Issue 44: Phase II & III H&H Issues

Background

Phase I of the NCFMP studies have primarily focused on the coastal plain and sandhills physiographic regions in of the State. Phase II and III study areas will focus on the piedmont, foothills, and mountains physiographic regions, each of which has unique physical and man-made features that may not have been previously encountered.

Issue

Many of the physical features in Phase II and Phase III have not been routinely encountered in NCFMP studies to date. As such, engineering approaches to handling these features have not been identified. In addition to programmatic and administrative differences between phases, Phase II and III, analyses may be impacted by several new issues, including large numbers of dams and lakes, severe stream slopes, limited gage data availability, and flashy hydrology. Due to the wide range of issues associated with the piedmont and mountain physiographic regions, guidance for several key issues is provided in the Recommendations section. The issues discussed in this paper include: lakes, stream slope, studies at the State line, digital submissions, USGS regression equations, low head weir identification, Mecklenburg County, gage data, major breaks in topographic data, NRCS flood projects, flash flooding, National and State parks, narrow floodplains, and outreach activities.

Recommendations

(1) Lakes

Phase II and III contain the vast majority of the State's dams and lakes. The current engineering modeling standards require the inclusion of all dams in the HEC-RAS models, regardless of dam size. To avoid exclusion of dams that may not be included in the dam safety database, the Engineering and Mapping Contractors (EMCs) should note the location of all dams during watershed surveys and the aerial photography should be reviewed for locations of standing water as indication of dam and weir structures.

The majority of the river basins in Phases II and III are regulated by large reservoirs and lakes, including a number of lakes owned by power generating companies. The lakes may or may not impact the hydrology of the impounded streams and access to the dam structure may be limited. The NCFMP has initiated partnering with Duke Power, Progress Energy, Alcoa, and the Tennessee Valley Authority for the purpose of acquiring more complete hydrologic and hydraulic data related to the group's dams (including outlet works) and water control practices. This effort should continue in advance of engineering model development and the EMCs should alert the NCFMP if further coordination is necessary.

(2) Stream Slope

Slopes of the study steams increases from the coast to the mountains, with the steepest slopes in the western mountains. It is likely that a significant portion of the study reaches in the headwaters of the piedmont physiographic region and streams in the foothills and mountains will flow at critical or super critical depths.. NCFMP studies to date have been limited to sub-critical analyses, which may predict higher water surface elevations in steep areas than those produced as a result of actual flooding events. For areas with high water marks, calibration may be difficult to achieve.

All studies, including studies in areas of adverse slope, should be modeled using a sub-critical flow regime. HEC-RAS will default to critical depth in areas where flow goes supercritical, so the resultant water surface elevations will always be based on normal depth calculations or will be conservative based on the critical depth versus the actual super-critical flow depth.

For streams that discharge floods in the super critical flow regime and have measured high water marks (HWMs), the sub-critical flow analysis may not calibrate well to the HWMs. In cases where the HWMs and the HEC-RAS water surface elevations do not compare well, the EMC should contact the appropriate NCFMP engineer to determine if a mixed flow or super-critical flow regime HEC-RAS model calibrated to HWMs will be required for review. Both models would be reviewed and following approval, the DFIRM mapping products would be generated from the sub-critical flow regime HEC-RAS model following approval by the NCFMP engineer.

(3) Studies at the State Line

Several of the Phase II and III river basins include upstream drainage areas in States other than North Carolina. The EMCs shall collect all base data necessary to conduct the H&H studies in these areas.

Hydrology backup data will include adequate topographic information to delineate basin boundaries and drainage areas. Accepted formats include Light Detection and Ranging (LiDAR) data, USGS topographic quadrangles, and USGS 30-meter Digital Elevation Models (DEMs). Information regarding urbanization, including percent impervious, shall also be collected on an as needed basis.

Hydraulic back up data will primarily be limited to tie-in information from effective studies. The NCFMP expects tie-ins with effective data to occur regardless of the State or community from which the effective data are derived. Topographic data and stream centerline data needs will typically not exceed the extents of the LiDAR. In locations where the NCFMP requests the study reach to extend beyond the limits of the LiDAR, the EMC shall use USGS topographic quadrangles to derive cross section data. In the event that the topographic data is unavailable or does not have adequate quality, the EMC should contact the NCFMP engineer assigned to the basin for assistance in acquiring base data from the border state.

Currently, FEMA specifications require the NCFMP DFIRMs to be trimmed at the State boundary. Until this specification is amended, it is not anticipated that the EMCs will need base

data from border States. Issue Paper 42 provides the NCFMP current approach to interstate issues including mapping and coordination with other States.

(4) Digital submissions

The NCFMP continues to move to include technological advances in the processes of DFIRM production. As a result, the H&H and base map deliverables are encouraged to be made in digital form (Issue Paper 45).

(5) USGS Regression Equations

The mountain region, due to topography, orographic affects, and geology tends to produce the highest state-wide discharges per square mile basis for both low flows and high flows Work completed by the NCFMP EMCs in the Catawba River basin indicates the NC rural regression equations have a tendency to under predict discharges, when compared to USGS gage data. This data trend occurred in the preliminary data developed in the Upper Yadkin River basin as well. Current NCFMP studies indicate a large amount of skew in the mountain gage data, so a region-wide solution is not currently available.

To avoid under prediction, the NCFMP EMCs should carefully review gage data in the study basins to determine the amount, if any, of under prediction by the USGS regression equations. Basin-wide adjustments to the regression equations should be utilized as needed to compensate for the under prediction. For gages which show the greatest under prediction, the EMCs should also consider extensions of gage weighting of the regression equations beyond the published 0.5 to 1.5 times the drainage area limits to allow contractor discretion in final discharge determination. For areas with significant under prediction by the USGS regression equations, the EMCs should contact the appropriate NCFMP point of contact to coordinate the appropriate approach prior to submittal of hydrology data.

The USGS is currently scheduled to update the NC rural regression equations following the end of the 2006 water year. During this update the NCFMP will coordinate with the USGS to request development of mountain physiographic region regression equations. The NCFMP will also encourage the USGS to consider multivariate analyses in the mountains for physiographic specific parameters such as elevation, orographic effects, and slope.

(6) Low head weir identification

The piedmont and mountains, to some extent, have a rich history of water power, primarily from mills. Most of these old mills are no longer operational and typically no longer structurally intact. The weir structures of the mills, however, may still be in place and functioning. Since it is impossible to anticipate the hydraulic height and potential impacts of the weir to base flood elevations (BFEs), all such weirs should be included in the hydraulic modeling unless they are determined to be hydraulically insignificant (i.e. do not impact BFEs). In addition, detailed studies should include all hydraulics structures, including weirs, regardless of impacts to BFEs. EMCs should review the following data sources to aid in weir identification:

1) USGS topographic quadrangles: these may indicate bodies of water and place names containing the word mill.
2) Aerial photography: during the dam / lake identification review, potential weir sites

should also be noted.

3) Water supply intakes: many intakes are located behind a dam or a weir to provide head above the intake. The NC DHHS Public Water Supply Section or the NC DENR Division of Water Resources should be consulted for intake locations.
4) Watershed surveys: field personnel should be trained to note features that may indicate the location of a mill or weir structure.

Incorporation of weirs in the hydraulic modeling may prove problematic, as weirs may be difficult to survey and LiDAR may not produce accurate elevation estimates if the weir crest is continuously crested. In these cases, measurements of the crest height from the downstream stream bed elevation should be taken to input into the modeling similar to the method used for measuring limited detailed study bridges or culverts..

(7) Mecklenburg County

Mecklenburg County is a FEMA Cooperating Technical Partner and has previously conducted a countywide study. The NCFMP plans to include Mecklenburg County in the Statewide DFIRM mapping. The NCFMP and Mecklenburg County have coordinated data sharing and DFIRM mapping of the Mecklenburg County data.

Per agreement between the two parties, the NCFMP will utilize the existing Mecklenburg County base, engineering, and DFIRM data and will map the data on the NCFMP panel scheme. Contiguous counties on multi-county panels will be shown with aerial imagery base, while the Mecklenburg County data will have a vector base.

(8) Major breaks in topographic data or extreme stream slope

The detail of the LiDAR data may capture stream features as detailed as waterfalls and steep runs. These areas often flow at critical or super-critical depths, adding instability to the HEC-RAS sub-critical flow analyses. To minimize instability, the EMC should add additional cross sections upstream and downstream of waterfalls and steep areas, similar to the placement around road crossings; to help the HEC-RAS computations transition from sub-critical flow reaches to the critical / super critical flow reaches. To help add stability to the models in areas transition from sub-critical to critical flow and vice versa (such as areas with steep slope), the models should be created with cross-section spacing less than every 500 feet in the steep reaches.

(9) NRCS flood projects

The Soil Conservation Service (SCS) and the NRCS constructed a number of flood control projects in Phase II and III basins. H&H development in previously studied Phase II basins indicated that some SCS and NRCS flood control projects attenuated short period recurrence floods (approximately 10-year events), while others attenuated the higher period recurrence intervals floods, including the 100-year flood.

To account for impact to the basin hydrology, the EMCs should gather information on all SCS and NRCS projects in the study basin and include attenuation of scoped discharges for impacted reaches, including effects of projects inside and outside of NC. If the EMC cannot acquire the SCS or NRCS data, or is in need of contact information to acquire the data, the EMC should contact the appropriate NCFMP engineer for assistance.

(10) Flash flooding

The topography and hydrology of the Phase II and III basins creates flash floods, which is a major focus of the National Weather Services forecasting in Western North Carolina. The IFLOWs system was in part developed to measure and forecast potential flooding events, including flash floods.

The current NCFMP study methods do not include provisions for mapping flash floods. Flash floods are defined to occur from intense rainfall in one (1) to six (6) hour durations. The amount of rainfall needed to initiate a flash flooding event depends on the soil moisture, soil type and topography of the stream drainage area. Since, the hydrology for FISs are long duration storms, it is not recommended that the study methods for DFIRM production be modified to include flash flooding.

As part of the westward expansion of the Flood Warning program and overall expansion of hazard mapping, the NCFMP should investigate mapping flash flooding as part of the creation of new flash flood maps or as an addition to the FIMAN. The project should be limited to Piedmont and Mountain basins where flash flooding is most likely to occur, and will require study efforts in addition to the on-going DFIRM driven H&H products.

(11) National and State Parks

One of the primary goals of the NCFMP is the elimination of unnumbered A zones. Replacement of A zones with limited detailed studies meets the requirements of Table 7.1 of the MIP and improves the ability of local floodplain administrators to safely regulate development. Phase III includes a larger than previously encountered amount of publicly held lands, most notably in the Little Tennessee River basin. Development potential in these areas is minimal or nonexistent.

In an effort to maximize funding and Table 7.1 of the MIP, the NCFMP recommends limiting new studies in public lands of the Phase III river basins to new A zones using GIS driven A zone development. The study limits for A zones studies are provided in Issue Paper 46 and NCFMP specifications for A zones are provided in Issue Paper .In areas where A zones are not replaced with new studies, the EMC will digitize the effective A zones for DFIRM panels.

(12) Narrow floodplains

The topography of the mountain region limits the width of the SFHAs to size that prohibits clarity of the DFIRM mapping components, namely BFEs, floodway and cross sections at the scale of the standard paneling scheme. To improve clarity and legibility the NCFMP will map the DFIRM panels in the Phase III river basins and the Phase II New and Watauga river basins 1:500 scale.

(13) Minimum Hydraulic Model Length

Many Piedmont and Mountain FIRMs include small, short tributary A zones that exceed the backwater of the main channel. In effort to meet the NCFMP goal of the elimination of all A zones, the EMCs have created new studies on these tributaries, many of which are only two (2)

or three (3) cross-sections in length. This has caused some concern with the validity of the water surface elevations within the models.

In effort to create viable models of a consistent minimum length, the NCFMP has set the minimum model length to be one-half (½ mile) or five (5) cross-sections. This length is to be used even if the effective study length is exceeded by the new model length.

(15) Outreach

Many of the western NC communities have flood maps that are up to 30 years old, and a number of communities have never been studied for inclusion in the NFIP. Interest in the mapping results will be heightened by the still fresh memory of the flooding from the 2004 hurricanes, and outreach efforts with public officials and community members may be taking place for the first time in many areas. It is anticipated a large number of inquiries for meetings and question regarding the maps will be generated as the preliminary DFIRMs are released. The NCFMP should communicate with local officials to gauge the need for modifying and/or providing additional outreach efforts, especially in previously unmapped communities and in communities hardest hit by the 2004 hurricanes.

Some communities in western North Carolina are opposed to zoning / land use planning and the DFIRMs could be interpreted as veiled control of private land rights in these areas. The outreach information should be upgraded to include information on impacts of the DFIRMs and SFHAs on property rights, development options, and land use rights of the property owners.

Discussion Summary

Date Discussed: N/A

Discussion Attendees: N/A

Summary of Discussion: N/A

Final Guidelines: N/A