

**Issue 23: Flood Insurance Study (FIS) and Flood Insurance Rate Map (FIRM)
Standards for Limited Detailed Studies**

Background

The State and the Federal Emergency Management Agency (FEMA) plan to publish 1% annual chance (100-year) flood elevations in areas that are being studied by limited detailed (approximate) methods. These data will be shown as Base (1% annual chance) Flood Elevations (BFEs) on the new FIRM panels. Further background on this decision is documented in Issue Paper 12, titled "Disseminating Flood Elevation Data for Areas Studied by Approximate Methods."

As opposed to detailed studies, the State does not plan to prepare flood profiles for limited detailed studies, nor delineate a regulatory floodway for these streams. A "floodway" run, however, is planned to be modeled for the streams studied by limited detailed methods. Further information on this decision is documented in Issue Paper 17, titled "Limited Detailed Studies." Therefore, because of the new nature of limited detailed studies, the technical standards for the FIS components, and graphical standards for the FIRM panels depicting these studies, need discussion and resolution.

Flood profile users have primarily included community floodplain administrators, FEMA, and FEMA's contractors. Historically, FEMA has tried to teach floodplain administrators to use flood profiles because they provide a comprehensive and definitive determination tool (versus BFEs plotted on a FIRM). A table could provide the same necessary information as a flood profile; however, the user (either the floodplain administrators or FEMA/FEMA's contractors) will have to linearly interpolate between determinations at selected points.

Therefore, the State plans to include a data table, which will include the calculated 1% annual chance water-surface elevations for all cross sections, in the FIS reports in lieu of flood profiles. It is also planned that these tables will document the non-encroachment widths (both left and right distance from the center of stream to non-encroachment boundary based on a 1.0 foot or less surcharge) modeled for the limited detailed studies. Floodway Data Tables will not be prepared for limited detailed studies because a regulatory floodway will not be shown on the FIRM.

Recommendation

FIS components

It is suggested that the "Engineering Methods" section of the countywide FIS reports for North Carolina include a description of the limited detailed studies. This could include the following:

- For the flooding sources studied by limited detailed methods in the county, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this FIS report and the FIRM panels. This method entails developing a HEC-RAS hydraulic model, resulting in the delineation of the 1% annual chance

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floodplain boundaries (designated as Zone AE) and BFEs. The hydraulic model is prepared using digital elevation data developed as part of the North Carolina Flood Mapping Program, without surveying bathymetric or bridge/culvert opening data. Readily available bridge or culvert data, such as plans from the North Carolina Department of Transportation, have been reflected in the hydraulic model. In addition, this method does not include field surveys that determine specifics on channel and floodplain characteristics.

- Flood Profiles have not been developed for streams studied by limited detailed methods; however, the 1% annual chance water surface elevations for every modeled cross section are given in this FIS report. In addition, regulatory floodways for streams studied by limited detailed methods are not delineated on the FIRM. Non-encroachment widths calculated from the limited detailed studies are provided in this FIS report so that communities can ensure that development is restricted in these areas.
- A limited detailed study is a “buildable” product with a supporting HEC-RAS model that can be upgraded to full detailed study at a later date by verifying stream channel and bridge/culvert opening characteristics and by analyzing multiple recurrence intervals. All streams listed in the tables below were studied by limited detailed methods.

The following table, titled “Limited detailed Flood Hazard Data Table” could be included in the FIS report for each stream studied by limited detailed methods to document BFEs and non-encroachment widths. Its format should be similar the Flood Hazard Data Tables proposed for FIRM panels with: column 1 showing the cross section letter or number (some will be blank), column 2 depicting the stream stationing, and column 3 depicting the flood discharge. It is suggested that drawdowns be corrected and that backwater and controlled flooding situations be reflected in the water-surface elevations shown in this table. These specifications result in extra effort, and therefore result in increased costs; however, the added benefit to FIS report users is believed worthwhile.

Limited Detailed Flood Hazard Data

Cross Section ¹	Stream Station ²	Flood Discharge (cfs)	1% Annual Chance Water-Surface Elevation (feet NAVD 88)	Non - Encroachment Width ³ (feet)
STREAM NAME				

¹This table reflects all modeled cross sections. Some cross sections shown in this table may not appear on map.

²Feet above mouth

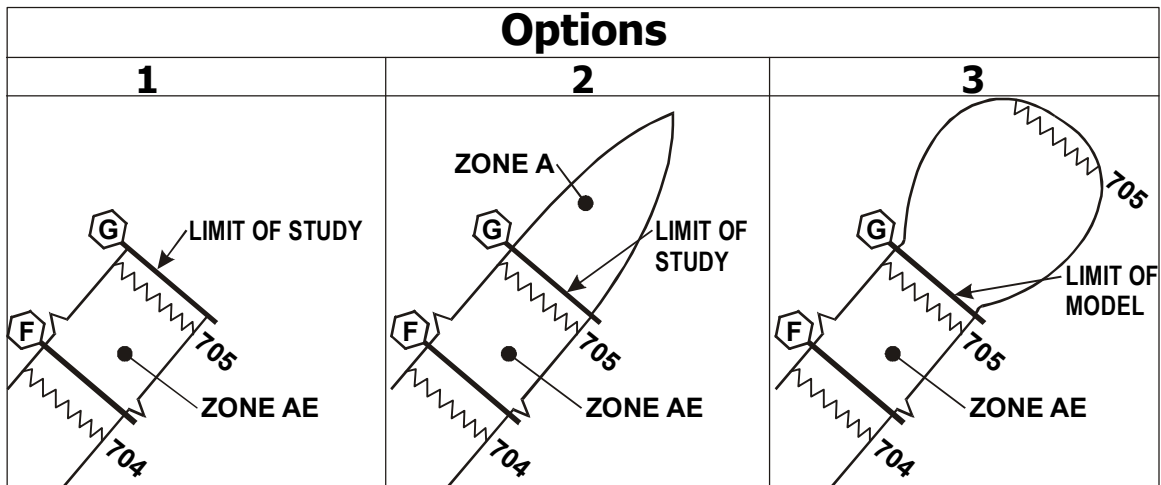
³Left/Right Distance from the Mapped Center of Stream to Non-encroachment Boundary Based on a 1.0 foot or less surcharge (Looking Downstream)

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FIRM panels

The printed FIRM will show the 1% annual chance floodplain (Zone AE), BFE lines and elevations, and selected cross sections for streams studied by limited detailed methods. It is suggested that the "lettered" cross section be placed on the FIRM every 1 to 6 inches (i.e., 1,000 to 6,000 feet for panels printed at 1"=1,000', 500 to 3,000 feet for panels printed at 1"=500') along the stream. The frequency of lettered cross sections depends on the size of the stream (a wide river would necessitate cross sections further apart), crossings (more bridges or culverts would require fewer cross sections), the scale of the printed panel (fewer cross sections should be shown on panels printed at 1"=1,000'), and the slope of the stream (a flat flood profile requires fewer cross sections).

In addition, the graphic specifications at the upstream ends of the limited detailed study need resolution. Option 1 or 2 is acceptable for most riverine areas. The advantage of option 1 is to minimize Zone A areas; however, some believe that this option perpetuates a belief that there is a lack of flood risk upstream of the limit of detail study. The advantage of option 2 is that it is the preferred cartographic technique. However, for Zone A areas where BFEs have not been determined, it is difficult to enforce floodplain management ordinances and determine if property or structures will be inundated by the 1% annual chance flood. Where a swamp or other ponding-flooding source is upstream of a limit of detail study, option 2 or 3 is suggested.



Discussion Summary

Date Discussed: 07/11/01
Discussion Attendees: Floodplain Mapping Core and State's Contractors

Summary of Discussion

The recommendations and the three options were discussed, as well as the terminology between "detailed" and "limited detailed" studies. The recommended FIS wording was agreed upon and additional language would need to be developed.

Final Guidelines

The recommendations above are accepted with Option 1 chosen as the preferred graphic specification at the upstream end of limited detailed studies. For full detailed studies, the "Limit of Detailed Study" label should be used. In follow-up to the discussion of this issue paper, it was resolved that the non-encroachment data developed for limited detailed studies would not be considered a regulatory floodway. This decision was made between FEMA and the State on September 24, 2001. Updated "Notes to Users" and wording for the FIS reports was developed during additional discussion in an August 2002 NC FMP Coordination Meeting (see Attachment A). Such revisions should be reflected in the FIS Reports and the FIRM panels.

Attachments

- A Notes to Users
- B FIS Report Wording for Limited Detailed Studies
- C Profile Notes Referencing Limited Detailed Studies

References

Issue Paper 12, "Disseminating Flood Elevation Data for Areas Studied by Approximate Methods."

Issue Paper 17, "Floodways for Limited Detailed Studies."

Attachment A: Notes to Users

This map is for use in administering the National Flood Insurance program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles, Floodway Data, Limited Detailed Flood Hazard Data, and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Boundaries of **regulatory floodways** shown on the FIRM for flooding sources studied by detailed methods were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data for flooding sources studied by detailed methods as well as **non-encroachment widths** for flooding sources studied by limited detailed methods are provided in the FIS report for this jurisdiction. The FIS report also provides instructions for determining a floodway using non-encroachment widths for flooding sources studied by limited detailed methods.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 4.4 "Flood Protection Measures" of the Flood Insurance Study report for information on the flood control structures in this jurisdiction.

Base map information and geospatial data used to develop this FIRM were obtained from various organizations, including the participating local community(ies), state and federal agencies, and/or other sources. The primary basis for this FIRM is aerial imagery acquired as part of the National Digital Orthophoto Program. The time period of collection for the imagery is 1998-1999. Information and geospatial data supplied by the local community(ies) that met FEMA base map specifications were considered the preferred source for development of the base map. See geospatial metadata for the associated digital FIRM for additional information about base map preparation.

Base map features shown on this map, such as **corporate limits**, are based on the most up-to-date data available at the time of publication. **Changes in the corporate limits may have occurred since this map was published.** Map users should consult the appropriate community official or website to verify current conditions of jurisdictional boundaries and base map features. This map may contain roads that were not considered in the hydraulic analysis of streams where no new hydraulic model was created during the production of this statewide format FIRM.

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This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

If you have **questions about this map**, or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at www.fema.gov.

An accompanying Flood Insurance Study report, Letter of Map Revision (LOMR) or Letter of Map Amendment (LOMA) revising portions of this panel, and digital versions of this FIRM may be available. Visit the **North Carolina Floodplain Mapping Program** website at www.ncfloodmaps.com, or contact the **FEMA Map Service Center** at 1-800-358-9616 for information on all related products associated with this FIRM. The FEMA Map Service Center may also be reached by Fax at 1-800-358-9620 and their website at www.fema.gov/msc.

MAP REPOSITORY

Refer to listing of Map Repositories on Map Index or visit www.ncfloodmaps.com.

EFFECTIVE DATE OF FLOOD INSURANCE RATE MAP PANEL

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to statewide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent, the North Carolina Division of Emergency Management or the National Flood Insurance Program at the following phone numbers or websites:

NC Division of Emergency Management
(919) 715-8000 www.nfip.ncem.org

National Flood Insurance Program
1-800-638-6620 www.fema.gov/nfip

**Attachment B
FIS Report Wording for Limited Detailed Studies**

The following is proposed, draft wording for the North Carolina FIS reports. These new and updated paragraphs tell users of the North Carolina FIRM how to use non-encroachment information for limited detailed study streams, assuming that this information is not a regulatory floodway, as well as detailed studied streams. After resolution of the final wording, these paragraphs need to be incorporated into the new FIS reports.

"Hydraulic Analyses" Section of Flood Insurance Study Report

Countywide Analyses

Flooding Sources Studied by Detailed Methods

Cross sections for the flooding sources studied by detailed methods were obtained from field surveys and digital topographic information obtained using Light Detection and Ranging (LIDAR) technology. All bridges, dams, and culverts were field surveyed to obtain elevation data and structural geometry. The channel sections were located at close intervals upstream and downstream of structures. The overbank cross section data were obtained from digital topographic information obtained as part of the North Carolina Statewide Flood Mapping Program.

Water-surface elevations of floods for the selected recurrence intervals were computed using the USACE HEC-RAS step-backwater computer program (USACE, 1999). Starting water-surface elevations for xxxx Brook were calculated using the slope/area method. The starting water-surface elevations for the yyyy River were obtained by using the mean high tide elevation because starting conditions produced water-surface elevations below mean high tide.

Roughness coefficients (Manning's "n") used in the hydraulic computations were based on field observations. The channel and overbank "n" values for all of the streams studied by detailed methods are shown in Table 14, "Roughness Coefficients".

Along certain portions of the yyyyy River, a profile base line is shown on the maps to represent channel distances as indicated on the Flood Profiles and in Table 15, "Floodway Data."

Flooding Sources Studied by Limited Detailed Methods

For flooding sources studied by limited detailed methods in the county, standard hydrologic and hydraulic study methods were used to determine the flood hazards data required for this report and the FIRM panels. This method entails developing a HEC-RAS hydraulic model, resulting in the calculation of BFEs and the delineation of the 1% annual chance floodplain (designated as Zone AE). Cross sections for the flooding sources studied by limited detailed methods were obtained using digital elevation data obtained with LIDAR technology developed as part of the North Carolina Statewide Flood Mapping Program. The hydraulic model is prepared using this digital elevation data, without surveying bathymetric or structural data. Where bridge or culvert

data are readily available, such as from the North Carolina Department of Transportation, these data have been reflected in the hydraulic model. If these structural data are not readily available, field measurements of these structures were made to approximate their geometry in the hydraulic models. In addition, this method does not include field surveys that determine specifics on channel and floodplain characteristics. A limited detailed study is a "buildable" product that can be upgraded to a fully detailed study at a later date by verifying stream channel characteristics, bridge and culvert opening geometry, and by analyzing multiple recurrence intervals.

The results of the HEC-RAS computations are tabulated for all cross sections (Table 16, "Limited Detailed Flood Hazard Data"). Flood Profiles have not been developed for streams studied by limited detailed methods. In addition, floodways for streams studied by limited detailed methods are not delineated on the FIRM. However the 1% annual chance water-surface elevations, flood discharges, and non-encroachment widths from the limited detailed studies for every modeled cross section are given in Table 16. The non-encroachment widths given at modeled cross sections can be used by communities to enforce floodplain management ordinances that meet the requirement defined in 44 CFR 60.3(c)(10).

Between cross sections for streams studied by limited detailed methods, 1% annual chance water-surface elevations should be calculated by mathematical interpolation using the distance along the stream centerline. Non-encroachment widths and, therefore, the location of a floodway boundary between cross sections should be determined based on either 1) mathematical interpolation, or 2) the non-encroachment width at the upstream or downstream cross section, whichever is larger. If the width determined by this second method is wider than the Special Flood Hazard Area (SFHA) or the 1% annual chance floodplain delineated on the FIRM for this location along the stream, the non-encroachment width shall be considered to be coincident with the SFHA. A full detailed study incorporating field survey data in the HEC-RAS hydraulic model may be submitted for a Letter of Map Revision (LOMR) request to map a regulatory floodway along a section of a stream in lieu of applying the non-encroachment widths listed in Table 16. FEMA's current (as of August 2001) map revision structure exempts submittal fees for map revision requests based solely on the submission of more detailed data.

Attachment C

Profile Notes Referencing Limited Detailed Studies

Background

The North Carolina CTS Floodplain Mapping Program will analyze streams by limited detailed methods. The limited detailed studies will replace areas previously studied by approximate methods, thereby adding more detailed information to the new North Carolina FIRM panels. These FIRM panels will show the Special Flood Hazard Areas (SFHAs), base flood elevations, and selected cross sections, while a table provided in the FIS Report will list 1% annual chance water surfaces elevations and encroachment data for all cross sections. Floodways will not be shown on the FIRM panels and flood profiles will not be created for flooding sources studied by limited detailed methods.

Some flooding sources that were previously studied by both detailed and approximate methods will now be studied by both detailed and limited detailed methods. In this case, the FIRM panel will clearly depict the boundary between the detailed and limited detailed information, as a floodway will not be shown for streams studied by limited detailed methods. The boundary dividing the two methods of study will be labeled "Limit of Floodway." Flood profiles will be produced only for areas studied by detailed methods (i.e., either new detailed study or redelineation of unredetailed study). It may be confusing to users when a FIRM panel shows detailed and limited detailed information for one continuous reach of a stream but the flood profile only shows the detailed information for that stream.

Issue

1. An issue may arise in cases where a stream studied by detailed methods is a tributary to a stream studied by limited detailed methods. In this case, the stream studied by detailed methods may experience backwater effects from the stream studied by limited detailed methods. The flood hazard analysis for the stream studied by limited detailed methods will be performed for only the 1% annual chance flood, while the flood hazard analysis for the stream studied by detailed methods will be performed for the 10%, 2%, 1%, and 0.2% annual chance floods. This may cause a lack of elevation data on the flood profile for the stream studied by detailed methods.

Resolution

1. A note should be added to the end of the flood profile where a contiguous limited detailed analysis begins or ends. Depending on whether the limited detailed analysis is downstream or upstream of the detailed analysis on the continuous reach, the note should state, "Downstream flood hazard information is provided in the Limited Detailed Flood Hazard Data table located in this FIS Report" or "Upstream flood hazard information is provided in the Limited Detailed Flood Hazard Data table located in this FIS Report."
2. The flood profile for the stream studied by detailed methods should reflect the 1% annual chance backwater effects from the stream studied by limited detailed methods. The 1% annual chance water surface elevation(s) from the limited detailed study should be added to

the flood profile of the stream studied by detailed methods for the length of the stream that is affected by the backwater. The 10%, 2%, and 0.2% annual chance flood elevation data should start on the profile at the first modeled cross section. The standard FEMA note and reach arrow should be added at the top of the flood profile stating, "1% annual chance backwater effects from ____." A second note should be added above the 1% annual chance backwater elevation stating, "10%, 2%, and 0.2% annual chance flood elevation data not available" (see Figure 1, below). This solution will allow the backwater effects from the stream studied by limited detailed to be clearly shown on the flood profile for the stream studied by detailed methods.

Figure 1: Backwater Profile

