

Delaware and Susquehanna River Basin Flood Data Assessment

Pennsylvania

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1. SECTION ONE INTRODUCTION

A severe rainfall event occurred in eastern Pennsylvania from June 23 to June 29, 2006, sparking the third significant flooding event in the Delaware and Susquehanna River basins in three years. Numerous flood recovery activities have been initiated by various agencies and organizations in response to these events. In order to avoid duplication of effort and to facilitate the efficient use of the data being prepared, the Department of Homeland Security's Federal Emergency Management Agency (FEMA) Region III tasked URS and Dewberry to compile an inventory of the ongoing activities and to provide recommendations on how this data can be used to update the Flood Insurance Rate Maps for impacted communities.

2. SECTION TWO DELAWARE RIVER BASIN

2.1 FLOODING HISTORY: DELAWARE RIVER

August 1955: Hurricanes Connie and Diane followed the same track up the Delaware Valley a few days apart from each other. This multi-storm event was the long-standing flood of record and the record against which subsequent flooding has been compared.

September 19, 2004: The remnants of Hurricane Ivan caused the most significant flooding on the Delaware River since 1955.

April 4, 2005: An event in excess of the September 2004 event was caused by early spring rainstorms. This event set new flood stage records in the New York portion of the Delaware River Basin. This event has been documented by the U.S. Geological Survey (USGS) in Scientific Investigations Report 2007-5067: Flood of April 2-4, 2005, Delaware River Main Stem from Port Jervis, New York to Cinnaminson, New Jersey, which is available at: <http://pubs.water.usgs.gov/sir2007-5067/>.

June 29, 2006: A third near record event occurred for the third straight year. This event impacted both the Delaware and Susquehanna Basins.

2.2 EFFECTIVE FLOOD INSURANCE STUDY INFORMATION: DELAWARE RIVER

The effective hydrology for all communities in Pennsylvania is derived from the 1984 Delaware River Basin Study, Survey Report. This consisted of a gage analysis that separately weighted hurricane and non-hurricane events. This hydrology was re-examined in the mid 1990s for possible update to include an additional 20 years of gage data. Due to the lack of significant flooding events in those 20 years, it was determined that updating the hydrology was not warranted for the revision of the Flood Insurance Study (FIS) that occurred at that time.

The hydraulic model and floodplain boundaries were updated by the U.S. Army Corps of Engineers (USACE), Philadelphia District, in the mid 1990s from the Philadelphia/Bucks County line to Tocks Island. This included all of the Delaware River in Bucks and Northampton Counties, and part of Monroe County. Four-foot contour interval topographic data was compiled for this study using aerial photogrammetry. The study was stopped at Tocks Island because from there up to the Town of Milford the entire floodplain is contained in the Delaware Water Gap National Recreational Area (DWGNRA).

In 2000, the hydraulic model and floodplain boundaries were updated by the USACE, Philadelphia District, from Milford, PA, to upstream of Matamoras. This study was conducted to reflect the impacts of an ice jam prevention project constructed by the USACE to reduce flooding in Matamoras and Port Jervis, NY. The flood elevations in this area had been increased based on historic record to reflect the risk observed due to ice jams, and, as a result, the previous effective FIS had reflected higher flood elevations than a standard hydraulic model would indicate.

2.3 POST-FLOODING ACTIONS: DELAWARE RIVER

The series of 3 major floods in 3 years (2004, 2005, and 2006) prompted stakeholders to question many factors, including whether the FIS needed to be updated to reflect conditions after these 3 recent events. Numerous activities have been initiated, with the hydraulic studies depicted in Figure 1, including:

- 2.3.1 USGS has updated the hydrology for the Main Stem Delaware River from Trenton to Callicoon. This effort was undertaken in coordination with USACE, FEMA Regions II and III, the Delaware River Basin Commission (DRBC), New Jersey Department of Environmental Protection (NJ DEP), and several FEMA contractors. NJ DEP has provided \$1M in funding to support an updated study of the Delaware River for the non-tidal reach in New Jersey.
- 2.3.2 FEMA Region II is committed to completing this project and providing new digital Flood Insurance Rate Maps (DFIRMs) for the reach.
 - a. This analysis will use the USGS hydrology described in section 2.3.1.
 - b. An investigation was done of the hydraulic wet sections used in the effective FIS for the Delaware River for the Pennsylvania side. This included surveying a sample set of new wet sections and comparing them to effective wet sections. Significant discrepancies were identified. FEMA Region II has tasked Medina Consultants to survey new wet sections for the entire New Jersey Reach of the Delaware River.
- 2.3.3 Region II has committed to making funding available to complete the hydraulic modeling and DFIRMs for the New Jersey portion of the river. The modeling for this reach will likely be completed no earlier than late 2008.
- 2.3.4 The USGS, USACE, and National Weather Service (NWS) have teamed to conduct a basin-wide hydrologic analysis that will allow for the evaluation of existing reservoirs for flood mitigation.
- 2.3.5 The DRBC conducted an investigation as to whether the existence of reservoirs in the basin was a contributing factor to recent flooding events. Historical records indicated that the flooding would have occurred with or without the reservoirs in place and that it would likely have been more severe without the reservoirs. A summary report is available at: http://www.state.nj.us/drbc/Flood_Website/WSResFloodControl-July07flyer.pdf.
- 2.3.6 To respond to the flooding events described above, FEMA Region II initiated a Hazard Mitigation Technical Assistance Program (HMTAP) effort HSFHQ-06-D-0162, Task Order 065 in New York State that includes, among other objectives, new Light Detection and Ranging (LiDAR), hydrology, hydraulics, and flood hazard mapping for the Delaware River in New York. This effort utilizes the hydrology prepared by the USGS as described in item 1, and extends the analysis further upstream and into tributaries. LiDAR acquisition, hydraulics, and flood hazard mapping will include the floodplain of the Delaware River in Pike and Wayne Counties.



Figure 1: Ongoing flood study updates in the Delaware River Basin

2.3.7 FEMA Region III initiated several mitigation efforts in response to the recent flooding. Mitigation efforts impacting the Delaware River Basin are described below:

- a. The USGS, New Cumberland, Pennsylvania office was tasked with conducting an updated stream gage analysis of the gages in northeastern Pennsylvania. The end result of this task is a set of new regression equations for streams in this part of the state.
- b. The USACE, Philadelphia District, was tasked with investigating a discrepancy in the hydraulic model in Lower Mount Bethel Township, Northampton County. The hydraulic model was revised in this area and is being incorporated into the Northampton County DFIRM as a Letter of Map Revision (LOMR).
- c. The USACE also re-ran the hydraulic model for the river using the discharges computed by the USGS in item 1 for the 10- and 50-year flood frequencies.
- d. Dewberry was tasked with overall coordination of the efforts outlined in this document to ensure consistency between products by different organizations in different states and counties. Applicable documentations prepared in this coordination process are included on the CD included with this report.

2.3.8 FEMA Region II tasked Leonard Jackson Associates (LJA) to perform an updated flood study of the Delaware River in the area of Port Jervis, New York. LJA obtained new bathymetric channel surveys for this area as part of this study. LJA did not model ice jams as in the effective study because the USACE ice jam project prevents their occurrence. This analysis is part of the DFIRM for Orange County, NY, which has been issued Preliminary.

2.4 OTHER ONGOING ACTIVITIES: DELAWARE RIVER

Pennsylvania LiDAR Acquisition: the Commonwealth of Pennsylvania has undertaken an effort, spearheaded by the Department of Natural Resources, to obtain topographic LiDAR data for the entire state. The data is being obtained for one third of the state each year, starting in the west. The eastern third of the state is tentatively scheduled to be flown in 2008. This portion of the initiative is currently unfunded, and the timeframe for completion of the eastern third of the state is uncertain. The earliest this data is likely to be available is 2009. This data will provide valuable topographic data as well as a quality base map.

2.5 COUNTY ASSESSMENT: DELAWARE RIVER COUNTIES

2.5.1 Wayne County

Current Status:

There is not an effective countywide FIS for Wayne County. The county includes 29 incorporated communities, with 117 effective panels. The USACE, Philadelphia District, was

previously tasked with the creation of a countywide DFIRM for Wayne County. The new countywide DFIRM will include 132 printed panels, 29 of which are directly impacted by the Delaware River. Additional panels could be impacted by backwater effects, but this cannot be determined until the hydraulic analysis is complete. Wayne County is tentatively scheduled for LiDAR acquisition by the state in 2008. The new study of the New York reach of the Delaware River, which is being conducted as part of HMTAP Task Order (TO 65), will be complete in early 2008.

Options for Updating:

- a. Incorporate new Delaware River analysis into the USACE countywide DFIRM effort and issue preliminary in late 2008.
- b. Wait for Pennsylvania LiDAR acquisition to redelineate all effective detailed study streams and develop refined Zone A floodplains countywide. This would likely result in a preliminary issuance in late 2009 or 2010. The benefits of the improved data need to be balanced against the uncertain impacts to schedule.

Recommendations:

Option a. provides a significant improvement to the county's FIRM with minimal delay and cost. In light of the investment already made with the USACE and by FEMA Region II, updating Wayne County should be high priority. If the LiDAR being obtained by Pennsylvania becomes available by the time that preliminary processing is started, the incorporation of the LiDAR should be reconsidered.

2.5.2 Pike County***Current Status:***

This is an effective countywide DFIRM of 71 panels, 34 of which are impacted by the Delaware River. Additional panels could be impacted by backwater effects, but this cannot be determined until the hydraulic analysis is complete. Pike County is tentatively scheduled for LiDAR acquisition by the state in 2008.

Options for Updating:

- a. Update Pike County immediately to reflect the new analysis prepared by LJA for Port Jervis. This would require converting the LJA study, which was prepared in North American Vertical Datum (NAVD) 88, to National Geodetic Vertical Datum (NGVD) 29 to maintain consistency with the rest of the county.
- b. Incorporate new modeling from HMTAP TO 65 and the New Jersey flood study into the effective DFIRM for Pike County. This would likely result in a preliminary issuance in 2009. As the new studies are being prepared in NAVD 88, this would require converting the rest of the county to NAVD 88.

- c. Wait for 2008 LiDAR to redelineate all effective detailed study streams and develop refined Zone A floodplains countywide. This would likely result in a preliminary issuance in 2009 or early 2010. Although the effective DFIRM for Pike County is relatively recent, it did not include new topographic data for flooding sources other than the Delaware River. Waiting for the new LiDAR is not likely to cause a significant delay beyond waiting for the new flood hazard analysis.

Recommendations:

Option c. is the recommended approach. It avoids the backward datum conversion of the Delaware River that Option a. entails and will likely not cause a significant delay compared to Option c. Given that Pike County is already a countywide DFIRM with relatively new engineering analyses for the Delaware River in the most heavily populated reach, this update is not high priority and can be completed in Phase 2 of Map Mod when data and funding become available.

2.5.3 Monroe County***Current Status:***

There is not an effective countywide FIS for Monroe County. The county includes 20 communities, with 120 effective panels. The USACE, Philadelphia District, was previously tasked with the creation of a countywide DFIRM for Monroe. The hydrology and hydraulics for this project are complete and are awaiting review. The new countywide DFIRM will include 139 printed panels, 7 of which are directly impacted by the Delaware River. Additional panels could be impacted by backwater effects, but this cannot be determined until the hydraulic analysis is complete. Monroe County is tentatively scheduled for LiDAR acquisition by the state in 2008. The effective FIS is in NGVD 29 while the LiDAR and the new study of the Delaware River will be in NAVD 88; therefore, a datum conversion will be required.

Options for Updating:

- a. Process the draft FIRM and DFIRM prepared by USACE at the earliest opportunity.
- b. Wait for the Pennsylvania LiDAR acquisition to redelineate all effective detailed study streams and develop refined Zone A floodplains countywide.

Recommendations:

Option a. is the logical choice given the investment that FEMA has already made into this county and the uncertain schedule of the Pennsylvania LiDAR.

2.5.4 Northampton County

Current Status:

This is an effective countywide DFIRM of 92 panels, 22 of which are impacted by the Delaware River. Additional panels could be impacted by backwater effects, but this cannot be determined until the hydraulic analysis is complete. Several panels are currently impacted by a LOMR for Lower Mount Bethel. Northampton County is tentatively scheduled for LiDAR acquisition by the state in 2008. The effective FIS is in NGVD 29 while the new study of the Delaware River will be in NAVD 88; therefore, a datum conversion will be required.

Options for Updating:

- a. Update the DFIRM for Northampton County to incorporate the new study of the Delaware River when it becomes available.
- b. Update the DFIRM for Northampton County to incorporate the new study of the Delaware River and use the Pennsylvania LiDAR to redelineate all effective detailed study streams and develop refined Zone A floodplains countywide.

Recommendations:

Option b. provides the most efficient improvement of the county's maps by incorporating all new data at one time. Given that Northampton County is already a countywide DFIRM with relatively new engineering analyses for the Lehigh River in the most heavily populated portion of the county, this update is not high priority and can be completed in Phase 2 of Map Mod when data and funding become available.

2.5.5 Bucks County

Current Status:

This is an effective countywide DFIRM, which is currently being updated by AMEC to incorporate topographic data provided by the Delaware Valley Regional Planning Commission. This update will also include a detailed study of Pennypack Creek that was conducted by Temple University. This study is anticipated to be issued preliminary in December 2008.

Thirty-eight of the 189 effective panels are impacted by the Delaware River. Additional panels could be impacted by backwater effects, but this cannot be determined until the hydraulic analysis is complete. Bucks County is tentatively scheduled for LiDAR acquisition by the state in 2008.

The floodway in Tincum Township was determined based on a 2-D analysis as a result of an extended appeals process and lawsuit by the township the last time that the FIRM was updated. Regardless of the update method chosen, any revisions to the Delaware River in Tincum Township will require extra coordination with the community. It is recommended that the floodway in Tincum NOT be revised based on a 1-D model unless the model can replicate the effective floodway.

Options for Updating:

- a. Issue the countywide update currently underway as planned, with a preliminary issuance in December 2008 and an effective date approximately one year later. Incorporate the revised study of the Delaware River by Medina as a Physical Map Revision when the data becomes available.
- b. Same as option a., but update 10- and 50-year profiles on the Delaware River to reflect the model that was re-run by USACE.
- c. Place the AMEC revision on hold to await the new study by Medina and incorporate all of this information into a new countywide study.
- d. Issue the countywide update currently underway as planned, with a preliminary issuance in December 2008 and an effective date approximately one year later. Incorporate the revised study of the Delaware River by Medina and redelineate Zone AE floodplains with new LiDAR topography when the data becomes available, resulting in a new countywide study.

Recommendations:

Option b. provides the best course for improving the county's flood maps in a timely manner. In this way all of the data that is currently available can be incorporated as early as possible and new information can be incorporated as it becomes available. Due to the number of flood hazard analysis activities going on in the county on a continuing basis, waiting for every work in progress to be complete would result in indefinite delays in providing better data to the county.

3. SECTION THREE SUSQUEHANNA RIVER BASIN**3.1 FLOODING HISTORY: SUSQUEHANNA RIVER**

June 1972: Tropical Storm Agnes was the flood of record for most of the Susquehanna River, causing massive flooding throughout the region and prompting the construction of multiple flood protection projects. 345,000 cubic feet per second (cfs) at Wilkes-Barre.

September 1975: 228,000 cfs at Wilkes-Barre.

January 1996: 221,000 cfs at Wilkes-Barre.

September 2004: 227,000 cfs at Wilkes-Barre – added urgency to levee raising project. Sparked additional concerns about impact of levee raising to downstream communities and resulted in funding for mitigation efforts and Flood Warning System from Wilkes-Barre down to Sunbury.

June 2006: 218,000 cfs at Wilkes-Barre. Severity in New York State prompted HMTAP TO 65.

3.2 EFFECTIVE FLOOD INSURANCE STUDY INFORMATION: SUSQUEHANNA RIVER

The effective FIS for the Susquehanna River is derived from Susquehanna River Basin Study, Appendix D - Hydrology, Susquehanna River Basin Study Coordinating Committee, Harrisburg, PA June 1970. A copy of this report was not available for inclusion in this document, and it is not available digitally.

3.3 POST-FLOODING ACTIONS: SUSQUEHANNA RIVER

- 3.3.1 FEMA Region III initiated several mitigation efforts in response to the recent flooding. Several of these impact the Susquehanna River Basin, as depicted graphically in Figure 2.
- a. The USGS, New Cumberland, Pennsylvania office was tasked with conducting an updated stream gage analysis of the gages in northeastern Pennsylvania. The end result of this task is a set of new regression equations for streams in this part of the state. The draft of this analysis was submitted to FEMA for review in April 2007. A revised version was completed in February 2008, and is currently under review at USGS headquarters.
 - b. GG3, a mapping contractor for Region III, was tasked with compiling and evaluating flood risk information for Bradford, Lackawanna, Luzerne, Sullivan, Susquehanna, and Wyoming Counties in the Susquehanna Basin. This effort is currently underway.
 - c. GG3 was tasked with preparing countywide DFIRMs for Luzerne and Lackawanna Counties. Luzerne was placed on a fast track for LiDAR acquisition by the state to facilitate this effort. The study of the Susquehanna River prepared by the USACE as part of the Flood Warning and Response System is being incorporated into this effort.

- d. GG3 was tasked to collect LiDAR for Lackawanna County. This effort is complete.
- e. Under HMTAP TO 34, URS/Dewberry was tasked with a flood hazard analysis of the Susquehanna River in Susquehanna County, Pennsylvania, to complete a 15 mile gap in the New York State HMTAP TO 65.

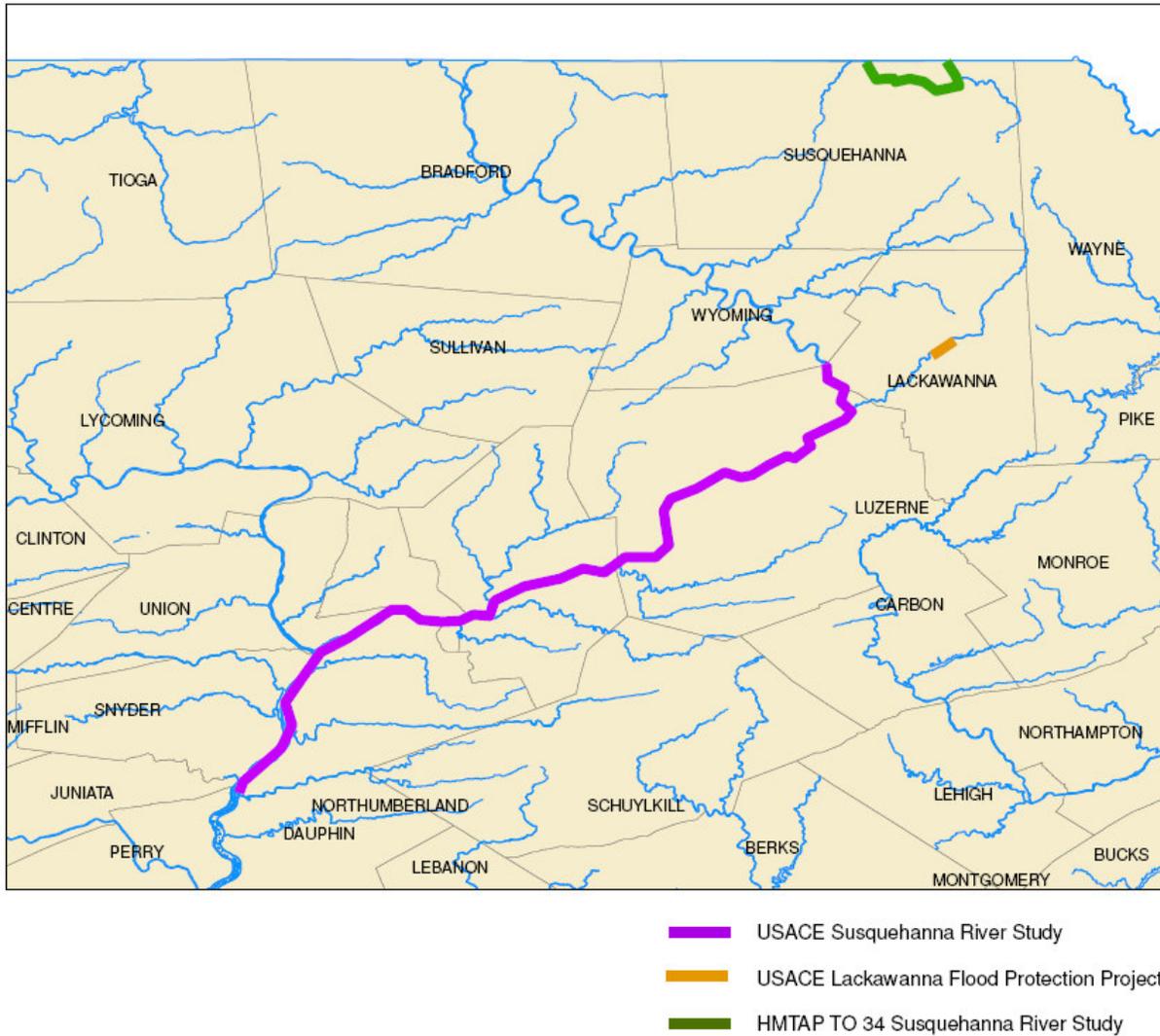


Figure 2: Ongoing flood study updates in the Susquehanna Basin

- f. Dewberry was tasked with overall coordination of the efforts outlined in this document to ensure consistency between products by different organizations in different states and counties. The documentation prepared in this coordination process is included in the appropriate appendix for each effort.

3.3.2 FEMA Region II initiated a HMTAP effort in New York State that includes, among other objectives, new LiDAR acquisition, hydrology and hydraulic analyses, and flood hazard mapping for the Susquehanna River in New York. Updated hydrology for the Susquehanna in New York has been completed. The hydraulic analyses are

underway. This effort will blend seamlessly with HMTAP TO 34 as described in 3.3.1.d.

3.4 OTHER ONGOING ACTIVITIES: SUSQUEHANNA RIVER

The USACE completed a detailed study of over 100 miles of the Susquehanna River from Sunbury to the upstream limit of Luzerne County, as part of the Wyoming Valley Levee Raising Project. The impacted counties are in various stages of countywide updates to include this new analysis.

3.5 COUNTY ASSESSMENT: SUSQUEHANNA RIVER COUNTIES

3.5.1 Susquehanna County

Current Status:

There is not an effective countywide FIS for Susquehanna County. The County consists of 38 incorporated communities on 150 effective panels. A complete countywide DFIRM would include 107 printed panels, 11 of which will be impacted by the new study of the Susquehanna River. Additional panels could potentially be impacted by backwater from the Susquehanna. All effective FISs are in NGVD 29; therefore, a datum conversion to NAVD 88 will be required.

- a. The entire reach of the Susquehanna River in Susquehanna County is being studied as part of HMTAP TO 34. This effort entails new LiDAR, structure and wet section surveys, hydrologic and hydraulic analyses. The study will match seamlessly with the corresponding analysis being conducted in New York under HMTAP TO 65. It is anticipated that this analysis will be completed early in 2008.
- b. The flood risk data compiled by GG3 will be a valuable component in determining the scope of Map Mod efforts for Susquehanna County.
- c. GG3 was tasked with compiling a countywide FIS text, including profiles and floodway data tables as well as pertinent base map information.

Options for Updating:

- a. Wait for Pennsylvania LiDAR acquisition to redelineate all effective detailed study streams and develop refined Zone A floodplains countywide. Incorporate the new analysis for the Susquehanna River. This would likely result in a preliminary issuance in 2010. The benefits of the improved data need to be balanced against the uncertain impacts to schedule.
- b. Update the entire county when the data for the Susquehanna River becomes available, conducting a digital conversion for the portions of the county that are not being restudied. This would result in a likely preliminary issuance in 2009.
- c. Update only the communities impacted by the Susquehanna restudy when the study is completed. This would result in likely preliminary issuances in 2009.

Recommendations:

Option b. provides the most efficient method for updating Susquehanna County unless the Pennsylvania LiDAR becomes available before the effort is initiated. Converting to a countywide format will decrease the effort involved for any subsequent revisions.

3.5.2 Bradford County***Current Status:***

There is not an effective countywide FIS for Bradford County. All effective FISs are in NGVD 29; therefore, a datum conversion to NAVD 88 will be required.

- a. HMTAP TO 65 will impact Bradford only at the state boundary.
- b. The flood risk data compiled by GG3 will be a valuable component in determining the scope of Map Mod efforts for Bradford County.
- c. The new LiDAR data proposed by the state will provide an excellent opportunity to improve the accuracy of the flood maps for the county; however, the timeframe for this data to become available is uncertain.
- d. GG3 was tasked with compiling a countywide FIS text, including profiles and floodway data tables as well as pertinent base map information.

Options for Updating:

Wait for Pennsylvania LiDAR acquisition to redelineate all effective detailed study streams and develop refined Zone A floodplains countywide. This would likely result in a preliminary issuance in 2010.

- a. Update Bradford County now with a digital conversion.
- b. When the Pennsylvania LiDAR becomes available, conduct a new engineering analysis of the Susquehanna to form a continuous model with the reaches studied in the Wyoming Valley and New York. This option is considerably more expensive and time consuming than the other options presented.

Recommendations:

Option a. is the logical course of action as a digital conversion will add minimal value to the county's flood maps and the effort would be largely wasted if LiDAR data becomes available shortly after completing the digital conversion. Option C would be preferred if funding could be procured.

3.5.3 Sullivan County

Current Status:

There is not an effective countywide FIS for Sullivan County. All effective FISs are in NGVD 29; therefore, a datum conversion to NAVD 88 will be required.

- a. The flood risk data compiled by GG3 will be a valuable component in determining the scope of Map Mod efforts for Sullivan County.
- b. The new LiDAR data proposed by the state will provide an excellent opportunity to improve the accuracy of the flood maps for the county; however, the timeframe for this data to become available is uncertain.
- c. GG3 was tasked with compiling a countywide FIS text, including profiles and floodway data tables as well as pertinent base map information.

Options for Updating:

- a. Wait for Pennsylvania LiDAR acquisition to redelineate all effective detailed study streams and develop refined Zone A floodplains countywide. This would likely result in a preliminary issuance in 2010.
- b. Update Sullivan County now with a digital conversion.
- c. When the Pennsylvania LiDAR becomes available, conduct a new engineering analysis of the Susquehanna to form a continuous model with the reaches studied in the Wyoming Valley and New York. This option is considerably more expensive and time consuming than the other options presented.

Recommendations:

Option a. is the logical course of action as a digital conversion will add minimal value to the county's flood maps and the effort would be largely wasted if LiDAR data becomes available shortly after completing the digital conversion. Option c. would be preferred if funding could be procured.

3.5.4 Wyoming County

Current Status:

There is not an effective countywide FIS for Wyoming County. All effective FISs are in NGVD 29; therefore, a datum conversion to NAVD 88 will be required.

- a. The flood risk data compiled by GG3 will be a valuable component in determining the scope of Map Mod efforts for Wyoming County.
- b. The new LiDAR data proposed by the state will provide an excellent opportunity to improve the accuracy of the flood maps for the county; however, the timeframe for this data to become available is uncertain.
- c. GG3 was tasked with compiling a countywide FIS text, including profiles and floodway data tables as well as pertinent base map information.

Options for Updating:

- a. Wait for Pennsylvania LiDAR acquisition to redelineate all effective detailed study streams and develop refined Zone A floodplains countywide. This would likely result in a preliminary issuance in 2010.
- b. Update Wyoming County earlier with a digital conversion.
- c. When the Pennsylvania LiDAR becomes available, conduct a new engineering analysis of the Susquehanna to form a continuous model with the reaches studied in the Wyoming Valley and New York. This option is considerably more expensive and time consuming than the other options presented.

Recommendations:

Option a. is the logical course of action as a digital conversion will add minimal value to the county's flood maps and the effort would be largely wasted if LiDAR data becomes available shortly after completing the digital conversion. Option c. would be preferred if funding could be procured.

3.5.5 Lackawanna County***Current Status:***

There is not an effective countywide FIS for Lackawanna County. All effective FISs are in NGVD 29; therefore, a datum conversion to NAVD 88 will be required.

- a. The scope of the countywide DFIRM update has been prepared by GG3. GG3 is currently tasked with updating Lackawanna County.
- b. The Lackawanna River Flood Protection Project was constructed by the USACE to protect portions of the Borough of Olyphant and City of Dickson. This project, which includes levee reconstruction and a floodwall with 100-year protection, is not reflected on the effective FIRM.
- c. Segments of a flood control project have been completed in Scranton, the remaining sections of the project are underway.
- d. GG3 has acquired LiDAR for Lackawanna County.

Recommendations:

Proceed with the GG3 countywide update. Reflect the flood protection project utilizing appropriate data from the USACE.

3.5.6 Luzerne County***Current Status:***

The scope of work for Map Mod in Luzerne County has already been evaluated and established. GG3 is updating the county to incorporate the analysis of the Susquehanna River that was conducted by USACE as part of the Wyoming Valley Levee Raising Project and associated flood warning system. Several streams within the county will be studied in detail as determined in coordination with the County Floodplain Manager.

Pennsylvania placed the LiDAR acquisition for Luzerne County on an expedited schedule to dovetail with this project. The LiDAR has been developed. No additional scope change is recommended.

4. SECTION FOUR REFERENCES**References provided on CD**

Delaware River Basin Commission, Project Proposal: Delaware River Basin Flood Analysis Model, May 2007.

Stuck, Marla H., and Roland, Mark A., US Geological Survey, New Cumberland Office, Preliminary Peak-Flow Regression Equations for Pennsylvania Streams, 2007.

URS, New York Flood Hazard Data Collection Analysis, FEMA-1650-DR-NY, Draft Hydrology Report, September 2007.

URS/Dewberry, Pennsylvania Flood Hazard Data Collection, FEMA-1649-DR-PA, Draft Hydrology Report Susquehanna River Basin, Susquehanna County, October 2007.

US Army Corps of Engineers, Philadelphia District, Delaware River Basin Study Report, Technical Appendix C: Hydrology and Hydraulics, 1984.

US Geological Survey, Trenton Office, updated hydrology for Delaware River (2 spreadsheets), April 2007.

US Geological Survey, Trenton Office, High Water Marks - Delaware River, April 2005.

US Geological Survey, Trenton Office, High Water Marks - Delaware River, June 2006.