



## Susquehanna River Post Flood Investigations

### Background:

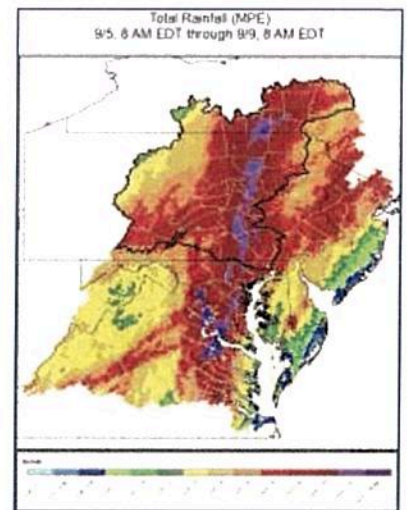
The effective Flood Insurance Study (FIS) and Flood Insurance Rate Map (FIRM) for the Susquehanna River in Columbia, Luzerne, Montour, Northumberland, Snyder, and Union counties, Pennsylvania is based on a detailed HEC-RAS hydraulic model prepared by the U.S. Army Corps of Engineers (USACE) in 2003. Detailed studies use topographic data, field survey of channel geometry, and bridge/culvert openings to conduct detailed hydrologic and hydraulic analyses and floodplain mapping. This model starts at the downstream border of Snyder and Northumberland Counties and extends 101 miles upstream. On September 4-8, 2011, Tropical Storm Lee dropped record-breaking rain on the region, producing widespread flooding. In response to this event, FEMA tasked the USACE to conduct a basin flood data assessment and update the 2003 analysis to reflect hydrologic and hydraulic changes that have occurred since the effective FIS.

### Hydrologic Update:

The peak flow for this study is based on a statistical analysis of past events at river gaging stations. The analysis was revised by USACE-Baltimore District as part of this investigation to include flow records up to and including Tropical Storm Lee (September 2011). This analysis verified that peak flow estimates have increased for the Susquehanna River.

### Hydraulic Update and Validation:

The 2003 HEC-RAS hydraulic model was revised to use the updated flows, reflect physical changes that occurred at 2 bridges, and correct channel geometry in Bloomsburg and downstream of PA Route 29. This model was calibrated to five historic events and eight frequency-based events. After the model was calibrated, a multiple profile analysis for the 50-, 20-, 10-, 4-, 2-, 1-, 0.2-percent annual chance events (2-year, 5-year, 10-year, 25-year, 50-year, 100-year, and 500-year, respectively) was performed. The regulatory floodway was not recomputed as part of this effort.



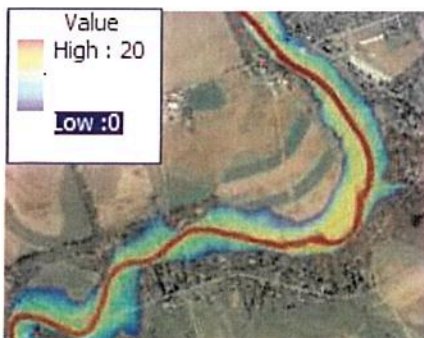
Tropical Storm Lee Rainfall Distribution

### Mapping:

Flood inundation boundaries were mapped for the 20-, 10-, 4-, 2-, 1-, 0.2-percent annual chance events. The inundation areas were created in a GIS environment by comparing the water-surface elevation profiles from the revised HEC-RAS model with the LiDAR data available through the PASDA PAMAP Program, which was captured between 2006 and 2008.

### Results:

The updated engineering analyses reflect that the 1% annual chance flood elevation has increased by amounts ranging from 0.7 to 4 feet in some locations along the Susquehanna River. Such significant increases in flood risk need to be communicated to residents and should be assessed to identify mitigation opportunities.



### Depth Grids:

As an additional tool for visualizing flood risk, flood depth grids were developed for 50-, 20-, 10-, 4-, 2-, 1-, 0.2-percent annual chance events. Depth grids depict the depth of flooding for a given event at any location. By allowing users to see flood depths at specific locations (for example a home), for various flood frequencies, depth grids provide a powerful tool for planning mitigation efforts.

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