

**Virginia PMP Study  
Technical Review Panel  
Final Report**

November 20, 2015

Results and conclusions in this report are based upon results from Applied Weather Associates, and we, the Technical Review Panel, used our best professional judgment in evaluating their work. We note that the final PMP estimates are based on the historical record of the past century and more, with the underlying assumption that this record across the eastern United States region yields insight into the PMP across the Commonwealth of Virginia. As such, we do not make any warranty, express or implied, regarding use of any information or method shown in the Probable Maximum Precipitation Study for the Virginia Department of Conservation and Recreation report, or assume any future liability regarding use of any information or method contained therein.

The Virginia Department of Conservation and Recreation, Division of Dam Safety and Floodplain Management (Virginia Dam Safety) contracted with Applied Weather Associates (AWA) in 2014 to conduct a Probable Maximum Precipitation Study for Virginia. The Chief Meteorologist and Project Manager for AWA was Mr. Bill Kappel. Virginia Dam Safety appointed a Technical Review Panel to provide technical recommendations and oversight to the PMP study. Panel members were selected by Virginia Dam Safety in consultation with AWA. The Panel was officially convened at a meeting on July 8, 2014.

The Technical Review Panel consisted of 4 individuals. The names and qualifications of the Panel members are:

**John Harrison, PE, D.WRE** - Mr. Harrison is a consulting engineer with Schnabel Dam Engineering, Inc with over 25 years of experience in hydraulics, hydrology, and dam engineering. He has experience in the inspection, analysis, design, independent review, and construction inspection for dams, levees, and canals, both new construction and rehabilitation projects. John serves as Technical Leader for dam design in Schnabel's West Chester, Pennsylvania office.

**Mathew Lyons, PE** - Mr. Lyons is a registered professional engineer and is the State Conservation Engineer for the USDA Natural Resources Conservation Service (NRCS) in Richmond, Virginia. Mr. Lyons has professional engineering responsibility and oversight for all of the engineering work performed by NRCS in Virginia. He has over 25 years' experience in dealing with flood control and watershed protection. He has worked for NRCS (formerly SCS) since 1989. Mr. Lyons has been the State Conservation Engineer since 2001. Prior to 2001, he served as a Project Engineer and Area Engineer with NRCS/SCS in Michigan and West Virginia.

**Art Miller, PE** - Dr. Miller is a Distinguished Professor Emeritus of Civil and Environmental Engineering at Penn State University and is a Science Practice Leader for AECOM. He is a registered professional engineer recognized nationally as an expert in hydrology, hydraulic engineering, dam safety, and water resource management. His over 40 years of experience includes research, consulting, and publishing in hydrology, hydraulics, floodplain delineation, dam safety, bridge scour, river mechanics, sediment transport, and impacts of climate change. Dr. Miller

teaches courses throughout the country for Federal and State Agencies, on topics ranging from fundamental hydraulics to open channel flow to hydrologic processes.

**Stephen Rich, CCM** - Mr. Rich has been a Certified Consulting Meteorologist since early 2009. The CCM designation is awarded by the American Meteorological Society (AMS). Prior to that, he served in the National Weather Service for 30 years, including 10 years as the Meteorologist in Charge of the NWS Weather Forecast Office (WFO) in Charleston, SC, before retiring in December 2003. He has also been an official NOAA/NWS Cooperative Observer since January 2004. Overall, he has over 40 years of experience in meteorological consulting, operations, observations and management – including the full range of NWS forecast and warning operations and oversight of all WFO programs.

Formal meetings were held at the Virginia Department of Conservation and Recreation office in Richmond, Virginia. Meetings were attended by members of the Panel, representatives from Virginia Dam Safety, Virginia Department of Conservation and Recreation personnel and FERC personnel. The purpose of the meetings was to discuss AWA progress, process and methodology and to provide input. Meetings were held on the following dates:

July 8, 2014

November 18, 2014

April 7-8, 2015

October 6-7, 2015

The Technical Review Panel was charged with reviewing and assessing each phase of AWA's statewide PMP study and for providing oversight, as necessary, to evaluate whether the study methodology was consistent with accepted PMP theories and procedures. Among other things, the Technical Review Panel assessed the hydrology and meteorology of the project and reviewed each phase of the analysis.

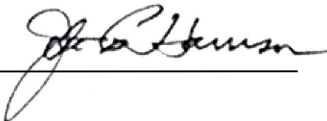
The Technical Review Panel performed the duties described above, but it should be noted that we acted in an advisory capacity only. Specifically, no calculations were performed by the Technical Review Panel nor were detailed reviews of calculations performed by the Panel. It has been our expectation that AWA utilized adequate quality assurance and control procedures to provide assurance that the calculations were performed accurately and without error.

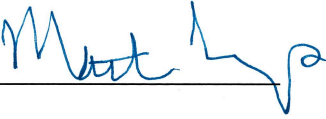
Further, we understand that the majority of procedures utilized in this study followed guidance in the NWS's HMR reports, while other procedures (such as the orographic transposition factor (OTF) and related assumptions) employed relatively new technology (based in part on the World Meteorological Organization's PMP Manual). We further understand that the application of these procedures has been accepted in other AWA studies throughout the United States. The Review Panel notes that the OTF process appears to be a significant improvement over previous methods that relied on several subjective assumptions. However, the Panel also acknowledges that the OTF process, limits and assumptions are not without their own level of judgment and subjectivity (e.g., normalization of Smethport storm to a maximum of 1.0 and associated adjustments, transposition zones for Smethport storm, etc.). As the Panel members do not purport to be experts in the meteorological aspects of the OTF assumptions, and given the significant influence of the OTF on


PMP values throughout the Commonwealth, we believe it would be prudent to conduct a peer review of the OTF process and related assumptions specifically as applied in Virginia.


In the opinion of the Technical Review Panel, AWA's Probable Maximum Precipitation Study for Virginia appears to be performed in accordance with scientifically sound and generally-accepted PMP practices utilizing appropriate data and analysis techniques. The Panel also recommends a peer review of the OTF process, limits and assumptions as currently detailed in the study. These results are applicable to Virginia only and should not be used in other States.

Respectfully submitted,

	11/20/15
_____ John Harrison, PE	_____ Date

	11/20/15
_____ Mathew Lyons, PE	_____ Date

	11/20/15
_____ Art Miller, PE	_____ Date

	11/20/15
_____ Stephen Rich, CCM	_____ Date