Issue 69: Standards for 3D Triangular Irregular Networks (TINs) and Elevation/Depth Grids

Background

The North Carolina Floodplain Mapping Program (NCFMP) has completed the initial preliminary statewide Digital Flood Insurance Rate Map (DFIRM) mapping and has started the map maintenance effort to maintain the high quality products for North Carolina flood studies. The NCFMP has contracted the production of map maintenance restudies to their Engineering and Mapping Contractors (EMCs) and the quality review of these flood studies to their third-party QA/QC Contractor. The NCFMP is currently developing and implementing a robust natural hazard risk management program to align with FEMA's Risk Mapping, Assessment, and Planning (Risk MAP) plan, called Integrated Hazard Risk Management (IHRM). This program includes enhancements to hazard risk identification, assessment, communication, and mitigation for multiple types of natural hazards, including flooding. As part of the flood risk identification program, new robust flood data models will provide more detailed flood risk information to stakeholders. There are several new products to be developed as part of the flood study production process to support the IHRM goal of enhanced flood risk identification. Countywide Three-Dimensional Triangular Irregular Networks (3D TINs) and elevation/depth grids are new IHRM products that were added to the deliverables to be created by the EMCs for map maintenance restudies. In an effort to maintain consistency between all EMCs, NCFMP is establishing guidelines for production, delivery, and management of 3D TINs and elevation/depth grids for subsequent flood hazard mapping updates.

Before production of 3D TINs and elevation/depth grids started, the EMCs were requested to submit a 'demonstration' package of 3D TINs and elevation/depth grids to the NCFMP. Following the submittals, a pre-production meeting took place on June 24, 2009 between NCFMP, Dewberry (NCFMP QA/QC Contractor), and members of IHRM project team to discuss the issues and submittals. As an outcome of the meeting, this issue paper sets specific guidelines and requirements for production, delivery, and management of 3D TINs and elevation/depth grids.

Issue

The 3D TINs and elevation/depth grids are being created for use in the IHRM enhanced database for visualization and communication of flood hazard risks to stakeholders. Since multiple EMCs are involved in the production of the 3D TINs and elevation/depth grids, guidelines and requirements are necessary to maintain consistency of products. Several issues were discussed regarding the production and management of datasets.

Discussion

During the June 24, 2009 pre-production meeting, several items were discussed regarding the deliverables, data management, standards for data production, and the independent QA/QC of the deliverables. Also discussed were means of communication of flood hazard risk to stakeholders. John Dorman requested that the grids be formatted such that varying flood frequency and risk can be color coded from the stream centerline outward. Ken Ashe brought forward the need for using the multi-frequency depth Grids to communicate the percent (%) chance of a structure flooding during the course of a typical 30-year mortgage.

Recommendations

The following standards are required by the NCFMP for production of 3D TINs and elevation/depth grids for map maintenance restudies under the NCFMP IHRM program:

Deliverables

- Elevation Grids – 10 ft x10 ft cell size countywide elevation grids, generated from 10 foot Digital Elevation Models (DEM) must be provided for all eight (8) flood events (i.e., 10%, 4%, 2%, 1%, and 0.2% annual chance and 10%, 20%, and 35% future conditions). Each grid will contain water-surface elevations for corresponding recurrence interval flood events for all streams in the county. The elevation grids will contain the backwater areas for mapped and unmapped tributaries. For all of the elevation grids, the stream centerline will be within the grid. For the 10%, 4%, and 2% elevation grids, the grids will be contained within the 1% annual chance floodplain. The elevation grid for 1% annual chance flood event will have a shape similar to 1% annual chance floodplain. The elevation grids for the 10%, 20%, and 35% impervious area future conditions and 0.2% annual chance event will exceed the 1% annual chance floodplain. The 0.2% annual chance event elevation grid will have a shape similar to 0.2% annual chance floodplain.
- Depth Grids – 10 ft x 10 ft cell size countywide depth grids, generated from 10x10 foot DEMs, and must be provided for all eight (8) flood events (i.e., 10%, 4%, 2%, 1%, and 0.2% annual chance and 10%, 20%, and 35% impervious area future conditions). The grids will contain depth (positive values) of the water for corresponding recurrence interval flood events for all streams within the county. The depth grids will contain the backwater areas for mapped and unmapped tributaries. For all the depth grids, the stream centerline will be within the grid. For the 10%, 4%, and 2% depth grids, the grids will be contained within the 1% annual chance floodplain. The depth grid for the 1% annual chance event will have a shape similar to 1% annual chance floodplain. The depth grids for 10%, 20%, and 35% impervious area future conditions and 0.2% annual chance event will exceed the 1% annual chance floodplain. The 0.2% annual chance

event depth grid will have a shape similar to 0.2% annual chance floodplain.

- 3D TINs – Countywide water-surface ESRI format TINs will be provided for all eight (8) flood events (i.e. 10%, 4%, 2%, 1%, and 0.2% annual chance and 10%, 20%, and 35% impervious area future conditions). The 3D TINs will contain water-surface elevations for corresponding recurrence interval flood events for all streams within the county. For all the 3D TINs, the stream centerline will be within the TINs. For the 10%, 4%, and 2% 3D TINs, the TINs will be contained within the 1% annual chance floodplain. The 3D TINs for 1% annual chance will have a shape similar to 1% annual chance floodplain. The 3D TINs for 10%, 20%, and 35% impervious area future conditions and 0.2% annual chance event will exceed 1% annual chance floodplain. The 0.2% annual chance event 3D TINs will have a shape similar to 0.2% annual chance floodplain. A z-tolerance of 0.2 ft will be used in creating the 3D TINs.
- Stream Centerline Shapefile – One countywide stream centerline shapefile from the approved hydraulic model must be provided.
- Cross-section Shapefile – One countywide cross section shapefile, from the approved hydraulic model with the water-surface elevations (up to one decimal place) for all flood events, must be provided.
- Floodplain Boundaries – smoothed 1% annual chance (and 0.2% annual chance, where generated) countywide floodplains, used for the DFIRM mapping, must be provided.

Data Management

- All deliverable must be produced in State Plane Coordinate System – North Carolina. The horizontal and vertical datums are NAD 1983 (ft) and NAVD 1988, respectively.
- The data must be transferred to the NCFMP and Dewberry in DVDs or Portable Hard Drive.
- The following naming convention must be implemented:
    - 3D TINs – 'T_County100Yr' and 'T_CountyF35'
    - Elevation Grids – 'EG_County100Yr' and 'EG_CountyF35'
    - Depth Grids – 'DG_County100Yr' and 'DG_CountyF35'

Due to the 13 alphabet limitation in the naming of ESRI files, the County name may be abbreviated to meet the requirements (e.g. 'Scotl' instead of 'Scotland'). The EMCs can choose a descriptive abbreviation for the County name but the naming convention described above shall be followed in naming the files.

Standards for Data Production

- The 3D TINs and elevation/depth grids will be produced for all streams irrespective of whether the stream was newly studied during the map maintenance restudy or an effective study not revised during the map maintenance restudy.

- All grids will be floating point with elevations up to one decimal place (e.g. 101.1 ft).
- The 3D TINs can be generated from the elevation grids using a 'Raster to TIN' utility.
- 3D TINs and elevation/depth grids must follow the shape of the floodplains and must include backwater areas for mapped and unmapped tributaries. It may require extension of the 3D TIN and grid boundary beyond modeled cross-section extents.
- The 3D TINs and grids may contain islands and isolated ponding areas outside floodplain.

Independent QA/QC

The 3D TINs and Depth Grid deliverables will go through the process of independent QA/QC. The data for streams newly studied as part of the map maintenance restudies will be reviewed by the NCFMP's QA/QC contractor (Dewberry) for the compliance to the guidelines discussed in this issue paper. Deliverables must be provided to Amit Sachan at Dewberry and Ken Ashe at NCFMP. The QA/QC comments will be provided by the NCFMP to the EMCs in a comments memo. After all the comments have been resolved, the NCFMP Engineer will provide his approval.

The data for the previous effective study streams that were not revised as part of the map maintenance restudied will be reviewed by the NCFMP. Draft deliverables must be provided to Ken Ashe at the NCFMP. Final, approved deliverables must be provided to Amit Sachan at Dewberry for archival in the final restudy package.

Discussion Summary

Date Discussed: June 24, 2009

Discussion Attendees:

NCFMP: John Dorman, Ken Ashe, Rodger Durham, Tom Cadwallader
Dewberry: Amit Sachan, Steve Kalaf (phone), James Mawby (phone)
ESP: David Key
AECOM: Rick Prosser, Richard Fogelman

Summary of Discussion

See meeting minutes from June 24, 2009

Final Guidelines

See Recommendations above

Point(s) of Contact

Ken Ashe, NCFMP
Amit Sachan, Dewberry