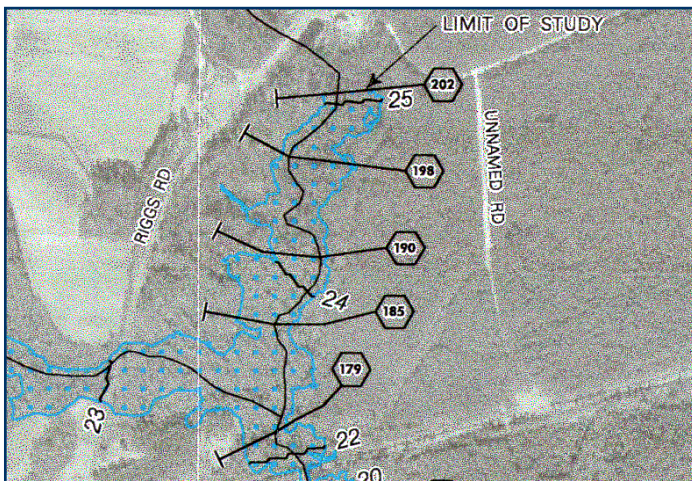


Flood Insurance Rate Maps (FIRMs) prepared by the State of North Carolina and the Federal Emergency Management Agency (FEMA) as part of the North Carolina Floodplain Mapping Program feature Special Flood Hazard Areas (SFHAs) studied by limited detailed methods. Floodplain management criteria associated with each level of study (i.e., detailed or approximate) must be enforced by a community as described by their flood damage prevention ordinance. Floodplain administrators and other local officials who have worked with traditional flood hazard maps are experienced in regulating development in SFHAs studied by detailed and approximate methods. The following information is provided to help extend sound floodplain management practices for SFHAs studied by limited detailed methods.



## What is a Limited Detailed Study?

“Limited detailed study” is the term given to a method of calculating the 1% annual chance flood elevations and delineating the resulting floodplain along rivers and streams. Unlike approximate methods previously used in mapping floodplains in undeveloped or sparsely developed areas, limited detailed study methods delineate the 1% annual chance floodplain and identify Base (1% annual chance) Flood Elevations (BFEs), which together are used as a basis for floodplain management and flood insurance rating. For flooding sources studied by limited detailed methods, standard hydrologic and hydraulic methods are used. This entails

developing a hydraulic model to calculate flood elevations that can be used with topographic information to delineate the 1% annual chance floodplain. Cross sections for the flooding sources studied by limited detailed methods are obtained from digital elevation models developed from Light Detection and Ranging (LIDAR) data collected as part of the Statewide Floodplain Mapping Program.

## How do Limited Detailed Study Methods Differ from Detailed Study Methods?

Detailed study methods involve determining specific channel profiles, bridge and culvert opening geometry, and floodplain characteristics using traditional field surveys. In contrast, limited detailed study methods are less rigorous and do not require field surveys. If bridge and culvert data are readily available, such as from the North Carolina Department of Transportation, these data will be reflected in the limited detailed hydraulic model. If data are not available, a structure will be field measured for a limited detailed study.

### Frequently Used Terms

***Floodway*** — Channel of a stream plus any adjacent floodplain areas that must be kept free from encroachments in order to contain the 1% annual chance flood.

***Non-Encroachment Area*** — Portion of a floodplain where construction, placement of fill, or similar alteration of topography may be prohibited by a community due to the effects such development would have on the conveyance of discharge.

***Non-Encroachment Width*** — Distance between the mapped center of a stream and the boundary of the non-encroachment area.

***Ordinance*** — Legally enforceable floodplain management regulation adopted by a community.

***Special Flood Hazard Area (SFHA)*** — Darkly shaded area mapped on a FHBM or FIRM as expected to be inundated by the 1% annual chance flood.

***Surcharge*** — Increase in flood elevation due to reduced conveyance capacity from encroachment in the floodplain.

The results of limited detailed studies are shown in a Limited Detailed Flood Hazard Data table, which is contained in the FIS Report. An example is shown on the following page. This table provides the following information on the 1% annual chance floodplains: BFEs, non-encroachment widths, and flood discharges at all cross sections studied by limited detailed methods. In contrast, detailed studies include mapped floodways and flood profiles showing the 10% (10-year), 2% (50-year), 1%, and 0.2% (500-year) annual chance flood elevations, streambed invert elevations, and bridge and culvert geometry.

For streams studied by detailed methods, regulatory floodways are mapped on the FIRM. Multiple model runs are used to optimize floodway widths at cross section locations to ensure that 1% annual chance water-surface elevations do not increase more than 1.0 foot due to development in the floodway fringe. The maximum allowable increase of 1.0 foot, known as the surcharge value, is specified in National Flood Insurance Program (NFIP) regulations. The resulting widths are interpolated between cross sections to derive the regulatory floodway boundaries shown on a FIRM. However, the floodway model for a limited detailed study is run using an input surcharge value (typically 0.7 foot) to calculate non-encroachment widths at cross sections. The non-encroachment areas are not shown on the FIRM for streams studied by limited detailed methods.

If a community would like to map a regulatory floodway on the FIRM for a stream studied by limited detailed methods, multi-profile and floodway models incorporating field survey channel and hydraulic crossing geometry are needed.

#### **How do the Floodplain Management Standards in SFHAs Determined by Limited Detailed Study Methods Differ from Approximate Study SFHAs?**

One difference is that limited detailed studied SFHAs include BFEs and are therefore designated as AE Zones, which is the same designation used for SFHAs determined by detailed study methods. As a result, the same NFIP regulations that apply to AE and A1-A30 Zones must be followed whether the flooding source is studied by detailed or limited detailed methods. Communities that have adopted the model North Carolina flood damage prevention ordinance, which requires development 2 feet above the highest adjacent grade in unnumbered A Zones, will instead need to require elevation of structures to or above the BFE in areas where unnumbered A Zones are replaced by AE Zones.

The other significant difference relates to regulation of development near stream channels. Communities that adopted the model North Carolina flood damage prevention ordinance are familiar with the setback provision that applies in unnumbered A Zones. This section of the ordinance prohibits development within a distance of 20 feet or 5 times the width of the stream, whichever is greater, from the top of the bank on each side of a stream mapped as an A Zone. However, according to NFIP regulations, general setbacks can no longer be solely used where unnumbered A Zones are replaced by AE Zones. The community must ensure that any development in a non-encroachment area causes no increase in BFEs. Therefore, communities must generally prohibit development within the area defined by the non-encroachment width data if it causes any increase in 1% annual chance elevations.

#### **Does the Community's Local Flood Damage Prevention Ordinance Need to be Changed if Limited Detailed Studies have been Performed in the Community?**

When a new FIRM is finalized for a community as part of the North Carolina Floodplain Mapping Program, the community must add additional language to their local flood damage prevention ordinance to comply with NFIP regulations that apply to riverine SFHAs that show BFEs, but not regulatory floodways.

Community model ordinance language can be obtained from the North Carolina Division of Emergency Management at (919) 715-8000 or by visiting: [http://www.dem.dcc.state.nc.us/Mitigation/NFIP\\_home.htm](http://www.dem.dcc.state.nc.us/Mitigation/NFIP_home.htm)

## What Method should be used to Determine the 1% Annual Chance Water-Surface Elevation Along Streams Studied by Limited Detailed Methods?

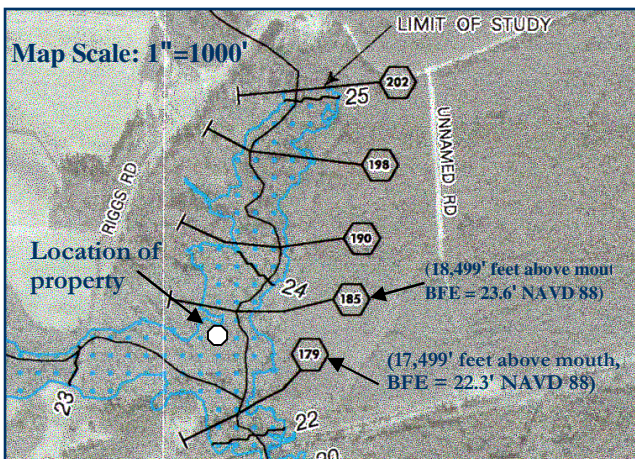
North Carolina FIRM panels show SFHAs, BFEs (rounded in whole foot increments), and numbered cross section locations along streams studied by limited detailed methods. Using the FIRM and information in the Limited Detailed Flood Hazard Data table (please see example below), the BFE can be determined for locations between studied cross sections through numerical interpolation.

**Limited Detailed Flood Hazard Data**

Cross Section	Stream Station <sup>1</sup>	Flood Discharge (cfs)	1% Annual Chance Water-Surface Elevation (feet NAVD 88)	Non-Encroachment Width (feet) <sup>2</sup>
<b>BERRY CREEK</b>				
179	17,857	854	22.3	50 / 60
185	18,499	777	23.6	60 / 80
190	18,993	777	24.3	5 / 200
198	19,754	777	24.8	115 / 25
202	20,235	777	25.2	120 / 50

<sup>1</sup> Feet above mouth

<sup>2</sup> Left/Right distance from the mapped center of stream to non-encroachment boundary based on a 1.0 foot or less surcharge (looking downstream)



- A** = upstream cross section station - downstream cross section station = distance between cross sections
- B** = upstream cross section BFE - downstream cross section BFE = BFE change between cross sections
- C** = distance along stream centerline from the downstream cross section to the location of interest
- D** = BFE at location of interest - BFE at downstream cross section = BFE change along stream center line from downstream cross section to location of interest

*When we estimate in this way to find an "in-between value," we are using interpolation.*

### Step 1 - Determine known variables (A, B, C, and D)

$$A = (18,499' - 17,857') \quad B = (23.6' - 22.3')$$

$$A = 642' \quad B = 1.3'$$

$$C = (.50' \text{ (distance along stream)} \times 1000' \text{ (map scale)})$$

$$C = 500'$$

$$D = ((C / A) \times B) = ((500' / 642') \times 1.3')$$

$$D = (.78) \times 1.3' = 1.0'$$

### Step 2 - Determine BFE at property location

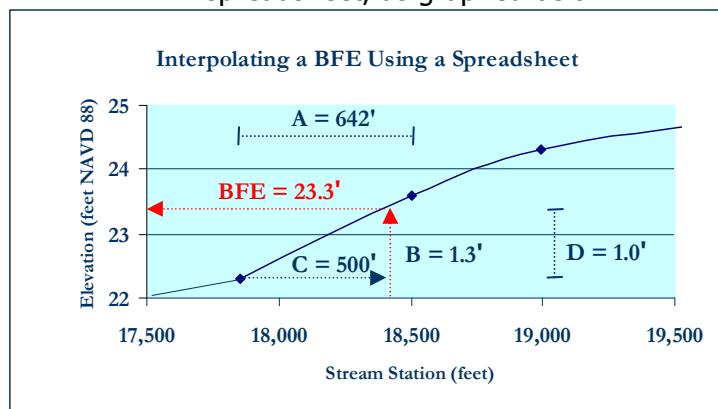
**BFE at location of property:**

$$= (D + (\text{downstream cross section's BFE}))$$

$$= (1.0' + 22.3')$$

$$= 23.3' \text{ NAVD 88}$$

Another variation for determining the BFE at a certain location by interpolation is using a spreadsheet, as graphed below.



## What Methods should be used to determine the Non-Encroachment Area Along Streams Studied by Limited Detailed Methods?

Non-encroachment widths at cross sections are listed in the Limited Detailed Flood Hazard Data table in the FIS Report. For locations between cross sections, there are two straightforward methods that can be used to determine the non-encroachment area and the widths that bound this area.

The simpler method involves comparing the non-encroachment widths at the cross sections located upstream and downstream from the location of interest. The larger of the two are then used to determine the non-encroachment area for any location between the two cross sections. Method 1 may result in a conservative estimate of the non-encroachment area, particularly if there is a large difference in non-encroachment widths at the two cross sections, and/or if the location of interest is close to the cross section with the smaller width. If the width of the floodplain at the location of interest is narrower than the non-encroachment width determined by this method, then the SFHA should be the non-encroachment area (i.e., no encroachment should be permitted within the boundaries of the limited detailed SFHA at the location of interest). The table below is based on the example on page 3 using Method 1.

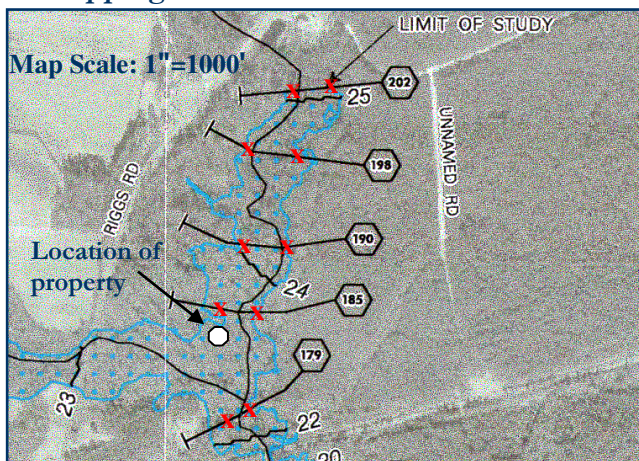
### Method 1

Non-Encroachment Width (in feet) from the Mapped Center of the Stream		
	Left	Right
From 179 to 185	60'	80'
From 185 to 190	60'	200'
From 190 to 198	115'	200'
From 198 to 202	120'	50'

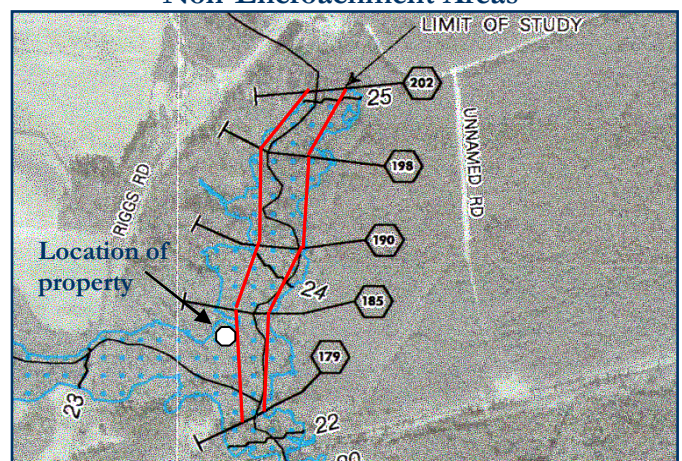
Therefore, if using Method 1, the community should generally prohibit development in the vicinity of the property location (i.e., between cross section 179 and 185 on the right side of Berry Creek looking downstream) 80' from the mapped center of the stream.

A more rigorous and possibly less conservative method of determining a non-encroachment width and the non-encroachment area between cross sections is to map the widths provided in the Limited Detailed Flood Hazard Data table in the FIS report. Method 2 is shown below using the example on page 3. In some cases, the non-encroachment area may be determined by straight line mapping.

### Mapping the Non-Encroachment Widths



### Straight-Line Mapping of the Non-Encroachment Areas



When a floodway to be mapped on a FIRM, engineering judgment is used to reflect the floodway boundary between cross sections considering that a floodway is a floodplain management tool used to preserve the flood conveyance of a stream. A community may wish to emulate this approach in enforcing floodplain management standards along streams studied by limited detailed methods. It is important to compare the non-encroachment areas determined by either of the two methods discussed in this fact sheet with the width of the SFHA and the streamline shown on the digital FIRM.