RECENT FLOOD STUDIES IN THE MOHAWK WATERSHED

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The Flood Insurance Study (FIS) and the Hazard Mitigation Technical Assistance Program (HMTAP) are the two Federal Emergency Management Agency (FEMA) managed programs that develop hydrology, hydraulic and flood hazard area determination studies in the Nation. In New York State they are carried out with co-sponsorship and in coordination with the State Floodplain Mapping Program, managed by the Department of Environmental Conservation (DEC). Although their primary purposes are flood insurance rate determination, floodplain management and emergency response planning, the studies provide valuable information for other purposes, hydrologic and otherwise. These include the H&H studies themselves, updates to the studied area topographic and hydrographic data, and the field collection of stream channel and near bank environment information. This abstract provides details about the existing and on-going HMTAP and FIS projects in the Mohawk Watershed, databases available and data distribution mechanism. It ends by pointing out some of the gaps in the studies, databases and data distribution mechanism, with some ideas on further work necessary to complete our knowledge and management capabilities of the landscape from a water resources point of view.

Terrain elevation data

In coordination between the FEMA and DEC floodplan mapping programs, several surface elevation data collection have been carried out in the watershed:

- Schoharie1998 and Greene1998: bare ground LiDAR was collected along the Schoharie Creek main stem and its main tributaries.
- FEMA DR1650 Mohawk2007: a 2-mile wide corridor centered on the Mohawk River with a few additions of LiDAR multiple return data were collected, and the point cloud was classified for bare ground. LAS format.
- CD2008 and Oneida2008: Area-wide multiple return LiDAR was collected in Albany, Schenectady and Oneida counties. As an example of the data characteristics some details about this data collection follow.

CD2008 collection

- In the spring of 2008, The Sanborn Map Company, Inc. acquired 451 square miles of terrestrial LiDAR data in Capital District, NY. An Optech ALTM 2050 Airborne LiDAR sensor was used for the collection. The LiDAR data associated with this metadata file is in LAS binary format, version 1.1.
- Accuracy: The data meets the FEMA specifications for a normal distribution and the overall RMSE of 0.097 meters (9.7 cm Table 3) is less than the National Standard for Spatial Data Accuracy (NSSDA) figure of 18.5 cm for 2 foot contour mapping. Individually, all of the ground cover categories also meet this standard. [As] expected the brush, high grass, and forested cover types have higher RMSE values as the vegetation removal algorithm used by the LiDAR vendor is not 100% efficient at removing points in which the vegetation intercepts the laser...

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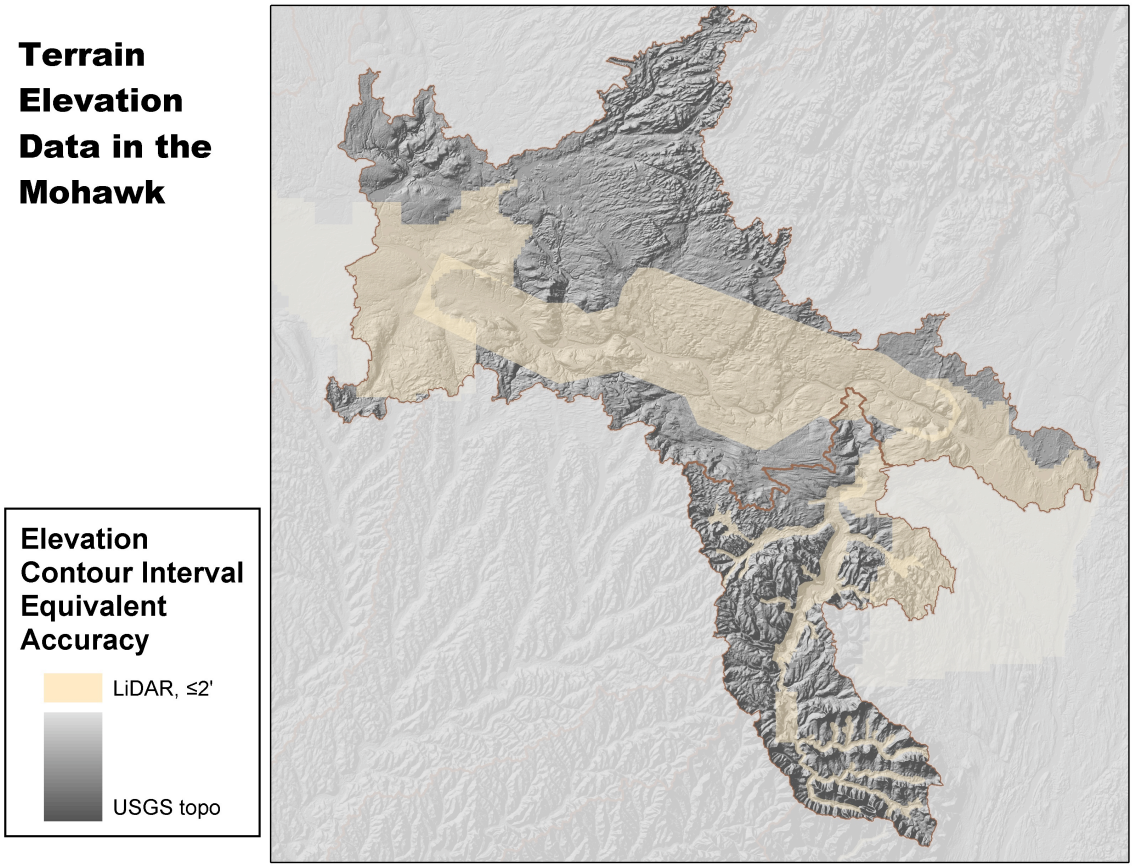

Figure 1 Terrain elevation data in the Mohwak Watershed.

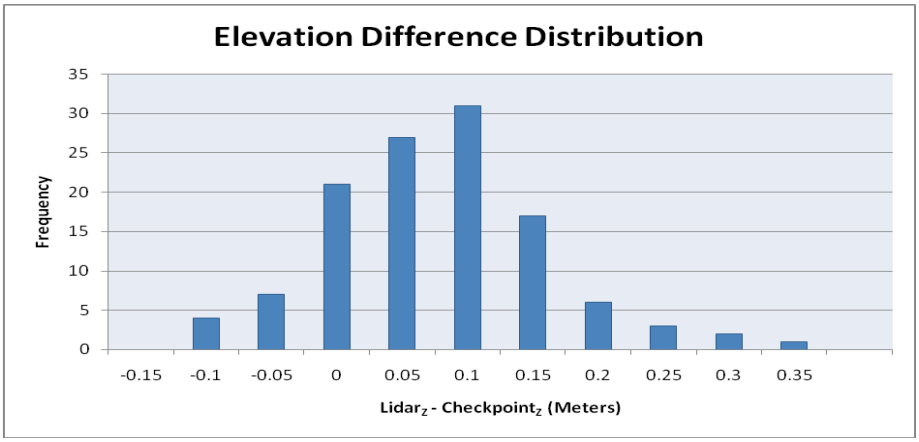

Figure 2 Capital District LiDAR collection area: Frequency Histogram for checkpoints, all cover types.

Table 1 Summary of Error Residual Statistics for All the Checkpoints

Cover Type	RMSE (m)	Average Elevation Difference (m)	Standard Deviation (m)	Maximum Elevation Difference Value (m)	Minimum Elevation Difference Value (m)	Number of Checkpoints Used in Analysis
All 5 Cover Types	0.09735	0.05198	0.08264	0.30759	-0.12283	123

Point Density: ~ 2.7 points/m2 and ~ 0.6 ground points/m2, i.e. an average ground point spacing of ~1.3 m.

Bare Ground Classification assessment: …many occurrences of bridges and overpasses left in the ground classification. There were also… holes in the ground averaging around 7m in depth…. There were some spots where at least one building point was classified as ground.

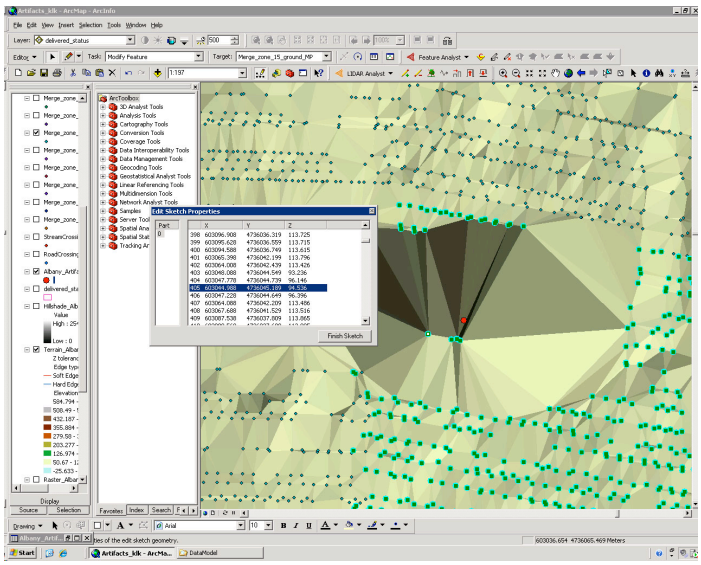

Figure 3 Example of a "Divot" artifact. The elevation of the points in the depression area are about 10m lower than the surrounding points.

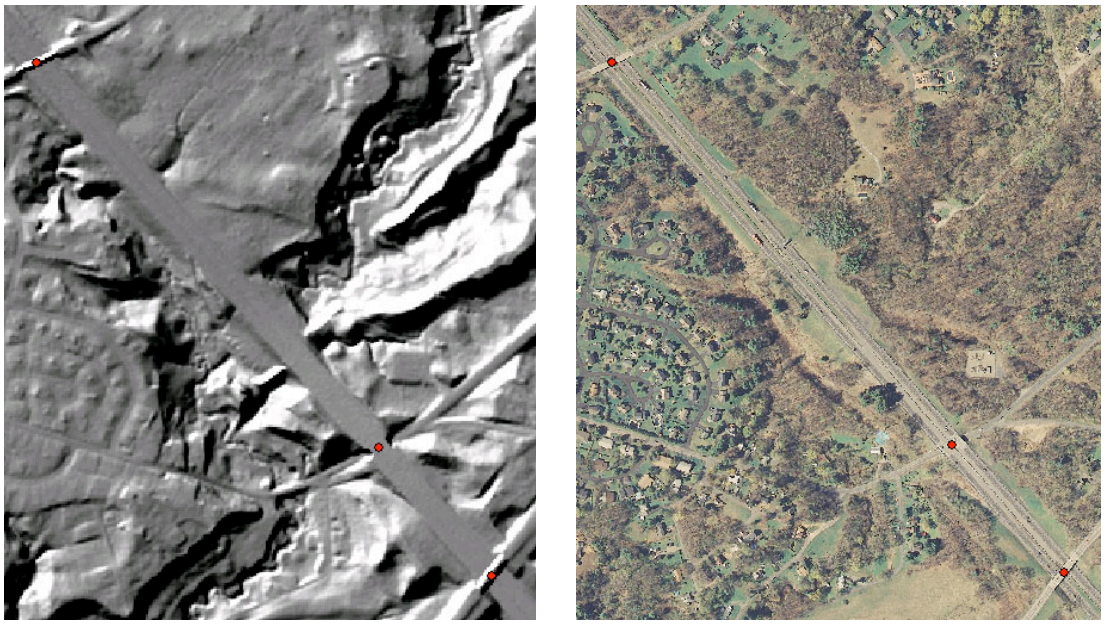

Figure 4 shows an example of elevated highways (overpasses) that were classified as ground.

Mohawk Watershed H&H Studies

Hydrologic and Hydraulic studies sponsored by FEMA and the NYS Floodplain Mapping Program seek to determine areas exposed to flood hazards in flood events of a set recurrence interval, the 100-year recurrence interval (1% yearly probability) flood being the most common. To arrive at these results the study uses stream flow determinations, terrain topography information and hydraulic models to arrive at the expected water surface elevation for such floods, using again the topography information to map the areas exposed to the flood hazard. To manage the available budget different stream segments are studied to different levels of detail: stream reaches along which the flood hazard level is higher get a more detailed study. Many stream reaches were studied in the 1970's and 80's, using mostly approximate methods (run off curve and USGS topo maps) or the HEC1 model. In the late 90's and this decade some of the previously studied stream segments have been re-studied, and a few never studied streams have received and approximate or detailed study. The level of detail in these more recent studies can be gleaned from the State Flood Mapping Program Planning Category Definitions memo, 12/15/05:

- Detailed (D)- …The level of effort includes orthophoto, LIDAR and stream breakline collection, survey of the channel and hydraulic obstructions (use of as-builts and DOT hydraulic studies, where appropriate and available), nomination of flowrates, and the development of HEC-RAS hydraulic models. Final maps will show the extent of the SFHAs, BFEs and floodways.
- Approximate (A)- …the anticipated level of development does not warrant the collection of field survey… The level of effort includes orthophoto, use of best available topography at the time of the scoping which may include LIDAR and stream breakline collection where available, use of as-builts and DOT studies (where appropriate and available), nomination of flowrates, and the development of HECRAS hydraulic models…

The following table and figure provides and overview of the studies carried out, or in the process of being finished, in the watershed.

Table 2 Recent and On-Going Detailed H&H Studies of the Mohawk River and Major Tribs

Flood Source	Study length (mi)	Downstream study limit	Upstream study limit
Mohawk main stem (Det., FW)	70.0	Montgomery/Schenectady County Border	Western border, City of Utica
Schoharie Creek	n/a	Several segments. Further downstream is Schoharie County border	4 mi S of Rt 30, S border of Middleburgh (T)
W Canada Creek (Det., FW)	2.4	Confluence w/Mohawk	County Hwy. 94 Bridge, Herkimer (T)
E Canada Creek (Det., FW)	9	Confluence w/Mohawk	Northern border, Dolgeville (V)
Fulmer Creek		Confluence w/Mohawk	Southern border, Mohawk (V)
Moyer Creek		Confluence w/Mohawk	Southern border, Frankfort (V)
Steele Creek		Confluence w/Mohawk	Southern border, Ilion (V)

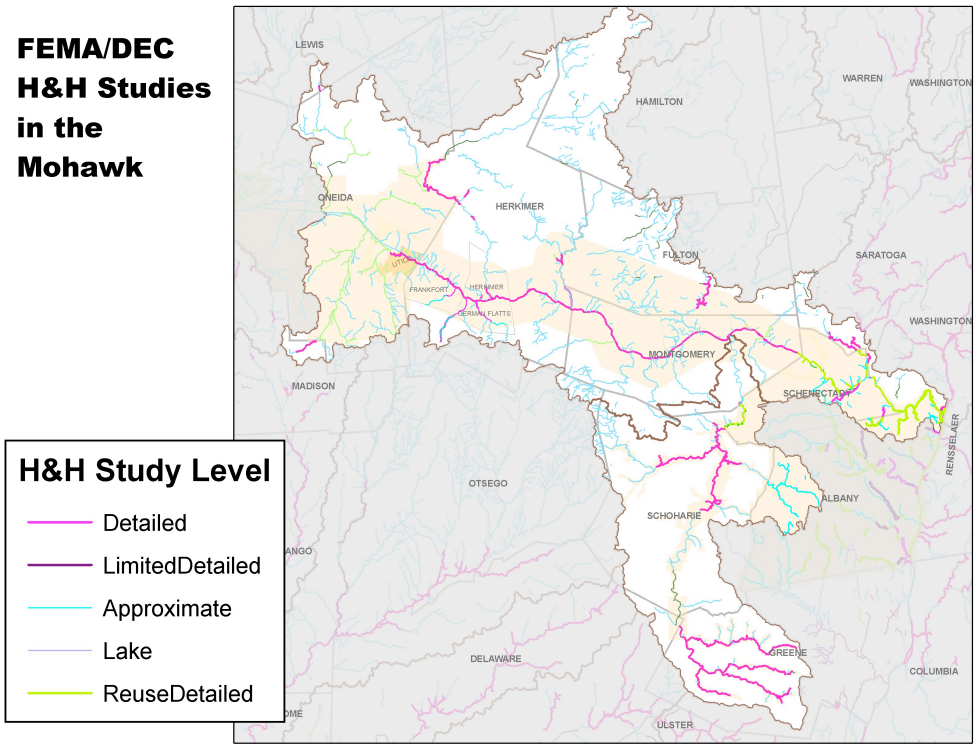

Figure 5 Recent and On-Going Detailed H&H Studies of the Mohawk River and Major Tribs

As an example of H&H study characteristics some details about the Mohawk River study follow.

Mohawk River HMTAP study

Detailed Data Collection: The contractor shall collect necessary data to perform the hydrologic and hydraulic analyses.

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- Historical flood information, including high water mark reports published by the USGS and data collected or maintained by local communities;
- High Water Marks collected by FEMA and USGS from the June/July 2006 flooding event;
- Historic weather data for hydrologic modeling;
- New stream rating curves (as necessary);
- Previous hydrologic and hydraulic information including Flood Insurance Studies;
- Dam operation records;
- Dam damage assessments performed under FEMA as part of the DR NY 1650 response;
- Design plans and/or survey data for any existing structures (i.e. bridges, culverts, dams, levees) along the waterway or affecting flows;
- Stream cross section information based on surveyed information;
- Vertical datum conversion factors;
- Base Map Information (GIS data, aerial imagery) from Federal, State, and/or local sources; and
- Land use / Mannings "n" data.

Hydrologic Analyses: For the targeted watershed, the contractor shall develop revised discharges for the 10%, 2%, 1%, and 0.2% annual chance events and summarize them in a Summary of Discharges table. The contractor shall utilize available gage data after consultation with the USGS. The contractor shall perform all hydrologic analyses in accordance with Appendix C: Guidance for Riverine Flooding Analyses of FEMA's *Guidelines and Specifications for Flood Hazard Mapping Partners*.

Hydraulic Analyses: For all but the Mohawk River, along the identified stream reaches, the contractor shall develop a revised HEC-RAS hydraulic model, Floodway Data Tables (where applicable) and flood profiles for the 10%, 2%, 1%, 0.2% annual chance events. The Mohawk-Erie Canal is to be analyzed using MIKE 11, which can include some two dimensional (2-D) aspects in a 'loop network' without the detail of a true 2-D model. This one dimensional-plus (1D+) model would allow for the river/canal exchange of flow and incorporate some of the split flow occurring in the areas of islands without the extensive effort for calibration, verification, and general modeling required of a 2-D model.

Where applicable, the newly delineated floodplain and floodway boundaries must tie in to existing floodplain and floodway boundaries to within 0.5 feet vertically and smooth transition horizontally. Newly delineated flood profiles must tie in to existing flood profiles within 0.5 feet.

Major flood protection systems exist along the Mohawk River in Montgomery County and in the Village of Herkimer in Herkimer County. The contractor shall perform detailed surveys of the toe and top of all levees, dikes and dams comprising these systems so that a preliminary determination regarding the viability of the systems can be made. The flood recovery mapping produced for these areas shall reflect the results of this preliminary determination.

Study Deliverables:

1. Hydrologic input and output for the 10%, 2%, 1%, and 0.2% annual chance events.
2. Hydraulic input and output for HEC-RAS modeling, including the flood profiles for the 10%, 2%, 1%, and 0.2% annual chance events. Profile sheets and floodway data tables for the studied reaches will be submitted. The data shall be in hard copy and electronic format. In addition, the submitted data will include:
   a. A geo-referenced stream channel network;
   b. A geo-referenced line data set showing the locations of cross sections used for the computation of water surface profiles;
   c. A geo-referenced line data set showing preliminary floodway, 1%, and 0.2% floodplain boundaries, where calculated;
   d. All geospatial data sets utilized for parameter calculation in final format

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(e.g. a spatial file of n-value polygons); and

e. Database tables summarizing key data.

3. A narrative description of the methodologies used to develop the hydrology and hydraulic information. This information will be provided in Technical Support Data Notebook (TSDN) format.
4. For the communities identified in Section IV, GIS-based workmaps showing the 1% and 0.2% floodplain boundaries and the floodway, cross-section locations, and base flood elevations, provided in digital and hard copy format.

Data Distribution

When the HMTAP/FIS projects have been completed, passed review and legally delivered to the affected communities, all data developed for these studies can be requested from FEMA via its *Map Service Center* web page at msc.fema.gov. It can also be requested by contacting NYSDEC Floodplain Management group, www.dec.ny.gov/lands/24267.html. Although the mechanisms for serving the data are improving and web page usability is being continuously improved, there are not publicly available web pages with a detailed listing of study components available for a particular stream segment and the tools to specify unambiguously the desired data request. This situation will have to await until the hydrologic and natural resource management community adopts an integrated water resources data model. The groundwork for this developments has already being laid through the work of David Maidment and his collaborators at the University of Texas Center for Research in Water Resources: the ArcHydro data model and the Flood Study Geodatabase data model. NYSDEC has collaborated with this with the development of a Terrain Elevation data model integrate to FSG. At this point there is no funding available for the implementation and deployment of the data models, hence the FEMA web page or direct contact with their or DEC's offices is the most reliable way to obtain the data.

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