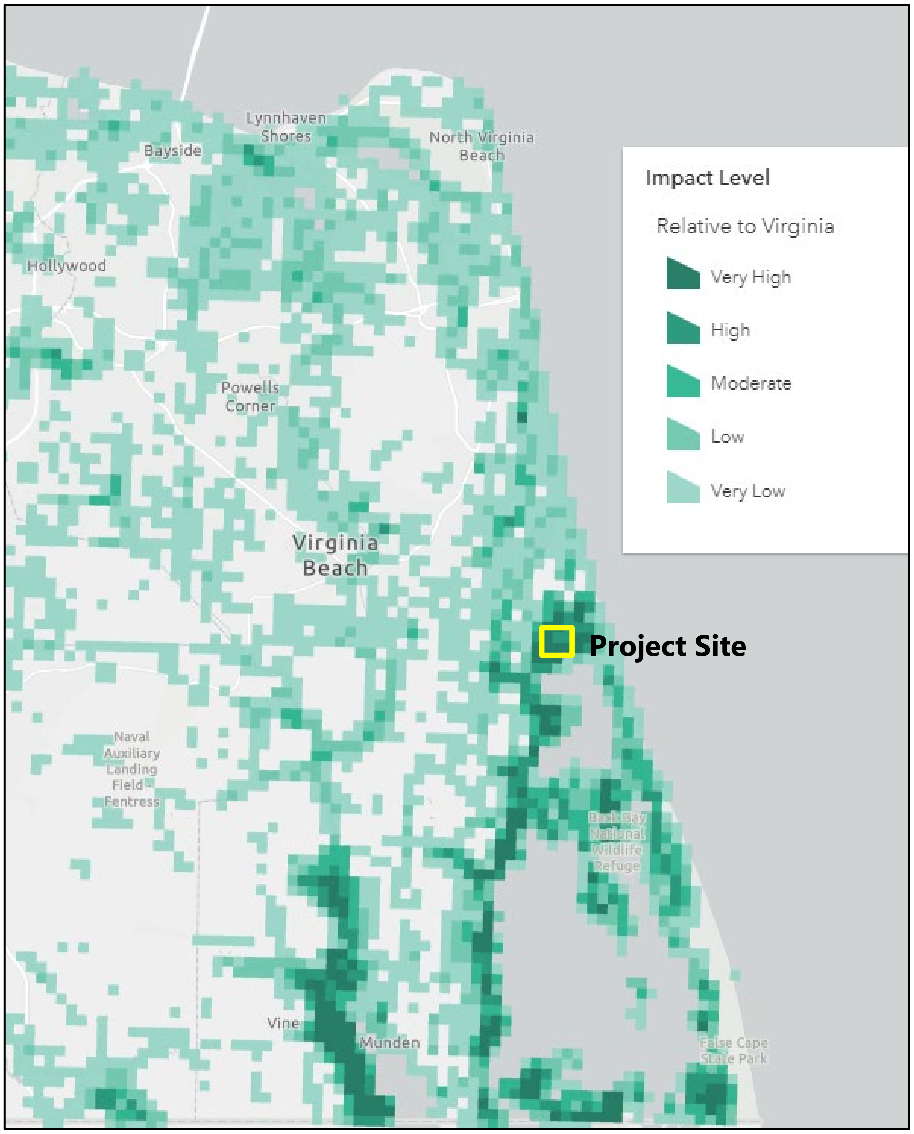

Figure 7: Virginia CRMP Impact Assessment for Tidal Wetlands.

Currituck Sound Coalition High Priority Area

In coordination with Audubon North Carolina, the Currituck Sounds Coalition designated the project site as a High Priority Area for restoring and enhancing vulnerable and degraded marshes with "high flood risk reduction benefits and habitat value" as shown in Figure 8[5].

[5] Audubon North Carolina. (2021). Currituck Sound Coalition Marsh Conservation Plan. (PDF)

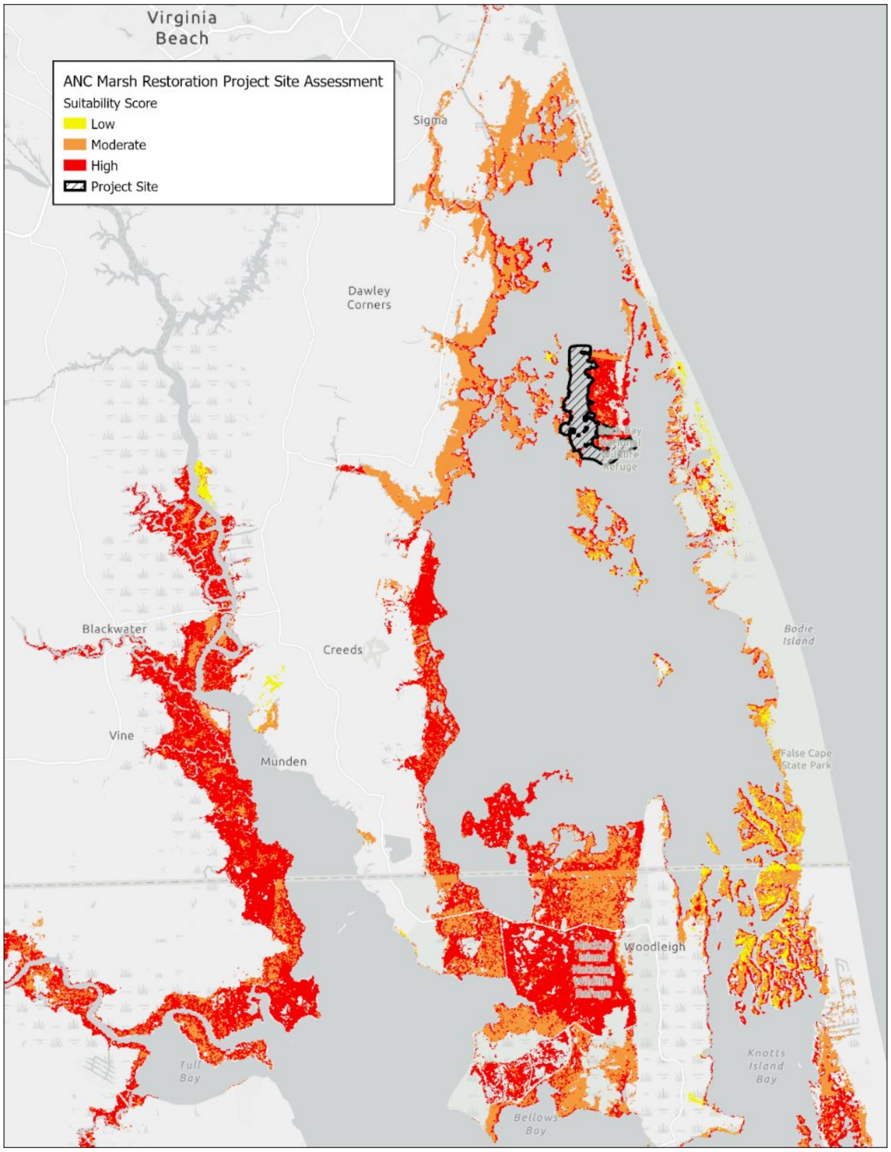

Figure 8: Audubon North Carolina Marsh Restoration Project Site Assessment

Ecological Core for Flood Resilience

The Virginia Department of Conservation and Recreation Natural Heritage Data Explorer provides data from ConserveVirginia v3.0 and other data to support conservation planning. The following map in Figure 9 displays Ecological Cores and the Floodplains and Flooding Resilience Category layer (blue polygon) from ConserveVirginia. The project area contains "High" (C3) and "General" (C5) Ecological Cores and is within the boundaries of the Floodplain and Flooding Resilience area.

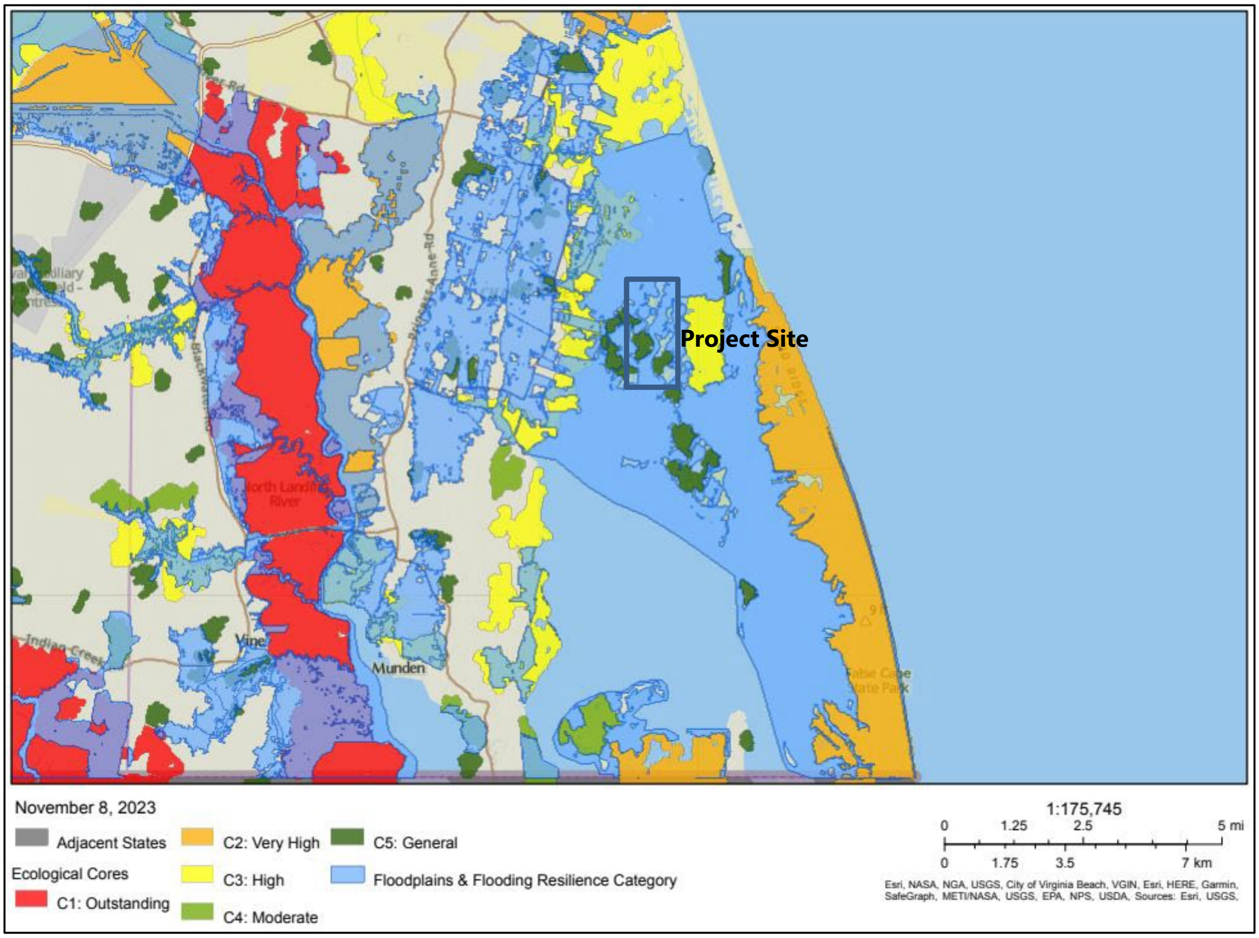

Figure 9: Virginia Natural Heritage Data Explorer Ecological Cores and ConserveVirginia Data.

The safety threats, or environmental concerns related to flood risk.

The City's risk assessment forecasts that approximately 70% of the remaining marsh (730 acres) surrounding the project site will convert to open water with three feet of sea level rise if unmitigated. Fragmentation of this adjacent marsh would result in about eight miles of fetch acting on the southern extent of the site in the predominant wind direction. Without these central marsh islands, the northern shorelines of Back Bay would be exposed to 12 miles of fetch from the Knotts Island Channel at the Virginia-North Carolina boundary. This condition would leave the fringing marshes highly vulnerable to accelerated erosion.

How does the project decrease the risk to public safety through flood risk reduction?

Construction of the forty-one individual marsh terraces, totaling 27,000 linear feet (a 51-acre footprint), across Bonney Cove offers a nature-based technique that will stabilize and protect the marsh island in the center of the bay and reduce erosion of the fringing marsh systems to the north. Numerical modeling was leveraged to quantify specific erosion reduction benefits of the project for wave heights and flow velocities:

- **Wave Height Reduction**: The marsh terraces are expected to reduce wave heights within the project site by approximately 45%. This reduction is consistent with other field studies, which have found that average wave heights within two terraced sites were 37% to 48% lower than those observed at the reference site (Brasher 2015). Wave energy reduction is anticipated to increase the potential for sediment deposition on the terraces' leeward side, leading to the growth of new emergent marsh and reducing erosion of adjacent marsh. Approximately five miles of marsh island shoreline around Bonney Cove will benefit directly from the erosion reduction associated with the computed wave attenuation.
- **Flow Velocity Reduction**: The marsh terraces reduce flow velocity within the project area. This reduction in velocity will reduce bottom shear stress, decrease turbidity, increase light penetration into the water column and promote the growth of SAV. Reducing bottom shear stress will make conditions more suitable for SAV growth between the terraces. Field studies of marsh terraces in Texas and Louisiana document an approximately 45% to 56% reduction in turbidity and the emergence of SAV in the years following terrace construction (Brasher 2015).
- **Wind Shear Stress Reduction**: Although not included as a parameter within the numerical modeling effort, the bald cypress trees planted on the terraces within the middle of the site are expected to reduce wind speed within the project site. This will further reduce wind-generated waves within the project site on the terraces' leeward and windward sides. Research shows that trees that grow to at least 30 feet at maturity result in lower wind speeds of up to 60 to 150 ft on the windward side and up to 900 ft on the leeward side (USDA).

How does the project protect or conserve natural resources?

The proposed project aims to restore marsh island communities in Bonney Cove that have historically provided environmental and flood reduction benefits to the communities in northern Back Bay. As illustrated in Figure 10, when an intact marsh begins to fragment and convert to open water, fetch increases and enables greater wave energy, increasing marsh erosion rates, and ultimately accelerating conversion to an ever-expanding body of open water. Strategic marsh restoration and creation in Bonney Cove would help mitigate the cycle of marsh island erosion and loss of SAV currently occurring in Back Bay, thereby protecting the remaining marsh islands and reducing fetch and wave energy.

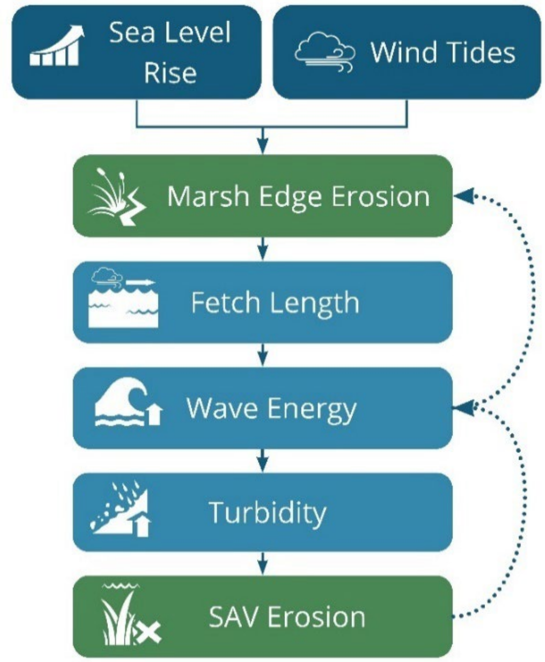

Figure 10: Cycle of marsh erosion, SAV loss, and increased wind-driven flooding.

The primary objective of this project is to create a sustainable coastal marsh island system in Back Bay through reclamation of historically lost marsh habitat and protection of existing marsh complexes from erosion. This restoration effort aims to provide multiple benefits of reduced flood impacts, enhanced fish and wildlife habitat, and improved water quality. The project is designed to achieve the following outcomes:

- Decrease turbidity to create conditions that promote the growth of emergent vegetation and aquatic grasses;
- Maximize habitat value for ecologically important fish and wildlife populations (e.g. Largemouth Bass, Bluegill, Yellow Perch, Striped Bass, Blueback Herring, Alewife, American Eel, etc.); and,
- Reduce fetch, wave heights, and flow velocities to mitigate erosion of fringing marsh systems that provide a buffer for the low-lying neighborhoods and roads that experience frequent flooding in northern Back Bay.

The City selected marsh terracing as the preferred restoration approach because the design is compatible with Back Bay's shallow bottom and the historical loss of habitat. Marsh terraces are narrow, man-made islands placed in shallow open water to restore previous marsh environments. Typically arranged in a chevron pattern, the overall field of marsh terraces dissipates waves, decreases turbidity, and slows down the moving water. The resulting calmer water conditions allow more sunlight to penetrate to the shallow bottom, promoting the establishment and growth of marsh seagrass and ultimately improving habitat quality for fish and wildlife. Further, as opposed to one continuous marsh platform, marsh terraces maximize habitat for a variety of fish and wildlife species, as illustrated in Figure 11.

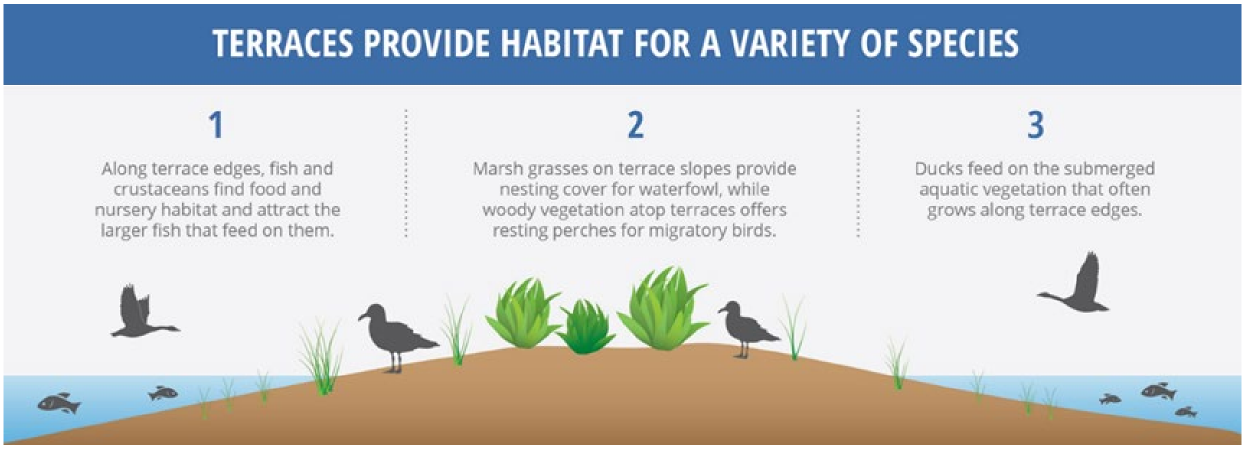

Figure 11: Conceptual diagram of marsh terraces.

Groups to be targeted who might directly benefit from this flood risk reduction effort.

The northern Back Bay communities adjacent to the project area and interested stakeholders have been engaged in the planning effort through public meetings. These meetings provided an opportunity for the community to provide feedback on the 30% and 95% designs and artistic renderings. We anticipate the project to benefit properties and infrastructure assets in northern Back Bay, including the following:

- **Reduce erosion rates along approximately 8 miles of shoreline by reducing wind and wave energy north of the project site.** Most of the properties along this reach of shoreline are not protected by traditional erosion risk reduction measures, such as bulkheads. Maintaining a naturalized shoreline while protecting fringe marsh is a priority of the City and its project partners. This approach will ensure that these marsh systems can migrate landward in response to sea level rise.
- **Reduce flood risk to commercial and residential properties north of the project site.** There are approximately 70 commercial and 2,350 residential structures within the two census block groups surrounding the project site. Around 635 of those structures are vulnerable to flooding during a 50-year event today. With three feet of sea level rise, approximately 2,060 structures are expected to be vulnerable to flooding during a 50-year return period event, representing about 85% of the residential structures within the project vicinity. These numbers underscore the importance of implementing the proposed project alongside complimentary flood risk reduction projects.
- **Reduce the magnitude and duration of flooding along critical access roads and critical facilities.** In addition to Muddy Creek Road, two other critical access roads are anticipated to benefit from delayed flooding. This includes Shipps Cabin Road (intersecting with Muddy Creek Road) and Sandpiper Road, which runs parallel to the eastern bank of Back Bay and provides ingress/egress out of the Sandbridge community (Figure 12).

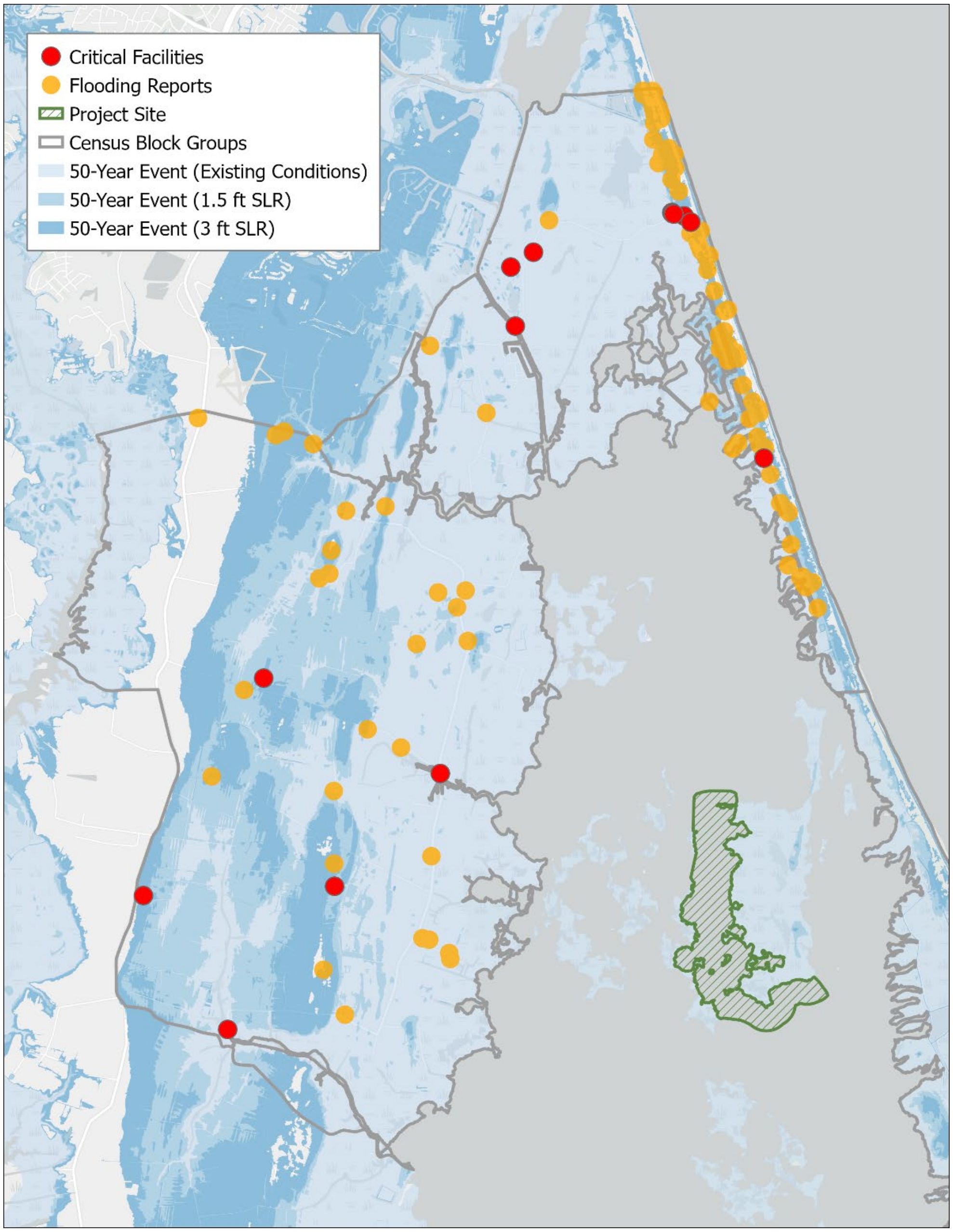

Figure 12: Critical facilities and flooding reports within project vicinity.

What would happen (or not happen) if the applicant does not receive funding?

If this project does not advance from design to construction, erosion of the adjacent marsh would continue to occur, resulting in fragmented habitat lacking the capacity to reduce wave action and slow water velocities. It is anticipated that wind-driven flooding events will continue to increase in frequency, resulting in increasing flooding of the low-lying properties and roadways surrounding northern Back Bay.

Alternatives Analysis

The proposed project offers the best approach for addressing the needs and problem statement outlined in this Scope of Work narrative. The project would result in the creation of 46.5 acres of marsh terraces, which would produce a net gain of approximately 16 acres of low/high marsh habitat by the end of the project construction compared to the No Action Alternative. The integrated system of marsh terrace ridges and perimeter rock armoring would stabilize the two critically eroding marsh islands (Long Island to the east, and a series of smaller unnamed islands to the west) from continued degradation. The tall terrace design improves the functionality and resiliency of the marsh system while also providing diversified habitat for fish and wildlife in the form of increased marsh edge as sea level rises. Numerical modeling of the preferred alternative demonstrated that the project would decrease wave heights and decrease the overall flow velocity of water moving through the project site, reducing water exchange in Back Bay during flooding events, encouraging sediment deposition, mitigating wave effects and consequent erosion, and result in localized water quality benefits. The proposed terraces would not only create a platform for vegetation growth within the marsh, but also reduce wave fetch in these large open water areas. The reduction in wave energy would lead to improved water clarity to promote the growth of SAV in the area between the terraces (approximately 310 acres).

Dredging in between the terraces to obtain sediment for the terrace cap would ensure no invasive vegetation is introduced into Back Bay, which is a high priority of the USFWS and VRMC. The dredging areas would also create valuable fish habitat to attract signature Back Bay fish and wildlife populations such as Largemouth Bass. The proposed dredging areas in between the terraces was evaluated and not anticipated to increase erosion of the adjacent marsh system. Furthermore, dredging in-situ material for building terraces is a widely accepted approach in Gulf Coast region marsh creation/terracing projects, as determined through conversations with project owners in Louisiana. Some terrace cap material will also be obtained from the Nimmo VII-A project. Through export of proven expertise from successful marsh terracing projects, this project would lay the foundation for future similar projects in the region through the development of detailed cost estimates, identification of best sources for local/regional materials, and establishment of partnerships with permitting officials at various levels of government.

Goals and Objectives

The overarching goal of this project is to construct the City's first nature-based adaptation project in the Southern Rivers Watershed and one of the CRMP's exemplary nature-based projects. This project aims to stabilize two critically eroding marsh islands from further degradation, decrease turbidity to promote the growth of aquatic vegetation, and provide flood risk reduction benefits through increased friction and wave attenuation. Table 1 below provides a high-level overview of the specific objectives established to solve the problem/need identified – specifically habitat degradation and wind tide flooding along with measure(s) of success. A more detailed description of these objectives is provided in the Supporting Documentation section.

Table 1: Overview of Project Objectives.

Objectives	Description	Measure(s) of Success	Timing of Measures
Objective 1	Create a Construction Access and Staging Area	a. Secured permits for construction. b. Contractor Selection. c. Construction of Staging Area.	a. December 2023 b. April-May 2023 c. June 2023 -February 2024
Objective 2	Restore Marsh and Aquatic Vegetation	a. Secured permits for construction. b. Restoration of 46.5 acres of habitat.	a. December 2023 b. March - October 2025 and March – October 2026
Objective 3	Engage Stakeholders and Disseminate Effective Practices	Number of people meaningfully engaged in the process of the project within the agreement period.	Continuous through period of performance.

Work Plan

Current Status and Ongoing Activities

The marsh terrace project design is progressing and will be ready for construction in the CFPF grant timeline. Table 2 summarizes ongoing tasks related to the project and an anticipated schedule for completion.

Table 2: Completed, ongoing, and anticipated activities leading up to construction.

Activity	Description	Schedule
Stakeholder Scoping Workshop	In November 2020, the City hosted a virtual workshop to receive initial input from project stakeholders.	Completed (Fall 2020)
Site Characterization and Vegetation Survey	In fall 2020, a site characterization and vegetation survey within Bonney Cove was conducted under a USFWS Special Use Permit (SUP). The purpose of the survey was to document existing emergent marsh and submerged aquatic vegetation (SAV) species composition and percent coverage within the proposed project area. MAP Environmental, Inc. conducted a literature review of marsh terracing projects in the Gulf Coast region to identify effective practices for project planning and design.	Completed (Fall 2020)
Bathymetric Survey	An updated bathymetric survey of Bonney Cove, also covered under a USFWS SUP, was completed in March 2021. This data serves as an input to identify appropriate design elevations to determine quantities of materials necessary to build the proposed marsh terraces and for numerical modeling of project alternatives.	Completed (Spring 2021)
Geotechnical Investigation	A geotechnical investigation of Bonney Cove was conducted in the spring of 2021. The permitted survey, (Virginia Marine Resources Commission (VMRC) Permit No. 2020-2286, U.S. Army Corps of Engineers (USACE) Permit No. 2020-02439, and USFWS SUP) included the collection of 10 soil borings in locations that avoided aquatic vegetation habitat. The soil samples were retrieved by drilling with a specialized airboat-mounted drill rig which was essential for drilling in shallow areas as it avoids disruption to bottom habitat. The soil samples were analyzed to determine the suitability and physical characteristics of the soils within the project area. Additional soil analysis was conducted to determine the suitability of Back Bay sediments for building components of the marsh terraces.	Completed (Spring 2021)

Activity	Description	Schedule
Water Quality and Hydrodynamic Survey	ODU conducted a water quality and hydrodynamic survey of Bonney Cove in the spring of 2021. The USFWS permitted survey collected water samples and deployment/retrieval of hydrodynamic sensors (pressure sensors, acoustic Doppler current profilers, and optical backscatter sensors) at three sampling points in Bonney Cove. Sensor equipment was deployed for two one-month periods (3/10/2021 – 4/12/2021 and 5/19/2021 – 6/8/2021). The water level, wave, and current data served as an input to the numerical model calibration. The water quality parameters (including pH, salinity, temperature, dissolved oxygen, chlorophyll, and turbidity) will serve as a reference to compare pre-and post-construction water quality conditions.	Completed (Summer 2021)
30% Design	Dewberry leveraged the field-collected data to establish design criteria for the project to ensure that it will be resilient in the face of changing future conditions during wind-tide events. Artistic design renderings were developed to enable stakeholders to visualize the implemented project.	Completed (Fall 2021)
Public Engagement – 30% Design	The City held a public information meeting on October 14, 2021, at Creeds Elementary School. The project team delivered a 10-minute presentation of the proposed project followed by an open-format discussion where participants reviewed the preliminary (30%) designs and artistic renderings and submitted comments regarding environmental and community impacts.	Completed (Fall 2021)
Numerical Modeling	Numerical modeling has been completed to evaluate the proposed project's impact on water levels, wave heights, and flow velocities within and surrounding the project area. Potential water quality impacts were also evaluated. The numerical modeling effort involved the development of an XBeach model, which is a nearshore model that accounts for wave-vegetation interactions based on field-derived drag coefficients.	Completed (Winter 2021)
Environmental Assessment and Scoping	In coordination with the USFWS and with technical assistance from Dewberry, the City evaluated the potential environmental impacts of the project. The draft environmental assessment document was distributed to key stakeholders with jurisdictional authority or a vested interest in the project for review and comment.	Completed (Summer 2023)

Activity	Description	Schedule
60% Design	After numerical modeling and stakeholder review of the 30% design, the engineering design plans were advanced from 30% to 60%.	Completed (Spring 2023)
95% Design and Public Engagement	The engineering design team prepared 95% engineering design plans to address comments on the 60% plan set. The City held a second public information meeting from 6:00 – 7:30 p.m. on July 13, 2023, at the Senior Resource Center in Virginia Beach where the project team delivered a 10-minute presentation of the proposed project followed by an open-format discussion where participants reviewed the 95% designs, updated artistic renderings, and submitted comments.	Completed (Fall 2023)
Construction Permit Applications Submitted	The City submitted the Joint Permit Applications for the proposed project, including the initial post-construction monitoring plan, to VMRC and the USACE in August 2023.	Completed (Summer 2023)
Modeling of Potential Adverse Impacts	In response to public concerns, the City performed additional numerical modeling of both northerly and southerly wind events and reviewed water level responses at locations in Back Bay for any potential adverse impacts. No adverse impacts were found for either type of event.	Completed (Fall 2023)
Publication of Frequently Asked Questions	The City will be publishing findings for the potential adverse impacts modeling, along with other responses to public concerns raised at the question in a Frequently Asked Questions webpage in November 2023.	In Progress (Fall 2023)
100% Design	The engineering design team prepared and submitted the 100% engineering design plans to the City for review. The plans will be finalized on receipt of any comments from the permitting process, anticipated to occur by end of 2023.	In Progress (Fall 2023)
Contractor Procurement	The engineering team will provide final plans, specifications, and construction estimates (PS&E). The City will prepare the bid Request for Proposal (RFP), provide Bid Packages, and review bids obtained, and select a construction contractor.	Planned (Winter 2023 - Spring 2024

What are the major activities and tasks?

The key activities and tasks to be competed under the agreement period are summarized in Table 3. Please refer to the Supporting Documentation section for a more detailed description of these activities and tasks.

Table 3: Overview of Activities and Tasks.

Activities	Description	Tasks
Activity 1	Construction Staging Area Preparation and Construction	1. Mobilize equipment 2. Stabilize road, establish construction staging area, abutments, install pre-engineered bridge, construct ramp to water and slurry basins. 3. Establish traffic flagging stations. 4. Install pipe and booster stations.
Activity 2	Marsh Terrace Construction	1. Construct 41 terraces (2-phased approach). 2. Demobilize equipment.
Activity 3	Stakeholder Engagement	1. Develop project marketing materials. 2. Attend and document engagement activities.

Who is responsible for completing the activities and tasks?

Responsibility for completing the project's activities and tasks lies with a collaborative effort led by the City's Department of Public Works. To ensure the successful execution of the project, the City has assembled a diverse team of consultants, advisors and subject matter experts. For a comprehensive understanding of the specific roles and responsibilities of each entity involved in carrying out the proposed scope of work, please refer to the *Supporting Documentation – Approach, Milestones, and Deliverables – Project Partner*s section of this report, which provides a detailed description of how each team member contributes to the project's overall success.

What is the timeframe for accomplishing activities and tasks?

An overview of the planned project timeline is shown in Figure 13. Grant activities will initiated in Summer 2024 with construction of the staging area and material acquisition. Please refer to the S*upporting Documentation – Approach, Milestones, and Deliverables –Milestone Schedule* section of this report for a detailed outline for each activity and associated deliverables.

Figure 13. Timeline overview for project implementation.

Identify the required partners to ensure success and where they are represented in the workplan.

A diverse team of consultants, advisors, and subject matter experts, led by the City's Department of Public Works, has been assembled to complete the project's activities and tasks. Please refer to the *Supporting Documentation – Approach, Milestones, and Deliverables – Project Partner*s section of this report for a detailed description of each team member's role, responsibilities, and contribution to the project's overall success.

Deliverables

An overview of the project deliverables is provided in Table 4. Please refer to the *Supporting Documentation – Approach, Milestones, and Deliverables* section of this report for more detail.

Table 4: Summary of Deliverables.

Activities	Deliverables
Activity 1: Construction Staging Area Preparation and Construction	1. Material acquisition. 2. Progression and completion of the construction staging area, with daily inspections to monitor progress. 3. Documented progress and completion through quarterly reports to DCR.
Activity 2: Marsh Terrace Construction	1. Progression and completion of the 2025 and 2026 construction phases, including plantings, with daily inspections to monitor progress. 2. Demobilization and removal of equipment from construction staging area. 3. Documented progress and completion through quarterly reports to DCR.
Activity 3: Stakeholder Engagement and Lessons-Learned Dissemination	1. Project marketing materials. 2. Records documenting number of stakeholders engaged during the outreach activities.

Maintenance plan tied to the identified viability of the project. Plan for sustaining the project after the agreement period (if applicable)

The City has developed a draft Annual Monitoring Plan and Post-Construction Monitoring Report that was submitted along with the Joint Permit Application for the project. See Attachment 5 for a copy of the draft report.

Project maintenance will be addressed by the City of Virginia Beach's Public Works Stormwater Operations Group. Any maintenance issues identified by the monitoring effort or other observers will be flagged to the Operations Group to address. The City intends to maintain the construction staging area to support future project maintenance needs. After completion of the monitoring program, the City will perform inspections every 2-5 years and make any repairs needed for the life of the project.

Evaluation

Indicators of Success

Indicators of success for this project have been identified during the development of the monitoring plan. Three (3) indicators of success were defined in relation to the primary objectives of the project (as defined elsewhere in this document), and include:

- The establishment of a sustainable coastal marsh island system.
- Stability of the marsh terrace structures.
- Establishment of a sustainable SAV community.

What data will be collected and how will it be used to measure success?

Data collection for the project has been detailed in the proposed monitoring plan and includes two sets of data: one set associated with as-built surveys to establish baseline reference conditions for subsequent monitoring efforts, and monitoring data to assess the success of the project in meeting the indicators defined above. Baseline and monitoring data will be compiled in an annual report and distributed to permitting agencies, and stakeholders as appropriate, to fulfill monitoring requirements and ensure success criteria are being met and maintenance needs are addressed.

Baseline data, which is proposed to be collected after the completion of each of two phases of terrace installation, will include the following data:

- Coordinates and diagrams of established transects, as well as site photographs from photo stations established along each sampling transect, as defined in the Methods section of the monitoring plan.
- Final location of all planted vegetation (upland plantings, high marsh plantings and low marsh plantings).
- Final location and extent of SAV plantings.
- Final grade topographic surveys (plan, profile, and cross sections).
- Discussion of the project design versus as-built conditions.

Monitoring data will be collected at the end of the full growing season during each monitoring year and include the following:

- Site photographs from photo stations defined in the Methods section of the monitoring report.
- Estimated percent cover and change in coverage from the as-built conditions to sampling year conditions for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- Estimated percent cover and change in coverage from planted conditions to sampling year conditions for SAV planting quadrants

- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

This monitoring data will be used to define success by tracking the establishment of the proposed vegetative communities on and between the proposed marsh terraces as well as the structural integrity of the marsh terrace structures themselves. Vegetation cover thresholds for each year will be defined to ensure planted communities are appropriately established on each marsh terrace. Acceptable measures of deviation will be defined for structural elements to ensure design requirements are met. Maintenance and mitigation measures defined in the monitoring plan will be implemented as required if success criteria are not met during any particular monitoring year.

How was cost effectiveness evaluated and measured against the expected outcomes?

Through a BCA approach using FEMA methods and ecosystem service valuations, a BCR of 1.17 was calculated for the project. This BCR is greater than 1, indicating the project can be considered cost-effective. The project also provides an additional $9.2M in value over the current estimated project costs.

A description of the BCA analysis and methods is provided in the following Benefit Cost Analysis Section.

What products, services, meetings, outreach efforts etc. will be conducted and how will success be measured?

The City is firmly dedicated to fostering meaningful engagement with project partners and external stakeholders throughout the project, with the goal of raising awareness about the project's approach and its benefits and enhancing the likelihood of its successful adoption in other areas within the region and the state.

Activity 4, titled "Stakeholder Engagement and Lessons-Learned Dissemination," provides a comprehensive outline of the City's outreach strategy, encompassing proposed deliverables and outreach endeavors. This strategic plan entails the development of project marketing materials, along with the facilitation of presentations and meetings with local and regional stakeholders, as well as participation in state and national-level conferences.

To gauge the effectiveness of our efforts, the City will employ metrics to track and document the number of individuals engaged throughout the project. This information will be regularly communicated to DCR to serve as a key performance indicator for project success.

For a more detailed breakdown of the tasks and deliverables associated with Activity 4, please refer to the Supporting Documentation section of this application.

Project Progress Monitoring Plan

The City's Project Progress Monitoring Plan is designed to guarantee the seamless and effective execution of the project. We have established a robust internal system to oversee the entire project lifecycle, ensuring that all key stakeholders are aligned with the project's objectives, activities, deliverables, and schedule.

The process commences with a kickoff meeting involving all project partners, where we collectively set the stage for the project. During this meeting, we thoroughly review the project's objectives and scope, ensuring that everyone is on the same page. This initial step is instrumental in fostering a shared understanding of the project's vision and goals among all involved parties.

In addition to the kickoff meeting, we place a strong emphasis on quality assurance and control. We meticulously assess each contractor's quality management system to ensure that well-defined procedures are in place to maintain the highest standards of quality throughout the project. This dedication to quality is paramount to delivering a successful project that meets the City's standards and the expectations of our stakeholders.

The City is committed to ongoing and transparent communication with our design and construction contractors, as well as our advisory stakeholders. Regular meetings will be held to monitor progress, address any potential challenges, and ensure the project adheres to the proposed milestone schedule and deliverables as outlined in this grant application. This proactive approach to project monitoring allows us to stay on track, identify and address issues promptly, and uphold our commitment to the successful completion of the project.

Supporting Documentation

Project Information

The following sections provide details regarding the project site and highlight the impacted population, residential and commercial structures, and critical facilities. This section also provides an overview of the historical, existing, and projected flood conditions in and around the project site.

Population

As shown in Figure 14, two census block groups (518100454.121 and 518100464.001) adjacent to Back Bay are within the extent of the anticipated project benefits. The total population of these two block groups is 3,531.[6] The residential population has grown approximately 1.8% in the past two decades. The median household income in 2021 dollars is $99,078. There are approximately 2,500 residential housing units, of which 43.1% are owner-occupied, 11.4% are renter-occupied, and 45.5% are vacant. The high percentage of vacant housing units can likely be attributed to seasonal rentals within the Sandbridge Resort Area. The race and ethnicity demographics of the community are 94.4% White, 1.4% Black, 3.4% Hispanic, and less than 1% Asian and American Indian.

[6] Population, household income, housing units, and demographic data obtained from Esri ArcGIS Community Analyst (2022). Esri forecasts for 2021 based on U.S. Census Bureau 2010 data.

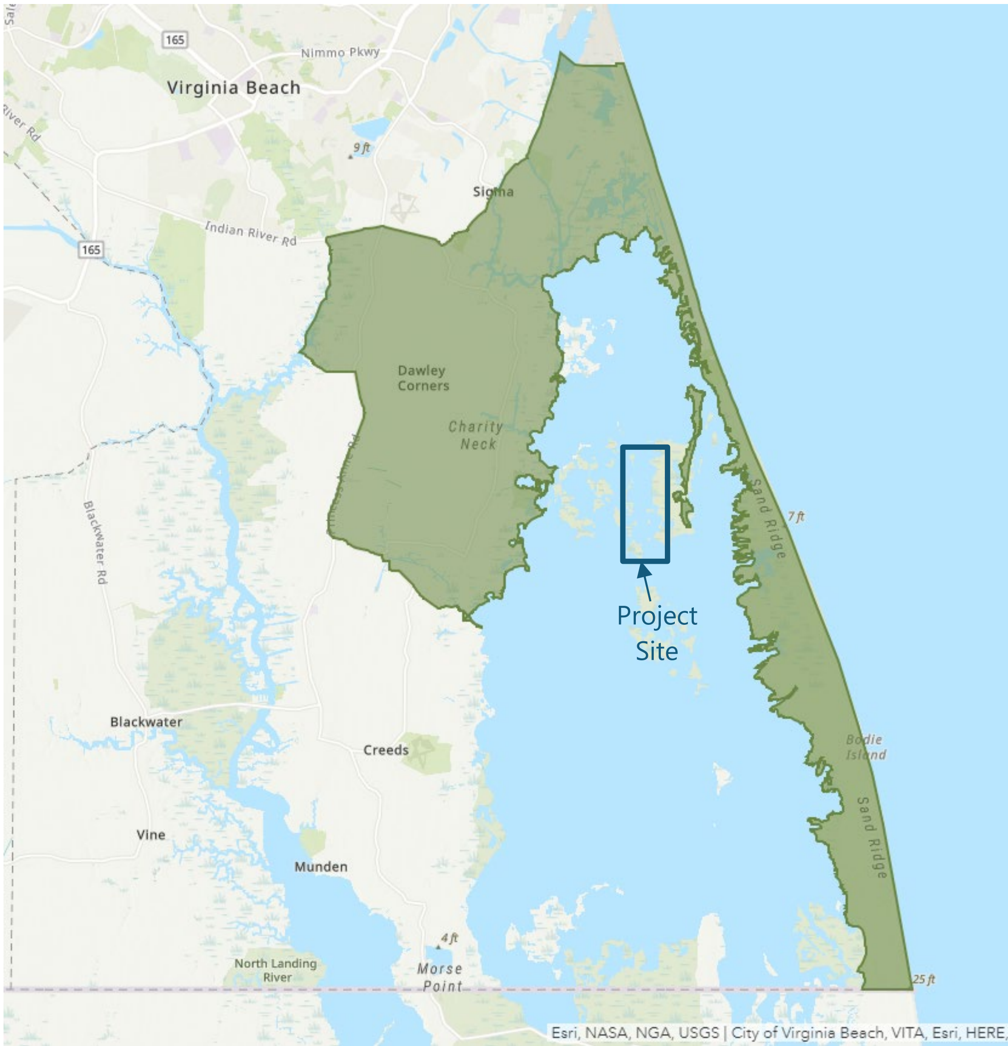

Figure 14: Census block groups selected for population estimates.

Historic Flooding Data and Hydrologic Studies Projecting Flood Frequency

Historical and Existing Flood Data

The project is located within a Federal Emergency Management Agency (FEMA) mapped Special Flood Hazard Area (SFHA), as shown in Figure 15 and Figure 16. Based on the City's current flood maps (effective January 16, 2015), the project site's flood zones are VE, AE, and Open Water. Portions of the site are within Otherwise Protected areas.

The following maps provide an overview of the existing flood hazards for the project area, including the northern boundary (Figure 15) and southern boundary (Figure 16). Based on the City's current flood maps (effective January 16, 2015), the project site contains VE and AE flood zones and Open Water.

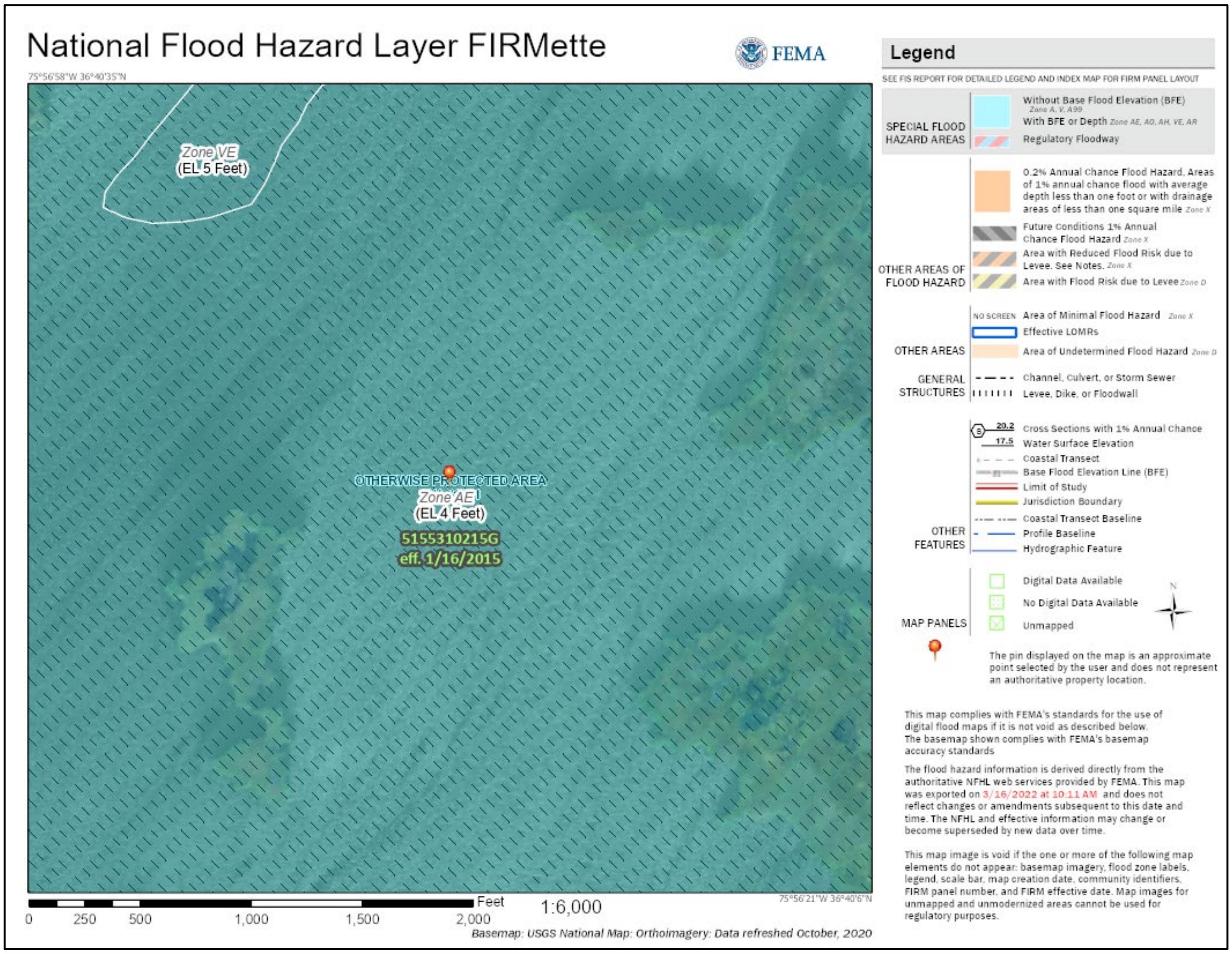

Figure 15: FIRMette for the project area (northern boundary).

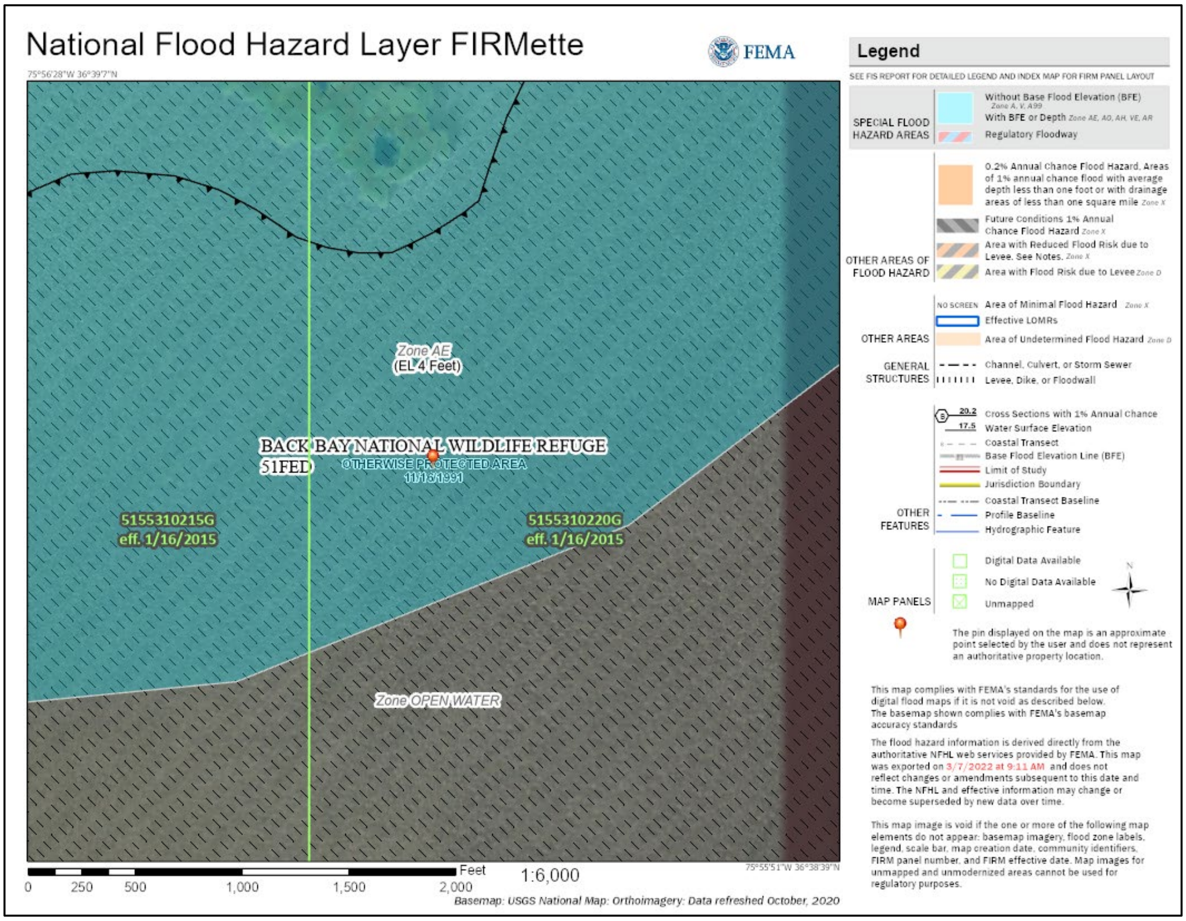

Figure 16: FIRMette for the project area (southern boundary).

The City maintains records of where residents report flood issues and what type of flooding is causing the issue. Residents regularly report flood issues through a hotline, which are then recorded in a flood event database. The census block groups adjacent to the project area reported 111 flood issues associated with heavy rain or high tide between 2001 and 2019. Critical facilities and flood incidences are relatively concentrated in the Sandbridge Resort Area.

Projected Flood Frequency

The USFWS, the City, and other stakeholders have made significant investments in detailed assessments, sophisticated computer models, and water level gauges to better understand historical and future wind tide flooding. Figure 17 displays the projected flood pathways under the 10-year and 100-year storm event under a 3 feet sea level rise scenario surrounding the project site.

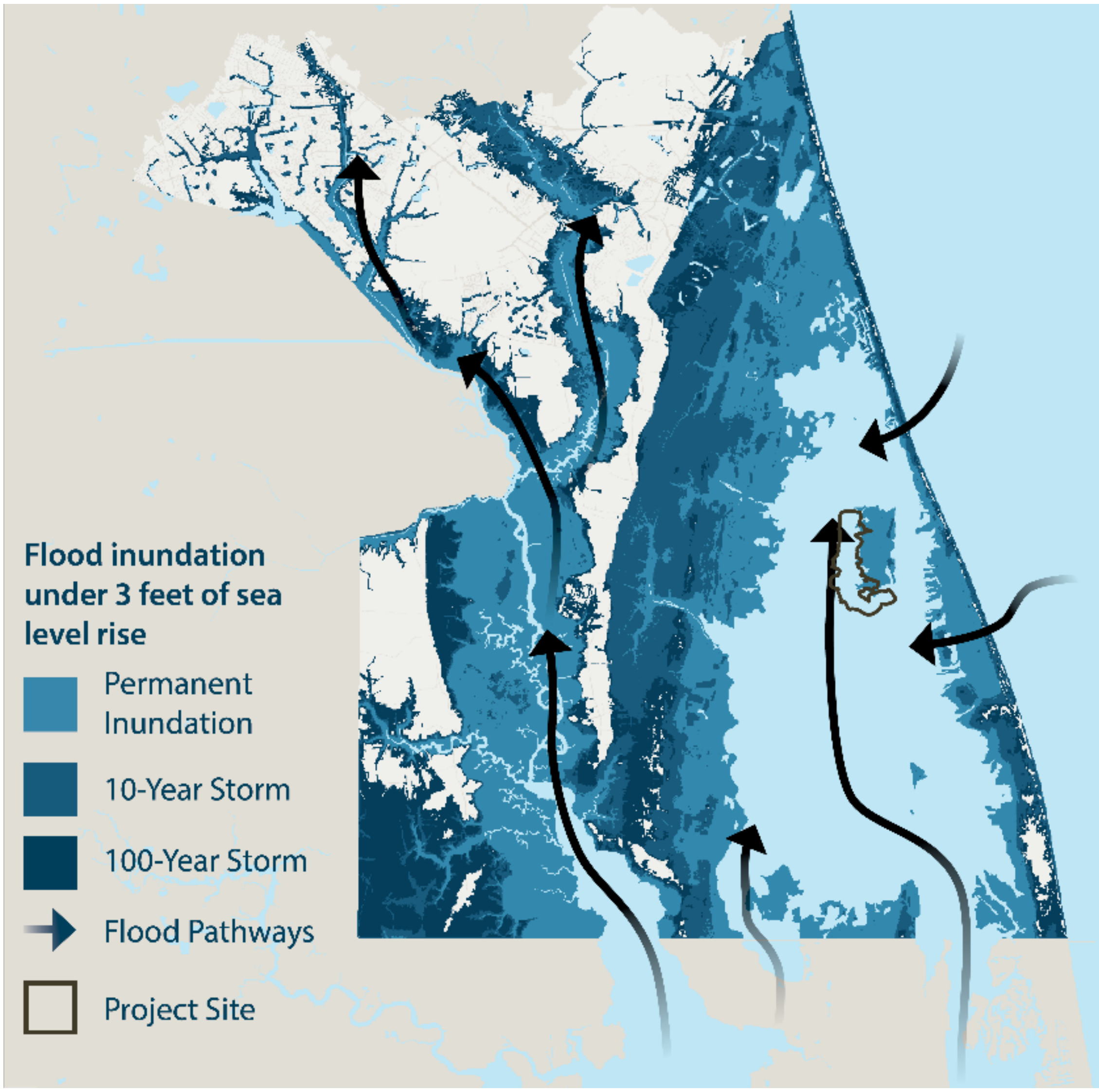

Figure 17: Flood pathways into the Southern Rivers Watershed with 3 feet of sea level rise.

Numerical modeling also shows that as sea levels continue to rise, a shorter duration wind event will produce more wind-induced flooding in less time. The three lines in Figure 18 represent the water level response to a sustained 15-mph wind for each sea level rise scenario. With the existing marsh system today (blue line), it takes approximately five days of sustained southerly wind to cause flooding. With 1.5 feet (yellow line) and 3 feet (red line) of sea level rise, the peak water level could be reached two to three days sooner, respectively. Model simulations showed that marsh island creation across Back Bay would help delay the onset of flooding by several days, which would allow the City and residents more preparation time[7].

[7] City of Virginia Beach. (2018). Analysis of Marsh Response to Sea Level Rise (PDF).

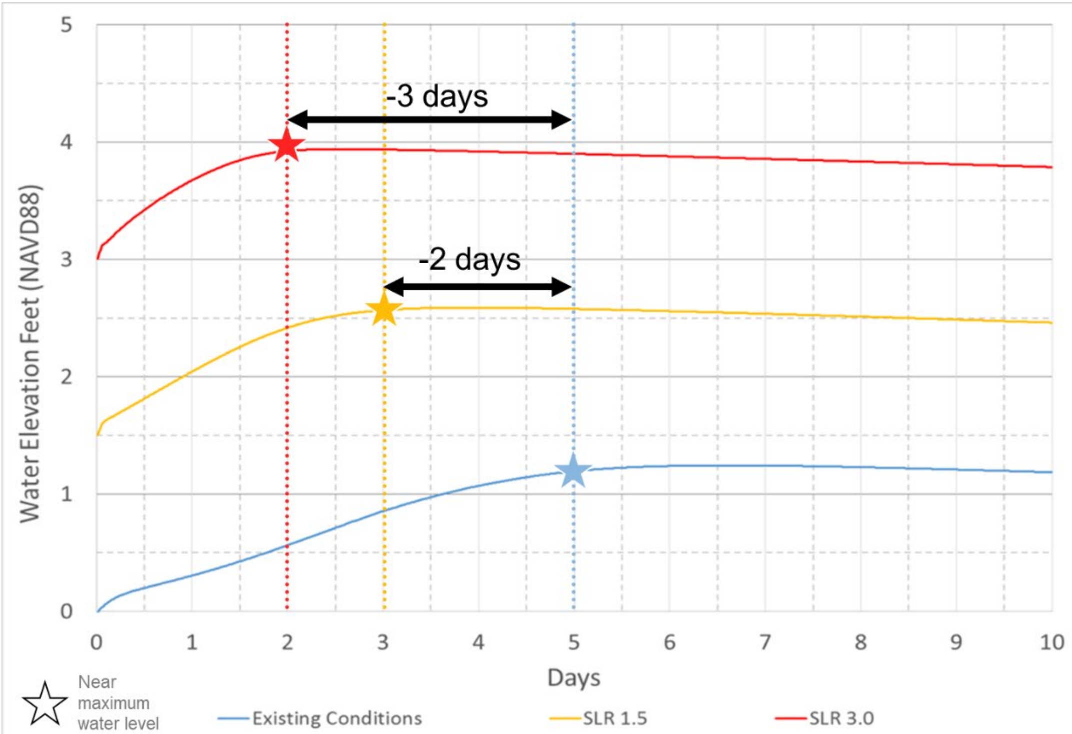

Figure 18: Water-level response under sustained 15-mph southerly wind.

The City analyzed future marsh conditions using the Sea Level Affecting Marshes Model (SLAMM).[7] Figure 19 illustrates areas likely to experience accelerated degradation of marsh in Back Bay due to rising water levels. If no action is taken, substantial marsh loss is projected in Bonney Cove under 3 feet of sea level rise. Within a 1-mile radius of Bonney Cove, the City's SLAMM model predicts that approximately 730 additional acres could be eroded into open water in response to sea level rise. This represents more than a 70% reduction as compared to the existing marsh system surrounding Bonney Cove today. It is also presumed that open water areas would continue to experience high levels of turbidity, which will continue to negatively affect SAV communities in Back Bay.

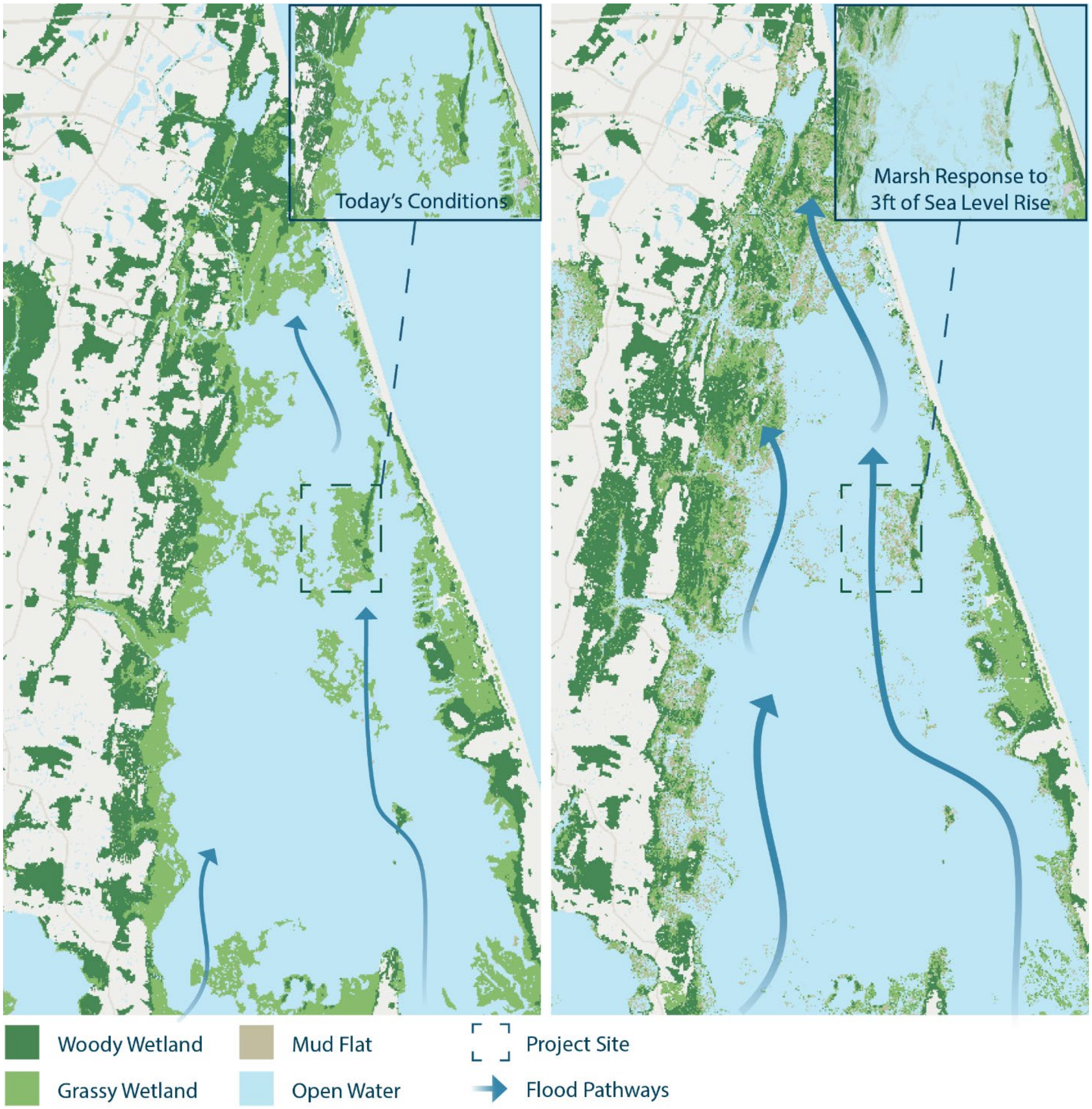

Figure 19: Comparison of current marsh conditions to future marsh conditions with 3 feet of sea level rise.

The proposed project site in Bonney Cove has a predominant south-southwest wind direction, which contributes to significant wave generation in the large unobstructed open-water areas and provides a continuous source of scouring and erosion in those areas. Marsh loss is likely to continue in the project area, creating a negative feedback cycle as continued fragmentation of the marsh would further deteriorate the remaining stands of healthy marsh and increase fetch. Today, the site faces low to medium fetch exposure, but in the future, the site could experience high to very high fetch exposure, as defined by the Virginia Institute of Marine Science (VIMS)

Shoreline Design Guidelines for Shore Protection in Virginia's Estuarine Environments.[8] Projections of increasing fetch at the site, along with the transects used for the wind fetch analysis, are summarized in Figure 20.

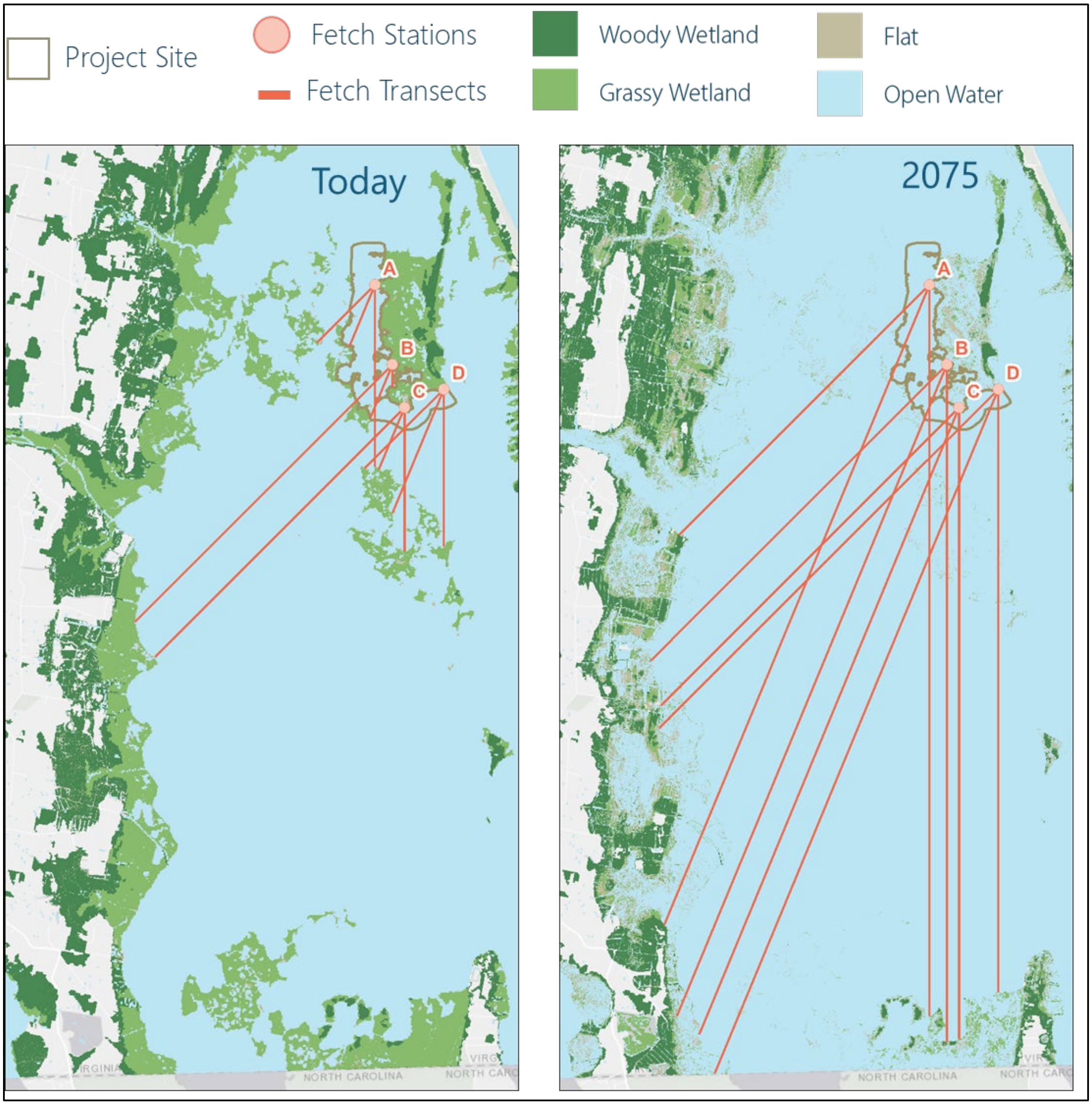

Figure 20: Wind fetch analysis of project area.

The following table displays specific values of fetch distances and classifications that correspond with the transects displayed in Figure 20 above.

[8] Virginia Institute of Marine Science. (2010). Living Shoreline Design Guidelines for Shore Protection in Virginia's Estuarine Environments; Version 1.2 (PDF).

Table 5: Measurements of fetch transects referenced in Figure 20.

Fetch Transect	Length, Miles (Today)	Classification	Length, Miles (3 feet SLR)	Classification
A-SW	0.9	Low	3.7	High
A-SSW	0.7	Low	7.3	Very High
A-S	1.9	Medium	7.7	Very High
B-SW	3.8	Medium	4.4	High
B-SSW	0.6	Low	7.4	Very High
B-S	0.2	Very Low	7.2	Very High
C-SW	3.7	Medium	4.4	High
C-SSW	0.7	Low	7.2	Very High
C-S	1.5	Medium	6.7	Very High
D-SW	1.2	Medium	5.1	Very High
D-SSW	1.4	Medium	7.8	Very High
D-S	1.7	Medium	6.4	Very High

No Adverse Impact

The City conducted additional hydraulic numerical modeling to identify any potential adverse impacts in response to concerns raised during a public meeting in July 2023. The City utilized a Danish Hydraulic Institute MIKE FLOOD model developed for stormwater master planning activities in Lower Southern Rivers Watershed of Virginia Beach. This model encompasses the entirety of Back Bay and extends into North Carolina's Currituck Sound. Model performance has been validated against observations from multiple flood events.

The effort looked at water level and velocities in response to a historical southerly wind tide flood in May 2017 and a northerly wind event associated with Tropical Storm Ophelia in September 2022. These events were ran with model grids depicting with- and without project conditions, considering the 100% project design specifications. The northerly wind event was

included to address concerns from residents of Knott's Island, at the southern end of Back Bay. Both the terrace field and the construction staging area were included in the with-project condition. The modeling found that there were no increases in water levels to areas within Back Bay or to Knotts Island. Negligible changes in water velocity (0.2 ft/s or less) were observed in the channel to the west of the terrace field. No increases in water levels were observed in the area of the construction staging area.

Local Government to Provide its Share of the Cost

The City of Virginia Beach is fully prepared to cover the cost share of the proposed project, as highlighted in the attached budget narrative, "Amount of Cash Funds Available." The funding for the grant match is contained within the City budget.

Benefit-Cost Analysis

FEMA recognizes the economic value of restoration projects and has provided ecosystem service economic valuations for benefit cost considerations. The approach and values used here are consistent with FEMA Benefit-Cost-Assessment (BCA) toolkit approaches and ecosystem service valuations published in "FEMA Ecosystem Service Value Updates, June 2022[9]." The 2022 FEMA guidance provides methods and values for various nature-based projects, including coastal wetlands. The valuations recognize ecosystem services for coastal wetlands including aesthetic value, climate regulation (carbon sequestration), flood and storm hazard reduction, habitat, recreation/tourism, water filtration and supply benefits of coastal wetland features.

Feasibility and Effectives Criteria

The project meets FEMA's Feasibility and Effectives Criteria for a Coastal Wetland as defined in the 2022 guidance, including:

- Land cover associated with the project is a "Estuarine and Marine Wetland" as classified for NWI for remaining marsh within and adjacent to the study area. The area of the project is also a historical marsh.
- The project demonstrates "ecosystem restoration" by using the terrace approach to recover degraded, damaged, and destroyed wetlands and submerged aquatic vegetation in the Back Bay ecosystem.
- The project meetings EPA concepts of restoration through direct creation of marshes (the terraces themselves) and enhancement of the ecosystem (reduction of water turbidity to enhance growth of submerged aquatic vegetation).
- The project will result in notable increased health and function of the local ecosystem in the "after mitigation" scenario through reduction of wave heights, water flow, and significantly decreased turbidity within the project area, as well as reduction of wave heights to adjacent areas.

[9] FEMA Ecosystem Service Value Updates, June 2022 (PDF).

- The project approach was aligned with established principles and techniques on wetland restoration, as outlined in the Coastal Wetlands and Tidal Flats section of the International Guidelines on Natural and Nature-base Features for Flood Risk Management10.

Design Life

As mentioned, the project useful life is 30-years. The FEMA 2022 guidance allows 50-years a typical lifespan; however, as stated in the project description, the elevation of the terraces was set based on a 30-year design life and estimated settlement.

Ecosystem Services Valuation

- The 2022 guidance values ecosystem services for coastal wetlands at $8,955 in 2021 U.S. dollars (USD), per acre, per year.
- The project will restore 46.5 acres of intertidal and upland marsh through direct creation of the marsh terraces. The project will also promote the growth of SAV in between the terraces, an area estimated at 310 acres. This provide for a total project benefit area of (46.5 + 310) = 356.5 acres.
- Project benefits occur over a period of time into the future; while most of the project costs are incurred up front and in the present. FEMA conducts its BCAs on a net present value basis, meaning the present value of the benefits gained from the project over the life of the project are compared to the total project cost to establish the BCR. Because project benefits accumulate over time, project benefits are calculated on an average annual basis ("annualized") and then multiplied by a Present Value Coefficient (PVC) to determine the present value of the annualized benefits.
- The present value coefficient is calculate as follows:

$$PVC = \left[\frac{1-(1-r)^{-T}}{r}\right]$$

  where *r* is the discount rate and *T* is the useful life of the project. The CFPF 2023 Grant Manual does not specify a discount rate for the benefits calculation; therefore, the latest FEMA program grant guidance was reviewed. For the 2023 FEMA Building Resilient Infrastructure and Communities (BRIC) and Floodplain Mitigation Assistance Grant Program (FMA) cycles FEMA has established a set discount rate of 3%[11]. The 3% discount rate provides for a PVC of 19.60 for a 30-year lifecycle for the project.
- Project benefits were calculated by:

$$Benefits = PVC \times Project\ Area \times Coastal\ Wetland\ Benefits$$

- The benefit cost ratio (BCR) was calculated as:

[10] International Guidelines on Natural and Nature-Based Features for Flood Risk Management - Engineering With Nature (dren.mil)

[11] FEMA Fact Sheet. Notice of Funding Opportunity for Fiscal Year 2023 Building Resilient Infrastructure and Communities Program (PDF).

$$BCR = \frac{Benefits}{Costs}.$$

A summary of the calculated values is provided in the below table:

Table 6. Summary of BCA parameters and results.

Project Area	Benefits (acre / year, 2021 USD)	Project Lifespan	Benefits, 3% discount rate	Project Cost	BCR, 3% discount rate
356.5	8,954	30	$62,566,588	$53,378,490	1.17

The calculated BCR for the project was 1.17, based on the FEMA ecosystem services valuation approach. This BCR is greater than 1, indicating the project can be considered cost-effective. The project also provides an additional $9.19M in value over the project cost.

Local Floodplain Management Regulations

The City recognizes the vital importance of floodplains in the natural movement of water through the community. Appendix K of the Virginia Beach Code of Ordinances regulates development in the community's floodplains. The City requires that a permit is obtained for any construction or development in the Special Flood Hazard Area. For more information and details regarding the City's floodplain management and ordinances, please refer to the following:

- Link to current floodplain ordinance: Virginia Beach Floodplain Ordinance.

In addition, a copy of the current floodplain ordinance has been included in *Part IV, Section E5*. For further information regarding the City's hazard mitigation and comprehensive planning, please refer to the following:

- Link to current hazard mitigation plan: Regional Hazard Mitigation Planning.
- Link to current comprehensive plan: Virginia Beach Comprehensive Planning.

Other Necessary Information to Establish Project Priority

Repetitive Loss and/or Severe Repetitive Loss Properties

The repetitive loss database shows 113 repetitive loss and severe repetitive loss properties within the two census block groups (518100454.121 and 518100464.001) associated with the project area.

Residential and/or Commercial Structures

A detailed economic flood loss assessment presented in the City's Resilience Plan showed that approximately 45% of the entire future risk exposure in the City is concentrated in the Southern Rivers watershed. Of that risk, 65% is concentrated in three communities north of Back Bay

(Figure 21).[12] Under a "no action" scenario, average annualized flood losses would increase from $974 thousand, representing present day conditions, to $6 million with 1.5 feet of sea level rise as anticipated by 2050. This figure equals an increase of six times present day conditions. With 3 feet of sea level rise as anticipated by 2080, annualized losses are expected to drastically increase to $80 million, more than 80 times today's conditions.

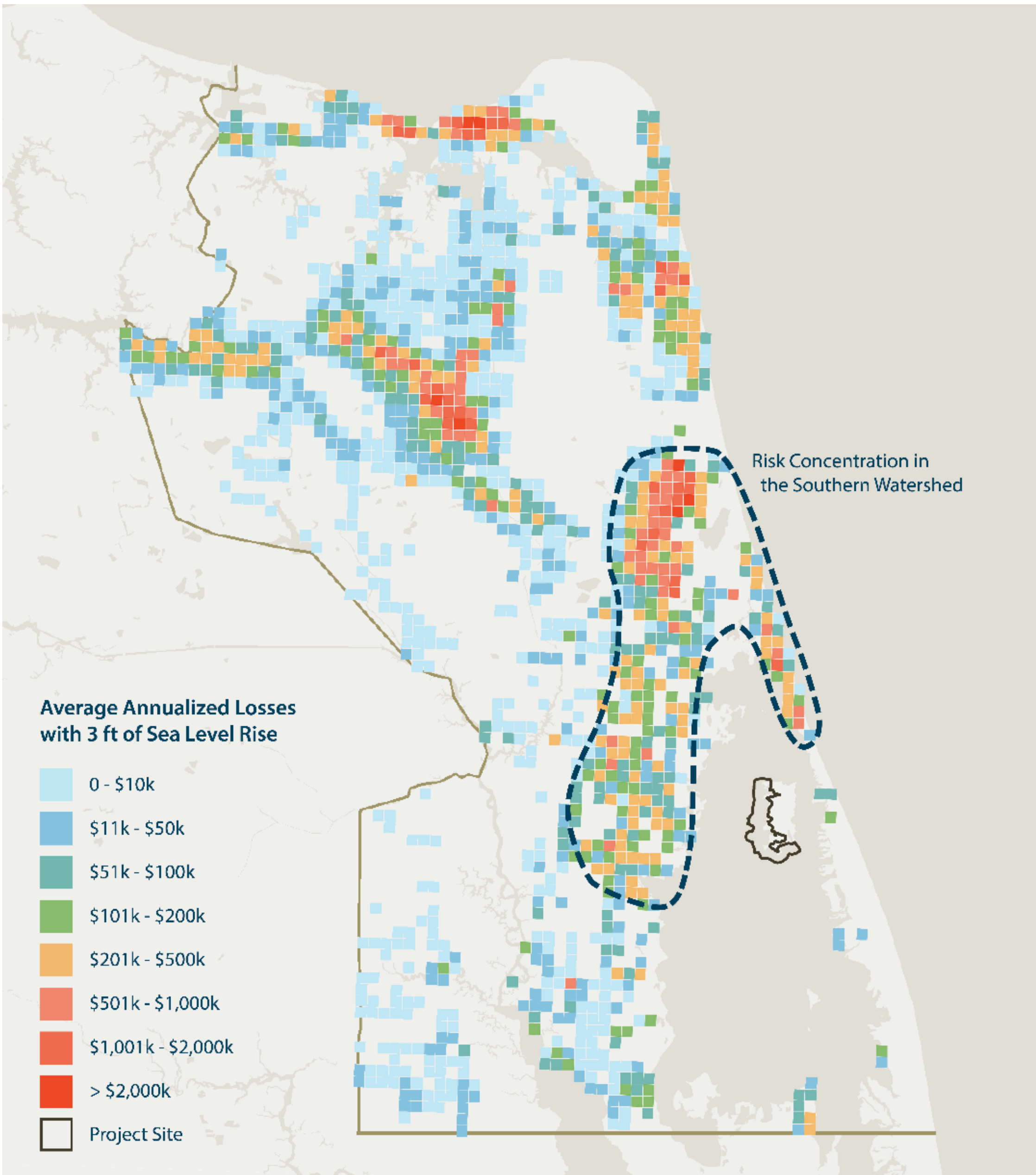

Figure 21: Concentration of average annualized losses estimated with 3 feet of sea level rise under a "no action" scenario presented in the City's Resilience Plan.

[12] City of Virginia Beach. (2020). Coastal Flooding and Economic Loss Analysis (PDF).

Within the two census block groups adjacent to Back Bay near the project area, there are approximately 70 commercial structures and 2,350 residential structures. Of those structures, approximately 635 structures are vulnerable to flooding during a 50-year event today. With 3 feet of sea level rise, approximately 2,060 structures are expected to be vulnerable during a 50-year event, representing approximately 85% of the residential structures within the project vicinity. These numbers underscore the importance of implementing the proposed project alongside complimentary flood risk reduction projects.

Critical Facilities

The two census block groups near the project site include 10 critical facilities. Table 7 summarizes critical facilities by type, total number, and the number of facilities exposed to the 50-year storm scenario under current and future "no action" scenarios. Under current 50-year storm conditions, 2 communication facilities and 1 electric power station would be exposed to flooding. With 3 feet of sea level rise, the number of critical facilities exposed to flooding increases to 9 total facilities.

Table 7: Summary of critical facilities located in the selected census block groups and flood hazard exposure to the 50-year storm event under current conditions and with 1.5 feet and 3 feet of sea level rise.

Type of Facility	Number of Facilities	Current 50-year storm	50-year storm with 1.5 feet sea level rise	50-year storm with 3 feet sea level rise
Communication	3	2 (66%)	2 (66%)	3 (100%)
Electric Power	1	1 (100%)	1 (100%)	1 (100%)
Fire Station	1	0	0	0
Potable Water	2	0	2 (100%)	2 (100%)
School	1	0	0	1 (100%)
Wastewater Treatment	2	0	0	2 (100%)

Need for Assistance

The City of Virginia Beach has invested significant time, money, and staff resources in understanding, communicating, and planning for the threats of sea level rise and recurrent flooding to the community. The City is ready to begin the implementation of adaptation measures, and the marsh terrace project is the first project to advance to construction from the City's Resilience Plan. The project represents the first step in restoring Back Bay and the larger Albemarle-Pamlico estuary, and serves as a pilot for additional restoration projects. Virginia Beach understands that flood mitigation costs are substantial and is seeking funds to support project implementation alongside dedicated resources procured by the City. The City's

Department of Public Works Stormwater Engineering Center has closely coordinated with the City's Department of Planning & Community Development throughout the design and permitting process. The Department of Public Works will oversee the construction of the marsh terrace project, including providing construction inspectors to monitor that the project is built to the City's design standards and technical specifications. Additionally, the City has access to necessary software, including AutoCAD and ArcGIS Desktop, and support from consultants to augment the City's technical capabilities.

Examples of City staff who will support the project include the following:

- Program Manager for the Technical Services Division of the Stormwater Engineering Center.
- Project Manager for Green Infrastructure Projects for the Technical Services Division of the Stormwater Engineering Center.
- Environmental Planner / Certified Floodplain Manager from the Wetlands & Shoreline Construction Team of the Planning Administration Division of the Department of Planning & Community Development.
- Planning Evaluation Coordinator from the Chesapeake Bay Preservation Area & Southern Rivers Watershed Team of the Planning Administration Division of the Department of Planning & Community Development.
- Full-time Construction Inspector assigned exclusively to this project from the City's Construction Bureau or under contract with the City Public Works Engineering Division.
- Grant Coordinator from the City's Public Works Engineering Division.

Additional staffing will be provided as needed to ensure project success.

This project benefits communities in northern Back Bay with a high concentration of flood losses (as shown in Figure 21). These communities contribute significantly to Virginia Beach's rural economy, including agriculture, forestry, fishing, hunting, and eco-tourism. In Hampton Roads, these industries contribute a combined $100 million in gross domestic product.[13] Protection of vulnerable natural infrastructure, such as the marshes in Back Bay, is critical to ensuring these industries can continue to thrive within the region.

Alternatives

Several other alternatives were considered but not advanced due to technical and environmental limitations. These alternatives are briefly summarized below.

[13] Office of Governor Ralph S. Northam Commonwealth of Virginia and Virginia Department of Conservation and Recreation. (2021). Virginia Coastal Resilience Master Plan Phase 1 (PDF); data referenced sourced from the US Bureau of Economic Analysis. (2019).

Alternative 1 - No Action Alternative

Under this alternative, no action would be taken to restore marsh habitat in the shallow open water channel of Bonney Cove. Erosion of the adjacent marsh would continue to occur, resulting in fragmented habitat lacking the capacity to reduce wave action and slow water velocities. It is anticipated that wind-driven flooding events will continue to increase in frequency, resulting in increasing flooding of the low-lying properties and roadways surrounding northern Back Bay.

Alternative 2 - Alternative Terrace Configuration Design(s)

Several configuration alternatives for the terraces were considered during the design process. These included four alternative layouts with different spacing and terrace top widths:

- **Alternative 2a** (Figure 22): Terraces would be spaced at approximately 300-foot intervals and have a top width of 15 feet. Between the base of the terraces, there would be approximately 220 feet for potential establishment of SAV habitat.
- **Alternative 2b** (Figure 23): Terraces would be spaced at approximately 300-foot intervals and have a top width of 30 feet. Between the base of the terraces, there would be approximately 200 feet for potential establishment of SAV habitat.
- **Alternative 2c** (Figure 24): Terraces would be spaced at approximately 600-foot intervals and have a top width of 15 feet. Between the base of the terraces, there would be approximately 520 feet for potential establishment of SAV habitat.
- **Alternative 2d** (Figure 25): Terraces would be spaced at approximately 600-foot intervals and have a top width of 30 feet. Between the base of the terraces, there would be approximately 500 feet for potential establishment of SAV habitat.

A common feature across all of these design alternatives was a breakwater that spanned the entire length of the southern extent of Long Island and a northern breakwater that spanned the northern exposed section of the project site.
Alternative 2a and 2b were eliminated due to constructability concerns regarding the quantity of sediment that would be required and due to the limited amount of room for SAV establishment in between the terraces (approximately 220- and 200- feet of potential SAV habitat between terraces for Alternative 2a and 2b, respectively).

Alternatives 2c and 2d were discussed extensively amongst the project team; however, it was ultimately determined that they did not maximize the opportunity for species diversity (by including both smaller and larger terraces). These alternatives were combined to form the preferred alternative presented in this document. Additional refinements that were made to these alternatives include the removal of the perimeter breakwater, as the proposed design elevation evaluated in the geotechnical analysis revealed stability issues with these large features.

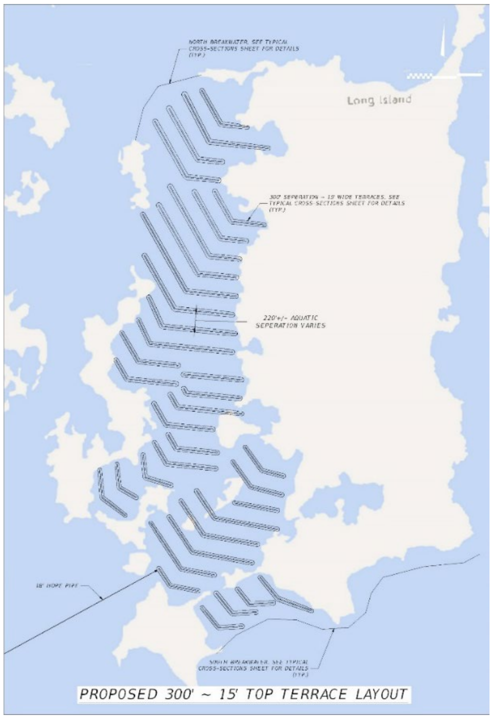

Figure 22: Alternative 2a.

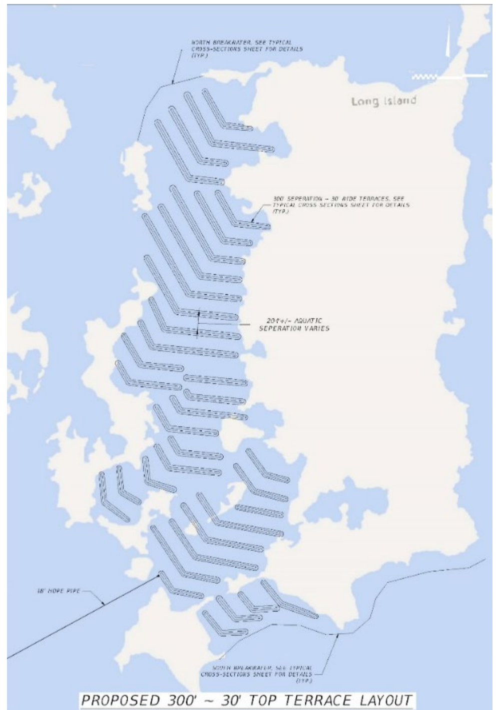

Figure 23: Alternative 2b.

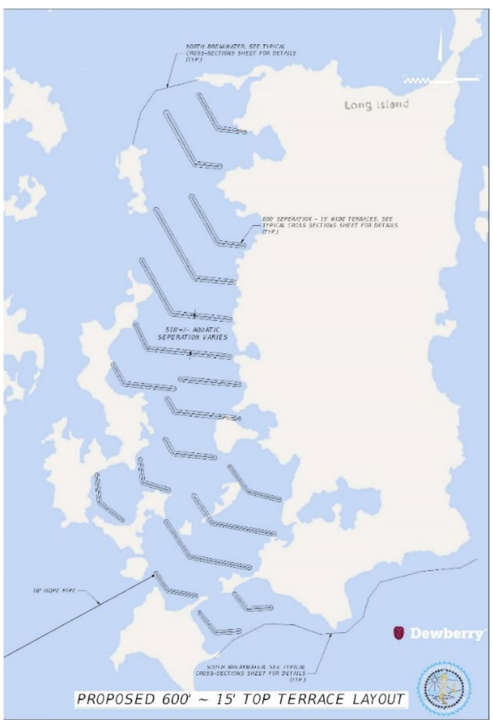

Figure 24: Alternative 2c.

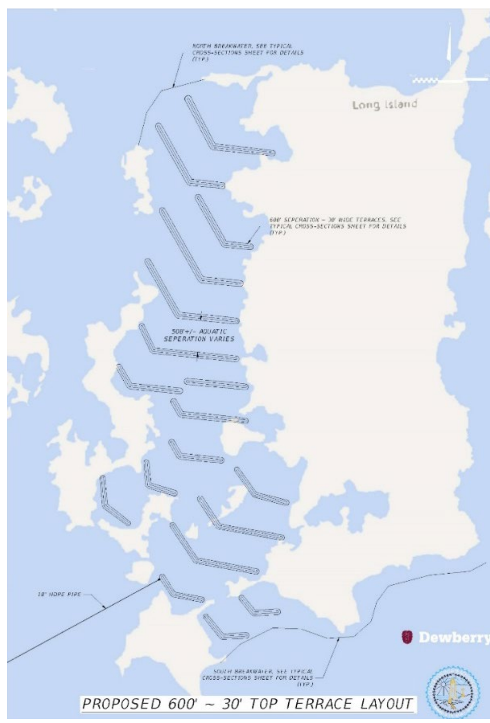

Figure 25: Alternative 2d.

Alternative Terrace Core Material Sources and Transportation – Alternative 3

In the proposed alternative with sand cores, a no-dredging alternative was considered. However, in order to successfully complete the project and establish the vegetation desired, material would need to be sourced, blended, transported, and placed. The City helped identify two potential borrow sources of material: Bow Creek Golf Course (Figure 26) and the Whitehurst Dredged Material Management Area (DMMA) (Figure 27).

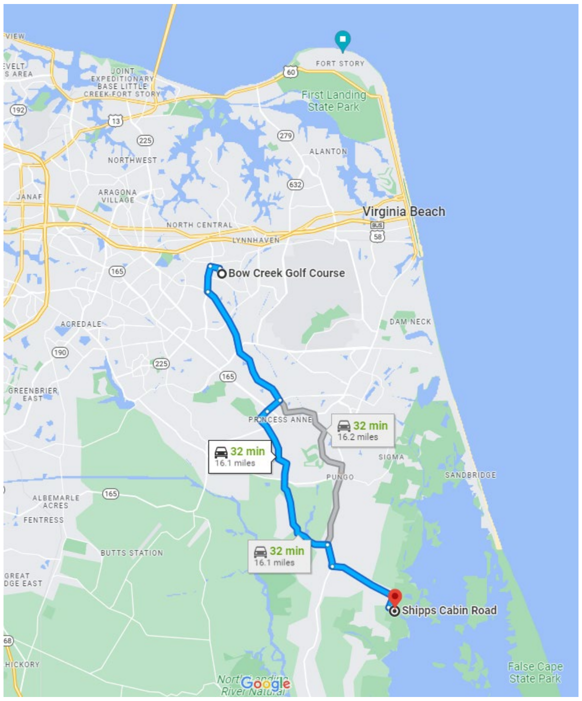

Figure 26: Distance from Bow Creek Golf Course to the proposed Shipps Cabin staging area.

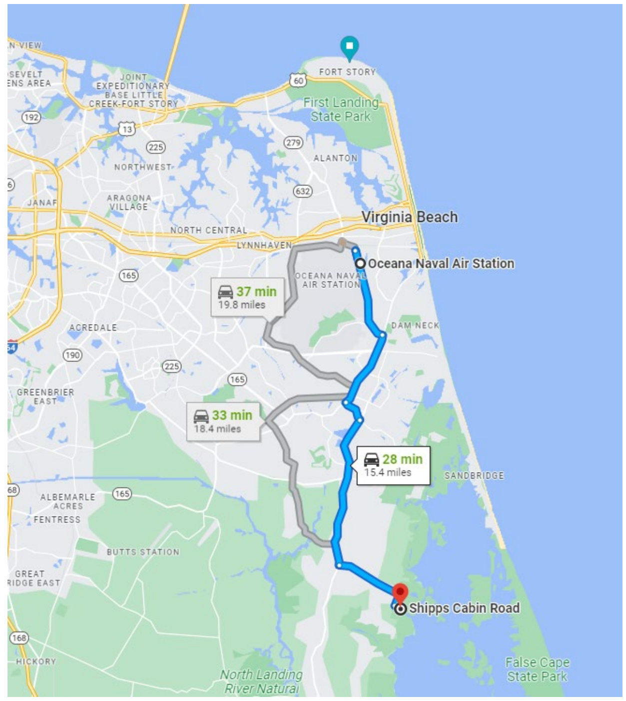

Figure 27: Distance from Whitehurst DMMA to the proposed Shipps Cabin staging area.

Bow Creek Golf Course: Bow Creek Golf Course is located approximately 16 miles from the proposed Shipps Cabin staging area. In the next few years, The Bow Creek Golf Course is scheduled to be converted into a Stormwater Park as one of 21 projects funded by the City's Stormwater Flood Protection Program. Large quantities of materials will be removed from the site for use within the City. The material from Bow Creek would need to be excavated, screened, and tested for foreign seeds and contaminants. Most likely, this material would have to be processed before it could be loaded again on dump trucks and hauled approximately 16 miles to a potential staging area where it would be loaded again on shallow draft barges.

Whitehurst DMMA: The Whitehurst DMMA is a similar distance to the proposed Shipps Cabin Road Construction Staging Area. The material at Whitehurst may not have to be processed as much; however, it would need to be tested for foreign seeds and contaminants. Because of the organic components in this soil and the need for the material to establish vegetation on the terraces, this material is not able to be hydraulically blended and pumped to the site. Therefore, this material would need to be loaded on shallow draft barges and then

placed by mechanical means. Further, the amount of material needed to cap the proposed terraces is approximately 110,000 cubic yards which equates to roughly 5,500 quad-axle dump trucks traveling city streets and damaging other infrastructure.

Barging of all materials was considered. Dewberry conducted meetings, site investigations, and talked with both industry leaders in maritime construction and locals who know the water in Back Bay. A typical 35-foot by 95-foot construction barge drafts approximately 7 feet. This type of barge is not able to be trucked to the landing site, nor is it able to be brought into Back Bay. There are truckable barges, but again the drafts of those barges can be in the 4 to 5 feet range when loaded and would require dredging a channel for access. Shallow draft barges can be used in Back Bay that only draft 1 to 3 feet, and they would need to be off-loaded from a staging site. To bring any materials such as stone, sandy fill, or terrace cap material by barge around Knotts Island is not feasible. The actual channel into the southern point of Back Bay has a height restriction due to the causeway serving Knotts Island.

Continuous Marsh Platform – Alternative 4

A continuous marsh platform to fill in the areas of historical marsh would help to restore this eroded habitat but would not provide conditions suitable for SAV establishment or optimize the wave/flow velocity attenuation through the project area. Furthermore, for a single marsh platform across Bonney Cove, the amount of material required would be more than 3 or 4 million cubic yards of material. To achieve that volume of material by dredging, significant areas of existing SAV present in Back Bay would need to be impacted. As the geotechnical report indicated, the existing material of the project site and surrounding areas is not capable of supporting itself in a constructed arrangement and would slough off back into the water. Further, providing this amount of material without dredging would require bringing external sediment sources into Back Bay, which could introduce invasive species. Finally, while the platform will reclaim marshland, it is not anticipated to establish extensive areas appropriate for SAV reestablishment and would eliminate deeper water areas preferred by some endemic wildlife species.

Goals and Objectives

The overarching goal of this project is to construct the City's first nature-based adaptation project in the Southern Rivers Watershed and one of the CRMP's exemplary nature-based projects. This project aims to stabilize two critically eroding marsh islands from further degradation, decrease turbidity to promote the growth of aquatic vegetation and provide flood risk reduction benefits through increased friction and wave attenuation. The following section summarizes the objectives through which this goal will be realized.

Objective 1 – Create a Construction Access and Staging Area

The project's first objective is to employ a construction approach that is compatible with the shallow nature of Back Bay and the large quantity of material required to build the marsh terraces. The engineering team performed a constructability review of suitable landing sites to

stage construction operations for the terraces. A property located at the end of Shipps Cabin Road (Figure 28) was identified as the preferred staging and construction access location for the following reasons:

- Shipps Cabin Road Construction Staging Area Proximity to site (2 miles).
- Shipps Cabin Road Construction Staging Area Proximity to sand borrow sources.
- Shipps Cabin Road between Muddy Creek Road and the Construction Staging Area is in disrepair and was identified as an opportunity to improve the condition of the road as part of the construction activities.

Figure 28: Proposed Construction Access.

On completion of the project, the City plans to retain the staging area for future monitoring and maintenance needs for the project. This future use is consistent with the sentiments of local stakeholders, as communicated during public engagement meetings for the study.

Expected Benefits:

- Enables constructability of the marsh terraces.
- Enable access to the project for post-construction monitoring and future marsh restoration projects.

Objective 2 – Restore Marsh and Aquatic Vegetation

The second objective of the project is to restore marsh and aquatic vegetation for habitat and flood resilience. Specifically, the City's construction of the marsh terraces will result in the restoration of approximately 46 acres of habitat within Back Bay, consisting of:

- 10 acres of low marsh habitat; low marsh plantings would include Big Cordgrass (*Spartina cynosuroides*) and Saltmarsh Cordgrass (*Spartina alterniflora*).
- 6 acres of high marsh habitat; high marsh plantings would include Black Needlerush (*Juncus roemerianus*) and Salt Meadow Hay (*Spartina patens*).
- 14 acres of upland vegetated habitat; upland vegetation would include Arrow-leaf Tearthumb (*Persicaria sagittate*), Groundsel Tree (*Baccharis halimifolia*), Wax Myrtle (*Myrica cerifera*), and Bald Cypress (*Taxodium distichum*).
- 16 acres of submerged terrace habitat anticipated to create suitable conditions for the emergence of SAV.

Additionally, approximately 310 acres of open water SAV habitat would remain between the proposed marsh terraces, and it is anticipated that construction of the terraces would create conditions within the project area favorable to the re-establishment of SAV populations.

Expected Benefits:

- Reduce wave heights, flow velocities, and wind sheer stress within the project area to protect marsh islands from continued erosion.
- Restore the natural buffer that helps protect low-lying neighborhoods and critical access roads from wind-driven flooding.
- Improved water quality by removing excess nutrients.
- Lowered transport of suspended sediment and prevention of resuspension of fine sediments in the water.
- Reduced flow velocity and absorbing wave/wind energy to reduce shoreline erosion.
- Creation of habitat (nursery and feeding areas) for fish (such as Largemouth Bass, Bluegill Yellow Perch, Striped, Blueback Herring, Alewife, and American Eel), migratory waterfowl (such as the Canvasback Duck [*Aythya vallisineria*]), and other aquatic animals.

Objective 3 – Engage Stakeholders and Disseminate Effective Practices

The City is committed to continued meaningful engagement with project partners and external stakeholders throughout the restoration and monitoring phases to ensure transferability to other sites in the region and state.

Expected Benefits:

- Ensure that the lessons from this project can be transferred and scaled to other sites in the state or region.

Approach, Milestones, and Deliverables

The following approach, milestones, and deliverables lay out a plan of action. The milestone schedule follows in *Section B: Milestone Schedule*.

Approach & Deliverables

Activity 1 – Construction Staging Area Preparation and Construction

Activity 1 involves preparing the Shipps Cabin Road property as a construction staging area. Construction activities will include stabilization of the road, laying geotextile to stabilize the ground under the construction staging area, filling with material for the construction staging area, adding fencing, creating bridge abutments and installing a temporary bridge and ramp for waterfront construction access, construction of slurry basins, and establishment of traffic flagging stations.

In the final step, the contractor will install pipe to pump the slurry material from the Shipps Cabin staging area to Bonney Cove. The pipe will be floated with subaqueous tie-downs at channels and certain points of access to maintain boat crossings. Those subaqueous locations will be marked by a buoy every 10 feet and temporary signage as reasonable. The contractor will install two booster stations along the alignment, one approximately half-way between the landing and Bonney Cove, and one at the edge of Bonney Cove. These booster stations will consist of a pontoon-mounted diesel engine pump capable of moving the sand slurry from the construction staging area to the site. It is estimated that 150 CY per hour of sand slurry would be pumped through the pipe in a 60:40 ratio. Additional booster stations may be required for manifolding and supplying slurry stations to individual terraces.

Relevant Objective(s): Objective 1

Deliverables:

- Conduct daily inspections to monitor construction progress of the Shipps Cabin Road Construction Staging Area preparation.

Assumptions:

- It is anticipated that the Shipps Cabin Road Construction Staging Area construction activities can occur simultaneously with material production in Year 1 (2024).

Activity 2 – Marsh Terrace Construction

Once the Shipps Cabin Construction Staging Area preparation is complete, marsh terrace construction activities can commence. The contractor will construct the terraces according to the 100% Final PS&E documents. The most recent engineering designs and design report are available upon request; they are not included as an attachment to this proposal due to file size. Figure 29 shows the overall layout of the terraces, and Figure 30 and Figure 31 show the project renderings. Terrace construction will begin in the northern extent of the project site at Terrace #100, noted in Figure 29, and the contractor will work south towards Terrace #140. The contractor will complete each terrace (including installation of plants) before moving onto the next.

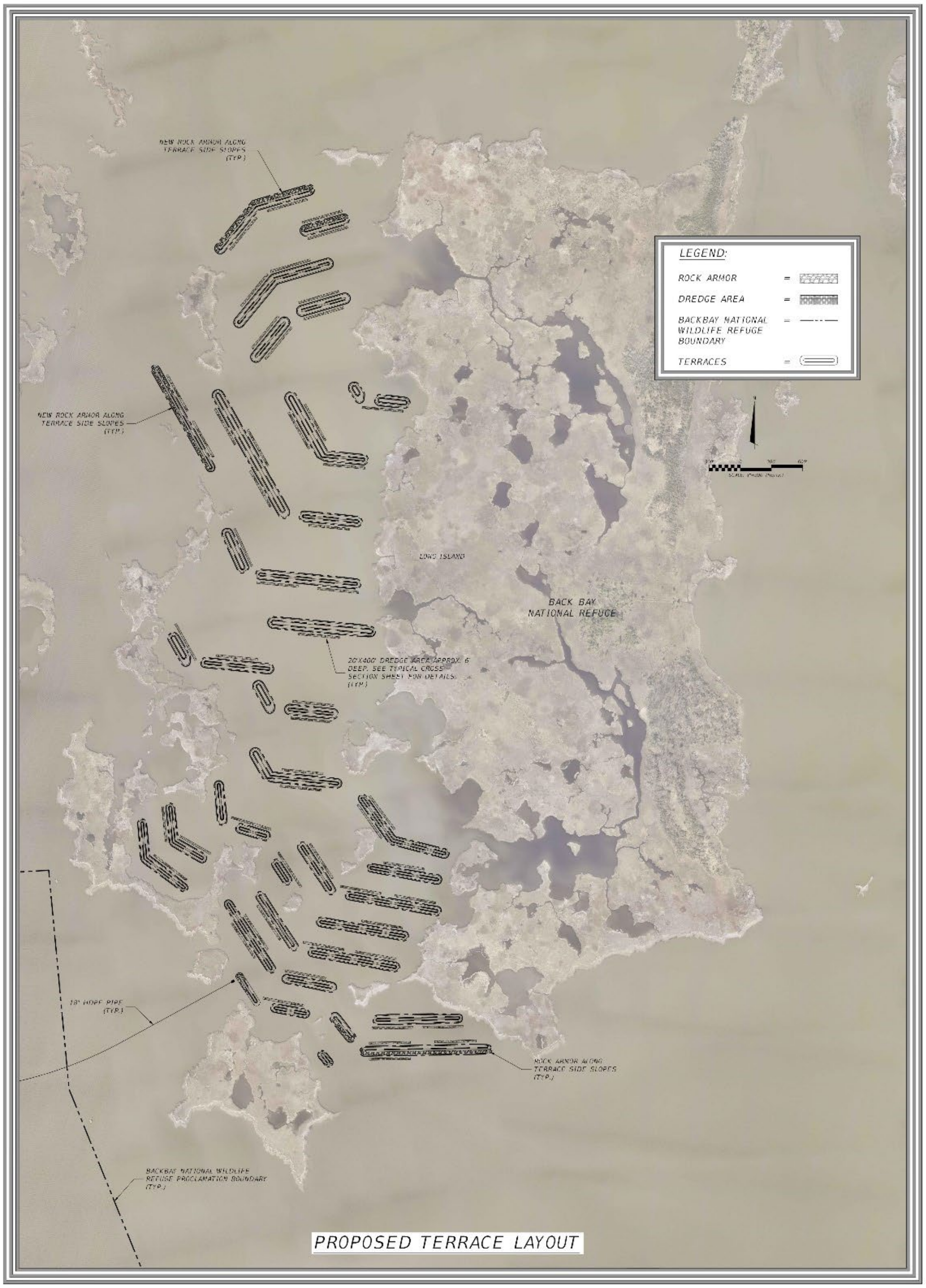

Figure 29: Marsh terrace layout across Bonney Cove.

Figure 30: Marsh terrace design rendering.

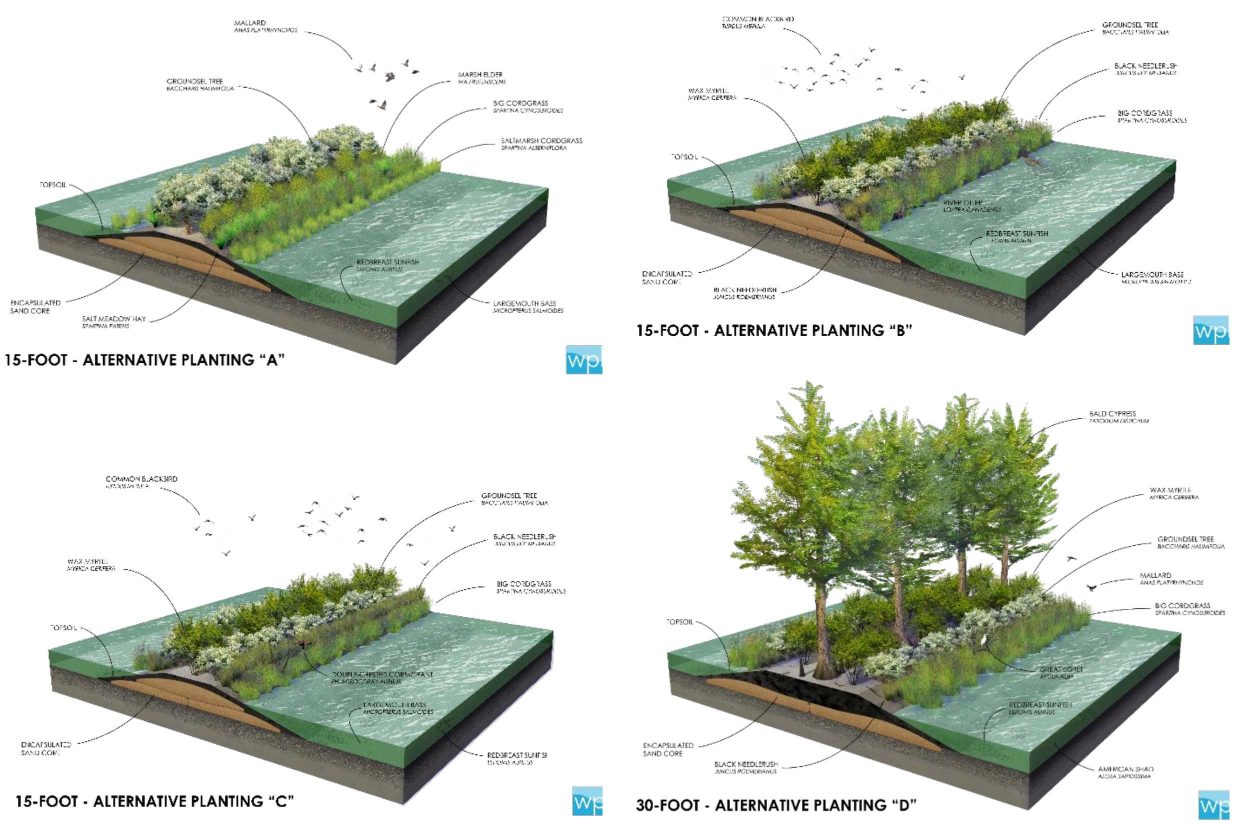

Figure 31: Marsh terrace cross-section design renderings.

The following section provides a high-level description of the proposed design and

construction approach.

Terrace Orientation:

The orientation of the terraces will be perpendicular to the predominant wind direction (south-southwest) to maximize wave energy reduction. The terraces in the northern extent of the project site will be angled perpendicular to a north-northwest wind direction. The terraces would be segmented in a chevron pattern (duck-wing pattern) to provide the most favorable fish and swimming crustacean (termed "nekton") habitat while also allowing adequate circulation to promote sedimentation and maintaining navigability throughout the project area. The terraces would not be connected to the adjacent marsh; this gap, or physical open water barrier, is intended to deter the invasion of Common Reed (*Phragmites australis*) stands from adjacent marshes.

Spacing:

The terraces would be spaced at approximately 300-foot intervals in the northern and southern quarters, and then 600-foot or greater intervals in the center. This arrangement aims to lessen the open water and subsequent wave action at the northern and southern ends of the site and allow adequate construction space for marine-based construction equipment.

Terrace Elevation and Width:

To achieve a sustainable marsh elevation throughout the project life, the marsh terraces would initially be built to a higher elevation during construction and allowed to settle to the desired target elevation over time. Taller terraces improve the functionality and resiliency of the system while also providing diversified habitat for fish and wildlife. The goal is that, by the end of the 30-year design life and with 1.5 feet of relative sea level rise, the terraces will be at or above the elevation of a moderate wind tide event (when Back Bay water levels are anticipated to reach +3.0 feet NAVD88 over the design water level). This threshold was determined to ensure the terraces would not be fully overtopped during a future wind tide event and maintain resiliency to anticipated sea level rise. The 1.5 feet sea level rise scenario is consistent with the near-term planning scenarios identified in the City's Resilience Plan to represent conditions from 2035 to 2050 and adopted by the Hampton Roads Planning District Commission (HRPDC) as part of resolution number 2018-01.

The terraces would have a top width of 15 or 30 feet and be built to an elevation of +4.5 to +5.0 feet NAVD88, depending on the width of the crest, underlying soils, and local bottom depth, with side slopes of 4 horizontal to 1 vertical (4H:1V). The +4.5- to +5.0-foot elevation is calculated based on a target elevation of +3.0 feet NAVD88 or higher at the end of the project's 30-year design life and an estimated settlement of approximately 1 to 2 feet, depending on where the terrace is located. The geotechnical investigation revealed that terraces in the site's southern portion are expected to experience greater settlement than those to the north.

Terrace Composition:

The terraces would consist of a sand-filled core that is encapsulated by a high-strength blend of woven and non-woven geotextile fabrics. The sand for this material will come from nearby offsite sources and be pumped through the 1-inch diameter pipe described in Activity 2. Once the cores are in place, long-reach excavators would travel along the tops of the terraces and begin to shape the cross slopes. Existing adjacent material devoid of SAV would be mechanically dredged and placed over the sand-filled cores. The marsh terraces would be covered with 1 to 3 feet of suitable fill, depending on crest widths, and then planted with native emergent and brackish plant species to stabilize the terraces and provide wind-driven flood reduction benefits.

Relevant Objective(s): Objective 2

Deliverables:

- Conduct daily inspections to monitor construction progress of the marsh terraces.

Assumptions:

- It is anticipated that construction of the terraces will occur in two phases over two years from 2025 through 2026, with the following assumptions:
    - Construction activities are not permitted within BBNWR from October 31 through February 28, annually, to limit disturbance to wintering waterfowl and migration during those months.

Activity 3 – Stakeholder Engagement and Lessons-Learned Dissemination

As the first large scale terracing project on the Atlantic coast, the City recognizes the importance of documenting lessons learned and effective practices during each of the proposed activities: contractor procurement, construction, and post-construction monitoring. The City plans to develop a set of project marketing materials (PowerPoint presentations, StoryMap, information flyers, etc.) to cover key topics, such as:

- Lessons learned during contractor procurement, construction, and post-construction monitoring.
- Effective practices for contractor procurement, bid development, and evaluation. This project is expected to require a highly specialized contractor given the complexity of the project, very shallow water depths, and distance of the site from available construction access and staging areas.
- Guidance for identifying the best sources for local and regional materials for building the terraces and developing a project construction schedule with enough lead time for producing the quantity of material needed for large-scale marsh creation projects.
- Effective practices for developing a post-construction monitoring plan for marsh terraces that a) aligns with permitting, grant, and other requirements and b) enables quantification of project benefits and areas for improvement.

- Effective practices for communicating project benefits based on a combination of field data collection, numerical modeling, and post-construction monitoring.

The City plans to leverage the materials to facilitate dissemination to key stakeholders to increase likelihood of transferability of the approach to other areas in the region and state. The City's plan for engagement is summarized in the following table. In addition to these efforts, the City is committed to collaborating with DCR to identify any additional opportunities to help socialize the project's innovative design and lessons learned.

Table 8: Summary of opportunities for City, regional, state, and national stakeholder engagement; expected benefits.

	Description of Proposed Outreach Activities

CITY	• Facilitate internal municipal awareness, coordination, and approval to gain budgetary approval for funding to expand the approach to other sites in Back Bay (such as "The Great Narrows", Mackay Island and Princess Anne Wildlife Management Areas, and Ragged Island) through presentations to the:
	  o Virginia Beach City Council
	  o City Manager Working Group for SLR and Recurrent Flooding, comprised of representatives from all City departments, to facilitate awareness, coordination, and action to advance the project to the restoration phase.
	• City of Virginia Beach Management Leadership Team (MLT), which includes the City Manager, Deputy City Managers, and Department heads from across the City.

REGION	• Collaborate with the National Audubon Society and Albemarle-Pamlico National Estuarine Partnership (APNEP) to:
	  o Highlight the marsh terrace project as a success story in the next iteration of the Currituck Sound Coalition Marsh Conservation Plan.
	  o Explore opportunities for marsh terrace projects in the Knotts Island Channel, a key flood pathway into Back Bay, as well as other locations in the Currituck and Albemarle-Pamlico Sound.
	• Share lessons learned to regional and state stakeholders, improving knowledge-based, awareness, and capacity for future efforts through presentations to:
	  o Hampton Roads Adaptation Forum – a regional dialogue for academics, non-profits, consultants, and municipalities committed to resilience measures.
	  o The Hampton Roads Planning District Commission (HRPDC) Coastal Resiliency Committee .
	  o Regional conferences on green infrastructure, coastal resilience, and SLR adaptation.
	• Collaborate with Wetlands Watch, a regional non-profit organization committed to the protection of wetlands using nature-based solutions, to socialize the project and disseminate lessons learned.

	Description of Proposed Outreach Activities
STATE	• Continue to coordinate with the Virginia Department of Conservation and Recreation (DCR) to: o Promote the project as a success story for the State Coastal Master Plan (CRMP), which highlighted the project as an "exemplary" resilience project that aligns with the Commonwealth's objective to protect and enhance the state's natural infrastructure. o Incorporate project updates and lessons learned on the CRMP website is an excellent mechanism for dissemination to all coastal Planning District Commissions (PDCs)/Regional Commissions (RCs) across the state. • Continue to collaborate with The Nature Conservancy (TNC), a national player in guiding the implementation of nature-based strategies, to help disseminate lessons learned on project implementation. The City has engaged in early discussions with TNC about partnering to host a state-level workshop that would draw from the network of TNC's local and regional chapters • Presentations at state-level conferences on water resources, floodplain management, and resilience, such as hosted by Resilient Virginia and Virginia Lakes and Watersheds Association.
NATION	• Disseminate lessons learned/effective practices through presentations at 1-2 relevant national conferences such as Restore America's Estuaries, Association of State Floodplain Managers, or the American Shore and Beach Preservation Association, etc. • Leverage working relationships and existing contract work with the U.S. Army Corps of Engineers and partners to integrate lessons learned into the International Natural and Nature-Based Feature Design Guidelines to promote consideration of marsh terraces within similar Back Bay environments (for example, in North Carolina, Maryland, New Jersey, and New York).

Relevant Objective(s): Objective 3

Deliverables:

- Project marketing materials.
- Records documenting number of stakeholders engaged during outreach activities.

Activities Not Included Under this Grant

Submerged Aquatic Vegetation Transplant Plan: The City will evaluate opportunities for restoring native submerged aquatic vegetation populations in Back Bay, such as Wild Celery (*Vallisneria americana*), through consultations with subject matter experts. After terrace construction, the City will formulate a plan for planting submerged aquatic vegetation in between the terraces in coordination with identified partners and the construction contractor.

Post-Construction Monitoring: Post-construction monitoring and inspections will occur for a minimum of five (5) years following construction. Given the period of performance for the CFPF grant, post-construction monitoring activities have not been included in this application.

Milestone Schedule

The scope of work proposed in this grant application are scheduled to occur between June 2024 and June 2027. Work activities are anticipated to complete in December 2026; however, the proposed schedule extends through June 2027 for contingency. The project's expected progression is shown in the following milestone schedule, noting deliverables for each milestone:

2024 Activities

- *1st Quarter* ***(pre-grant period activities):***
  - 100% Final PS&E
  - Submit Bid Documents
- *2nd Quarter (pre-grant period activities):*
  - Final Bid Coordination/Acceptance
  - Construction NTP
- ***Begin Year 1 Grant Activities – 2nd Quarter 2024:***
  - Mobilization for Shipps Cabin Road Construction Staging Area
  - Initiation of Marsh Terrace Material Production
- *3rd Quarter:*
  - Construction NTP and Mobilization for Slurry Basin Installation
- *4th Quarter:*
  - Completion of Shipps Cabin Road Construction Staging Area and Slurry Basin Construction

2025

- *1st Quarter*
  - Completion of Marsh Terrace Material Production
  - Construction Mobilization for Marsh Terraces (beginning on March 1, 2025)
  - Oversight, Management, and Inspection Services of Slurry Basin Installation
- ***Begin Year 2 Grant Activities - 2nd Quarter 2025***
  - Construction of Marsh Terraces #100 – 105
- *3rd Quarter*
  - Construction of Marsh Terraces #106 – 114
- *4th Quarter*
  - Construction of Marsh Terraces #115 – 119
  - Marsh Terrace Construction Demobilization (to accommodate break in construction period from October 31, 2025 – February 28, 2026)

2026

- *1st Quarter*
  - Construction Re-Mobilization for Marsh Terraces (beginning on March 1, 2026)
- ***Begin Year 3 Grant Activities - 2nd Quarter 2026***

  - Construction of Marsh Terraces #120 – 134
- *3rd Quarter*
  - Construction of Marsh Terraces #135 – 140
- *4th Quarter*
  - Shipps Cabin Road Construction Staging Area Final Improvements & Demobilization

2027

- *1st and 2nd Quarter*
  - *Contingency for any delays experienced through end of 2026*

End Year 3 Grant Activities

Project Partners

The following table highlights the specific project partners, their roles, and their capabilities concerning the proposed project.

Table 9: Potential Project Partners.

Entity	Role	Description
U.S. Fish and Wildlife Service, Back Bay National Wildlife Refuge	Project Partner / Advisor / Adjacent Land Owner	BBNWR owns the land adjacent to the project footprint and monitors migratory bird hunting within Presidential Proclamation boundaries. BBNWR has coordinated with the City on project design and will continue to be involved during project construction as a stakeholder and advisor.
Virginia Department of Wildlife Resources	Project Advisory / Stakeholder	The City has coordinated closely with VDWR on project design. Furthermore, VDWR has been monitoring SAV distribution in Back Bay for decades and will be a critical partner for identifying native seagrass species and techniques for restoration based on extensive experience from previous SAV restoration projects in Back Bay.
Virginia Beach Department of Planning & Community Development	Permit Compliance	The City's Department of Public Works has been in close coordination with the City's Department of Planning & Community Development throughout the design and permitting process. Continued involvement and coordination during construction and post-construction monitoring is anticipated.
Dewberry	Engineering Contractor	Engineering consultant to support the City with contractor procurement and construction administration.
To be Determined	Construction Contractors	Construction contractor for the Shipps Cabin Road Construction Staging Area and marsh terrace construction activities.

Entity	Role	Description
Friends of Back Bay	Project Advisory / Stakeholder	Friends of Back Bay was formed in the 1980s to lead efforts to expand and conserve BBNWR, including securing millions in funding to support the Refuge's expansion. The City has coordinated with the BBNWR Society throughout the design and permitting process and will continue this coordination through construction and post-construction monitoring.
Back Bay National Wildlife Refuge Society	Project Advisory / Stakeholder	The Back Bay National Wildlife Refuge Society (BBNWR Society) is an independent, 501(c)(3) non-profit group dedicated to supporting the mission of the USFWS National Wildlife Refuge System and specifically promoting awareness of the BBNWR through education and participation. The City has coordinated with BBNWR Society throughout the design and permitting process and will continue this coordination through construction and post-construction monitoring.
Back Bay Restoration Foundation	Project Advisory / Stakeholder	Back Bay Restoration Foundation (BBRF) is an independent, 501(c)(3) non-profit group focusing on growing concerns about issues such as recurrent flooding, sea level rise, and development in the Southern Rivers Watershed. The group aims to serve as an advocate for the Bay and surrounding residents. The City has coordinated with BBRF throughout the design and permitting process and will continue this coordination through construction and post-construction monitoring.

Relationship to Other Projects

This project represents the first nature-based project in the Southern Rivers Watershed to advance to design and construction to implement the City's Wise Resilience Plan. The project is also an aspect of the Stormwater Green Infrastructure aspect of the City's Flood Protection Plan. The City has received a $3M award from the CFPF to support another project in the Stormwater Green Infrastructure element of the Flood Protection Program – the Elizabeth River Wetland and Floodplain Restoration Project (Round 1 CFPF Grant Awards).

The City has also received two NFWF NRCF grants from the Marsh Restoration in Back Bay project. Approximately $135,000 in NFWF NRCF funding was awarded in 2020 for the previous phase (design and permitting) for the project. The City continues to meet the obligations and period of performance of this NFWF grant. In 2022, the NFWF NRCF awarded $9,886,400 to support construction activities.

In its Resilience Plan, Virginia Beach identifies an adaptation approach for the Southern Rivers Watershed that emphasizes natural mitigation methods and integrated systems of defenses. As a natural mitigation strategy, the marsh terrace project aims to serve as a first line of defense during flood events, reducing wind-driven fetch, wave energy, and flow velocities to protect the important marsh buffer surrounding the shorelines of Back Bay. Other projects are also needed to provide multi-layered flood protection to northern Back Bay communities (Figure 32). Several

of these projects are highlighted below. It should be noted that the projects described below are either not yet funded or will be funded in the future through the City's Capital Improvement Program.

Figure 32: Southern Rivers Watershed Adaptation Vision.

Marsh island restoration serves as a critical first line of defense of the multi-layered protection system in the Southern Rivers Watershed. The following map (Figure 33) shows the structural adaptation projects proposed for the Southern Rivers Watershed, including the Muddy Creek Road and Sandbridge flood defense systems. The City's numerical modeling shows that, if implemented, there is potential for small increases in flooding outside of these structural protection systems.[14] This emphasizes the need for complimentary measures, including the marsh terrace project, land acquisition, and conservation efforts, to mitigate this residual risk.

[14] City of Virginia Beach (2020). City-wide Structural Alternatives for Coastal Flood Protection (PDF).

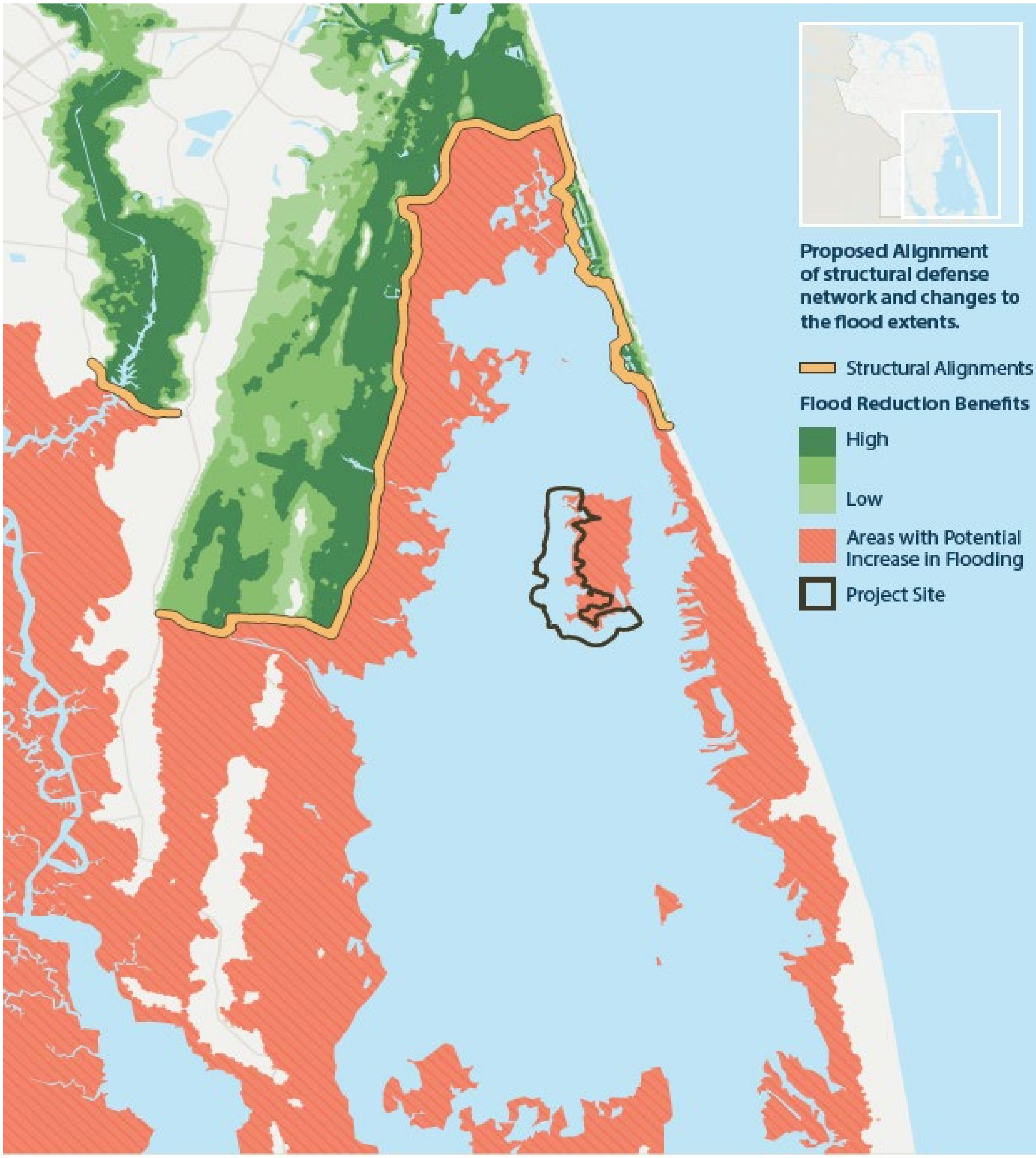

Figure 33: Structural adaptation projects proposed for the Southern Rivers Watershed, including the Muddy Creek Road and Sandridge flood defense systems.

Backside of Sandbridge Flood Defense System

Protection of the Sandbridge resort community from increasing coastal flood hazards would require a complex and expensive structural protection system because of the manufactured land configuration on the backside of Sandbridge. The proposed protection system includes elevating Sandbridge Road and constructing a network of seawalls, levees, and gates along the Back Bay shoreline of Sandbridge. This project does not have designated funding at this time.

Hell Point Creek Flood Defense System

As part of the integrated Sandbridge City-Wide flood defense network, a storm surge barrier across Hell Point Creek could block flood waters originating from Back Bay. Sandbridge Road would also need to be raised to ensure floodwaters could not flank the system. This project does not have designated funding at this time.

Sandbridge/New Bridge Intersection Improvements

Road and shoulder improvements are planned to increase safety at the New Bridge Road/Sandbridge Road intersection and reduce the need for road closures due to flooding from the adjacent Ashville Creek.

Muddy Creek Road Flood Defense System

Muddy Creek Road provides access to important rural and agricultural communities and Back Bay and the Wildlife Refuge. Muddy Creek Road is one of the lowest-lying roadways in all of Virginia Beach and frequently floods. This City-Wide Structural Alternative Flood Protection analysis identified this roadway as a critical location to provide flood protection. The proposed system, known as the Muddy Creek Road Alignment, would transform much of Muddy Creek Road into a levee, with the road on the top. The City's numerical modeling effort shows that the Muddy Creek Road Flood Defense System could potentially increase flood risk to the east of Muddy Creek Road, as shown in Figure 33. Therefore, the implementation of nature-based strategies suitable to the low-lying shorelines of Back Bay is essential to mitigate these impacts. This project does not have designated funding at this time.

Voluntary Acquisition Program

Virginia Beach City Council has recently funded a $2.0 million City-wide voluntary acquisition program to encourage flood-prone property owners to apply for a buyout. Parcels acquired by the City, in the Southern Rivers Watershed, would then be converted to open space to serve as flood storage and a marsh migration buffer.

Stormwater Master Plan

The City Council initiated an update of the City's Stormwater Master Plan in 2014. This effort is interchanging information with aspects of the City's Resilience Plan to account for the impact of sea level rise on the stormwater system's performance. Specific stormwater drainage improvement projects are included within the Lower Southern Rivers Watershed Drainage Basin.

Virginia Coastal Resilience Master Plan

The CRMP highlighted the marsh terrace project as an exemplary nature-based resilience project. The CRMP emphasizes Virginia Beach's strategic use of multiple funding streams to implement a large-scale nature-based project. DCR’s contribution to the project’s construction could be highlighted as a success story for implementation of the CRMP.

Audubon North Carolina Currituck Sound Coalition Marsh Conservation Plan

In coordination with Audubon North Carolina, the Currituck Sounds Coalition identified marsh restoration priorities based on criteria for siting restoration projects, including vulnerability to sea level rise, historic increase in surface water, and distance to hardened shorelines. This assessment identified Virginia Beach's marsh terrace project site as a high-priority area for restoration. There is an opportunity to highlight this project as a success story in the next iteration of the Audubon's Marsh Conservation Plan, which is slated to be updated every three years.

Maintenance Plan

Standard maintenance measures have been defined as part of the draft Annual Monitoring Plan and Post-Construction Monitoring Report developed for this project. See Attachment 5 for a copy of the draft report.

Subsequent to the monitoring period, project maintenance will be addressed by the City's Public Works Stormwater Operations Group, who will also respond to any maintenance issues identified by the monitoring effort or other observers. The City intends to maintain the construction staging area to support future project maintenance needs. The City will perform inspections every 2-5 years and make any repairs needed for the life of the project after completion of the initial monitoring program.

As described by the draft Annual Monitoring Plan and Post-Construction Monitoring Report, maintenance measures include the replacement of plantings (including upland, marsh and SAV plantings), the removal of debris from the terraces, the removal of invasive vegetation identified in the planting areas, the addition of sediment to eroding areas of the terraces, and the replacement of waterfowl barriers as necessary. In addition, structural maintenance measures that might be identified and prescribed during monitoring efforts include replacement of dislodged stones, addition of stone to address structure settlement, and general repair of sand cores or other structural elements. As proposed, these measures would become conditions of the wetland permits required for this project, in addition to standard commitments and requirements defined by the permitting agencies.

In addition to the commitments made in the monitoring plan, and those anticipated to be defined during the permitting process, it is the assumption that the placement of the proposed marsh terrace structures in state waters (subaqueous bottoms) will require the City to maintain the marsh terraces in perpetuity. As previously defined through coordination with VMRC, the City would obtain a compensable interest in the property that has been filled on top of state-owned subaqueous bottomlands (i.e. the terraces). As such, the City would be responsible for maintaining the proposed marsh terraces structures to ensure they fulfill their intended functions, as defined in the objectives and indicators of success previously defined in this proposal.

Criteria

The project receives a total score of **65 Points**. An explanation of how the project meets each

of the applicable scoring criteria contained in Appendix D is provided below.

Eligible Project (Type)

Category/Points: Wetland/floodplain restoration, Living shorelines and vegetated buffers (25 Points)

Explanation: Marsh terraces are considered a type of wetland restoration or a component of a living shoreline project:

- Wetland Restoration: Wetland restoration aims to reestablish or enhance natural wetland ecosystems. Marsh terraces can be constructed in areas where wetlands have been degraded or lost, and they help to recreation or support wetland functions. They provide habitat for various species, improve water quality, and can contribute to the overall health and resilience of a wetland ecosystem.
- Living Shoreline Project: Living shorelines are designed to protect shorelines from erosion while also promoting ecological and environmental benefits. Marsh terraces are often used as a component of living shoreline projects. They can serve as a buffer against wave action, stabilize shorelines, and create suitable habitat for marsh and aquatic species.

Social Vulnerability Index Score

Category/Points: Low Social Vulnerability (0 Points)

Explanation: Based on the Virginia Flood Risk Information System (VFRIS) Social Vulnerability Index Layer, the Social Vulnerability Index scores of the communities located in the two census block groups adjacent to Back Bay near the project site are -1.07 and -0.43 (an average of -0.75), which falls into the Low Social Vulnerability category.

Community Scale Benefits

Category/Points: More than one census block group (30 Points)

Explanation: As documented in the *Supporting Documentation - Project Information – Population* section of this document, the project is anticipated to benefit two census block groups (518100454.121 and 518100464.001).

Expected Lifespan of Project

Category/Points: Over 20 Years (10 Points)

Explanation: As documented in the *Supporting Documentation – Approach, Milestones, and Deliverables – Activity 3 (Marsh Terrace Construction)* section, the marsh terraces have a 30-year design life.

Budget Narrative

The following budget narrative details the proposed project expenditures. See Appendix B for completed budget spreadsheet.

Estimated Total Project Cost

The current estimated total project cost is **$53,378,490.** This estimate includes design, site acquisition for the construction staging area, construction, inspections and support, implementation, and contingencies, as shown in the below table. The design engineer's opinion of probable cost for construction is provided

Project Activity	Capital Improvement Program Estimate
Design	$276,800
Site Acquisition	$50,000
Construction	$41,839,900
Inspections and Support	$5,609,200
Implementation	$750,000
Contingencies	$4,852,590
Total:	$53,378,490

Funds Requested from the Fund

The City is requesting a total of **$5,000,000.00** in funding from the CFPF Round 4. These funds will support contractual services of the engineering consultant and construction contractor to execute Activity 2 (Construction Staging Area Preparation and Construction) and Activity 3 (Marsh Terrace Construction). No support is requested for City personnel.

These funds will be used to support ongoing construction activities through 2024-2026. Example activities include contractor construction services, mobilization/demobilization, construction staging area construction, slurry pipe installation, portions of the terrace materials, and waterfowl barriers. Construction costs are based on a detailed estimate from the design engineer that includes detailed breakdown of estimated quantities and costs from the 95% design package using industry standards for the anticipated aspects of the project construction. The City has withheld the detailed estimate as it provides information that would affect bidding on the construction.

Amount of Funds Available

The City as prime recipient is providing a cash match of $38,356,966 from funds fully programmed and available from the City's Flood Protection Program Capital Improvement Program to support the project. The Flood Protection Program is supported by a related bond referendum that provided $567.5M to fund more than 40 projects identified for Phase 1 of the Program. The program is tightly managed by the City, an independent contractor, and has a resident oversight board. The City is fully confident these funds will be available for constructing this project.

The City's dedicated funds will provide cash match to cover contractual services to support Activity 1 (Construction Staging Area Preparation and Construction), Activity 2 (Marsh Terrace Construction), Activity 3 (Stakeholder Engagement and Dissemination), and all related City support and direct overhead costs related for the project.

The National Fish and Wildlife Foundation is also supporting the project through two grant awards from the National Coastal Resilience Fund. This includes an initial award of $135,124 in 2020 for design and a second award of $9,886,400 in 2022 to support construction. The 2022 grant funds are dedicated to purchasing the native vegetation and a portion of the materials needed to build the marsh terraces.

A summary of project costs, funds available, and funds requested is provided below:

Item	Amount
Project Cost:	$53,378,490.00
Funding Sources Available	
NFWF Grant:	$10,021,524.00
CFPF Grant Request:	$5,000,000
City Funds Available:	$38,356,96600
Total Project Funding:	**$53,378,490.00**

Authorization to Request for Funding

Please refer to *attachment* for the documentation authorizing the funding request.

Attachment 1: Virginia Beach Resilience Plan DCR Approval

Matthew J. Strickler
Secretary of Natural Resources

Clyde E. Cristman
Director

COMMONWEALTH of VIRGINIA
DEPARTMENT OF CONSERVATION AND RECREATION

Rochelle Altholz
Deputy Director of Administration and Finance

Russell W. Baxter
Deputy Director of Dam Safety & Floodplain Management and Soil & Water Conservation

Nathan Burrell
Deputy Director of Government and Community Relations

Thomas L. Smith
Deputy Director of Operations

July 20, 2021

Toni Utterback, P.E.
Department of Public Works
2875 Sabre Street, Suite 250
Virginia Beach, VA 23452

RE: Virginia Beach Resilience Plan Second Submission - CFPF

Dear Ms. Utterback:

Thank you for the resubmission of the Sea Level Wise Adaptation Plan for City of Virginia Beach. After careful review and consideration, the Virginia Department of Conservation and Recreation has deemed the Plan complete and meets all the criteria outlined in the June 2021 Community Flood Preparedness Grant Manual. This approval will remain in effect for a period of three years, ending on July 31, 2024.

The following elements were evaluated as part of this review:

1. **Element 1: It is project-based with projects focused on flood control and resilience. DCR RESPONSE**

    a. Project-based: Four watersheds—each with a defined geographic area, analysis of community social and environmental characteristics, types of flooding, and a tailored flood resilience strategy with discrete projects identified.

Projects focused on flood control and resilience include:

Neighborhood	Flood Control Project
Elizabeth River	City-wide alignment, living shoreline, marsh restoration, land conservation
Lynnhaven	Chesapeake Bay alignment, Lesner Bridge Neighborhood alignment (East & West), beach & dune nourishment, ecological revetments, shellfish reef restoration, seagrass restoration
Oceanfront	Atlantic Oceanfront alignment, Rudee Heights alignment
Southern Rivers	West Neck Creek city-wide alignment, Muddy Creek Road city-wide alignment, Sandbridge city-wide alignment

**additional projects listed within the Sea Level Wise Adaptation Strategy.*

2. **Element 2: It incorporates nature-based infrastructure to the maximum extent possible. DCR RESPONSE**

    a. Nature-based infrastructure: Flood mitigation projects throughout the city incorporate nature-based solutions and were identified for maximum use within specific watersheds.

3. **Element 3: It includes considerations of all parts of a locality regardless of socioeconomics or race. DCR RESPONSE**
    a. All parts of a locality: Locality divided into four watersheds, covering the entirety of the jurisdictional boundary.
    b. Social vulnerability: Social implications of flood hazards and analysis of populations at-risk documented.
    c. Demographic Analysis: Demographic and Population Vulnerability Analysis conducted by Dewberry and incorporated into the Plan.

4. **Element 4: It includes coordination with other local and inter-jurisdictional projects, plans, and activities and has a clearly articulated timeline or phasing for plan implementation. DCR RESPONSE**
    a. Coordination with other projects, plans, and activities: Contains the planning processes and frameworks which outline local and regional plans used by the City and address resilience; and how they have been integrated for flood adaptation planning.
    b. Clearly articulated timeline or phasing for plan implementation: Program phases clearly articulated and described in detail—Impact assessment, Adaptation research, Strategy development, and Long-term implementation.

5. **Element 5: Is based on the best available science, and incorporates climate change, sea level rise, storm surge (where appropriate), and current flood maps.**
    a. Technically backed water-resources analysis, sea level rise projections, storm surge, and climate change incorporated into strategic approach.

VA DCR looks forward to working with you as you work to make Virginia Beach a more resilient community. If you have questions or need additional assistance, please contact us at cfpf@dcr.virginia.gov. Again, thank you for your interest in the Community Flood Preparedness Fund.

Sincerely,

Wendy Howard Cooper, Director
Dam Safety and Floodplain Management

cc: Darryl Glover, DCR

Attachment 2: Authorization to request funding from the Fund from governing body or chief executive of the local government

City of Virginia Beach

DEPARTMENT OF BUDGET AND MANAGEMENT SERVICES
(757) 385-8234
(757) 385-1857 FAX

VBgov.com
MUNICIPAL CENTER
BUILDING 1, 3RD FLOOR
2401 COURTHOUSE DRIVE
VIRGINIA BEACH, VA 23456-9001

INTER-OFFICE MEMORANDUM

DATE: November 1, 2023

TO: Patrick A. Duhaney, City Manager

FROM: Stuart McCrery, Budget and Policy Analyst KJ for SM

SUBJECT: Application for Virginia Community Flood Preparedness Fund Grant

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The Department of Public Works is requesting permission to apply for the Virginia Community Flood Preparedness Fund Grant from the Virginia Department of Conservation and Recreation. The Virginia Community Flood Preparedness Fund was established in the 2020 session of the General Assembly. Money in this fund comes from the auction of carbon allowances through the Regional Greenhouse Gas Initiative. It was established to provide support to localities across Virginia to reduce the impacts of flooding, including flooding driven by climate change.

Public Works is requesting a total of $5,000,000 to construct marsh terraces in Back Bay to promote wetland restoration and mitigate frequent flooding. The City has already made significant investments into this project through CIP project 100551 "Stormwater Green Infrastructure."

This grant also requires a local match of 30% for projects that implement nature-based solutions; however, the City has more than met this requirement through its current appropriations to CIP project 1000551 "Stormwater Green Infrastructure" which currently total over $49 million from the Referendum and other grant awards.

Budget & Management Services recommends this grant application for approval. Please indicate approval or disapproval below. Applications are due by November 12, 2023.

Approve 11/1/2023 (Date) | Disapprove (Date)

Attachment 3: Virginia Beach Floodplain Administrator Support Letter

City of Virginia Beach

VBgov.com

DEPARTMENT OF PLANNING & COMMUNITY DEVELOPMENT
PHONE (757) 385-4621
FAX (757) 385-5667
VA Relay Number TTY: 711

2875 SABRE STREET, SUITE 500
VIRGINIA BEACH, VA 23452-7385

November 7, 2023

Division of Dam Safety and Floodplain Management
600 East Main Street, 24th Floor
Richmond, Virginia 23219

RE: Community Flood Preparedness Fund – Marsh Terrace Creation, Back Bay

The proposed project is located in both open water and a Federal Emergency Management Agency (FEMA) mapped Special Flood Hazard Area (SFHA). Hydraulic modeling analysis identified Bonney Cove as a location where marsh restoration has the potential to reduce the propagation of floodwater through key pathways within Back Bay. This project aims to stabilize two critically eroding marsh islands that serve as a key flood pathway into northern Back Bay, promote the growth of aquatic vegetation, and provide flood risk reduction benefits to communities in the surrounding area. Within the two census block groups that would benefit from this project, there are 113 repetitive loss and severe repetitive loss properties.

If I can provide any further information or assistance, please call me at 757-385-4621, or e-mail me at wmcnamar@vbgov.com.

Sincerely,

Whitney McNamara

Whitney McNamara, CFM
Floodplain Administrator and CRS Coordinator

Attachment 4: Letters of Support

Back Bay
Restoration
Foundation

PO Box 57041 • Virginia Beach, Virginia • 23457• 757-818-4829

November 6, 2023

Department of Conservation and Recreation
Dam Safety and Floodplain Management
600 E. Main St., 24th Floor
Richmond, VA 23219

Re: Virginia Community Flood Preparedness Fund Grant

Grantors:

The Back Bay Restoration Foundation (BBRF), is a 35 year-old non-profit watershed organization, founded in 1986 by a group of local citizens concerned about deterioration of the Back Bay watershed visible then through decreases in Submerged Aquatic Vegetation (SAV), fish, and waterfowl. BBRF is the only voice solely dedicated to conserving and improving Virginia Beach's two Southern Watersheds; namely, the Back Bay and North Landing River watersheds. Our efforts focus on education, stewardship and outreach to conserve the largest watersheds in Virginia Beach. We team with other non-profits, and city, state and federal agencies to work toward best solutions for the future of the Back Bay and North Landing River watersheds. BBRF strives to raise awareness, addressing issues that negatively affect these watersheds such as sea level rise, land subsidence and land use changes.

Back Bay is a historical, nationally significant, watershed. With the Back Bay National Wildlife Refuge (NWR) and significant State conservation lands at its core, the watershed was recognized as an Aquatic Resource of National Importance (ARNI) in 2008 by both the US Fish and Wildlife Service and the US Army Corps of Engineers. Back Bay is a wind-tidal oligohaline estuary and is located at the northern tip of the Albemarle/Pamlico estuarine system, the second largest estuarine complex in the United States. The Albemarle/Pamlico estuarine system was designated as an Estuary of National Significance in 1987 and selected to be studied as part of the Environmental Protection Agency's National Estuary Program. Back Bay is a shallow-water aquatic ecosystem with an average depth of four feet. Winds can influence the water depth by as much as three feet.

BBRF supports the City of Virginia Beach's application for Round 4 of VADCR's Community Flood Preparedness Fund. We were strong advocates of the City's successful applications to the National Fish and Wildlife Foundation (NFWF), and have seen what they accomplished with the initial NFWF funding they received. With the combined funding of NFWF, the City of Virginia Beach, and this application for DCR funding, their project of creating a Marsh Terrace Network to Achieve Restoration and Flood Resilience has overachieved by any measure. From community engagement and the NEPA process to conceptual and preliminary designs as described in the recent Army Corps Public Notice, the City has been productive and completely transparent.

As noted above, the City's community engagement and partnerships with organizations like ours has been transparent and resulted in broad support. Although the current project is localized in its first application, we expect the results will significantly mitigate SLR, land subsidence and wind tides in Back Bay. Similarly, this restoration will provide the biotic building blocks to maintain the watershed's national importance for wildlife. The innovative designs proposed will inform future projects at the landscape level. Although innovative, we believe the project is technically sound based on BBRF's 35 years of experience in habitat restoration.

Please feel free to contact us for further information.

Jared Brandwein

Executive Director
Back Bay Restoration Foundation

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Back Bay National Wildlife Refuge
1324 Sandpiper Road
Virginia Beach, VA 23456

October 30, 2023

Wendy Howard Cooper
Division of Dam Safety and Floodplain Management
600 East Main Street, 24th Floor
Richmond, Virginia 23219

Dear Ms. Cooper,

The City of Virginia Beach is proposing to install marsh terraces in the waters of Back Bay adjacent to Back Bay National Wildlife Refuge. This project is expected to reduce wave energy and thus decrease the speed of erosion of remaining islands in the project area, many of which are managed by the U.S. Fish and Wildlife Service and provide habitat for migratory birds and other species. Additionally, the addition of multiple vegetative structures added to the bay will supplement habitat and provide nesting grounds for multiple species.

The mission of the U.S. Fish and Wildlife Service is *working with others to conserve, protect, and enhance fish, wildlife, plants, and their habitats for the continuing benefit of the American people*. Although much work is conducted on federal property to achieve this mission, the Service equally coordinates with external partners to further mutual goals. The proposed marsh terrace project is an excellent example of local and federal government coordination, and we support the City of Virginia Beach's proposed project.

Megan Reed

Megan Reed
Refuge Manager

Albemarle - Pamlico
National Estuary Partnership

*Our mission is to identify, protect, and restore
the significant resources of the Albemarle-Pamlico estuarine system.*

October 26, 2023

Wendy Howard Cooper
Virginia Dept. of Conservation and Recreation
Division of Dam Safety and Floodplain Management
600 E. Main St., 24th Floor
Richmond, VA 23219

Dear Wendy,

The Albemarle-Pamlico National Estuary Partnership (APNEP) strongly endorses the City of Virginia Beach and partners' application to Round 4 of The Virginia Community Flood Preparedness Fund (CFPF). The proposal is to support construction of the Back Bay Marsh Terrace Restoration Project.

APNEP relies on regional partnerships and collaboration to implement our 2012-2022 Comprehensive Conservation & Management Plan (CCMP) within the waterways of our congressionally designated "estuary of national significance." The proposed partnership between the City of Virginia Beach and the U.S. Fish and Wildlife Service will also advance our 2020 Memorandum of Understanding between Virginia and North Carolina to protect the ecosystem resources in the shared waterways between our two states. The project also addresses a "high priority" area for restoring and enhancing vulnerable marshes with high flood risk reduction benefits and habitat value, as identified by Audubon's Currituck Sound Coalition Marsh Conservation Plan released in 2021.

The marsh terrace project employs the use of natural features to build resilience to flooding in the Back Bay watershed. The project offers coastal resilience and habitat protection and conservation co-benefits including preserving marsh islands, restoring Submerged Aquatic Vegetation, migratory bird and fish habitat, reducing flow that could exacerbate wind tide flooding in local communities, and filling a gap in prior applied research on predominantly fresh water coastal lagoons. These features support the following CCMP actions:

- A2.3: Support research on adapting to impacts associated with climate change and sea level rise.
- C3.2: Develop and implement a coordinated wetland restoration strategy.
- C3.3: Develop and implement a submerged aquatic vegetation (SAV) restoration strategy.
- D3.3: Provide assistance to state, regional, and local governments to incorporate climate change and sea level rise considerations into their planning processes.

In closing, we strongly support the full funding of the City of Virginia Beach's proposal to Round 4 of The Virginia Community Flood Preparedness Fund (CFPF). Please contact Steve Anderson, Partnership Coordinator, at (919) 707-8743 with questions.

Sincerely,

W. Crowell

William L. Crowell, Jr., Ph.D., AICP, CEE
Director

1601 Mail Service Center, Raleigh, North Carolina 27699-1601
Phone/Fax: 919-707-8633 | www.apnep.org

Attachment 5: Copy of the Current Floodplain Ordinance

ORD-3685

AN ORDINANCE TO AMEND SECTIONS 1.1, 1.2, 1.3, 1.8, 2.1, 2.2, 2.3, 2.4, 2.8, 2.11, 3.1, 4.1, 4.2, 4.3, 4.4, 4.6, 4.8, 4.9, 4.10, 5.1, 6.1, AND 6.3 OF APPENDIX K, FLOODPLAIN ORDINANCE OF THE CITY CODE PERTAINING TO HOUSEKEEPING THE DELETION OF PUBLIC WORKS REQUIREMENTS AND THE ADDITION OF A COASTAL A ZONE AND A COASTAL HIGH HAZARD ZONE

Sections Amended: 1.1, 1.2, 1.3, 1.8, 2.1, 2.2, 2.3, 2.4, 2.8, 2.11, 3.1, 4.1, 4.2, 4.3, 4.4, 4.6, 4.8, 4.9, 4.10, 5.1, 6.1, and 6.3 of Appendix K, Floodplain Ordinance

WHEREAS, the public necessity, convenience, general welfare and good zoning practice so require;

BE IT ORDAINED BY THE CITY COUNCIL OF THE CITY OF VIRGINIA BEACH, VIRGINIA:

That Sections 1.1, 1.2, 1.3, 1.8, 2.1, 2.2, 2.3, 2.4, 2.8, 2.11, 3.1, 4.1, 4.2, 4.3, 4.4, 4.6, 4.8, 4.9, 4.10, 5.1, 6.1, and 6.3 of Appendix K, Floodplain Ordinance is hereby amended and reordained to read as follows:

APPENDIX K FLOODPLAIN ORDINANCE

ARTICLE I. GENERAL PROVISIONS

Sec. 1.1. Statutory authorization and purpose.

A. This ordinance is adopted pursuant to the authority granted to localities by Code of Virginia § ~~10.1-600 et seq~~ 15.2-984.

B. The city council finds the purpose of these provisions is to prevent the loss of life and property, the creation of health and safety hazards, the disruption of commerce and governmental services, the extraordinary and unnecessary expenditure of public funds for flood protection and relief, and the impairment of the tax base by:

1. Regulating uses, activities, and development that, alone or in combination with other existing or future uses, activities, and development, will cause unacceptable increases in flood heights, velocities, and frequencies;

2. Restricting or prohibiting certain uses, activities, and development from locating within districts subject to flooding;
3. Requiring all uses, activities, and developments that do occur in flood-prone districts be protected or flood-proofed against flooding and flood damage;

4. Protecting individuals from buying land and structures that are unsuited for intended purposes because of flood hazards; and

5. Acknowledging that the tide data over the last one hundred (100) years shows that Virginia Beach is facing an increased danger of flooding caused by both sea level rise and subsidence<u> and has adopted the Sea Level Wise Adaptation Report as part of the Comprehensive Plan</u>.

Sec. 1.2. Applicability.

These provisions shall apply to all privately and publicly owned lands within the jurisdiction of the City of Virginia Beach and identified as areas ~~of special flood hazard~~ <u>at risk of flooding by the City of Virginia Beach or shown</u> ~~according to~~ <u>on </u>the Flood Insurance Rate Map (FIRM) <u>or included on the flood insurance study (FIS)</u> that ~~is~~ <u>are</u> provided to the City of Virginia Beach by the Federal Emergency Management Agency (FEMA) and dated January 16, 2015 ~~or identified as floodplains subject to special restrictions in section 4.10 of this ordinance~~.

Sec. 1.3. Definitions.

. . . .

City manager. The City Manager of the City of Virginia Beach, or his designees.

<u>*Design Flood Elevation (regulatory flood protection elevation)*. The base flood elevation plus the freeboard required by this ordinance.</u>

. . . .

Recreational vehicle. A vehicle that is:

1. Built on a single chassis;
2. Four hundred (400) square feet or less when measured at the largest horizontal projection;
3. Designed to be self-propelled or permanently towable by a light duty truck; and
4. Designed primarily not for use as a permanent dwelling but as temporary living quarters for recreational camping, travel, or seasonal use.

~~*Regulatory flood protection elevation (design flood elevation)*. The base flood elevation plus the freeboard required by this ordinance.~~

. . . .

Sec. 1.8. Penalty for violations.

Any person who fails to comply with any of the requirements or provisions of this ordinance or directions of the ~~d~~Directors of ~~p~~Planning ~~or public works~~ or any authorized employee of the City of Virginia Beach shall be guilty of the appropriate violation and subject to the penalties therefore. Any violation of the provision of this ordinance shall be punishable by a fine of not more than one hundred dollars ($100.00). Each person shall be deemed guilty of a separate offense for each and every day or portion thereof during which any violation of any of the provisions of this ordinance is committed.

The Virginia Uniform Statewide Building Code (VA USBC) addresses building code violations and the associated penalties in ~~section 104 and section 115~~ VA USBC § 104 and § 115. Violations and associated penalties of the Zoning Ordinance for the City of Virginia Beach are addressed in § 104 of the Zoning Ordinance.

In addition to the above penalties, all other actions are hereby reserved, including an action in equity for the proper enforcement of this ordinance. The imposition of a fine or penalty for any violation of, or noncompliance with, this ordinance shall not excuse the violation or noncompliance or permit it to continue, and all such persons shall be required to correct or remedy such violations within a reasonable time. Any structure constructed, reconstructed, enlarged, altered, or relocated in noncompliance with this ordinance may be declared by the City of Virginia Beach to be a public nuisance and abatable as such. Flood insurance may be withheld from structures constructed in violation of this ordinance.

ARTICLE II. ADMINISTRATION

Sec. 2.1. Designation of the floodplain administrator.

The City Manager of the City of Virginia Beach is hereby appointed the floodplain administrator to administer and implement this ordinance. The floodplain administrator has delegated the duties and responsibilities set forth in this ordinance to the ~~departments of public works and planning, as specified below~~ Department of Planning and Community Development.

Sec. 2.2. Duties and responsibilities of the ~~department of public works~~ floodplain administrator or his designee.

The duties and responsibilities of the ~~department of public works~~ floodplain administrator of his designee shall include but are not limited to:

A. Interpreting floodplain boundaries and providing available base flood elevation and flood hazard information;

B. Verifying that applicants proposing an alteration of a watercourse have notified adjacent communities, the department of conservation and recreation (division of dam safety and floodplain management), and other appropriate agencies (Virginia Department of Environmental Quality (VADEQ), United States Army Corps of Engineers (USACE), etc.) and have submitted copies of such notifications to FEMA;

C. Advising applicants for new construction or substantial improvement of structures that are located within an area of the coastal barrier resources system established by the Coastal Barrier Resources Act that Federal flood insurance is not available on such structures; areas subject to this limitation are shown on FIRMs as coastal barrier resource system areas or otherwise protected areas;

D. Submitting to FEMA, or requiring applicants to submit to FEMA, data and information necessary to maintain FIRMs, including hydrologic and hydraulic engineering analyses prepared by or for the city, within six (6) months after such data and information becomes available if the analyses indicate changes in base flood elevations;

E. Maintaining and permanently keeping records that are necessary for the administration of these regulations, including:

1. ~~flood~~ Flood insurance studies, FIRMs (including historic studies and maps and current effective studies and maps) and letters of map change; and

2. Documentation supporting issuance and denial of permits, Elevation Certificates, documentation of the elevation (in relation to the datum on the FIRM) to which structures have been floodproofed, inspection records, other required design certifications, variances, and records of enforcement actions taken to correct violations of these regulations.

F. Notifying FEMA when the corporate boundaries of the City of Virginia Beach have been modified and:

1. Providing a map that clearly delineates the new corporate boundaries or the new area for which the authority to regulate pursuant to this ordinance has either been assumed or relinquished through annexation; and

2. If the FIRM for any annexed area includes SFHAs that have flood zones with regulatory requirements that are not set forth in this

ordinance, prepare amendments to this ordinance to adopt the FIRM and appropriate requirements, and submit the amendments to the city council for adoption; such adoption shall take place at the same time as or prior to the date of annexation and a copy of the amended ordinance shall be provided to the department of conservation and recreation (division of dam safety and floodplain management) and FEMA.

G. Upon the request of FEMA, completing and submitting a report concerning participation in the NFIP, which may request information regarding the number of buildings in the SFHA, the number of permits issued for development in the SFHA, and the number of variances issued for development in the SFHA.

H. Reviewing applications for permits to determine whether proposed activities will be located in the SFHA;

I. Reviewing applications to determine whether proposed activities will be reasonably safe from flooding and requiring new construction and substantial improvements to meet the requirements of this ordinance;

J. Reviewing applications to determine whether all necessary permits have been obtained from the federal, state, or local agencies from which prior or concurrent approval is required; in particular, permits from state agencies for any construction, reconstruction, repair, or alteration of a dam, reservoir, or waterway obstruction (including bridges, culverts, structures), any alteration of a watercourse, or any change of the course, current, or cross section of a stream or body of water, including any change to the SFHAs of free-flowing non-tidal waters of the state;

K. Approving applications and issuing permits to develop in flood hazard areas if the provisions of this ordinance have been met, or disapproving applications if the provisions of this ordinance have not been met;

L. Granting administrative variances pursuant to section 6.1 of this ordinance;

M. Inspecting, or causing to be inspected, buildings, structures, and other development for which permits have been issued to determine compliance with this ordinance or to determine if non-compliance has occurred or violations have been committed;

N. Reviewing elevation certificates and requiring incomplete or deficient certificates to be corrected;

O. Maintaining and permanently keeping documentation supporting the issuance and denial of permits, elevation certificates, documentation of the elevation (in relation to the datum on the FIRM) to which structures have been flood proofed, and other required design certifications, variances, and records of enforcement actions taken to correct violations of this ordinance;

P. Enforcing the provisions of this ordinance, investigating violations, issuing notices of violations or stop work orders, and requiring permit holders to take corrective action;

Q. Advising the city council regarding the intent of this ordinance and, for each application for a variance, preparing a staff report and recommendation; and

R. Administering the requirements related to proposed work on existing buildings:

1. Making determinations as to whether buildings and structures that are located in flood hazard areas and that are damaged by any cause have been substantially damaged; and

2. Making reasonable efforts to notify owners of substantially damaged structures of the need to obtain a permit to repair, rehabilitate, or reconstruct, and prohibit the non-compliant repair of substantially damaged buildings except for temporary emergency protective measures necessary to secure a property or stabilize a building or structure to prevent additional damage.

S. Undertaking, as determined appropriate by the floodplain administrator due to the circumstances, other actions that may include but are not limited to: issuing press releases, public service announcements, and other public information materials related to permit requests and repair of damaged structures; coordinating with other federal, state, and local agencies to assist with substantial damage determinations; providing owners of damaged structures information related to the proper repair of damaged structures in SFHAs; and assisting property owners with documentation necessary to file claims for increased cost of compliance coverage under National Flood Insurance Program (NFIP) flood insurance policies; and

T. It is the duty of the city floodplain administrator to take into account flood, mudslide, and flood-related erosion hazards, to the extent that they are known, in all official actions relating to land management and use throughout the entire jurisdictional area of the city, whether or not those

hazards have been specifically delineated geographically (e.g., via mapping or surveying).

~~Sec. 2.3. Duties and responsibilities of the department of planning.~~ Reserved.

~~The duties and responsibilities of the department of planning shall include but are not limited to:~~

~~A. Reviewing applications for permits to determine whether proposed activities will be located in the SFHA;~~

~~B. Reviewing applications to determine whether proposed activities will be reasonably safe from flooding and requiring new construction and substantial improvements to meet the requirements of this ordinance;~~

~~C. Reviewing applications to determine whether all necessary permits have been obtained from the federal, state, or local agencies from which prior or concurrent approval is required; in particular, permits from state agencies for any construction, reconstruction, repair, or alteration of a dam, reservoir, or waterway obstruction (including bridges, culverts, structures), any alteration of a watercourse, or any change of the course, current, or cross section of a stream or body of water, including any change to the SFHAs of free-flowing non-tidal waters of the state;~~

~~D. Approving applications and issuing permits to develop in flood hazard areas if the provisions of this ordinance have been met, or disapproving applications if the provisions of this ordinance have not been met;~~

~~E. Granting administrative variances pursuant to section 6.1 of this ordinance;~~

~~F. Inspecting, or causing to be inspected, buildings, structures, and other development for which permits have been issued to determine compliance with this ordinance or to determine if non-compliance has occurred or violations have been committed;~~

~~G. Reviewing elevation certificates and requiring incomplete or deficient certificates to be corrected;~~

~~H. Maintaining and permanently keeping documentation supporting the issuance and denial of permits, elevation certificates, documentation of the elevation (in relation to the datum on the FIRM) to which structures have been flood proofed, and other required design certifications, variances, and records of enforcement actions taken to correct violations of this ordinance;~~

~~I. Enforcing the provisions of this ordinance, investigating violations, issuing notices of violations or stop work orders, and requiring permit holders to take corrective action;~~

~~J. Advising the city council regarding the intent of this ordinance and, for each application for a variance, preparing a staff report and recommendation; and~~

~~K. Administering the requirements related to proposed work on existing buildings:~~

~~1. Making determinations as to whether buildings and structures that are located in flood hazard areas and that are damaged by any cause have been substantially damaged; and~~

~~2. Making reasonable efforts to notify owners of substantially damaged structures of the need to obtain a permit to repair, rehabilitate, or reconstruct, and prohibit the non-compliant repair of substantially damaged buildings except for temporary emergency protective measures necessary to secure a property or stabilize a building or structure to prevent additional damage.~~

~~Sec. 2.4. Shared duties and responsibilities.~~ Reserved.

~~The duties and responsibilities shared by the departments of public works and Planning shall include but are not limited to:~~

~~A. Undertaking, as determined appropriate by the floodplain administrator due to the circumstances, other actions that may include but are not limited to: issuing press releases, public service announcements, and other public information materials related to permit requests and repair of damaged structures; coordinating with other federal, state, and local agencies to assist with substantial damage determinations; providing owners of damaged structures information related to the proper repair of damaged structures in SFHAs; and assisting property owners with documentation necessary to file claims for increased cost of compliance coverage under National Flood Insurance Program (NFIP) flood insurance policies; and~~

~~B. It is the duty of the city floodplain administrator to take into account flood, mudslide, and flood-related erosion hazards, to the extent that they are known, in all official actions relating to land management and use throughout the entire jurisdictional area of the city, whether or not those hazards have been specifically delineated geographically (e.g., via mapping or surveying).~~

. . . .

Sec. 2.8. Interpretation of district boundaries.

Initial interpretations of the boundaries of the floodplain districts shall be made by the floodplain administrator. Should a dispute arise concerning the boundaries of any of the districts~~, the city council shall make the necessary determination. The person questioning or contesting the location of the district boundary shall be given a reasonable opportunity to present his case to the city council and to submit his own technical evidence if he so desires~~ a surveyor shall provide either an elevation certificate or recent survey showing topographic elevations and delineating the Special Flood Hazard Area.

. . . .

Sec. 2.11. Appeals to decisions made by the floodplain administrator.

It is further provided that any decision of the floodplain administrator or his designee may be modified, reversed, or affirmed by the city council upon appeal by any aggrieved party to such decision, if such appeal is filed with the floodplain administrator within thirty (30) days of such decision through the application for a Floodplain Variance outlined in Section VI of this ordinance.

ARTICLE III. ESTABLISHMENT OF FLOODPLAIN DISTRICTS

Sec. 3.1. Description of floodplain districts.

A. Special flood hazard areas (SFHA). The SFHAs shall include land in the floodplain subject to a one (1) percent or greater chance of being flooded in any given year. The basis for the delineation of these districts shall be the FIS and the FIRM for the City of Virginia Beach prepared by FEMA, Federal Insurance Administration, dated January 16, 2015, and any subsequent revisions or amendments thereto.

The boundaries of the SFHAs are established as shown on the FIRM, which is declared to be a part of this ordinance and shall be kept on file at the City of Virginia Beach Department of ~~Public Works~~ Planning and Community Development, and include the following districts:

1. The Floodway District is in an AE Zone and is delineated, for the purposes of this ordinance, using the criterion that certain areas within the floodplain must be capable of carrying the waters of the one (1) percent annual chance flood without increasing the water surface elevation of that flood more than one (1) foot at any point. The areas included in this district are specifically defined in Table 7 of the above-referenced FIS and shown on the accompanying FIRM.

2. The AE or AH Zones on the FIRM accompanying the FIS shall be those areas for which one (1) percent annual chance flood elevations have been provided and the floodway has not been delineated.

3. The A Zone on the FIRM accompanying the FIS shall be those areas for which no detailed flood profiles or elevations are provided, but the one (1) percent annual chance floodplain boundary has been approximated.

4. The AO Zone on the FIRM accompanying the FIS shall be those areas of shallow flooding identified as AO on the FIRM.

5. ~~Reserved.~~ The Coastal A Zone on the FIRM accompanying the FIS shall be those areas labeled as AE and are located seaward of the limit of moderate wave action (LiMWA) line.

6. The VE or V Zones on FIRMs accompanying the FIS shall be those areas that are known as coastal high hazard areas, extending from offshore to the inland limit of a primary frontal dune along an open coast and any other area subject to high velocity wave action from storm or seismic sources.

B. ~~Floodplain subject to special restrictions~~ *Local Flood Hazard Areas*. The City of Virginia Beach may identify and regulate local flood hazard or ponding areas that are not delineated on the FIRM. These areas are ~~identified in section 4.10 and may be delineated on a map using best available topographic data and locally derived information such as flood of record, historic high water marks, or approximate study methodologies~~ identified as follows:~~.~~

a. *Other areas of flood risk*. The X and the X(Shaded) Zone on the FIRM where the City of Virginia Beach Stormwater Master Plan has identified areas, outside SFHAs delineated on the FIRM, that area susceptible to flooding. The most recent updated version of the modeling shall be used to identify areas that are likely to experience flooding.

b. *Floodplain Subject to Special Restrictions*. The Floodplain Subject to Special Restrictions is identified in section 4.10 and includes areas in the southern part of the city which are characterized by wind tides, low topography, and poorly draining soils.

ARTICLE IV. FLOODPLAIN DISTRICT PROVISIONS

Sec. 4.1. Permit and application requirements.

. . . .

B. Site plans and permit applications. All applications for development within any floodplain district and all building permits issued within ~~the~~ any floodplain district shall incorporate the following information:

1. For any addition, conversion of any non-habitable space to habitable space, or the construction or installation of a new accessory structure that requires a building permit.

   a. A physical survey, performed after the effective date of the FIRM that:

      i. accurately depicts current improvements on the property;
      ii. provides a flood zone determination and BFE or flood depth at the stie; and
      iii. delineates the location of the flood zones on the property.

   b. For structures located in the SFHA delineated on the FIRM, a current elevation certificate sealed by a licensed design professional.

2. For new construction and any substantial improvement of the principal structure:

   a. a proposed site plan sealed by a registered design professional that provides:

      ~~1~~i. The elevation of the base flood at the site;

      ~~2~~ii. The elevation of the lowest floor (including basement) or, in V Zones, the lowest horizontal structural member;

      ~~3~~iii. For structures to be flood-proofed (non-residential only), the elevation to which the structure will be flood-proofed; and

      4iv. Topographic information showing existing and proposed ground elevations.

Sec. 4.2. General standards.

. . . .

5. Electrical, heating, ventilation, plumbing, air conditioning equipment, and other service facilities, including duct work, shall be designed and/or ~~located so as to prevent water from entering or accumulating within the components during conditions of flooding~~ or above the design flood elevation.

6. New and replacement water supply systems shall be designed to minimize or eliminate infiltration of flood waters into the system.

7. New and replacement sanitary sewage systems shall be designed to minimize or eliminate infiltration of flood waters into the systems and discharges from the systems into flood waters.

8. On-site waste disposal systems shall be located and constructed to avoid impairment to them or contamination from them during flooding.

9. No use shall be permitted if such use will increase the amounts of potentially damaging materials, including those likely to be injurious to health, that might be transported in floods.

10. For properties located in SFHAs delineated on the FIRM, an elevation certificate and, if applicable, a flood-proofing certificate shall be provided to the Floodplain Administrator prior to any foundation inspection, final inspections, and the issuance of any certificates of occupancy, in order to assure compliance with these floodplain regulations.

11. Prior to any proposed alteration or relocation of any channels or of any watercourse or stream within the city, a permit shall be obtained from the USACE, VADEQ, the Virginia Marine Resources Commission, and the Wetlands Board through the joint permit application process. Furthermore, notification of the proposal shall be given by the applicant to all affected adjacent jurisdictions, the department of conservation and recreation (division of dam safety and floodplain management), other required agencies, and FEMA.

12. The flood carrying capacity within an altered or relocated portion of any watercourse shall be maintained.

~~B. In all SFHAs, the following additional provisions shall apply:~~

~~1. Prior to any proposed alteration or relocation of any channels or of any watercourse or stream, within the city a permit shall be obtained from the USACE, VADEQ, the Virginia Marine Resources Commission, and the Wetlands Board through the joint permit application process. Furthermore, notification of the proposal shall be given by the applicant to all affected adjacent jurisdictions, the department of conservation and recreation (division of dam safety and floodplain management), other required agencies, and FEMA.~~

~~2. The flood carrying capacity within an altered or relocated portion of any watercourse shall be maintained.~~

3. ~~Sand dunes, barrier beaches, and other natural protective barriers shall remain intact to provide protection against wind, waves, and erosion drainage. Any person who desires to use or alter any coastal primary sand dune, other than for the purpose of conducting the activities specified in section 1602 of the Zoning Ordinance of the City of Virginia Beach, shall first obtain a permit from the USACE, VADEQ, the Virginia Marine Resources Commission, and the Wetlands Board through the joint permit application process.~~

Sec. 4.3. Elevation and construction requirements.

In all ~~SFHAs where base flood elevations have been provided in the FIS or generated by a licensed professional in accordance with section 4.6 of this ordinance~~ floodplain districts, with the exception of Coastal A and Coastal High Hazard (VE) zones, the following provisions shall apply:

A. Residential construction requirements. ~~New construction or substantial improvement of any residential structure or manufactured home in Zones AE, AH, and A with detailed base flood elevations shall have the lowest floor, including basement, elevated to a minimum of two (2) feet above the base flood level.~~ The lowest flood, including basement, shall be set to the higher of the following:

   i. A minimum of two (2) feet above the base flood elevation established on the most recent FIRM or by the most recent FIS or,

   ii. A minimum of one (1) foot above the 100-year HGL elevation measured at the nearest existing or proposed public drainage structure or BMP, in the City Stormwater Master Plan.

B. Non-residential construction requirements. New construction or substantial improvement of any commercial, industrial, or non-residential building or manufactured home shall have the lowest floor, including basement, elevated as ~~minimum of two (2) feet above the base flood level~~ established in Section 4.3 A of this ordinance. Buildings ~~located in AE or AH Zones~~ may be flood-proofed in lieu of being elevated provided that all areas of the building components below the ~~elevation corresponding to the base flood elevation plus a minimum of two (2) feet freeboard~~ design flood elevation are watertight with walls substantially impermeable to the passage of water, and use structural components having the capability of resisting hydrostatic and hydrodynamic loads and the effect of buoyancy. A professional engineer or architect licensed by the Commonwealth of Virginia shall certify that the standards of this subsection are satisfied. Such certification, including the specific elevation (in relation to NAVD88) to which such structures are flood proofed, shall be maintained by the building official.

C. ~~Space below the lowest floor requirements. In Zones A, AE, AH, and AO,~~ ~~f~~Fully enclosed areas of new construction or substantially improved existing structures that are below the ~~regulatory~~ design flood protection elevation shall:

1. Not be designed or used for human habitation, but shall only be used for parking of vehicles, building access, or limited storage of maintenance equipment used in connection with the premises. Access to the enclosed area shall be the minimum necessary to allow for parking of vehicles (garage door), limited storage of maintenance equipment (standard exterior door), or entry to the living area (stairway or elevator).

2. Be constructed entirely of flood resistant materials below the ~~regulatory~~ design flood ~~protection~~ elevation.

3. Space below the lowest floor of SFHAs delineated on the FIRM shall ~~I~~include measures to automatically equalize hydrostatic flood forces on walls by allowing for the entry and exit of floodwaters. To meet this requirement, the openings shall either be certified by a professional engineer or architect licensed by the Commonwealth of Virginia or meet or exceed the following minimum design criteria:

. . . .

Sec. 4.4. Floodway requirements.

. . . .

B. The placement of new or replacement manufactured homes (mobile homes) is prohibited.

~~C.~~ ~~The following uses and structures may be permitted in the floodway district, subject to the requirements of articles III, IV, V, and VI of this ordinance:~~

~~1.~~ ~~Public and private outdoor recreational facilities;~~

~~2.~~ ~~Agricultural uses, including farming, grazing, and the raising of poultry or livestock; provided, that poultry or livestock shall not be housed within five hundred (500) feet of any residential, apartment, or hotel district;~~

~~3.~~ ~~Open uses, such as public and private roadways, off street parking, or loading and unloading areas related to uses in adjoining districts;~~

~~4.~~ ~~Commercial mining, soil removal, and sand pits subject to regulations applicable to extractive industries as set forth in the conditional use provisions of the Zoning Ordinance of the City of Virginia Beach;~~

~~5.~~ ~~Public improvements, such as dams, levees and channel improvements, and utilities installations and substations, including temporary storage of materials, except flammable, toxic or noxious materials, and temporary location of maintenance installations; and~~

~~6.~~ ~~Uses and structures customarily accessory and clearly incidental and subordinate to uses listed above, including in connection with agricultural uses; roadside stands for the sale of agricultural products produced on the premises; provided that:~~

~~a.~~ ~~Only one (1) such stand shall be permitted per lot;~~

~~b.~~ ~~No such stand shall exceed five hundred (500) square feet in floor area; and~~

~~c.~~ ~~No such stand on the street frontage shall be erected within twenty (20) feet of the property line.~~

. . . .

Sec. 4.6. A Zone requirements.

. . . .

B. The floodplain administrator reserves the right to require a hydrologic and hydraulic analysis for any development and to determine the base flood elevation. When such base flood elevation data is utilized, the lowest floor shall be elevated to minimum of two (2) feet above the base flood level. During the permitting process, the floodplain administrator shall obtain:

1. The elevation of the lowest floor (including the basement) of all new and substantially improved structures; and

2. If the structure has been flood-proofed in accordance with the requirements of this ordinance, the elevation (in relation to NAVD88) to which the structure has been flood-proofed.

~~C.~~ ~~When the data is not available from any source, the lowest floor of the structure shall be elevated to not less than two (2) feet above the highest adjacent grade.~~

Sec. 4.8. ~~Reserved~~ X and X(Shaded) Zone requirements. (Other Areas of Flood Risk).

A. *Residential construction requirements*. The lowest floor, including basements, shall be set to a minimum of one (1) foot above the 100-year HGL elevation measured at the nearest existing or proposed public drainage structure or BMP, in the City Stormwater Master Plan.

B. *Non-residential construction requirements*. New construction or substantial improvement of any commercial, industrial, or non-residential building or manufactured home shall have the lowest floor, including basement, elevated as established in Section 4.8 A of this ordinance above. Buildings may be flood-proofed in lieu of being elevated provided that all areas of the building components below the design flood elevation are watertight with walls substantially impermeable to the passage of water, and use structural components having the capability of resisting hydrostatic and hydrodynamic loads and the effect of buoyancy. A professional engineer or architect licensed by the Commonwealth of Virginia shall certify that the standards of this subsection area satisfied. Such certification, including the specific elevation (in relation to NAVD88) to which such structures are flood proofed, shall be maintained by the building official.

Sec. 4.9. – Coastal High Hazard (~~V and~~ VE Zone) requirements.

The following provisions shall apply within ~~V and VE Zones~~ Coastal A Zones and Coastal High Hazard Areas:

A. All new construction and substantial improvements, including to manufactured homes, shall be elevated on pilings or columns so that:

1. The bottom of the lowest horizontal structural member of the lowest floor (excluding the pilings or columns) is elevated to a minimum of ~~two~~ three (~~2~~3) feet above the base flood ~~level~~ elevation; and

2. The pile or column foundation and structure attached thereto is anchored to resist flotation, collapse, and lateral movement due to the effects of wind and water loads acting simultaneously on all building components. Wind and water loading values shall each have a one (1) percent chance of being equaled or exceeded in any given year.

B. A professional engineer or architect licensed by the Commonwealth of Virginia shall develop or review the structural design, specifications, and plans for the construction and shall certify that the design and methods of construction to be used are in accordance with accepted standards of practice for meeting the provisions of article IV, section 4.6 A. A V Zone

Design Certificate shall be submitted to Permits and Inspections with plans for a building permit.

. . . .

I. ~~The man-made alteration of sand dunes, which would increase potential flood damage, is prohibited.~~ Sand dunes, barrier beaches, and other natural protective barriers shall remain intact to provide protection against wind, waves, and erosion drainage. Any person who desires to use or alter any coastal primary sand dune or beaches, other than for the purpose of conducting the activities specified in Article 1600, Section 1602 of the Zoning Ordinance of the City of Virginia Beach, shall first obtain a permit, or authorization, from the USACE, VADEQ, the Virginia Marine Resources Commission, and the Wetlands Board through the joint permit application process.

J. Manufactured homes are prohibited.

Sec. 4.10. Floodplain subject to special restrictions.

A. All ~~FIRM delineated~~ SFHAs that ultimately drain to Back Bay or the Currituck Sound ~~located in the following areas~~ shall be identified as a floodplain subject to special restrictions~~:~~.

~~1. North Landing River and its tributaries south of Lynnhaven Parkway;~~

~~2. West Neck Creek and its tributaries south of Shipps Corner Road, London Bridge Road, and the portion of Dam Neck Road east of its intersection with London Bridge Road; and~~

~~3. Bays, creeks, lakes, guts, coves, wetlands, marshes and swamps and their tributaries comprising the Back Bay and Small Coastal South watersheds south of South Birdneck Road and east of Princess Anne Road and General Booth Boulevard.~~

B. The following provisions shall apply within the floodplain subject to special restrictions:

1. Notwithstanding any provision of this ordinance to the contrary, no filling shall be permitted, including filling with material excavated from the same floodplain except for:

a. The purpose of public roadway or other similar public works construction undertaken by the Department of Public Works or Virginia Department of Transportation, or their agent for

construction. This construction includes flood protection and flood mitigation projects;

b. The maintenance, alteration, or relocation of bona fide agricultural ditches, swales, or agricultural pathways or those ditches required for proper lot drainage;

c. For shoreline stabilization or maintenance projects, such as riprap revetment, bulkheads, or other treatment used to stabilize and protect the banks of waterways, the city manager or his designee may approve the placement of fill provided the following criteria are met:

i. A joint permit application is submitted;

ii. The alignment of the stabilization structure is along the escarpment or in line with adjacent stabilization structures; ~~and~~

iii. If there is an existing shoreline stabilization structure, any proposed replacement structure shall be no more than six (6) inches higher than the existing structure; and

~~iii~~iv. Fill must be the minimum necessary to support the stabilization project.

2. The city manager, or his designee, may approve the placement of fill provided that the following criteria are met:

a. Proposed fill within the floodplain:

i. Shall be mitigated to result in no decrease in flood storage volume on the site;

ii. Shall be mitigated entirely on the same site that will incur the fill;

iii. Shall be contiguous to the existing floodplain that is being filled; and

iv. Shall be limited to the smallest amount of area and volume possible to correct irregularities within the boundary of the project.

b. The combined areas of fill and mitigation shall not exceed five (5) percent of the total area within the floodplain located on the site that will incur the fill.

3. Residential dwelling structures shall not be located within the floodplains subject to special restrictions on lots created after October 23, 2001. Residential dwelling structures located in ~~local flood hazard areas as of~~ a SFHA and constructed prior to October 23, 2001 may be expanded with attached additions to a total footprint of less than one thousand (1,000) square feet; such additions shall also comply with the requirements set forth in article V of this ordinance.

. . . .

ARTICLE V. EXISTING STRUCTURES IN FLOODPLAIN AREAS

Sec. 5.1. Existing structures.

A structure or use of a structure or premises that lawfully existed prior to the adoption of this ordinance, but which is not in conformity with this ordinance, may be continued subject to the following conditions:

A. Any existing structures in the floodway area shall not be expanded or enlarged unless it has been demonstrated through hydrologic and hydraulic analyses performed in accordance with standard engineering practices that the proposed expansion or enlargement would not result in any increase in the base flood elevation.

B. Any modification, alteration, repair, reconstruction, or improvement of any kind to a structure and/or use located in any floodplain ~~areas~~ district to an extent or amount of less than fifty (50) percent of its market value shall conform to the VA USBC and meet the freeboard height in effect at the start of construction for the original structure.

C. Any modification, alteration, repair, reconstruction, or improvement of any kind to a structure and/or use, in any floodplain ~~area~~ district to an extent or amount of fifty (50) percent or more of its market value shall be undertaken only in full compliance with this ordinance and shall require the entire structure to conform to the VA USBC.

ARTICLE VI. VARIANCES AND APPEALS

Sec. 6.1. Administrative variances.

The floodplain administrator shall approve or deny an application requesting an administrative variance after receipt of a complete application. Administrative variances may only be granted for the following uses, development, or redevelopment:

A. As defined in section 4.10, floodplains subject to special restrictions, for filling only.

B. Any structure or use sustaining damage not caused by flood to an extent or amount of fifty (50) percent or more of its market value to allow the structure to be rebuilt to the freeboard height in effect at the start of construction for the original structure. If the structure is a pre-FIRM structure, full compliance with the current VAUSBC freeboard above the base flood elevation is required. Structures that are utilizing an approved land management plan for their on-site waste disposal may be allowed to continue the use of the land management plan as long as it is approved by the city and the health department, even for damage or destruction resulting from flood.

C. As defined in section 4.8 B, X and X(Shaded) Zone requirements. (Other Areas of Flood Risk), and 4.3 A(ii) when the required finished floor is higher than the BFE plus two feet of freeboard, where the floodplain administrator, in consultation with the Development Services Center, has determined that the proposed stormwater engineering design will approximately mitigate any impacts to the finished floor of the nonresidential development.

Sec. 6.3. Application process.

A. Applications for variances from the requirements of this ordinance shall be made to the city council and filed with the director of planning. The fee for such applications shall be ~~six hundred fifty dollars~~ seven hundred eighty ($~~650~~780.00). Such fee shall include all costs of notifications and advertising. Except in cases in which such fee is waived, the director shall not accept any application not accompanied by payment of the required fee. The procedure for the advertising, hearing and determination of applications for floodplain variances shall be in accordance with the requirements pertaining to applications for subdivision variances, as set forth in section 9.4 of the subdivision ordinance. In cases in which a variance application is filed by reason of a natural disaster that is the subject of a federal declaration of emergency, application and associated advertising fees shall be waived and such application shall be given expedited processing to the maximum practical extent.

B. All applications shall be accompanied by the following:

1. A separate map, on a 1″ = 100′ or greater scale, identifying all proposed land disturbance, including fill and mitigation areas, and the limits of the existing and proposed SFHAs, tidal and non-tidal wetlands, Southern Rivers Watershed Management Area Buffer, and CBPA Resource Protection Area Buffer; and

2. A preliminary floodplain study addressing the physical and environmental characteristics of the floodplain located on adjoining properties and in the general area. Such study shall be sufficient to show that the variance, if granted, will meet the standards defined in section 6.~~3~~<u>4</u> and in addition thereto, shall:

    a. Contain supporting data and calculations <u>required for a Preliminary Stormwater Engineering Analysis</u> as appropriate~~,~~ ~~given the preliminary nature of the floodplain study~~;

    b. Comply with the Public Works Design Standards Manual; and

    c. Be certified by a professional engineer, architect, surveyor, landscape architect or practitioner of a related field having a valid license issued by the Commonwealth of Virginia or who is exempt from licensure pursuant to applicable provisions of the Virginia Code.

Adopted by the Council of the City of Virginia Beach, Virginia, on the 1st day of February, 2022.

Attachment 6: Copy of Monitoring/Maintenance Plan

Dewberry

[DRAFT] Annual Monitoring Plan and Post-Construction Monitoring Report

Marsh Restoration in Back Bay, Virginia Beach, VA

Prepared by: Dewberry Engineers, Inc.

[July 6, 2023]

[REPORT VERSION [DRAFT]]

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INTRODUCTION

This project is intended to implement one of the nature-based projects proposed in Virginia Beach's "Sea Level Wise" (SLW) Adaptation Strategy[1] adopted by the Virginia Beach City Council in June 2020. The SLW Adaptation Strategy presents a holistic framework for addressing flood risks across the City, consisting of four general strategies – natural mitigations, engineered defenses, adapted structures, and prepared communities. These strategies were applied to each major watershed in the City and tailored to their unique characteristics and risk profiles. The adaptation vision for the Lower Southern Rivers Drainage Basin, where the proposed project is located, focuses on employing natural mitigation methodologies to strategically reduce flow into and within Back Bay, along with an integrated system of defense structures and complementary adaptation measures, such as land-use strategies, to improve flood storage and overall coastal resiliency. The Bonney Cove area of Back Bay, where the project site is proposed, is particularly suitable for the use of nature-based strategies given the low elevations of marshlands and documented historic degradation of habitat. Participants at the 'near-neighbor' public engagement meetings held during the SLW Adaptation Strategy development were supportive of these types of strategies.

The City has several dedicated Capital Improvement Program (CIP) initiatives for the Lower Southern Rivers Drainage Basin for implementation of these strategies. The City's Stormwater Green Infrastructure CIP has obligated approximately $421,700 in contracts to support field investigations, environmental assessments, and engineering designs of the project – a true indication of the City's commitment to nature-based approaches and the critical first step in a broader effort. During the General Election on November 2, 2021, Virginia Beach residents voted to authorize $567.5 million dollars in debt to fund the design and construction of 21 Phase 1 projects in the citywide Flood Protection Program. [2] The Back Bay Marsh Terrace project is included under the Stormwater Green Infrastructure Master Project.[3] Other Southern Watershed projects that received funding under the Flood Protection Program include the West Neck Creek Bridge City-Wide Sea Level Rise Strategy, the Pungo Ferry Road Improvements, and the Sandbridge/New Bridge Intersection Improvements projects.

Outside of this project, the Virginia Beach City Council has recently funded a $5.2 million dollar voluntary acquisition program to encourage flood-prone properties to apply for a buyout to enable the City to convert parcels to open space to serve as flood storage and a marsh migration buffer. The City's

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[1] City of Virginia Beach Sea Level Wise Adaptation Strategy webpage: https://www.vbgov.com/government/departments/public-works/comp-sea-level-rise/Pages/default.aspx

[2] City of Virginia Beach Flood Protection Program webpage: https://www.vbgov.com/government/departments/public-works/flood-protection-program/Pages/Flood-Protection-Program.aspx.

[3] Stormwater Green Infrastructure Page: https://www.vbgov.com/government/departments/public-works/flood-protection-program/Pages/Stormwater-Green-Infrastructure-.aspx

Stormwater Green Infrastructure CIP is also supporting the implementation of other natural and nature-based projects across the City, including a wetland and floodplain restoration project along the Eastern Branch of the Elizabeth River.

An assessment of restoration opportunities in the City's Lower Southern Rivers Drainage Basin with dual flood reduction and habitat restoration benefits identified the Bonney Cove area as a potential project site for several reasons. The Bonney Cove site has experienced significant historical ecological degradation. Historical shoreline data from 1869 indicates approximately 50% of present-day open water in Bonney Cove (260 acres) was previously marsh (Figure 1). Loss of the marsh island habitat within Bonney Cove has resulted in the opening of a secondary channel allowing increased flow exchange between the upper and lower bays. In comparison to shore-adjacent restoration, off-shore marsh restoration leveraging hydraulic modeling identified Bonney Cove as a location where marsh restoration has the potential to reduce the propagation of floodwaters through key pathways within Back Bay. The United States Fish and Wildlife Service (USFWS) and the Virginia Department of Wildlife Resources (VDWR) also identified Bonney Cove as a restoration priority as this area serves as an ideal location for Submerged Aquatic Vegetation (SAV) reestablishment and vital habitat for migratory birds and fish.

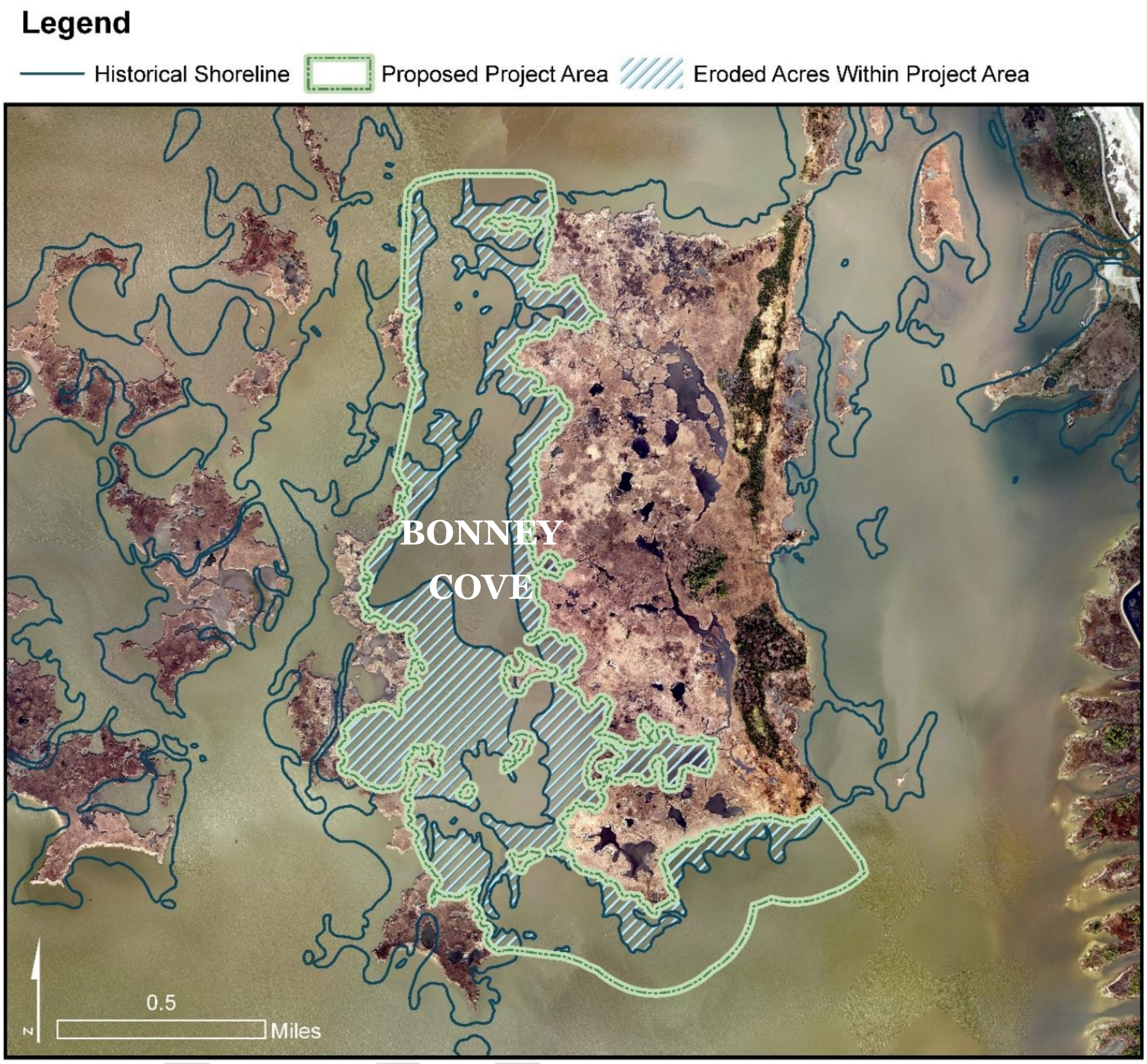

Figure 1: Historical marsh erosion within the project area.

The project is situated within the Bonney Cove area of Back Bay, spanning the western and southern lengths of Long Island, as shown in Figure 1.

Project Background

Marsh island restoration through terracing was identified as a particularly viable solution given Back Bay's shallow bottom and the historical loss of habitat. The marsh terraces are narrow man-made islands that will be arranged across areas that were historically marsh but are now shallow open water. A series of these islands, or terraces, are typically arranged in a chevron pattern. The overall field of terraces dissipates waves and slows down water moving through the area. In turn, the calmer water allows more sunlight to penetrate to the shallow bottom, promoting establishment and growth of marsh

and SAV habitats. Further, as opposed to one continuous marsh platform, marsh terraces maximize habitat for a variety of fish and wildlife species.

The Preferred Alternative includes the creation of 41 individual marsh terraces totaling approximately 25,000 linear feet (or an approximately 47-acre footprint) across Bonney Cove. These 47 acres of terraces are comprised of approximately 13 acres of emergent (low and high marsh) vegetated habitat, 14 acres of upland vegetated habitat, and 16 acres of submerged terrace habitat. Approximately 310 acres of suitable SAV habitat will remain in between the terraces.

Terrace Construction and Orientation

Terrace construction will begin in the northern extent of the project site, and the contractor will work towards the southern extent of the site. The contractor will complete each terrace, including installing plants, before moving to the next. Marsh terrace construction will occur over two years (2025 to 2026) and will pause annually between October 31st and March 1st to limit disturbance to wintering waterfowl and migration, in accommodation of BBNWR's requirement. Approximately 20 terraces will be constructed in 2025 ("Phase 1"), and 21 terraces will be constructed in 2026 ("Phase 2"). The following sections summarize the proposed design and construction approach.

Terraces will be generally oriented perpendicular to the predominant wind direction (south-southwest) to maximize wave energy reduction. The terraces will be segmented in a chevron (duck-wing) pattern to create the most favorable fish and swimming crustacean (termed "nekton") habitat, facilitate adequate circulation, and maintain navigability throughout the project area. The terraces will not be connected to the adjacent marsh to maintain a physical open water barrier to deter the invasion of Common Reed (*Phragmites australis*) stands.

The terraces will be spaced at approximately 300-foot intervals in the northern and southern quarters and span 15 feet in width, and at least 600-foot intervals in the center and span 30 feet in width. This arrangement will lessen the amount of open water and subsequent wave action at the northern and southern ends of the site and provide space for marine-based construction equipment. The design team reviewed the final spacing layout of the terraces to ensure navigability of a watercraft through the project site which will be required for post-construction monitoring, any needed maintenance, as well as community recreational access.

The terraces would consist of a sand filled core encapsulated by a high-strength blend of woven and non-woven geotextile fabrics ("geobags"). The sand for this material would need to come from offsite sources. Back Bay is too shallow to accommodate conventional barges for material placement. To avoid extensive impacts to the bottom of the bay, the slurry basin will pump sand for the project from the proposed Shipps Cabin Road staging area to Bonney Cove. The slurry pipeline will consist of approximately 10,424 linear feet of 12" diameter HDPE fused/welded pipeline that will be assembled on land and floated into its proposed alignment within Back Bay. The pipe would be marked by floats

every 5 feet and temporary signage as reasonable. It is anticipated the pipeline will be submerged to the bottom of the bay at channel crossings and adjacent to a duck hunting cabin adjacent to the alignment. By establishing a floating pipeline, it will limit disturbances to the subaqueous bottomlands along the alignment and allow for the retraction of the pipeline during the winter inactive periods and inclement weather events. Booster stations would be placed approximately every mile. These booster stations would consist of a pontoon mounted diesel engine pump capable of moving the sand slurry from the laydown area to the site. Given the distance to the site, four or five of these booster stations are anticipated to be necessary to create the sand cores of the terrace. It is estimated that 450 Gallons Per Minute (GPM) of sand slurry would be pumped through the pipe.

Once the cores are in place, long reach excavators would travel along the tops of the terraces and begin to shape the cross slopes. Appropriate materials for establishing vegetation atop the terraces will be primarily sourced from materials dredged during the Sandbridge Road Nimmo Parkway Phase VII-A project located immediately north of Back Bay (VMRC 15-1564, USACE IP NAO-2015-00151). Materials will be tested and screened to remove organics prior to application to the terraces. As needed, dredging sites adjacent to the proposed terrace locations that are confirmed to be devoid of SAV will be utilized to provide supplemental soil materials to top the proposed terraces[4]. It was determined that the in-situ bay sediment would be suitable for vegetation growth. The marsh terraces would be covered with 1 to 3 feet of suitable fill, depending on crest widths. Jute netting will cover the topsoil to control erosion and promote vegetation establishment. Coir logs will be places along the terrace slope controls to further promote vegetation establishment along the slope.

SAV Plantings

The City has partnered with Virginia Polytechnic Institute and State University ("Virginia Tech") to evaluate opportunities for restoring populations of native Wild Celery (*Vallisneria americana*) in Back Bay. The Virginia Tech research team has developed an innovative technique to grow Wild Celery in an aquaculture center that results in larger, mature plants that can better withstand Back Bay's turbidity. Once transplanted, plants are surrounded by cages to prevent predation. These founder colonies can be used for propagation throughout Back Bay. After terrace construction, the City will transplant Wild Celery in an area adjacent to the site. This founder colony will be used to strategically transplant Wild Celery in between the terraces for 5 years after construction (2026 – 2029) with the ultimate goal of establishing 10 acres of SAV vegetation in between the marsh terraces.

[4] The 60% preliminary design showed preliminary siting of these dredge areas based on avoidance of existing SAV habitat; however, pre-construction surveys of SAV would be required to re-delineate these dredging areas.

Terrace Plantings – Upland and Marsh Vegetation

The terraces' intertidal perimeter will be planted with appropriate emergent estuarine plant species (e.g., Saltmarsh Cordgrass [*Spartina alterniflora*] and Salt Meadow Hay [*Spartina patens*]) and brackish plant species (e.g., Big Cordgrass [*Spartina cynosuroides*]). These plants will be installed as soon as possible after construction to stabilize planting areas and protect the terrace from erosion. In addition to emergent grass, woody growth (i.e., shrubs and trees) within the terrace crest will be incorporated to protect the terraces' surfaces from rain and wind erosion and hold the landform together through substantial root systems.

Appropriate native species were identified based on the review of the reference marshes surrounding the project site and a review of water levels in Back Bay. Since the Bay's water levels are not affected by lunar tides and instead by wind-driven fluctuations, the project team evaluated average water elevations at the U.S. Geological Survey (USGS) Beggars Bridge Creek Gauge (Gauge ID 0204300267) from 2016 – 2021 to determine ranges of inundation to achieve functional marsh elevations throughout the project life, defined as:

- *Mean Low Water (MLW)*: the average low water at the site (10th Percentile: -0.62 ft NAVD88)
- *Mean High Water (MHW)*: the average high water at the site (95th Percentile: 1.22 ft NAVD88)
- *Mean Tide Level (MTL)*: halfway between MLW and MHW (0.3 ft NAVD88)
- *Upper Limit of Wetlands (ULW)*: approximately 1.5 times the mean tide range at the site (2.76 ft NAVD88)

These elevations were correlated to suitability for low marsh, high marsh, and upland species, as shown in Table 1.

Table 1: Proposed planting elevation zones.

Planting Zone	Definition	Elevation Range	Elevation (feet NAVD88)	Percentage of record where water reaches these elevations
Low Marsh	Marsh that is flooded frequently but exposed sometimes	MTL - MHW	0.3 – 1.2 ft	48%
High Marsh	Marsh that is generally only flooded during higher-than average water conditions	MHW – ULW	1.2 to 2.8 ft	7%
Upland Habitat	Habitat that is rarely flooded, only during extreme conditions	> ULW	> 2.8 ft	0%

Five planting schemas were identified to provide the highest possible environmental benefit in terms of erosion control, habitat diversity, and fetch reduction. The wider (30-foot) terraces will be planted with Bald Cypress (*Taxodium districhum*) trees capable of withstanding rising water levels. The full list of species and quantities is provided in the 95% design plan set.

The final engineered design component is the strategic placement of rock on the exposed perimeter terraces on the project site's north, west, and southern extents. The need for the rock armor was determined through analysis of wind data both from NOAA and ASCE-7-10 50-year return period anticipated 3-second gust values. These values were used to calculate fetch-generated waves at the project site. The calculations performed confirmed that armored protection would be required to protect the proposed terraces from the forces created by wave action. The stone sizes required for these features (Class II rip rap) were calculated following the procedures laid out in the USACE Coastal Engineering Manual (CEM) and Virginia Institute of Marine Science (VIMS) Living Shoreline Design Guidelines for Shore Protection in Virginia's Estuarine Environments. Two calculation methods, Hudson (1974) and Van Der Meer (1988), from the CEM were utilized to evaluate the range of acceptable rock armor for the exposed perimeter. These two methods calculate the armor stone size based on several design inputs including initial wave height, allowable damage level, revetment slope, and breaking versus non-breaking waves. The two methods often result in corresponding values that are used by the engineer to make an experienced determination on the final rock armor sizing. The rock armor will serve as a nature-based design element by acting as a substrate for the Wild Celery grass that has proven to be successful for SAV establishment in Back Bay (see Figure 2).

Figure 2: Example Back Bay SAV experiment; photo courtesy of Virginia Tech.

Monitoring Goals and Objectives

Annual post-construction monitoring of the site is required by the Virginia Marine Resource Commission (VMRC) (TBD) Permit (VMRC #XXXX-XXXX) and the U.S. Army Corps of Engineers (USACE) Individual Permit (NOA-20XX-XXXXX). [Insert details of the relevant permits and permit conditions]. The following goals, objectives, and metrics were established to enable consistent tracking of the primary living shoreline project components across each monitoring year.

1. **Monitoring Goal 1**: Establishment of a Sustainable Coastal Marsh Island System
   a. Objective 1a: Establish Emergent Marsh Habitat
      - Metric: For each monitoring year, the project area should maintain or increase the overall coverage of emergent marsh vegetation. There should be no significant signs of herbivory or invasive species establishment.

   b. Objective 1b: Establish Upland Habitat
      - Metric: For each monitoring year, the project area should maintain or increase the overall coverage of upland vegetation. There should be no significant signs of herbivory or invasive species establishment.
2. **Monitoring Goal 2**: Stability of Marsh Terraces
   a. Objective 2: Marsh Terrace Structures
      - Metric: For each monitoring year, the terrace structures should show no significant signs of damage, deterioration or extreme settlement.
3. **Monitoring Goal 3**: Establishment of a Sustainable SAV Community
   a. Objective 3: Establish SAV Communities

- Metric: For each monitoring year, the SAV planting areas should maintain or increase the overall coverage of SAV vegetation. There should be no significant signs of herbivory or invasive species establishment.

MONITORING PLAN

The monitoring plan includes stakeholders, a schedule for the annual monitoring inspections, the monitoring strategy/sampling plan, and approach for addressing any needs for maintenance.

Monitoring Stakeholders

An Environmental Scientist from Dewberry Engineers Inc. will perform the annual monitoring inspections and provide a copy of the monitoring report to the City of Virginia Beach, USACE, VDEQ, VMRC, and the City of Virginia Beach Wetlands Board as necessary. As owners of the project, the City of Virginia Beach will review monitoring recommendations and perform corrective actions as necessary.

Annual Inspection Schedule

Monitoring inspections should be conducted annually, during the peak growing season, which is defined by VMRC as between June and August. To enable consistent tracking of project performance from year to year, annual monitoring inspections will be conducted prior to the end of the growing season in September of each year, with annual reports to be submitted to regulatory stakeholders prior to November 30th [or an annual date defined in the permit conditions] of each year. The following outlines the monitoring inspection schedule and deliverables.

Phase 1 Post-Construction As-Built Report (Date: Prior to December 31st, 2025)

To serve as a baseline for the post-construction annual monitoring, an as-built report for the Phase 1 terraces will be completed following the construction of each phase of terraces and submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following.

- Coordinates and diagrams of established transects, as well as site photographs from photo stations 1-40 as defined in the Methods section.
- Final location of all planted vegetation (upland plantings, high marsh plantings and low marsh plantings).
- Final grade topographic surveys (plan, profile, and cross sections).
- Discussion of the project design versus as-built conditions.

Phase 2 Post-Construction As-Built Report (Date: Prior to December 31st, 2026)

To serve as a baseline for the post-construction annual monitoring, an as-built report for the Phase 2 terraces will be completed following the construction of each phase of terraces and submitted to the

City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following.

- Coordinates and diagrams of established transects, as well as site photographs from photo stations 41-80 as defined in the Methods section.
- Final location of all planted vegetation (upland plantings, high marsh plantings and low marsh plantings).
- Final location and extent of SAV plantings.
- Final grade topographic surveys (plan, profile, and cross sections).
- Discussion of the project design versus as-built conditions.

Year 1a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2026)

At the end of the first full growing season following planting of the Phase 1 terraces, a Year 1a monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 40 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 1 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion; it is anticipated that the wetland planting contractor will provide a one-year post construction maintenance and guarantee period for the wetland plantings.

Year 1b/2a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2027)

At the end of the first full growing season following planting of the Phase 2 terraces following planting, and the second full growing season of the Phase 1 terraces, a Year 1b/2a monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 1 conditions (for Phase 2 terraces) and to Year 2 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).

- Estimated percent cover and change in coverage from planted conditions to Year 1 conditions for SAV planting quadrants
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion; it is anticipated that the wetland planting contractor will provide a one-year post construction maintenance and guarantee period for the wetland plantings.

Year 2b/3a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2028)

At the end of the second full growing season of the Phase 2 terraces following planting, and the third full growing season of the Phase 1 terraces, a Year 2b/3a monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 2 conditions (for Phase 2 terraces) and to Year 3 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- Estimated percent cover and change in coverage from planted conditions to Year 2 conditions for SAV planting quadrants
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

Year 3b/4a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2029)

At the end of the third full growing season of the Phase 2 terraces following planting, and the fourth full growing season of the Phase 1 terraces, a Year 3b/4a monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 3 conditions (for Phase 2 terraces) and to Year 4 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).

- Estimated percent cover and change in coverage from planted conditions to Year 3 conditions for SAV planting quadrants
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

Year 4b/5a Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2030)

At the end of the fourth full growing season of the Phase 2 terraces following planting, and the fifth full growing season of the Phase 1 terraces, a Year 4b/Final (Year 5a) monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 1 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 4 conditions (for Phase 2 terraces) and to Year 5 conditions (for Phase 1 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- Estimated percent cover and change in coverage from planted conditions to Year 4 conditions for SAV planting quadrants
- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

Year 5b Post-Construction Annual Monitoring Report (Date: Prior to November 30th, 2031)

At the end of the fifth full growing season of the Phase 2 terraces following planting, a Final (Year 5b) monitoring report will be submitted to the City of Virginia Beach, USACE, VMRC, VDEQ, and the City of Virginia Beach Wetlands Board that includes the following:

- Site photographs from photo stations 41 – 80 defined in the Methods section.
- Estimated percent cover and change in coverage from the as-built conditions to Year 5 conditions (for Phase 2 terraces) for all planted vegetation (upland plantings, high marsh plantings, and low marsh plantings).
- Estimated percent cover and change in coverage from planted conditions to Year 5 conditions for SAV planting quadrants

- General observations of project performance within each monitoring quadrant, including documentation of any problem areas associated with the planted vegetation, terrace structures, or invasive species.
- Results from inspections of the breakwaters, vegetated and non-vegetated design features.
- Maintenance, corrective actions and estimated schedule for completion.

Monitoring Strategy

The monitoring strategy consists of established transects with photo stations and quadrants that cover the area between transects. This approach enables monitoring of the four primary features of the living shoreline: uplands, low-marsh plantings, high-marsh plantings, and SAV*.

*Note: The planting scheme for SAV has not yet been established but it is anticipated that some SAV will be planted along the submerged portions of the marsh terraces. If more suitable planting locations are determined to be between terraces, separate transects will be established and sampled to track SAV survival apart from the proposed terrace transects.

Transects/Photo Points

A total of eighty (80) transects will be established across the project site, with 10 transects located along each of 8 terraces. Transects will span perpendicular to the length of each terrace from the ridge to the edge of the planted/vegetated area. See Figures 3 and 4 for graphic depictions of the proposed transect locations and layouts. Terraces were selected using a random stratified method to ensure representative terraces in each location within the project area (North Interior, North Exterior, South Interior, South Exterior), and of each planting scheme, were represented in the proposed monitoring plan. The selected terraces are as follows:

- North Interior: T-110, T-113
- North Exterior: T-100, T-106
- South Interior: T-124, T-131
- South Exterior: T-123, T-140

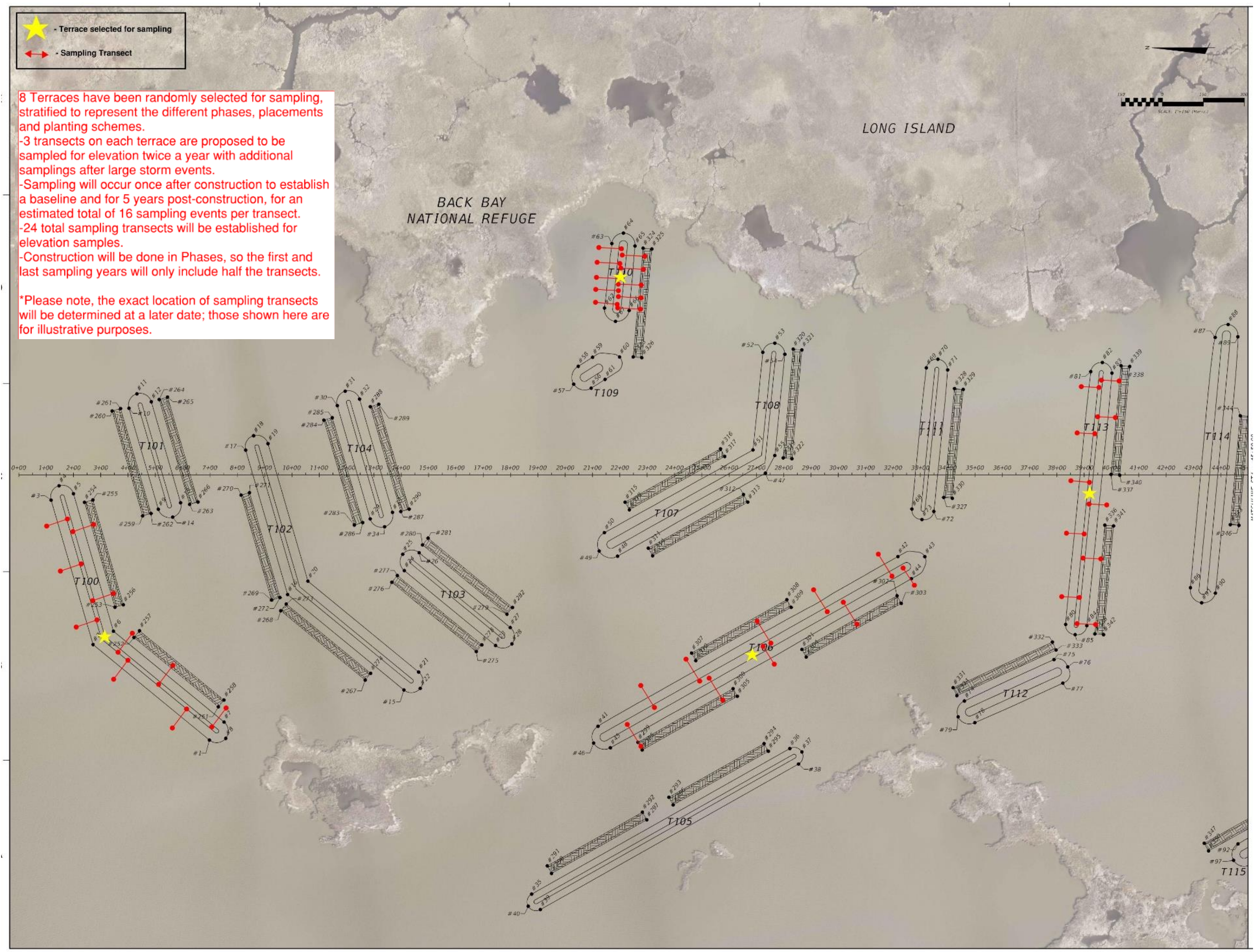

Figure 3: Monitoring design site plan – North Terraces

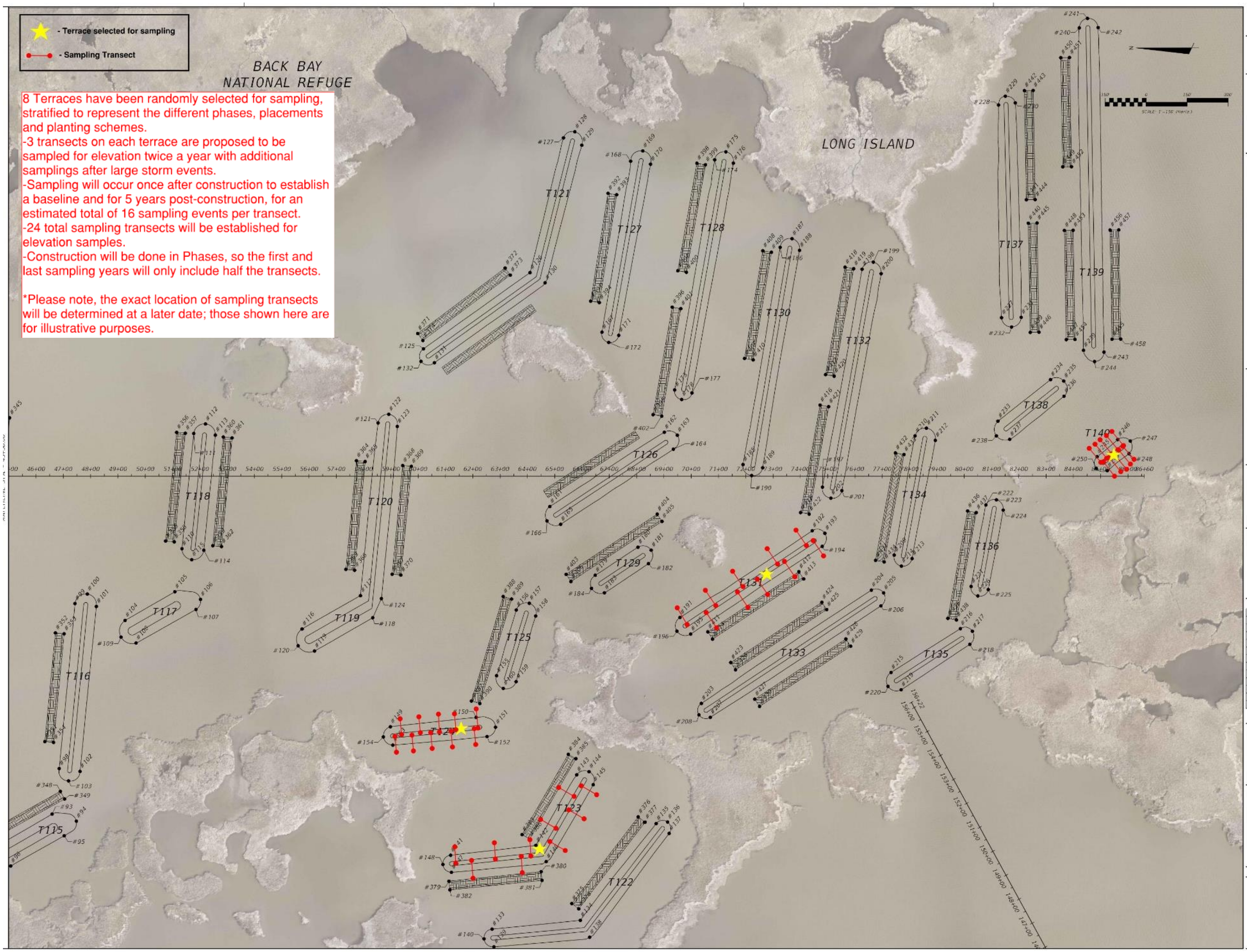

Figure 4: Monitoring design site plan – South Terraces

Permanent photo stations will be established at each quadrant along each transect to capture the design features/established habitats and vegetation. Figure 5 shows the general proposed locations (indicated by the red arrows/labels) for each quadrant and photograph station along each transect. Photos were shot from each photo location on [DATE]. These photos will be collected annually and compiled in Appendix B.

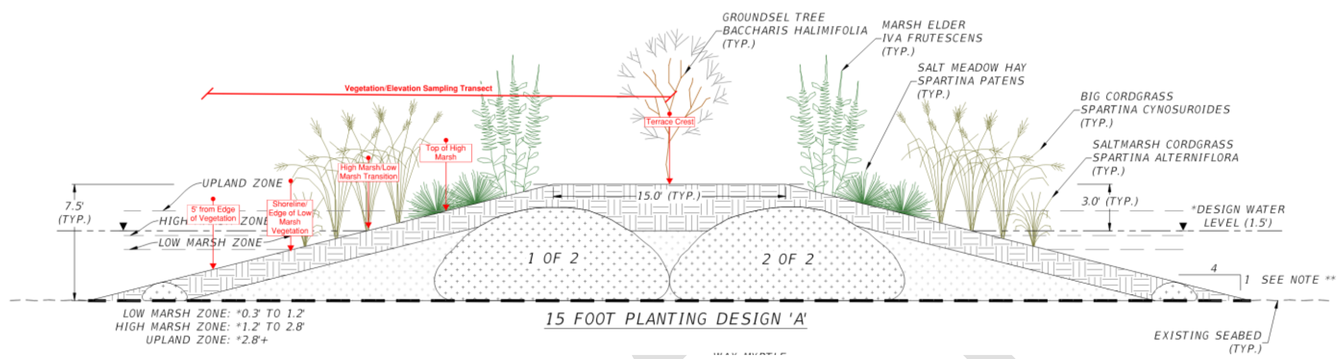

Figure 5: Photo station layout example

Quadrants

To estimate percent cover of vegetation, four (4) quadrants along each of ten (10) transects will be established on the eight selected terraces to allow for estimates of habitat coverage and planting survival. Estimates of coverage and survival were compared to post-construction conditions to evaluate changes.

Further, the following guiding questions were established to monitor overall project performance, presence of invasive species, and identify any needs for maintenance:

1. Are there specific problem areas where plants are dying or appear unhealthy?
2. Were any signs of herbivory observed?
3. Are there any undesirable plant species present?
4. Condition of the terrace structures: Is there any observed settlement, dislodged stone, significant debris etc.?
5. If an updated survey was conducted, are there any significant changes in the profile of the marsh terraces?
6. Does the upland portion of each terrace show any significant signs of erosion or loss of vegetation?

MONITORING RESULTS

Table 2: Low Marsh Vegetation Percent Cover Monitoring Results (Example Table – Terrace 1).

		Estimated Percent Coverage						Percent Change in Coverage (from Baseline)				
Terrace/ Transect	Photo Station Reference	Baseline (2024)	Year 1 (2025)	Year 2 (2026)	Year 3 (2027)	Year 4 (2028)	Year 5 (2029)	Baseline to Year 1	Baseline to Year 2	Baseline to Year 3	Baseline to Year 4	Baseline to Year 5
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1 - 9	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 10	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
Overall		**Choose an item.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**

Table 3: High Marsh Vegetation Percent Cover Monitoring Results (Example Table – Terrace 1).

		Estimated Percent Coverage						Percent Change in Coverage (from Baseline)				
Terrace/ Transect	Photo Station Reference	Baseline (2024)	Year 1 (2025)	Year 2 (2026)	Year 3 (2027)	Year 4 (2028)	Year 5 (2029)	Baseline to Year 1	Baseline to Year 2	Baseline to Year 3	Baseline to Year 4	Baseline to Year 5
1 - 1	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 2	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 3	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 4	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 5	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 6	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 7	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 – 8	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 9	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
1 - 10	TBD	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.
Overall		**Choose an item.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**	**Click or tap here to enter text.**

Table 4: General Observations for Wetland Planting Areas on the Marsh Terraces (Example Table – Terrace 1)

Monitoring Questions	Terrace/Transect									
	1 - 1	1 - 2	1 - 3	1 - 4	1 - 5	1 - 6	1 - 7	1 - 8	1 - 9	1 - 10
Are there specific problem areas where plants are dying or appear unhealthy?	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☒ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.
Were any herbivory issues observed?	YES ☐ NO ☒ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☒ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.
Are there any undesirable plant species present?	YES ☐ NO ☒ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☒ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.
If updated survey was conducted, are there any significant changes in the profile of the living shoreline system?	YES ☐ NO ☒ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☒ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.

Table 5: General Observations for the Unplanted Structural Components of the Marsh Terraces (Example Table – Terrace 1)

	Terrace/Transect									
Monitoring Questions	1 - 1	1 - 2	1 - 3	1 - 4	1 - 5	1 - 6	1 - 7	1 - 8	1 - 9	1 - 10
Are there any structural issues with the planted terrace structures (e.g. observed settlement, loss of topsoil, etc.)?	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☒ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.
Is there any observed growth in SAV on or adjacent to the marsh terraces?	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☒ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.	YES ☐ NO ☐ If yes, describe: Click or tap here to enter text.

Are there any structural issues with the rock armoring on the terraces (e.g. observed settlement, dislodged stone, significant debris, etc.)?	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☒	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.	If yes, describe: Click or tap here to enter text.

MAINTENANCE RECOMMENDATIONS

The following table outlines the recommendations for maintenance, including estimated quantities and specific guidance, based on the results of the [YEAR] monitoring results.

Table 6: Maintenance Recommendations Checklist

Design Feature/ Monitoring Objective	Maintenance Elements	Location & Estimated Quantity	Specific Guidance
Terrace Upland and Wetland Habitats and Wetland Soils – Monitoring Objectives 1a/1b	☐ Replace plants	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Add new plants	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Remove debris	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Remove invasive vegetation	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Add sand to eroding areas	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Replace waterfowl barrier	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.

Design Feature/ Monitoring Objective	Maintenance Elements	Location & Estimated Quantity	Specific Guidance
Terrace Structures & Stone Armoring, Monitoring Objective 2a/2b	☐ Re-place dislodged stones	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Add additional stone to address settlement	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Remove debris	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Repair sand cores or other structural elements	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
SAV Establishment, Monitoring Objective 3	☐ Replace plants	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.
	☐ Add new plants	If applicable: Click or tap here to enter text.	If applicable: Click or tap here to enter text.

APPENDIX A: AS-BUILT PLANS

[Page left intentionally blank; as-built plans will be included in the Year 1 monitoring report]

APPENDIX B: MONITORING PHOTOGRAPHS

Table 7: Terrace 1 Transect 1 Photographs

Photograph from Photo Location 1A	Photograph from Photo Location 1B
Photograph from Photo Location 1C	Additional photos of any problem areas.

Table 8: Terrace 1 Transect 2 Photographs

Photograph from Photo Location 2A	Photograph from Photo Location 2B
Photograph from Photo Location 2C	Additional photos of any problem areas.

Table 9: Terrace 1 Transect 3 Photographs

Photograph from Photo Location 3A	Photograph from Photo Location 3B
Photograph from Photo Location 3C	Additional photos of any problem areas.

Table 10: Terrace 1 Transect 4 Photographs

Photograph from Photo Location 4A	Photograph from Photo Location 4B
Photograph from Photo Location 4C	Additional photos of any problem areas.

Table 11: Terrace 1 Transect 5 Photographs

Photograph from Photo Location 5A	Photograph from Photo Location 5B
Photograph from Photo Location 5C	Additional photos of any problem areas.

Table 12: Terrace 1 Transect 6 Photographs

Photograph from Photo Location 6A	Photograph from Photo Location 6B
Photograph from Photo Location 6C	Additional photos of any problem areas.

Table 13: Terrace 1 Transect 7 Photographs

Photograph from Photo Location 7A	Photograph from Photo Location 7B
Photograph from Photo Location 7C	Additional photos of any problem areas.

Table 14: Terrace 1 Transect 7 Photographs

Photograph from Photo Location 7A	Photograph from Photo Location 7B
Photograph from Photo Location 7C	Additional photos of any problem areas.

Table 15: Terrace 1 Transect 8 Photographs

Photograph from Photo Location 8A	Photograph from Photo Location 8B
Photograph from Photo Location 8C	Additional photos of any problem areas.

Table 16: Terrace 1 Transect 9 Photographs

Photograph from Photo Location 9A	Photograph from Photo Location 9B
Photograph from Photo Location 9C	Additional photos of any problem areas.

Table 17: Terrace 1 Transect 10 Photographs

Photograph from Photo Location 9A	Photograph from Photo Location 9B
Photograph from Photo Location 9C	Additional photos of any problem areas.

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