REAL-TIME FLOOD INUNDATION MAPPING IN NORTH CAROLINA

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Abstract: The U.S. Geological Survey, in cooperation with the North Carolina Floodplain Mapping Program has developed a real-time flood inundation mapping system. The purpose of this system is to provide useful real-time flood inundation maps and related information and projected inundation maps based on National Weather Service forecasts of flood flows to emergency managers and the public as floods are occurring. The system was implemented in the Tar River basin from the headwaters to Washington, North Carolina, where the Tar River becomes the Pamlico River estuary. Project activities included (1) collecting real-time streamflow or river stage data at 19 gaged sites in the Tar River basin; (2) producing a high-resolution (1:24,000-scale) National Hydrography Dataset for the basin; (3) hydraulic modeling of flood flows at the gaged river reaches; and (4) developing flood inundation maps for selected water-surface elevations using LIDAR-derived terrain data.

As part of the North Carolina Floodplain Mapping Program, LIDAR topographic data were collected across the entire Tar River basin to provide base maps for digital flood-insurance rate maps. The topographic data satisfy a vertical root mean-square error accuracy standard of 20 centimeters at the 95-percent confidence level and can be contoured at roughly a 0.6-meter vertical contour interval. Digital elevation models with 1.6 by 1.6-meter grids were developed from the raw LIDAR data for the flood inundation maps. High-resolution hydrography was developed for the basin and combined with the elevation models, which were hydrologically enforced so that streams always flow downstream and continue beyond bridges and dams.

Steady-flow hydraulic models based on the U.S. Army Corps of Engineers HEC River Analysis System model were developed for each of 18 reaches equipped with USGS stream or stage gages. Models were constructed using the digital elevation data, supplemented with field surveys of channel bathymetry, bridge and(or) culvert-opening geometry, and channel and flood-plain characteristics. Models were calibrated by using USGS stage-discharge relations and high-water marks from Hurricane Fran (1996) and Hurricane Floyd (1999) flooding, which produced peak flows in excess of the 100-year exceedance level at many locations in the basin. Calibrations were for flows ranging from near bankfull to the highest recorded stage, which occurred during Hurricane Floyd at most sites. Simulated water levels generally were within 0.25 meter of measured values.

A library of inundation maps was prepared for each gaged site. Each map represents a particular river stage, ranging from bankfull to the maximum observed stage; for a given stage at a particular site, the inundation map illustrates the water depth and lateral extent of inundation over the mapped reach. When a given stage is reported in real time by the gage, the associated inundation map will be displayed on a Web page. Users also willbe able to retrieve inundation maps for selected stages to estimate potential inundation associated with a forecast river flow. At least two map bases will be used for the

inundation maps: 1998 USGS digital orthophotos and geographic information system coverages of roads and key buildings, such as public facilities.