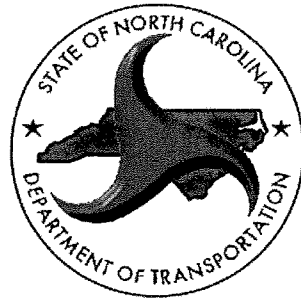


# **STREAM MITIGATION PLAN**

## **Tick Creek Condoret Property Chatham County, North Carolina**

**State Project No. 8.U492107  
TIP No. U-2524WM**



Prepared for:  
North Carolina Department of Transportation  
Project Development and Environmental Analysis Branch  
Raleigh, North Carolina

**September 2002**

## **EXECUTIVE SUMMARY**

The North Carolina Department of Transportation has identified a portion of Tick Creek for preservation and its tributary for stream restoration. The portions of Tick Creek and its tributary to be preserved and restored are on the Jon A. and Joan Condoret Property located southeast of Siler City in Chatham County. The proposed work includes approximately 6,330 linear feet of stream. The preservation includes 3,733 feet of Tick Creek, and the restoration includes 2,597 linear feet of Tick Creek's Tributary. The mitigation site is composed of 29 acres of land.

Field surveys of the existing stream channels and surrounding floodplains were conducted on February 26 through 28, 2002, March 4, 2002, March 6, 2002, and May 1, 2002 to determine the potential for stream mitigation. Analysis of the data obtained and field observations revealed that Tick Creek should be preserved and its Unnamed Tributary restored. An aquatic survey performed by NCDOT's biologists reveals that Tick Creek contains a viable and diverse mussel fauna that includes at a minimum one North Carolina Endangered Species and Federal Species of Concern. Tick Creek is of great significance for the viability of freshwater mussel populations in the Rocky River Subbasin of the Cape Fear River Basin.

Tick Creek classifies as a C-type stream. It has a sinuosity of 1.3, with average width-to-depth ratios of 12 and an average Bank Erodibility Hazard Index (BEHI) that correspond to Moderate Bank Erosion Potential (BEP). The thick bank vegetation and vast amounts of bedrock insure that Tick Creek will remain in its stable state. The average bankfull area of 126 falls well within the confidence limits of the North Carolina Rural Piedmont Regional Curve. Field observations support that Tick Creek within the Condoret Property is a stable reach.

A large drainage feature at the site is an Unnamed Tributary to Tick Creek. The tributary has suffered from past unrestricted cattle access. The cattle used the stream and its forested buffer frequently for water and shade, and, as a result, there are large eroded crossings along the entire stream. The entire stream is unstable and classifies as E or G-type channels. The majority of the tributary is located on the Condoret Property, and restoration of the entire reach would increase its own ecological functions, as well as add to the protection of the valuable mussel habitat throughout Tick Creek.

The proposed plan would preserve Tick Creek through the establishment of a 114-foot vegetative riparian buffer (23 acres) along Tick Creek. It would also restore the entire 2,597 linear feet of the Unnamed Tributary to stable C or E-type channels with 50-foot vegetative riparian buffers (6.0 acres). The entire reach of Tick Creek will be classified as preservation qualifying for 3:1 mitigation credit due to the diversity of freshwater mussels. The entire Unnamed Tributary will be classified as stream restoration qualifying for 1:1 mitigation credit. The proposed stream will be about 2,946 feet in length, which is 349 feet longer than the existing stream.

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Appendix A	Existing Conditions Data
Appendix B	DWQ Stream Habitat Evaluation
Appendix C	Supporting Letters
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## **1.0 INTRODUCTION**

The North Carolina Department of Transportation (NCDOT) has identified a portion of Tick Creek for potential preservation and its tributary for potential stream restoration. The portions of Tick Creek (NCDWQ Stream Index Number – 17-43-13) and its tributary to be preserved and restored are on the Jon A. and Joan Condoret Property located southeast of Siler City in Chatham County (Figure 1). The proposed work includes approximately 6,330 linear feet of stream. The preservation includes 3,733 feet of Tick Creek, and the restoration includes 2,597 linear feet of Tick Creek's Tributary. The mitigation site is composed of 29 acres of land.

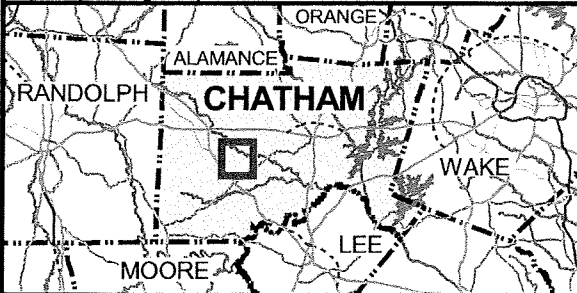
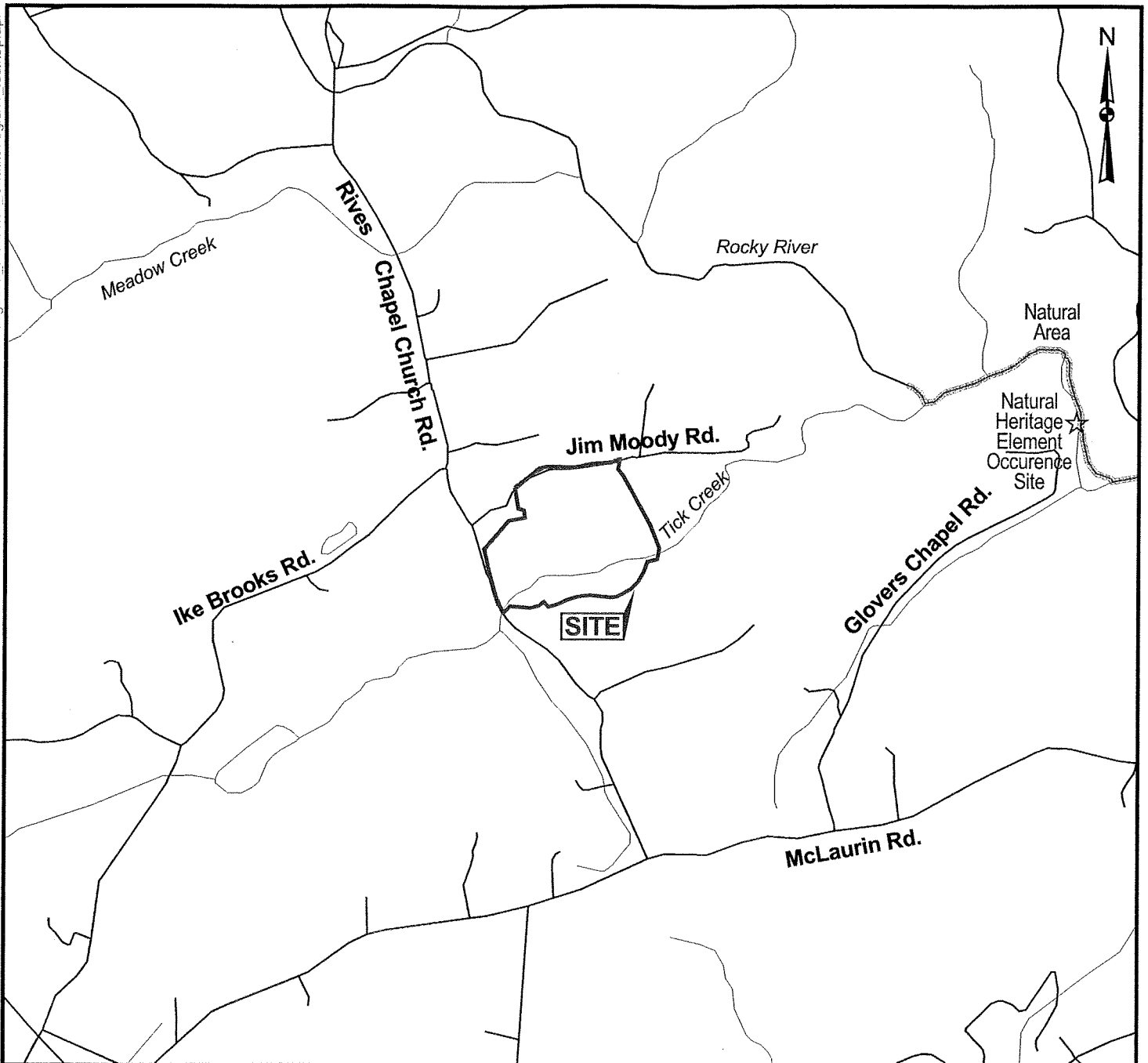
Restoration requires determining the extent a stream has departed from its natural stability and then establishing the stable form of the stream under the current hydrologic conditions within the drainage area. The proposed restoration of the Unnamed Tributary will include constructing a stable meander geometry, modifying channel cross-sections, raising the existing streambed elevation where possible, and establishing a floodplain at the new stream elevation, thus restoring a stable dimension, pattern, and profile. This restoration is based on analysis of current watershed hydrologic conditions, evaluation of the project site, and assessments of stable reference reaches. The following recommendations are included in this restoration plan:

- Form a stable channel with the proper dimension, pattern, and profile.
- Raise the existing streambed elevation where possible.
- Establish a floodplain along the stream channel.
- Place natural material structures in the stream to improve stability and enhance aquatic habitat.
- Stabilize stream banks with herbaceous and woody vegetation.
- Create or enhance a minimum of a 100-foot riparian zone to provide aesthetic value, wildlife habitat, and bank stability.

Preservation requires determining the current condition a stream and then evaluating the value of protecting the natural resources present. The proposed preservation of Tick Creek will include establishing a permanent buffer along the stream to insure that the existing stream habitat will remain undisturbed. This preservation is based on analysis of current watershed hydrologic conditions, evaluation of the project site, and surveys of existing freshwater mussels.

### **1.1 PROJECT DESCRIPTION**

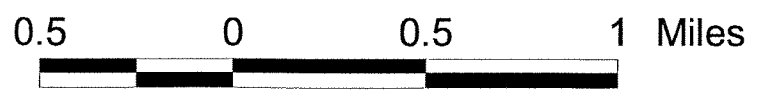
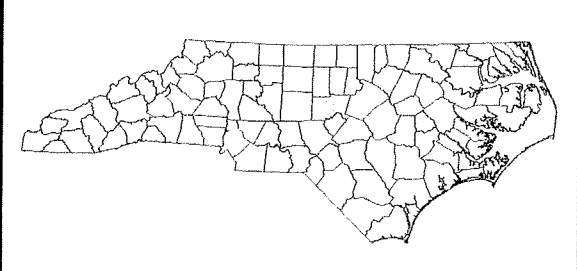
The studied portions of Tick Creek and the Unnamed Tributary are located adjacent to Jim Moody Road (S.R. 2172) outside Siler City, North Carolina on the 134-acre property tract owned by Jon A. and Joan Condoret (Figure 1). The current reach of Tick Creek to be preserved is approximately 3,733 feet in length and begins at the Rives Chapel Church Road Bridge (Figure 2). During field visits, a tributary approximately 2,597 feet in



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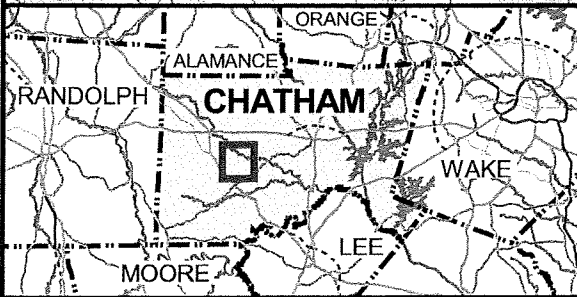
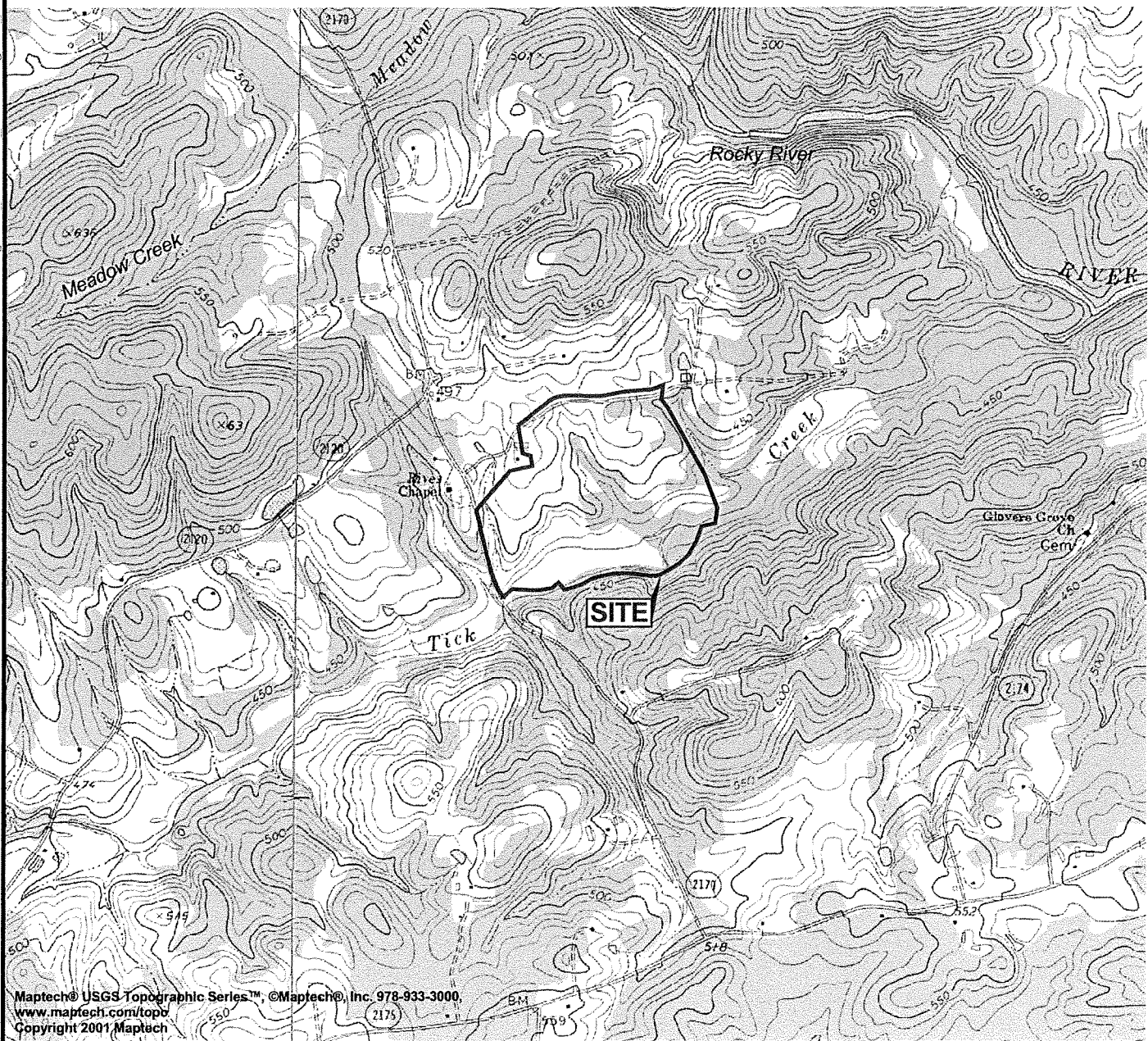
**FIGURE 1  
 PROJECT LOCATION**

**RESTORATION PLAN  
 TICK CREEK  
 CHATHAM COUNTY**



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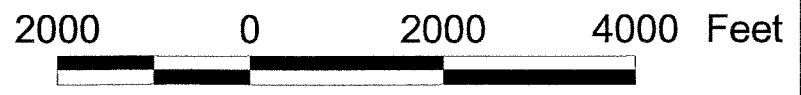
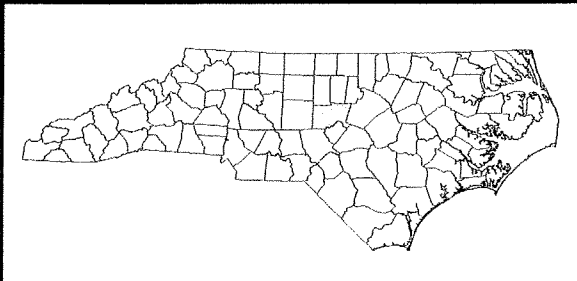
SOURCE: USGS Quadrangles:  
Siler City, NC, 1969, Photoinspected 1988; Siler City NE, NC, 1970, Photoinspected 1980.



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FIGURE 2  
 VICINITY MAP

RESTORATION PLAN  
 TICK CREEK  
 CHATHAM COUNTY



length was located. The tributary crosses underneath Jim Moody Road to the north and travels south, bisecting the Condoret's property.

The main factors for the degradation and impairment of the Unnamed Tributary are the result of increased agricultural practices throughout the watershed and past cattle ranching on-site. The past unrestricted cattle access to the stream has severely affected the riparian vegetation along the tributary. In alluvial soils, such as the ones found on-site, instability is compounded when deep rooting vegetation is removed. The increased sediment supply resulting from the bank instability has induced disturbance of the channel bedform features and impaired in-stream habitat.

The tributary appears to have been straightened for agricultural purposes in the past. A stream of this type in a well-developed floodplain typically has a more sinuous pattern than the existing channel. This straightening has altered the natural pattern of the stream as well as impacted the channel bedform relationship.

## **1.2 GOALS AND OBJECTIVES**

This project has the following goals and objectives:

1. Preserve 3,733 linear feet of Tick Creek (as measured along the thalweg).
2. Restore 2,946 linear feet (349 feet longer than the existing reach) of an unnamed tributary.
3. Provide a minimum of a 200-foot buffer along the Tick Creek reach being preserved for the protection of freshwater mussels found along the 3,733 linear foot reach.
4. Provide a stable stream channel for the Unnamed Tributary that neither aggrades nor degrades while maintaining its dimension, pattern, and profile with the capacity to transport its watershed's water and sediment load.
5. Improve water quality and reduce erosion by stabilizing the stream banks for both streams by improving riparian vegetation.
6. Reconnect the Unnamed Tributary to its floodplain.
7. Improve aquatic habitat of the tributary with the use of natural material stabilization structures such as root wads, rock vanes, woody debris, and a riparian buffer.
8. Provide aesthetic value, wildlife habitat, and bank stability through the creation or enhancement of a riparian zone.

## **1.3 STREAM SURVEY METHODOLOGY**

The US Forest Service General Technical Report RM-245, Stream Channel Reference Sites: An Illustrated Guide to Field Technique is used as a guide when taking field measurements. Accurate field measurements are critical to determine the present



condition of the existing channel, conditions of the floodplain, and watershed drainage patterns. NCDOT obtained the topographic survey of the restoration site in March 2002. This mapping was used to evaluate present conditions, new channel alignment and grading volumes. Mapping at this time does not provide the locations of property pins, fence lines, large trees, vegetation lines, culverts, or roads.

A walkover of the property was conducted to better evaluate the drainage properties of the area surrounding the restoration site. Chatham County provided Geographic Information System (GIS) data to evaluate the watershed. A windshield survey was also conducted to determine the existing conditions within the watershed. During the Condoret Tract site visits, fifteen (15) cross-sections were taken using standard differential leveling techniques. These cross-sections were used to gather detail on the present dimension and condition of the channel. Cross-sectional area was calculated using the bankfull features. See Appendix A for a copy of the existing condition surveys.

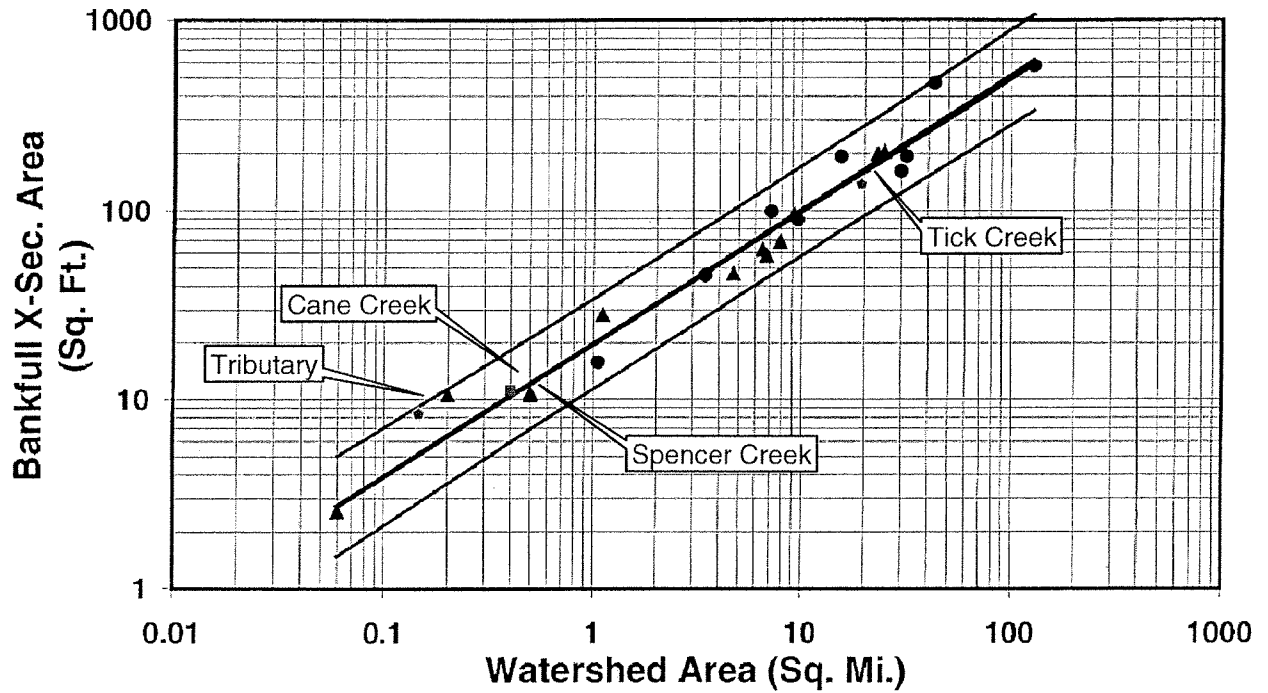
#### **1.4 BANKFULL VERIFICATION**

The foundation of Dave Rosgen's classification system is the concept of bankfull stage, which is the point of incipient flooding. If bankfull is incorrectly determined in the field, the entire restoration effort will be based on faulty data. It is important to verify the physical indicators observed in the field with either gage data or a regional curve to ensure the correct assessment of the bankfull stage.

The most common method of verifying bankfull stage is to compare the field determined bankfull stage with measured stages at a stream gaging station. This calibration can be performed if there is a stream gage within the study area's hydrophysiographic region.

In ungaged areas, Dave Rosgen recommends verifying bankfull with the development of regional curves. The regional curves normally plot bankfull discharge ( $Q_{bkt}$ ), cross-sectional area, width, and depth as a function of drainage area. The cross-sectional areas of Tick Creek, the Unnamed Tributary, and the reference reach sites used for this report are plotted on the Rural Piedmont Regional Curve of North Carolina developed by the North Carolina State University (NCSU) Water Quality Group, 2000 (Figure 3).

Data obtained from field surveys described in Section 2.2.2 were used to compute the morphological characteristics shown on the graph. The cross-sectional areas for Tick Creek and the Unnamed Tributary plot along the trend line for the Rural Regional Curve. The bankfull cross-sectional area for the Unnamed Tributaries design channel was determined from evaluating the North Carolina regional curve relationships and comparing them to the reference reach sites surveyed near the restoration site.



$A_{bkf} = 18.21 A_w^{0.75}; (R^2 = 0.98)$   
 $A_w = \text{watershed drainage area (mi}^2)$   
 $A_{bkf} = \text{bankfull cross sectional area (ft}^2)$

- ▲ Reference Reaches
- Gage Stations
- Project Reference Reaches
- Project Site
- Upper 95%
- Predicted
- Lower 95%



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**FIGURE 3**  
**SPENCER CREEK**  
**NORTH CAROLINA REGIONAL CURVE**  
**RESTORATION PLAN**  
**TICK CREEK**  
**CHATHAM COUNTY**

## 2.0 EXISTING CONDITIONS

### 2.1 WATERSHED

#### 2.1.1 General Description of the Watershed

Tick Creek is located within the Piedmont Physiographic Province of the Cape Fear River Basin (USGS Cataloging Unit 03030003). The headwaters to this third order stream originate about 7.2 miles west of the project area. Tick Creek flows from the beginning of the project area for approximately 2.0 miles before joining with the Rocky River. Portions of the Rocky River downstream of Tick Creek are designated as a Proposed Critical Habitat area for the Cape Fear Shiner (*Notropis mekistocholas*).

The watershed is approximately 13,056 acres or 20.4 square miles to the end of the project site (Figure 4). Topography of the area is characterized as hilly with fairly flat floodplains adjacent to the large drainage ways. The watershed gradient is approximately 0.51 percent. The floodplain near the project site is wide and flat meeting adjacent hillslopes. The small headwater streams that feed into Tick Creek are typically forested with few small cleared areas. However agricultural fields are present along the larger tributaries and Tick Creek

The Unnamed Tributary to Tick Creek watershed is approximately 96 acres or 0.15 square miles to the confluence with Tick Creek. The headwaters originate about 0.75 miles north of the confluence with Tick Creek.

#### 2.1.2 Surface Waters Classification

Surface waters in North Carolina are assigned a classification by the DWQ that is designed to maintain, protect, and enhance water quality within the state. Tick Creek (NCDWQ Stream Index Number – 17-43-13) is classified as a Class C water body (NCDENR, 2001). *Class C* water resources are waters protected for aquatic life propagation and survival, fishing, wildlife, secondary recreation, and agriculture. Secondary recreation includes wading, boating, and other uses involving human body contact with water where such activities take place in an infrequent, unorganized, or incidental manner. There are no restrictions on watershed development activities.

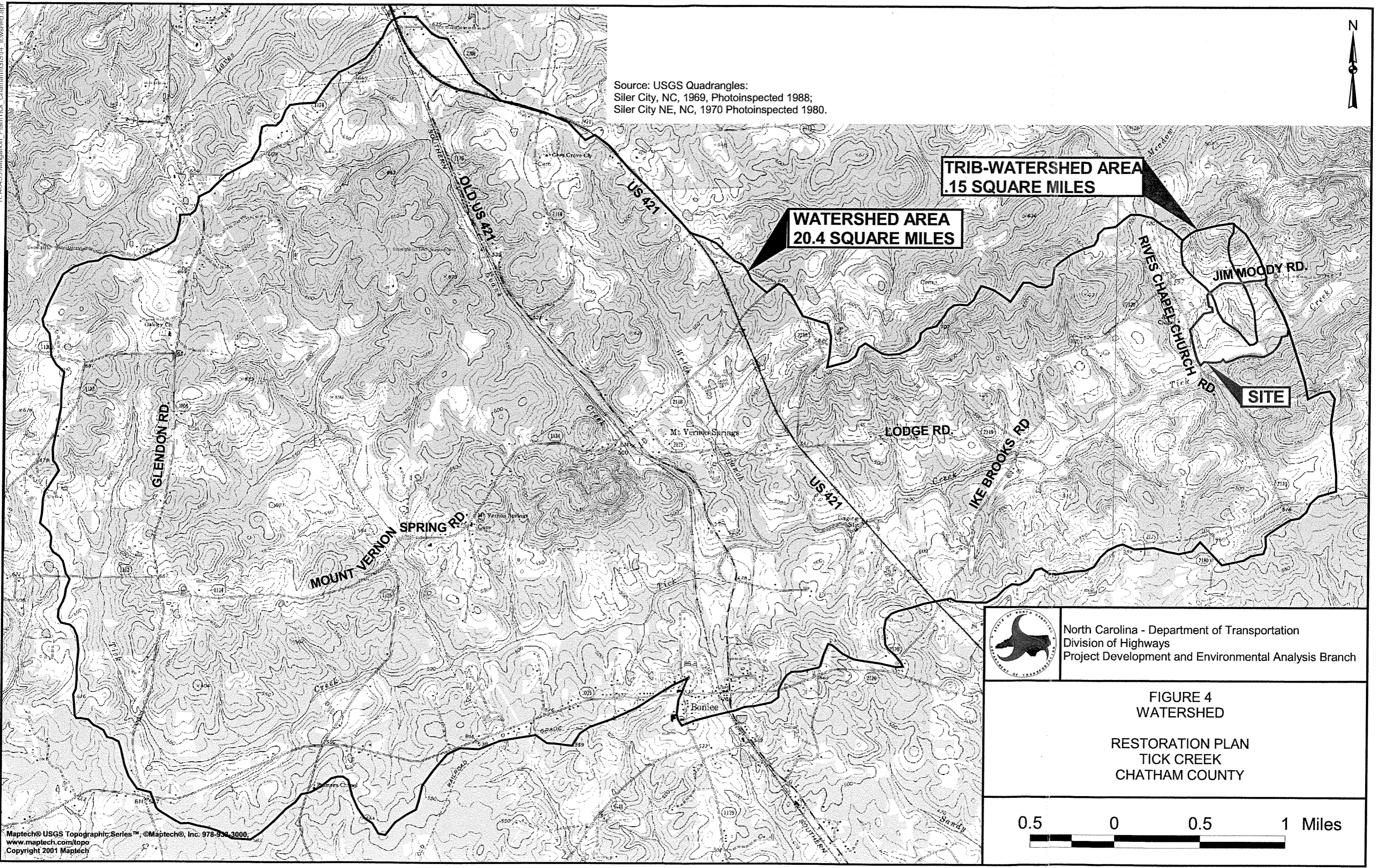
#### 2.1.3 Soils of the Watershed

The majority of the soils in the watershed are moderately permeable Georgeville silt loam and silty clay loam, and the Georgeville-Badin soil complex. The moderately permeable Nanford-Badin soil complex also constitutes a large portion of the watershed. These soil types are found on moderate side slopes and rolling hills ranging from 2 to 30 percent slope and are well drained. The upland soils were largely formed in material weathered from fine-grained metavolcanic rocks of the Carolina Slate Belt.

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Source: USGS Quadrangles:  
Siler City, NC, 1969, Photoinspected 1988;  
Siler City NE, NC, 1970 Photoinspected 1980.



**TRIB-WATERSHED AREA  
1.5 SQUARE MILES**

**WATERSHED AREA  
20.4 SQUARE MILES**

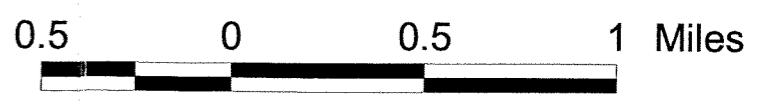
**SITE**



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**FIGURE 4  
WATERSHED**

**RESTORATION PLAN  
TICK CREEK  
CHATHAM COUNTY**



#### **2.1.4 Land Use of the Watershed**

The main land use throughout the watershed is agriculture with about half of the watershed remaining forested (Figure 5). The majority of the large pasture areas are located along the flat floodplains of Tick Creek, since the upland areas are not as conducive for farming. US 421 bisects the watershed into an east and west section. All of the parcels of land in the watershed support agriculture and/or single-family housing. It is unclear at this time if any future development is planned within the watershed.

### **2.2 RESTORATION SITE**

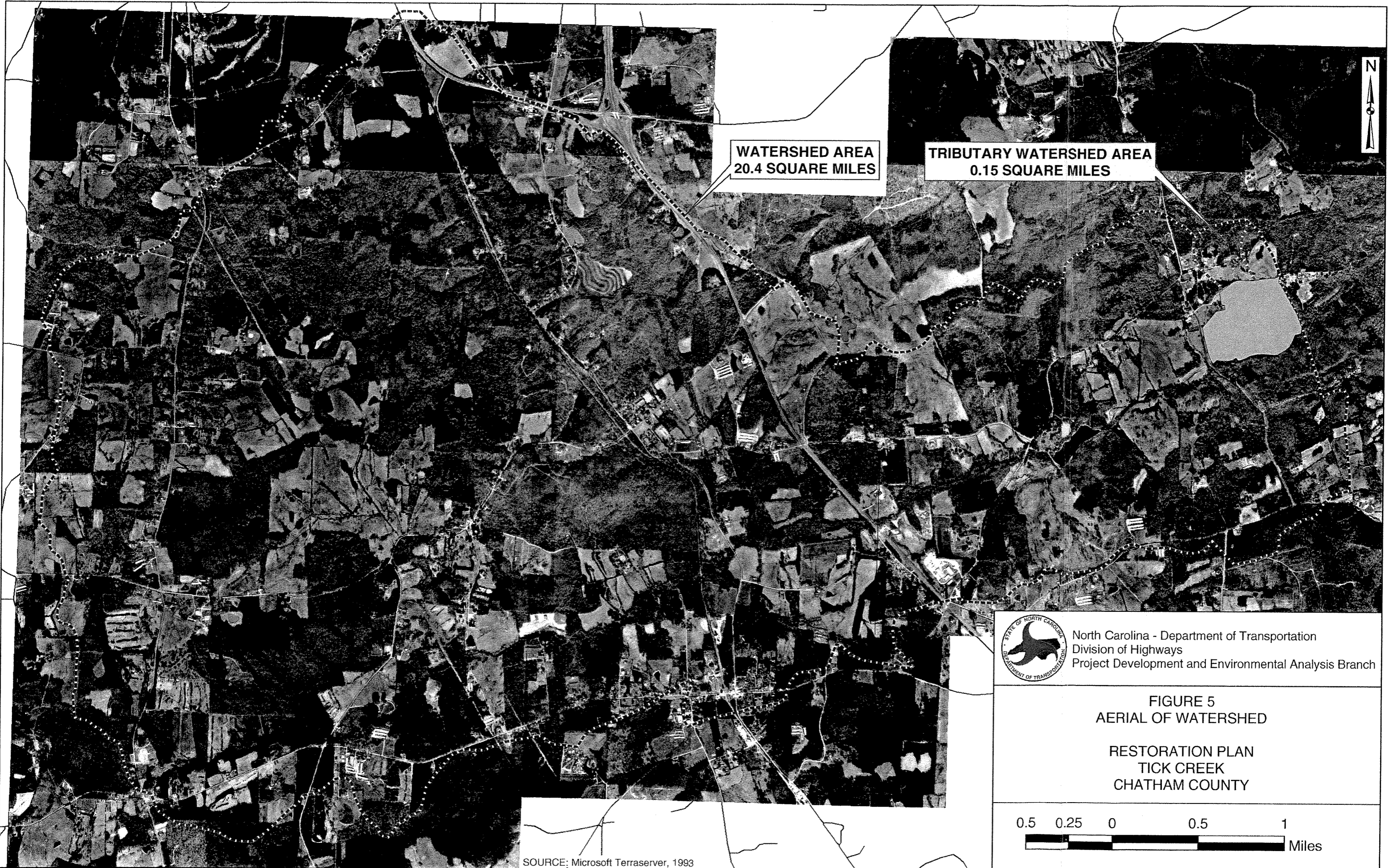
The following sections provide a description of existing site conditions. This includes the current stream conditions, soils, and surrounding plant communities.

#### **2.2.1 Site Description**

The site is located in the central portion of Chatham County, east of the Rocky River and southeast of Siler City, North Carolina. The Condorets own the 134-acre tract of land containing 3,733 linear feet of Tick Creek and 2,597 linear feet of the Unnamed Tributary to Tick Creek. The land adjacent to the streams is in pasture and was managed for cattle production. Until taking the pastures out of use permanently this year, the Condorets leased the land out to a farmer in the area who raised approximately 90 head of cattle during the fall and winter. The two streams were the only source of water for the cattle, and therefore, they were given unrestricted access to the streams. Thus, severe erosion is occurring on the unvegetated streambanks.

The site has a wide flat floodplain along Tick Creek with adjacent rolling hills, where as the tributary has a narrow valley along the majority of the stream before flowing into the floodplain of Tick Creek. The floodplain along Tick Creek varies from 200 feet to 500 feet across, and the floodplain of the tributary has an average width of 100 feet.

According to the Chatham County Flood Insurance Rate Map (370299 0125 B, July 16, 1991), the floodplain along Tick Creek is designated as Zone A. Zone A is registered by the Federal Emergency Management Administration (FEMA) as an area inside of the 100-year floodplain with no base flood elevations determined.



### **2.2.2 Existing Stream Characteristics**

Field surveys of the existing stream channels and surrounding floodplains were conducted on February 26 through 28, 2002, March 4, 2002 and March 6, 2002 to determine the potential for stream mitigation on-site. The stream measurements are critical to the classification and assessment of the existing stream type and provide data to classify the stream using the Rosgen classification method, Levels I and II (Rosgen 1996). Appendix A contains the existing conditions data.

Six (6) cross-sections of the existing Tick Creek channel were established. Nine (9) cross-sections of the existing Unnamed Tributary to Tick Creek were established. Pebble counts, pavement, and subpavement samples were taken along Tick Creek and its tributary. Meander length, beltwidth, and radius of curvature were measured in areas with sinuosity. An estimation of the bank erosion potential was conducted at the fifteen cross-sections using the Bank Erodibility Hazard Index (BEHI) developed by Rosgen (1996).

While conducting the field survey, visual observations were made regarding the stream condition, seep locations, disturbed wetland areas, stream crossings, fencing layout, and other unique features of the stream and surrounding floodplain.

The main drainage feature at the site is Tick Creek. The stream enters the site from the west and flows along the southern portion of the property to the east for approximately 3,733 feet. The stream has a sinuosity of 1.3. The banks along the entire stream are almost entirely vertical, but have substantial vegetation in place that supply the banks stability. A few areas have localized instability due to recent beaver activity and debris jams. The stream is already beginning to regain stability from these short timeframe events. The thick bank vegetation and vast amounts of bedrock insure that Tick Creek remains in its stable state. The bedrock provides natural grade control for the stream throughout the Condoret property.

The existing bankfull width for Tick Creek averages 39 feet. The maximum depth is 4.2 feet with a mean depth of 3.2 feet. The average bankfull area is 126 square feet, which falls well within the confidence limits of the North Carolina Rural Piedmont Regional Curve. According to the North Carolina Piedmont Regional Curve, this section of channel should have a bankfull cross-sectional area of about 85 to 300 square feet. The average Bank Erodibility Hazard Index (BEHI) for Tick Creek corresponds to a Moderate Bank Erosion Potential (BEP). The entire reach classified as a C-type channel. The width to depth ratio for the entire stream averages about 12.

The second largest drainage feature at the site is the Unnamed Tributary to Tick Creek. The stream enters the site from the north and flows approximately 2,597 feet south, bisecting the property before emptying into Tick Creek. The tributary has suffered from unrestricted cattle access. The cattle used the stream and its forested buffer frequently for

water and shade, and, as a result, there are large eroded stream crossings along the entire stream. The stream can be separated into three reaches. The upper reach (Reach 1) classifies as an E-type channel. The middle reach (Reach 2) begins as an E-type channel and transitions into a G-type before entering the floodplain of Tick Creek. Reach 3 is entirely within the floodplain of Tick Creek and classifies as a G-type channel.

The average bankfull width for the entire tributary is 7.5 feet. The maximum depth is 1.7 feet and the mean depth 1.2 feet. The average bankfull area is 8.8 square feet. Because of its small drainage area, the North Carolina Piedmont Regional Curve is not applicable. However, existing reference reach data from other small Piedmont streams indicates that the tributary should have a bankfull cross-sectional area between 2.5 and 10 square feet. The tributary has an average Bank Erodibility Hazard Index (BEHI) that corresponds to a High Bank Erosion Potential (BEP).

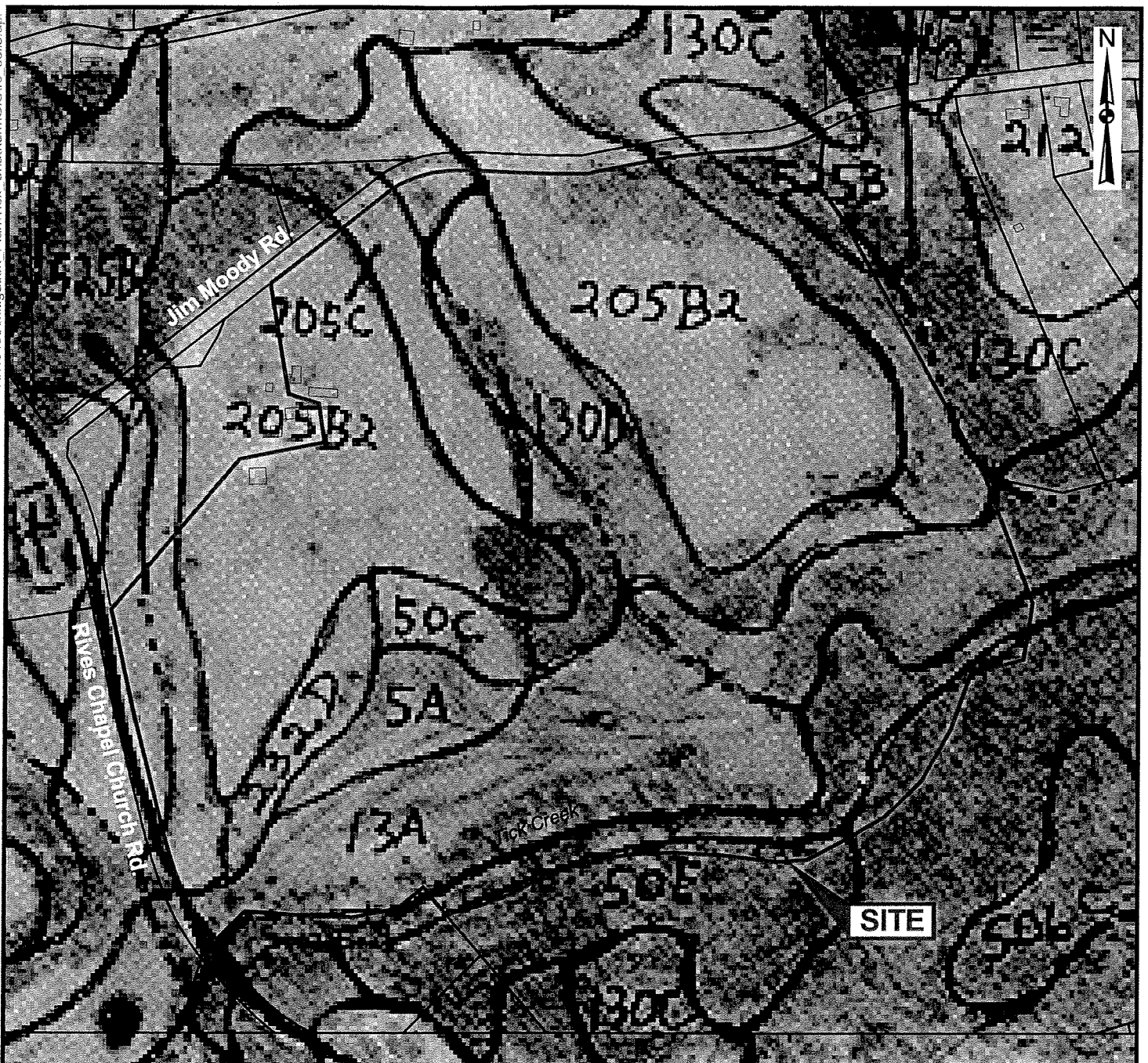
### **2.2.3 Soils of the Restoration Site**

Draft soil maps and descriptions provided by the Chatham County Soil Survey Office show Riverview silt loam (13A) mapped on both banks of Tick Creek (Figure 6). This soil ranges from slightly to very strongly acid, and has moderate permeability. It is formed in loamy alluvium on floodplains. Flooding occurs for short periods in winter or early spring. The seasonal high water table is 3-5 feet below the surface. Riverview silt loam is not considered a hydric soil.

The section of the Unnamed Tributary from its confluence with Tick Creek to a point about 400 feet upstream also runs through the Riverview map unit. From this point to a point 1300 feet upstream, the Nanford-Badin complex (130D) is mapped on both banks. From this point to the origin of the Unnamed Tributary, Georgeville silt loam (205C) is mapped on both banks. The Nanford-Badin complex consists of soils that are deep to moderately deep, well drained, and moderately permeable. These soils formed in residuum weathered from fine-grained metavolcanic rock. The water table is more than 6 feet below the surface. Georgeville soils are very deep, well drained soils, with moderate permeability. They formed in similar parent material and also have a water table more than 6 feet deep.

A small pocket of Chewacla and Wehadkee soils (5A) is mapped in the floodplain adjacent to the Riverview unit. Chewacla and Wehadkee soils are somewhat poorly drained to very poorly drained soils. Flooding ranges from rare to frequent. Chewacla soils have a seasonal high water table within 24 inches of the surface. Wehadkee soils are on the national hydric soils list and have a seasonal high water table within 12 inches of the surface. Chewacla soils are considered hydric when frequently flooded. The location of this unit at the base of a slope suggests that the hydrology may be influenced more by seepage and poorly drained soils than by flooding. The bank height of Tick Creek, as well as the distance from the slope, may preclude frequent flooding of this area.





Source: Chatham County Progressive Soil Survey, Sheet D4, 1993.



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Soils	
5A	Chewacla & Wehadkee soils, 0-2% slopes, frequently flooded
13A	Riverview silt loam, 0-3% slopes, frequently flooded
50C,130C	Badin-Nanford Complex, 10-15% slopes
50E,130D	Nanford-Badin Complex, 15-30% slopes
205B2	Georgeville silty clay loam, 2-6% slopes, moderately eroded
205C	Georgeville silt loam, 6-10% slopes
232D	Georgeville-Badin complex, 2-6% slopes
525B	Cid-Lignum complex, 2-6% slopes

FIGURE 6  
SOILS

RESTORATION PLAN  
TICK CREEK  
CHATHAM COUNTY



## 2.2.4 Terrestrial Plant Communities

NRCS aerial photographs show that the pastures have remained relatively unchanged since 1955. The riparian buffer along Tick Creek has widened, especially on the downstream half of the reach. Currently, a relatively undisturbed forest lines both banks of this reach of Tick Creek through the entire study area. The trees along Tick are currently mature enough for harvesting, an activity that would eliminate any remaining riparian buffer. A steep forested slope rises from the right bank at the upstream end of the study reach. The remainder of Tick Creek runs through a flat floodplain. The vegetative cover associated with the Unnamed Tributary includes treeless pasture, a single row of trees with shrubby and herbaceous understory, and a 50-foot wide forest buffer. Most of the remainder of the property consists of pastures and hayfields. Two small areas of hayfield were evaluated for wetland restoration potential. The vegetation in these areas is described below.

### 2.2.4.1 Bottomland Hardwood Forest

A strip of bottomland hardwood forest covers both banks of Tick Creek and both banks of the lower reach of the Unnamed Tributary. The width of this forest buffer is 200 feet or greater along Tick Creek, but only about 50 feet along the Unnamed Tributary. The mixed-age stand has a diverse species composition and a dense understory. Tree species include mockernut hickory (*Carya tomentosa*), bitternut hickory (*Carya cordiformis*), shagbark hickory (*Carya ovata*), hackberry (*Celtis laevigata*), swamp chestnut oak (*Quercus michauxii*), sycamore (*Platanus occidentalis*), green ash (*Fraxinus pennsylvanica*), sweetgum (*Liquidambar styraciflua*), ironwood (*Carpinus caroliniana*), river birch (*Betula nigra*), red cedar (*Juniperus virginiana*), box elder (*Acer negundo*), buckeye (*Aesculus sylvatica*), possumhaw (*Ilex decidua*), and hop-hornbeam (*Ostrya virginiana*). Shrubs, vines, and herbs include spicebush (*Lindera benzoin*), paw-paw (*Asimina triloba*), muscadine (*Vitis rotundifolia*), trumpet creeper (*Campsis radicans*), greenbrier (*Smilax rotundifolia*), violets (*Viola* spp.), false stinging-nettle (*Boehmeria cylindrica*), cardinal flower (*Lobelia cardinalis*), monkey flower (*Mimulus ringens*), pennywort (*Centella asiatica*), poison ivy (*Toxicodendron radicans*), and Christmas fern (*Polystichum acrostichoides*). Several exotic invasive plants are also well established in the understory. These include autumn olive (*Eleagnus umbellata*), Chinese privet (*Ligustrum sinense*), Japanese grass (*Microstegium vimineum*), and Japanese honeysuckle (*Lonicera japonica*).

### 2.2.4.2 Mesic Mixed Hardwood Forest

Mesic mixed hardwood forests in the Carolina Piedmont occur on steep to moderate slopes where topographic position or aspect result in rich, moist conditions. At the upstream end of the Tick Creek study reach, a steep north-facing slope rises from the right bank. It is dominated by large-diameter beeches (*Fagus grandifolia*) and has a sparse understory with occasional rocky outcrops. Other species in this community

include mockernut hickory, sweetgum, river birch, yellow poplar (*Liriodendron tulipifera*), paw-paw, American holly (*Ilex opaca*), flowering dogwood (*Cornus florida*), buckeye, Christmas fern, wild ginger (*Hexastylis arifolia*), yellowroot (*Xanthorhiza simplicissima*), and Japanese grass. Bluffs such as this one are often rich in spring ephemerals such as trout lily (*Erythronium umbilicatum*), liverwort (*Hepatica americana*), mayapple (*Podophyllum peltatum*), and foamflower (*Tiarella cordifolia*).

The upper reaches of the Unnamed Tributary flow through moderately sloping, gently rolling pastures. Although only a very narrow strip of vegetation remains on the banks in this area, the pastures were probably a mesic mixed hardwood forest at one time. This assumption is based on the soil type, the position on the lower slope of a hillside, and the hydrologic regime. Along the middle reach of the Unnamed Tributary, the riparian buffer widens somewhat as the topography flattens out and the floodplain area increases. This area is dominated by beech and includes American elm (*Ulmus americana*), yellow poplar, red maple, and persimmon (*Diospyros virginiana*). The herb layer is dominated by Japanese grass. Japanese honeysuckle, giant cane (*Arundinaria gigantea*), greenbrier, and false stinging-nettle are also sparsely distributed.

#### 2.2.4.3 Managed Herbaceous Community

A 3-acre area in the southeast corner of the property is currently managed as a hayfield or pasture. It lies between two drainages mapped as intermittent streams by the NRCS. Two shallow ditches cross the field perpendicular to the mapped drainages. This whole area is mapped as Riverview silt loam, a non-hydric soil. Only a small area between the ditches was found to have hydric soils. The area is dominated by planted forage grasses, but some hydrophytic vegetation occurs as well, mainly in and along the ditches. Species include swamp milkweed (*Asclepias incarnata*), monkey flower (*Mimulus alata*), ironweed (*Vernonia noveboracensis*), and sensitive fern (*Onoclea sensibilis*) in the field. Black willow (*Salix nigra*), rushes (*Juncus* spp.), spotted jewelweed (*Impatiens capensis*), and green ash (*Fraxinus pennsylvanica*) occur in the ditches.

A similar one-acre area occurs in the southwest corner of the property. It lies at the base of a slope and is crossed by two ditches that run parallel to Tick Creek. The ditches merge at the base of the dam and a single ditch continues across the pasture, emptying into the Unnamed Tributary. Soils in the one-acre area are mapped as Chewacla and Wehadkee soils. The surrounding 4-5 acre pasture is Riverview silt loam. The vegetation is the same as described above, with the addition of cardinal flower (*Lobelia cardinalis*), arrowhead (*Sagittaria latifolia*), a spikerush (*Eleocharis* sp.) and a beakrush (*Rhynchospora* sp.) along the ditches.

#### 2.2.5 Rare and Protected Species

Plants and animals with a federal classification of Endangered (E), Threatened (T), Proposed Endangered (PE), and Proposed Threatened (PT) are protected under provisions of Section 7 and Section 9 of the Endangered Species Act of 1973, as amended. Federal Species of Concern (FSC) are not legally protected under the Endangered Species Act

and are not subject to any of its provisions, including Section 7, until they are formally proposed or listed as Threatened or Endangered. The USFWS lists 4 species under federal protection and 7 FSC species for Chatham County as of March 22, 2001 (USFWS 2001). These species are listed in the table below along with an evaluation of habitat in the project area.

Common Name	Scientific Name	Status	Habitat Present
<b>Vertebrates</b>			
Bachman's sparrow	<i>Aimophila aestivalis</i>	FSC	No
Bald eagle	<i>Haliaeetus leucocephalus</i>	Threatened	No
Cape Fear shiner	<i>Notropis mekistocholas</i>	Endangered	Yes
Carolina redbreast	<i>Moxostoma sp.</i>	FSC	Yes
Red-cockaded woodpecker	<i>Picoides borealis</i>	Endangered	No
<b>Invertebrates</b>			
Atlantic pigtoe	<i>Fusconaia masoni</i>	FSC	Yes
Brook floater	<i>Alasmidonta varicosa</i>	FSC	Yes
Septima's clubtail dragonfly	<i>Gomphus septima</i>	FSC	Yes
Yellow lampmussel	<i>Lampsilis cariosa</i>	FSC	Yes
<b>Vascular Plants</b>			
Harperella	<i>Ptilimnium nodosum</i>	Endangered	No
Virginia quillwort	<i>Isoetes virginica</i>	FSC	No

No habitat exists in the project area for any threatened or endangered species except perhaps the Cape Fear shiner. Tick Creek drains to the Rocky River, which is designated as Critical Habitat for this small fish. Tick Creek, within the project area, contains habitat of this type. The habitat for the Cape Fear shiner is described as "clean streams with gravel, cobble, or boulder substrates with pools, riffles, shallow runs and slackwater areas with large rock outcrops and side channels and pools with water of good quality with relatively low silt loads." A survey for this species should be conducted if any work is planned for this reach of Tick Creek.

Cape Fear shiner Critical Habitat in the Rocky River is located three miles downstream from the mitigation site. As noted earlier, Tick Creek within the project area contains habitat of this type. Protection of the riparian habitats along the Rocky River and its tributaries such as Tick Creek is critical for the continued survival of the Cape Fear shiner.

The NCDOT conducted a survey for mussel species in Tick Creek. This survey yielded eight mussel species in addition to two clams and three aquatic snails. Four species have state protection designations. Although not found during the July 2002 survey, it was noted that habitat in Tick Creek exists for Atlantic pigtoe, brook floater and Savanna liliput and the potential for locating these species in future surveys exists. These species are currently listed as Federal Species of Concern. A report documenting the survey can be found in Appendix C.

Although no federally protected species were found, the survey revealed that a viable and diverse mussel fauna occurs in Tick Creek. Mussel populations in the main channel of Rocky River have shown a decline in recent years. Thus, Tick Creek serves as valuable refugia for these species, and it is a significant stream for maintaining species diversity in the Rock River Subbasin. The threat of the possible harvesting of mature trees that remain along the riparian buffer of Tick Creek could severely damage mussel and aquatic habitat. The protection of wide riparian habitat of Tick Creek is crucial to the continued survival of the freshwater mussel species population in the creek.

### **3.0 REFERENCE REACHES**

#### **3.1 SPENCER CREEK**

Spencer Creek, a first order stream, is located in Uwharrie National Forest within the Yadkin-Pee Dee River basin, Piedmont Physiographic Province. The reach length surveyed is 266 feet. This reach classifies as an E4 stream type with a drainage area of 0.5 square miles (Figure 7). Spencer Creek has an average bankfull width of 8.7 feet and a water surface slope of 0.013 ft/ft. This stream has a very low sinuosity and dense shrub, deciduous, and coniferous vegetation lining the banks and floodplain. This vegetation, along with bedrock outcroppings, has an impact in defining pattern and bedform. Bankfull indicators are prevalent along the stream. These indicators include breaks in slope of the bank, depositional benches on the inside of meanders, and scour lines along riffles and outside meander banks. The bank height ratio of Spencer's Creek is equal to 1.0 and the entrenchment ratio is 26.3.

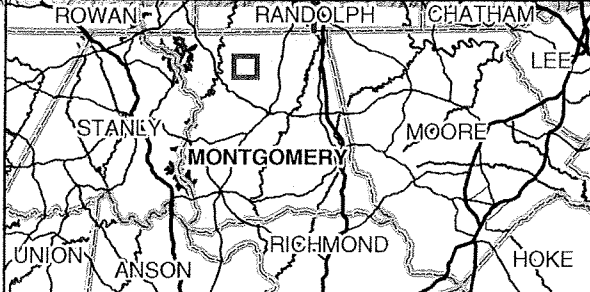
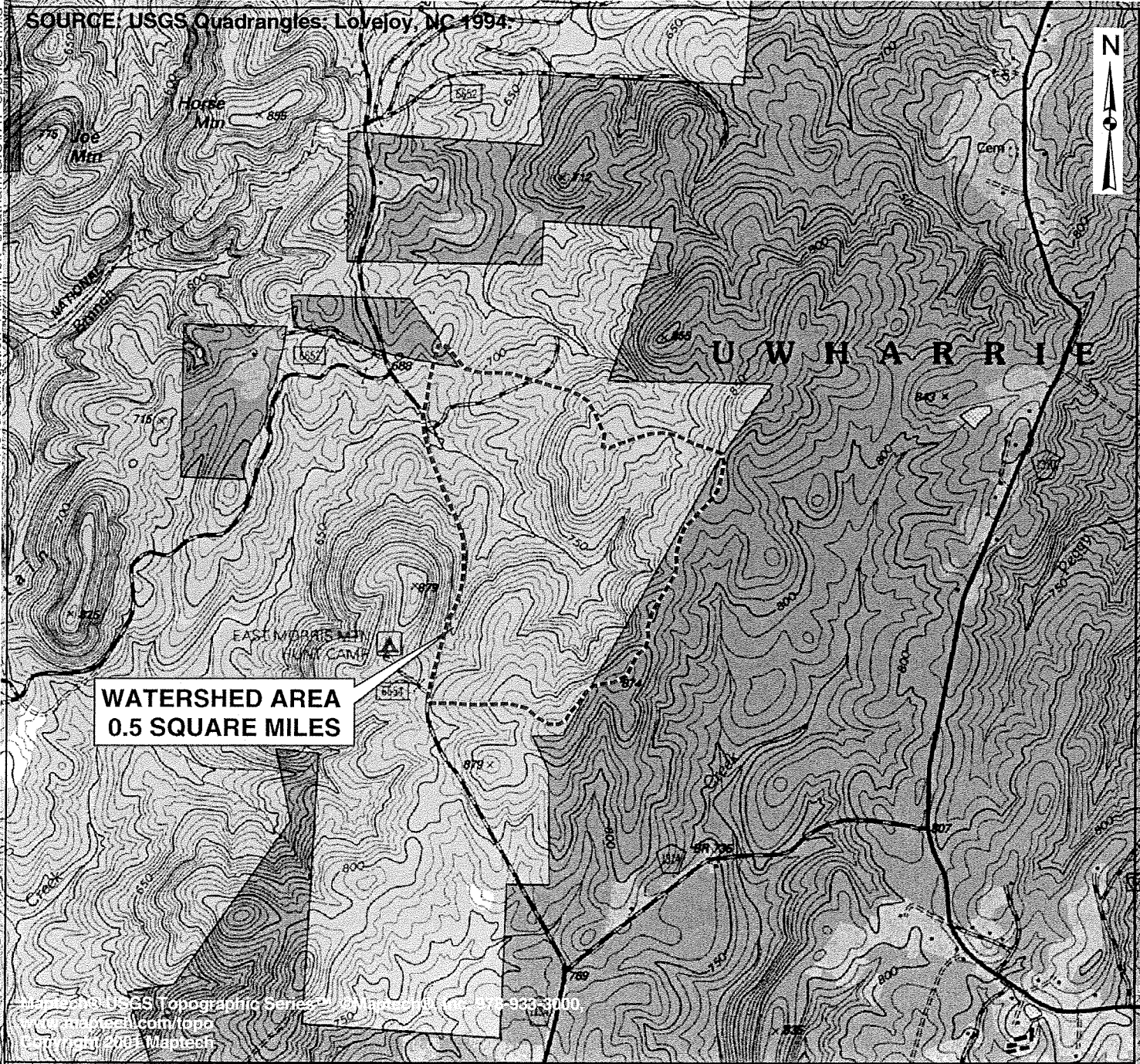
#### **3.2 TRIBUTARY TO SOUTH FORK OF CANE CREEK**

The Tributary to South Fork of Cane Creek, a second order stream, is located to the east of Crutchfield Crossings in Chatham County. Crutchfield Crossings is to the north of Highway 64 and Siler City (Figure 8). The reach surveyed is located to the southeast of Tom Stevens Road and begins approximately 300 feet downstream of the culvert. The drainage area for the reach surveyed is 260 acres or 0.41 square miles. The site has a relatively narrow floodplain with adjacent rolling hills. The watershed has a 4 percent slope with a stable landuse consisting of large forested areas with few pasture areas. The floodplain has mature forest with a well-developed understory and no signs of recent disturbance from farming practices. Well-established deciduous vegetation lines the banks and adjacent hillslopes.

Earth Tech surveyed the stream on April 2, 2002. Channel dimension, pattern, and profile were measured for 460 linear feet of stream. The stream had a bankfull channel width of 13.1 feet and a bankfull mean depth of 0.9 feet. The Tributary to South Fork of Cane Creek is a C4 stream type. A biological assessment was not conducted on this stream. Longitudinal profile, cross-sections, and the pebble count for this reference reach are located in Appendix D.

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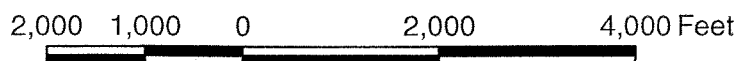
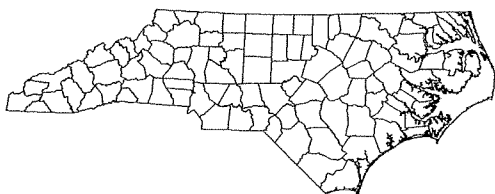
SOURCE: USGS Quadrangles: Lovejoy, NC 1994.



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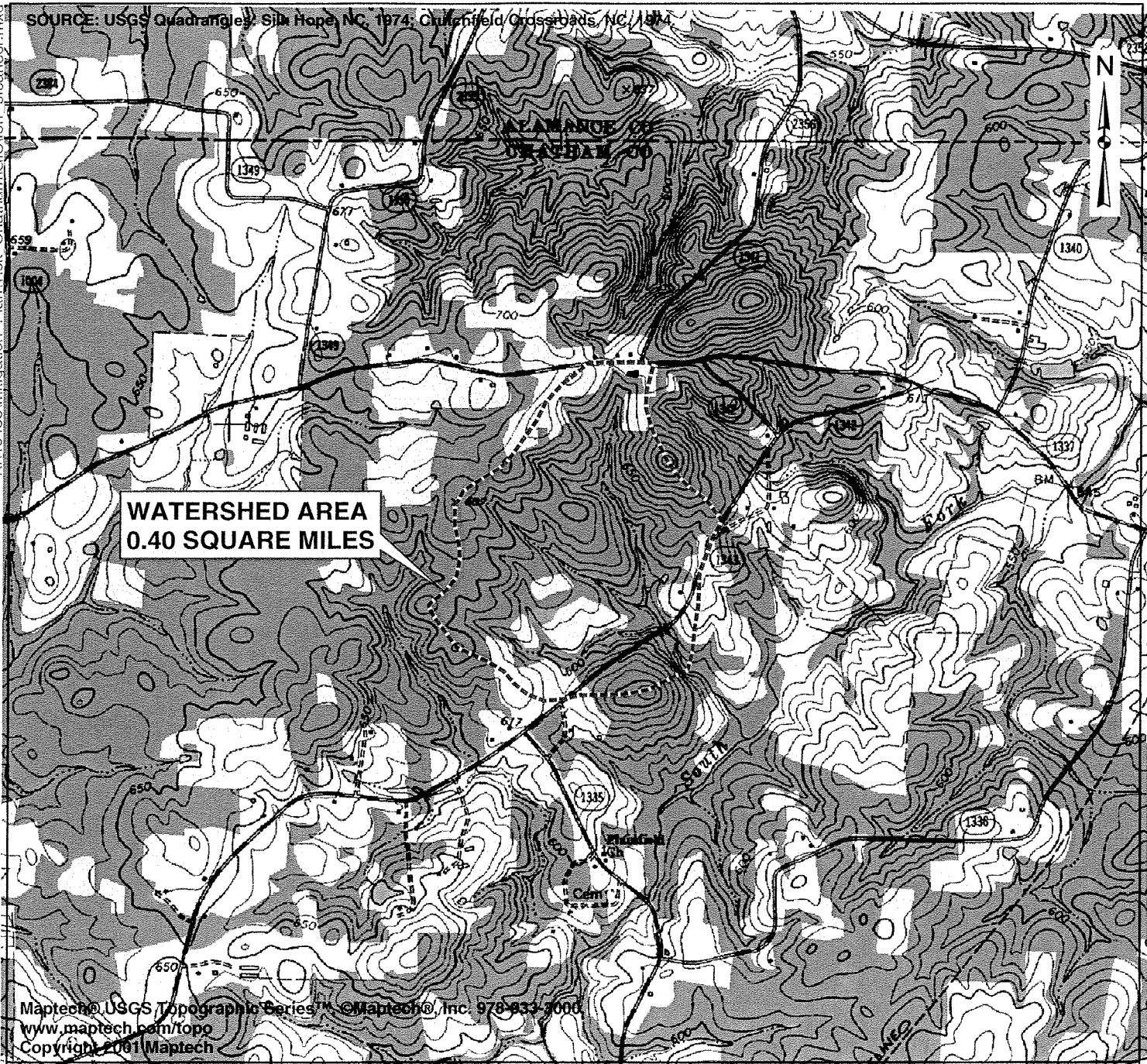
**FIGURE 7**  
**SPENCER CREEK - WATERSHED**

**RESTORATION PLAN**  
**TICK CREEK**  
**CHATHAM COUNTY**



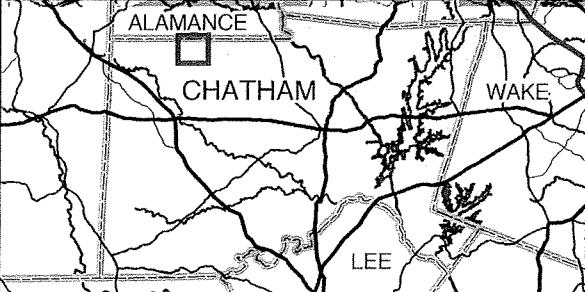
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SOURCE: USGS Quadrangles: Silk Hope, NC, 1974; Cliftonfield/Crossroads, NC, 1974



**WATERSHED AREA  
0.40 SQUARE MILES**

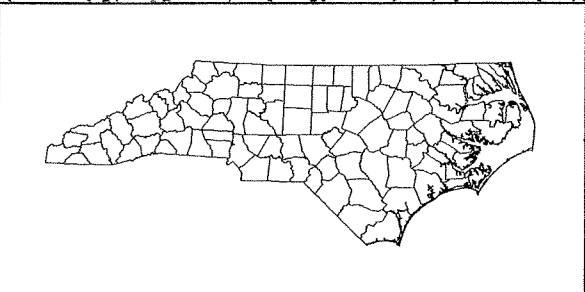
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### FIGURE 8 UT SOUTHFORK CANE CREEK WATERSHED

### RESTORATION PLAN TICK CREEK CHATHAM COUNTY



## **4.0 STREAM MITIGATION DESIGN**

The design was based upon Dave Rosgen's 40-step natural channel design methodology. Morphological characteristics were measured on the existing stream and reference reaches to determine a range of values for the stable dimension, pattern, and profile of the proposed channel. The measured and proposed morphological characteristics are shown in Table 1.

### **4.1 COMPONENTS**

A Priority 1 restoration will be used to adjust the stream dimension, pattern and profile of the Unnamed Tributary to allow the stream to more fully transport its water and sediment load. A combination of bedform transformations, channel dimension adjustments, pattern alterations, structure installation, and vegetation will be used to accomplish this. The Unnamed Tributary will be split into three distinct reaches to accurately represent the three different stream valleys.

#### **4.1.1 Dimension**

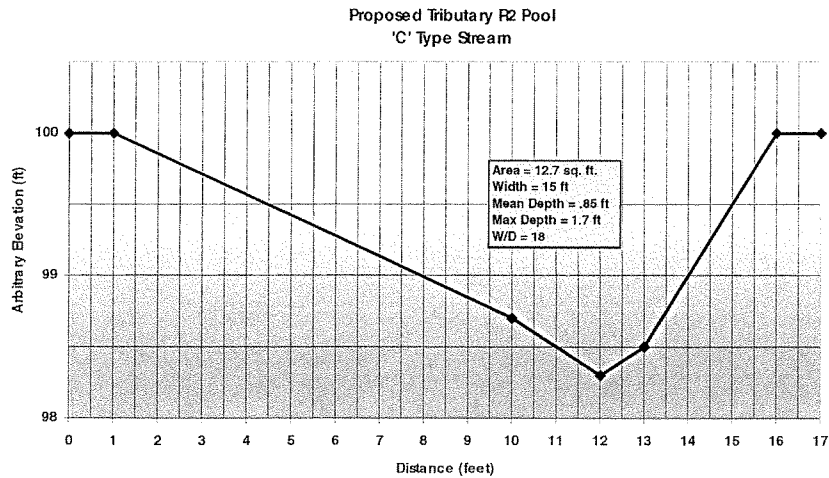
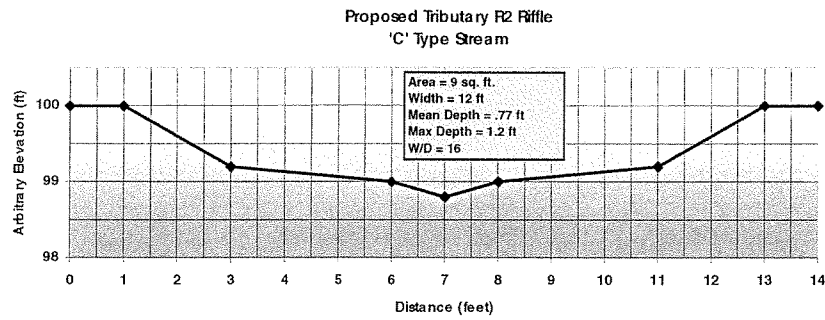
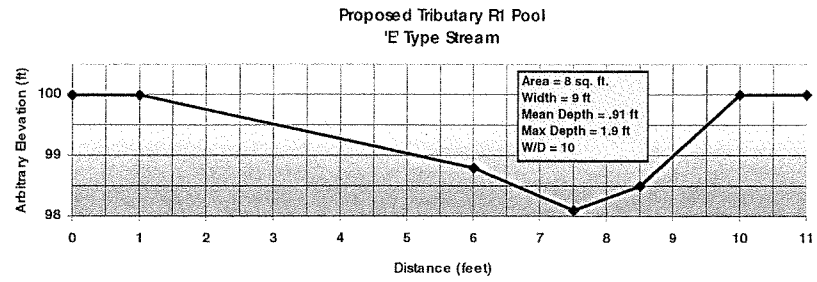
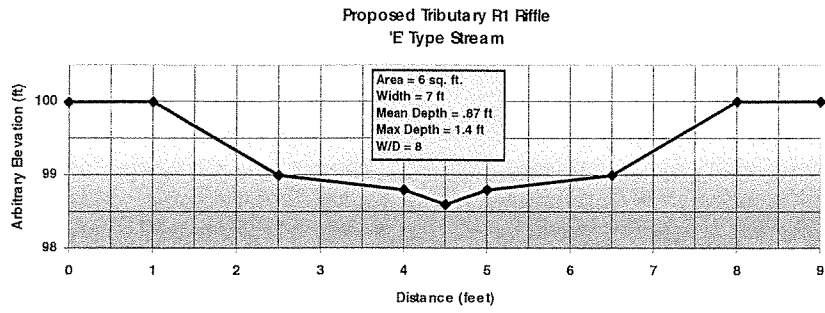
The bankfull widths of the Unnamed Tributary channel range from 6.8 to 7.8 feet with cross-sectional area ranging from 6.3 to 9.4 square feet. The design channel will be constructed to bankfull target dimensions that are based on reference reach data and regional curve information for C and E-type channels under the Rosgen Stream Classification System.

The proposed Tributary channel will begin as an E-type stream in Reach 1, transitioning to a C-type stream in Reach 2, and back to an E-type in Reach 3. The bankfull cross-sectional area of the Tributary will range between 6 and 9 square feet with widths ranging between 6.9 and 12 feet. The proposed cross-sections for each of the reaches are provided below in Figure 9a and 9b.



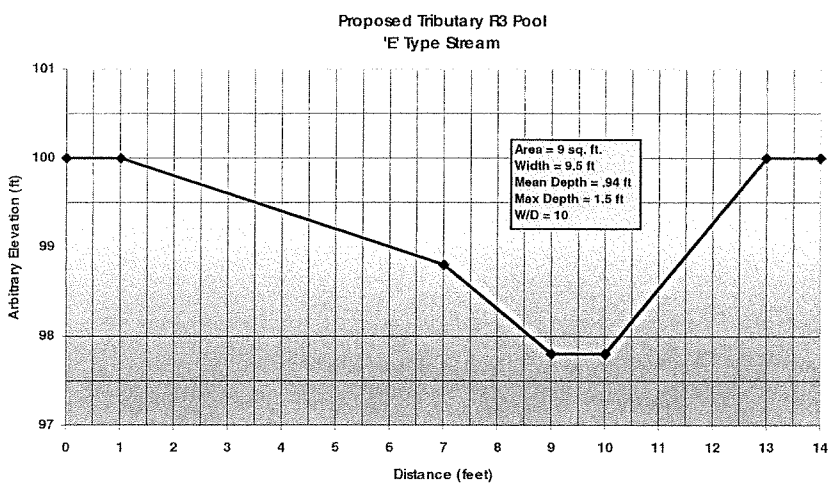
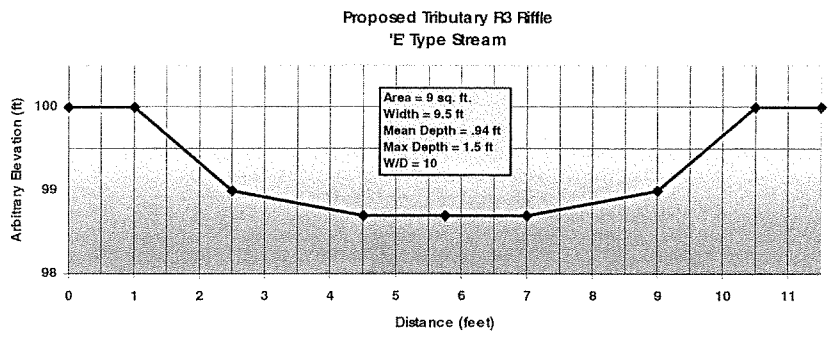
Table 1. Morphological Characteristics: Existing, Reference, and Proposed Reaches

Variables	Tributary REACH 1	Tributary REACH 2	Tributary REACH 3	Tick Creek	Reference Reach-Tributary to South Fork of Cane Creek	Reference Reach-Spencer's Creek	Proposed Tributary Channel REACH 1	Proposed Tributary Channel REACH 2	Proposed Tributary Channel REACH 3
Stream Type (Rosgen)	E4b	E4-G4	E4	C4/E4	C4	E4	E4b	C4	E4
Drainage Area (sq. mi.)	0.15	0.15	0.15	20	0.41	0.5	0.15	0.15	0.15
Bankfull Width ( $W_{bkf}$ , ft)	7.3	7-8.6	5.6-7.9	36-41	13.0-13.1	8.7-12.3	6.9	12.0	9.5
MEAN	7.3	7.8	6.8	39	13.1	10.5			
Bankfull Mean Depth ( $dbkf$ , ft)	0.9	0.9-1.3	1.2-1.7	3.0-3.6	0.9	0.9-1.2	0.87	0.75	0.95
MEAN	0.9	1.2	1.50	3.20	0.9	1			
Width/depth Ratio ( $W_{bkf}/dbkf$ )	8.5	5.5-7.0	3.3	10.3-13.7	14.0-14.5	7.2-14.0	8	16	10
MEAN	8.5	6.3		12.7	14.3	13.3			
Bankfull Cross-sectional Area ( $A_{bkf}$ sq. ft.)	6.3	7.9-9.7	9.3-9.5	120-129	11.6-12.2	10.6-10.8	6	9	9
MEAN	6.3	9	9.4	126	11.9	10.7			
Bankfull Maximum Depth ( $d_{max}$ ft)	1.5	1.5-1.9	1.9-2.1	1.5-2.1	1.4	1.8-1.9	1.4	1.2	1.5
MEAN	1.5	1.6	2	1.7	1.4	1.9			
Ratio Bankfull Maximum Depth to Mean Bankfull Depth ( $d_{max}/dbkf$ )	1.7	1.3	1.3	0.5	1.6	1.6-2.0	1.6	1.6	1.6
Lowest Bank Height to Bankfull Maximum Depth Ratio	2.0	2.6	2.7	1.5	1.0	1.0	1.0	1.0	1.0
Width of Flood Prone Area ( $W_{fpa}$ ft)	33	11-50	50	90-150	26-36	229	>19	>19	>19
MEAN	33	31	50	116	31	229			
Entrenchment Ratio ( $W_{fpa}/W_{bkf}$ )	4.5	4.1	7.4	2.9	2.4	22.4	>2.8	>1.6	>2.0
Meander Length ( $L_m$ ft)	0	25-31	-	251-418	32-58	54-196	17-39	29-68	23-54
MEAN	0	28	-	322	43	125	28	48.5	38.5
Ratio of Meander Length to Bankfull Width	0	3.2-4.0	-	7.0-10	2.4-4.4	15.9-30	2.4-5.7	2.4-5.7	2.4-5.7
( $L_m/W_{bkf}$ )									
MEAN	0	3.6	-	8.3	3.3	11.9	4.1	4.1	4.1
Radius of Curvature ( $R_c$ ft)	0	7-10	8-9	45-400	16-25	5.4-22.1	9.5-17	16-29	13-23
MEAN	0	8	9	144	22	12.9	13.3	23	18
Ratio of Radius of Curvature to Bankfull Width	0	0.9-1.3	1.2-1.3	1.3-9.8	1.2-1.9	1.8-3.0	1.4-2.5	1.3-2.4	1.4-2.4
( $R_c/W_{bkf}$ )									
MEAN	0	1.0	1.3	3.7	1.7	1.2	1.9	1.9	1.9
Belt Width ( $W_{bit}$ ft)	0	10-22	26	66-128	14-30	24-52	8.0-17.0	13-29	10.0-23.0
MEAN	0	16	26	91	19	38	12	22	17
Meander Width Ratio ( $W_{bit}/W_{bkf}$ )	0	1.3-2.8	3.8	1.8-3.1	1.1-2.3	4.2-13.3	1.1-2.4	1.1-2.4	1.1-2.4
MEAN	0	2.1	3.8	2.3	1.5	3.6	1.8	1.8	1.8
Sinuosity (Stream Length/Valley Length, $k$ - ft/ft)	1.0	1.0	1.0	1.3	1.2	1.1	1.1	1.3	1.4
Valley Slope ( $S_{valley}$ ) ft/ft	0.024	0.024	0.024	0.0016	0.0017	0.0139	0.038	0.020	0.014
Average Water Surface Slope ( $S_{avg}$ )	0.039	0.022	0.0056	0.0012	0.0078	0.0130	0.034	0.015	0.010
Pool Slope ( $S_{pool}$ )	0.000-0.014	0.000-0.0069	0.000-0.0031	0.000-0.00952	0.000-0.0026	0.000-0.020	0.014	0.0073	0.0046
MEAN	0.0039	0.0028	0.0011	0.0004	0.001	0.0015	0.014	0.0073	0.0046
Ratio of Pool Slope to Average Slope ( $S_{pool}/S_{avg}$ )	0.1	0.18	0.2	0.36	0-0.33	0.00-1.52	0.41	0.49	0.46
Riffle Slope ( $S_{riff}$ ft/ft)	0.022-0.20	0.0072-0.078	0.0006-0.053	0.000-0.035	0.0043-0.041	.01-0.67	.040-.053	.02-.029	.010-.019
MEAN	0.0287	0.0385	0.015	0.0092	0.021	0.03	0.05	0.028	0.013
Ratio of Riffle Slope to Average Slope ( $S_{riff}/S_{avg}$ )	0.56-5.3	0.0024-0.051	0.11-9.5	0.000-29	0.55-5.3	0.76-5.1	1.2-1.6	1.3-1.9	1.0-1.9
MEAN	2.2	2.5	2.7	7.6	2.7	2.3	1.5	1.9	1.3
Maximum Pool Depth ( $d_{pool}$ ft)	1.5	2.3	2.3	5.5	1.9	2.5	1.9	1.7	2.1
Ratio of pool depth to mean bankfull depth ( $d_{pool}/dbkf$ )	1.7	1.9	1.5	1.7	2.1	2.4	2.2	2.2	2.2
Pool Width ( $W_{pool}$ ft)	—	8.6	7.9	35.7	12.5	8.4	9.0	16.0	12.0
Ratio of Pool Width to Bankfull Width ( $W_{pool}/W_{bkf}$ )	—	1.1	1.2	0.9	1.0	0.8	1.3	1.3	1.3
Pool to Pool Spacing (P-P ft)	8.5-68	11-72	18-50	111-390	37-81	13-47	13-22	36-61	19-38
MEAN	25	39	35	215	58	24	19	45	30
Ratio of P-P to Bankfull Width (P-P/ $W_{bkf}$ )	1.1-9.1	1.5-9.6	2.4-6.7	2.8-10	2.8-6.2	1.5-3.8	1.9-3.2	3.0-5.0	2.0-4.0
MEAN	3.4	5.1	4.6	5.5	4.4	2.3	2.8	3.8	3.2



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**FIGURE 9a**  
**PROPOSED CROSS SECTIONS FOR**  
**REACHES 1 & 2 OF TRIBUTARY**  
**RESTORATION PLAN**  
**TICK CREEK**  
**CHATHAM COUNTY**



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FIGURE 9b  
PROPOSED CROSS SECTIONS FOR  
REACHE 3 OF TRIBUTARY  
RESTORATION PLAN  
TICK CREEK  
CHATHAM COUNTY

#### **4.1.2 Pattern**

Pattern will be introduced into the stream by increasing the sinuosity of the stream (Figure 10) through Priority 1 restoration. A Priority 1 restoration involves building a new C or E-type channel that is connected to its original floodplain. Meanders will be introduced into the channels with appropriate radius of curvatures and lengths based on the reference reach data and existing site constraints for a C or E-type stream channel. Because this site has minimal lateral constraints, the sinuosity of the stream will be maximized to the extent possible. Introduction of these meanders will increase stream length, sinuosity, and habitat while lowering slope and shear stress.

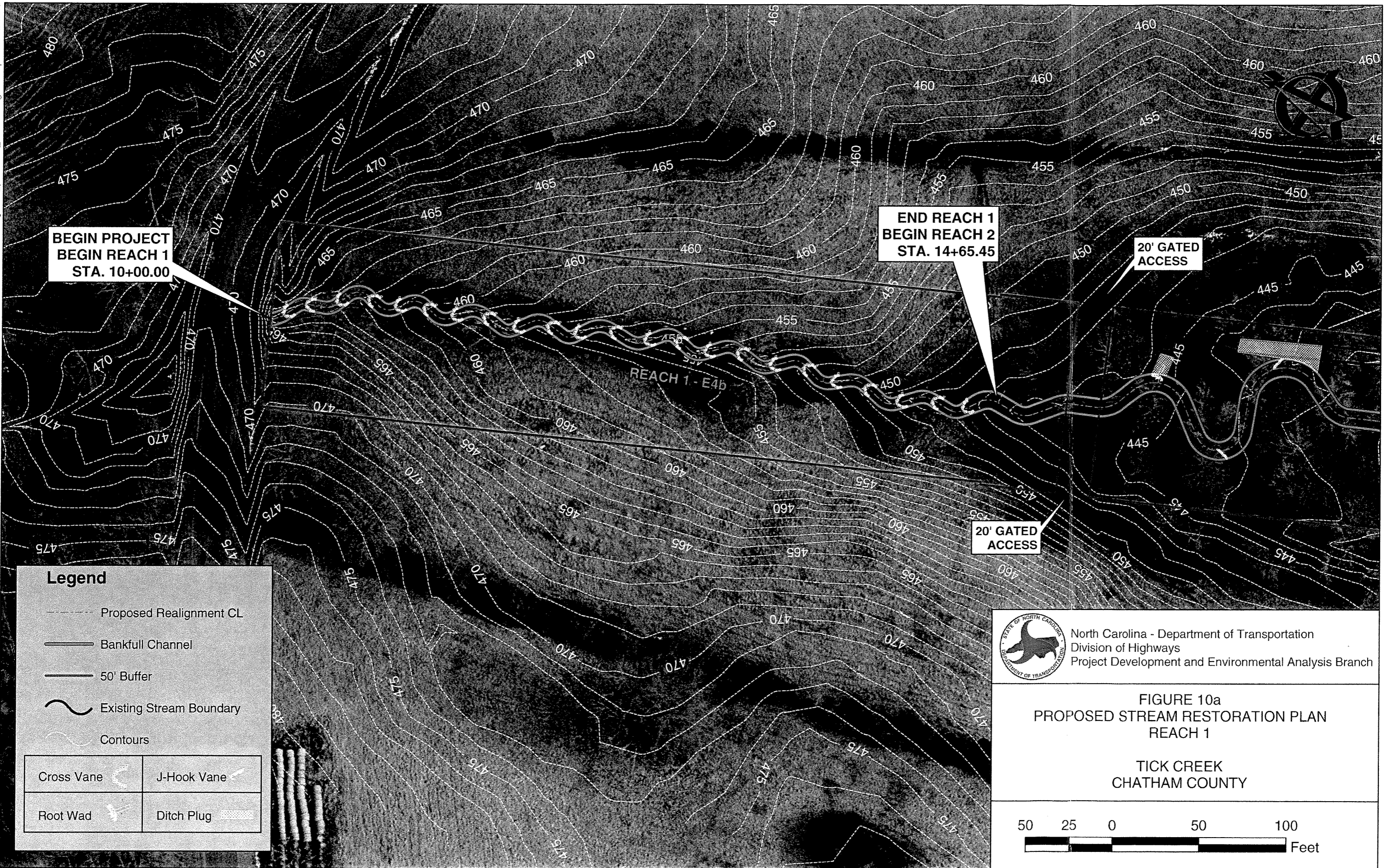
#### **4.1.3 Bedform**

The existing Unnamed Tributary has some existing riffle/pool sequences, but they are sporadic. The design channel will incorporate riffles and pools to provide bedform found in C and E stream types with gravel bottoms (Figure 11). Pools will be located in the outside of meander bends with riffles in the inflection points between meanders. The degree of bedform alterations will relate to the type of valley the existing channels flow through. The proposed riffles will have a thalweg depth that ranges between 1.2 to 1.5 feet. Cross vanes will be utilized as grade control structures throughout the proposed channels. The cross vanes will be constructed out of natural materials such as boulders and stone. Modifications to the bedform will provide stability and habitat to the channel.

#### **4.1.4 Structures**

Several structure types will be installed in the stream channels. These structures include cross vanes, j-hook vanes, and root wads, which will all be constructed from natural materials. The need for additional structure types will be assessed during the final design stage.

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**BEGIN PROJECT  
BEGIN REACH 1  
STA. 10+00.00**

**END REACH 1  
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**20' GATED  
ACCESS**

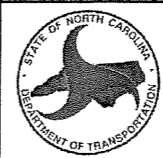
**20' GATED  
ACCESS**

REACH 1 - E4b

**Legend**

- Proposed Realignment CL
- Bankfull Channel
- 50' Buffer
- Existing Stream Boundary
- Contours

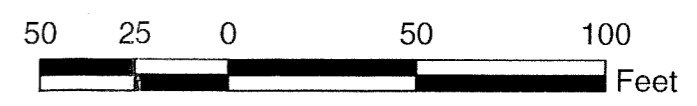
Cross Vane	J-Hook Vane
Root Wad	Ditch Plug

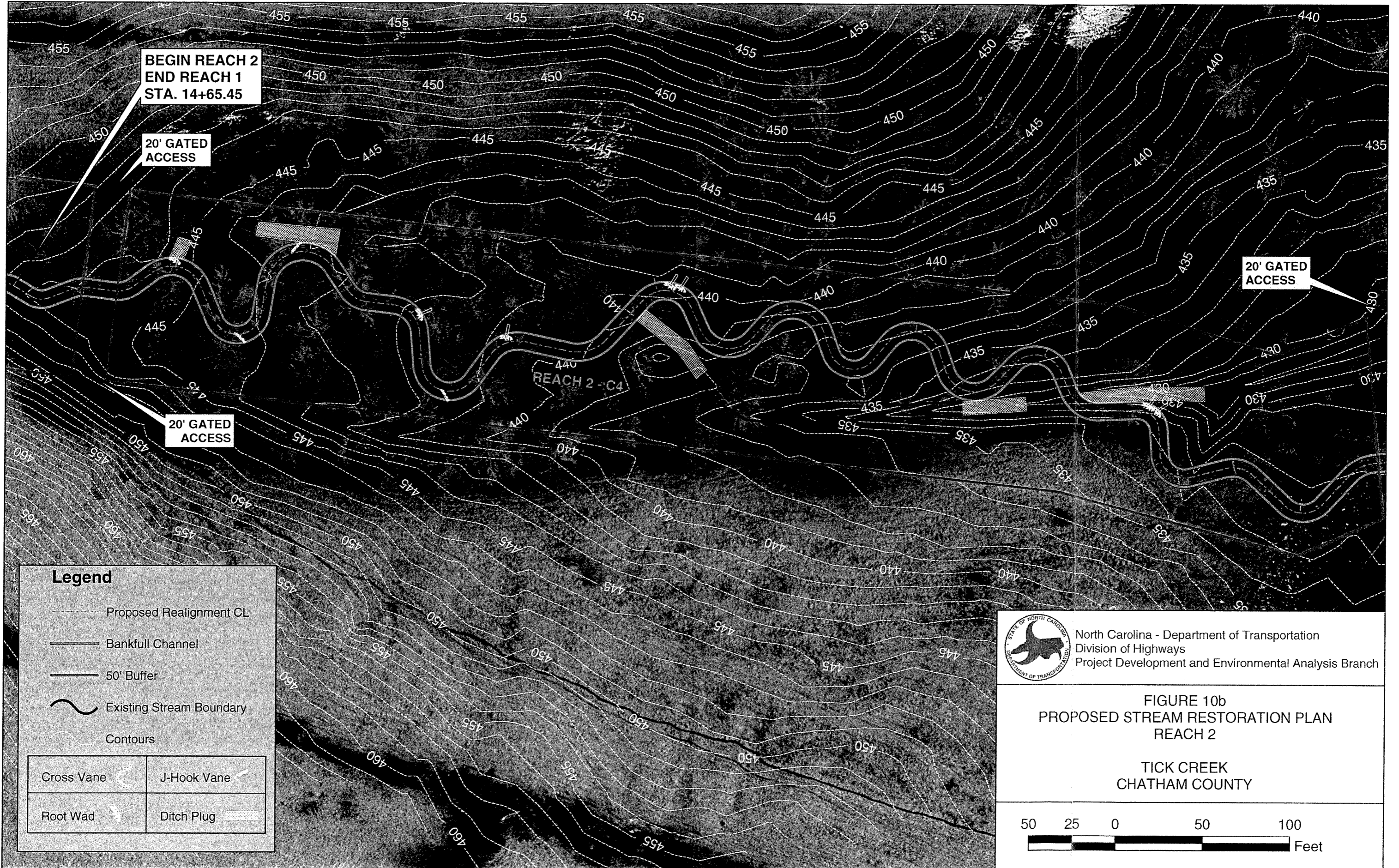


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**FIGURE 10a  
PROPOSED STREAM RESTORATION PLAN  
REACH 1**

**TICK CREEK  
CHATHAM COUNTY**





**Legend**

- Proposed Realignment CL
- ===== Bankfull Channel
- ===== 50' Buffer
- ~~~~~ Existing Stream Boundary
- ~~~~~ Contours

Cross Vane	J-Hook Vane
Root Wad	Ditch Plug

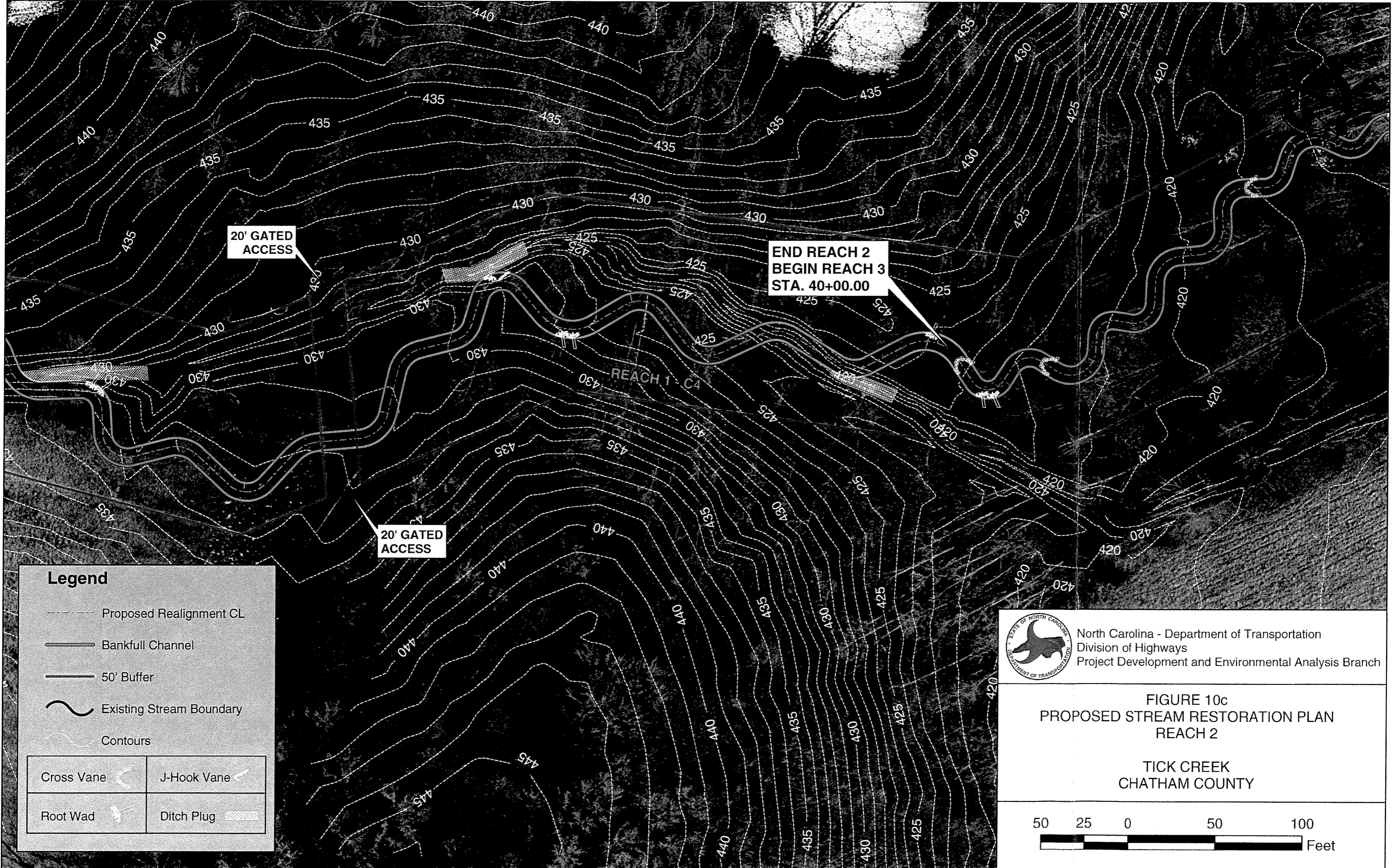


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**FIGURE 10b**  
**PROPOSED STREAM RESTORATION PLAN**  
**REACH 2**

**TICK CREEK**  
**CHATHAM COUNTY**






**Legend**

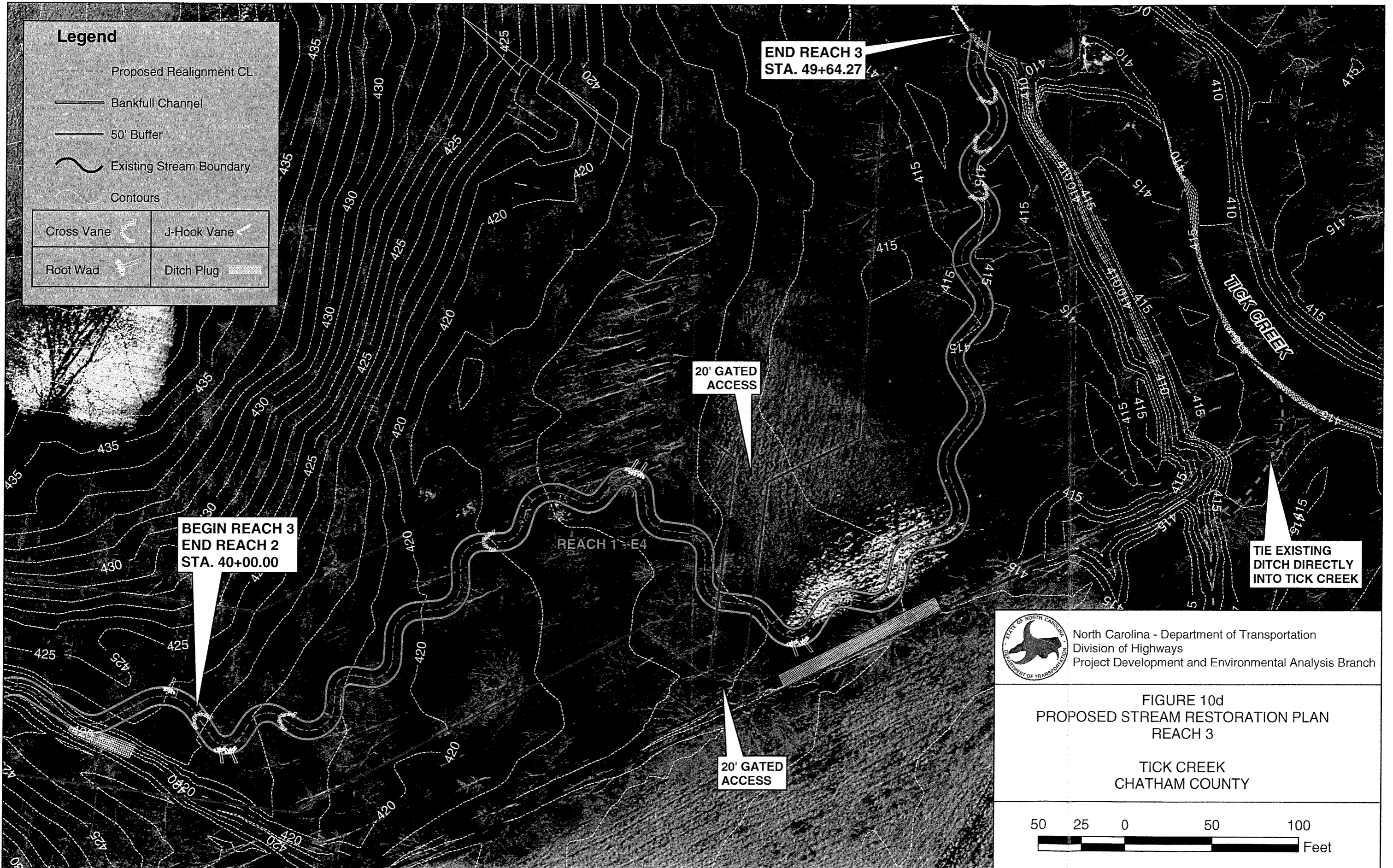
- Proposed Realignment CL
- ===== Bankfull Channel
- ===== 50' Buffer
- ~~~~~ Existing Stream Boundary
- Contours

Cross Vane	J-Hook Vane
Root Wad	Ditch Plug


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**FIGURE 10c**  
**PROPOSED STREAM RESTORATION PLAN**  
**REACH 2**  
  
**TICK CREEK**  
**CHATHAM COUNTY**





**Legend**

- Proposed Realignment CL
- Bankfull Channel
- 50' Buffer
- ~ Existing Stream Boundary
- Contours

Cross Vane	J-Hook Vane
Root Wad	Ditch Plug

**BEGIN REACH 3  
END REACH 2  
STA. 40+00.00**

**END REACH 3  
STA. 49+64.27**

**20' GATED  
ACCESS**

**20' GATED  
ACCESS**

**TIE EXISTING  
DITCH DIRECTLY  
INTO TICK CREEK**



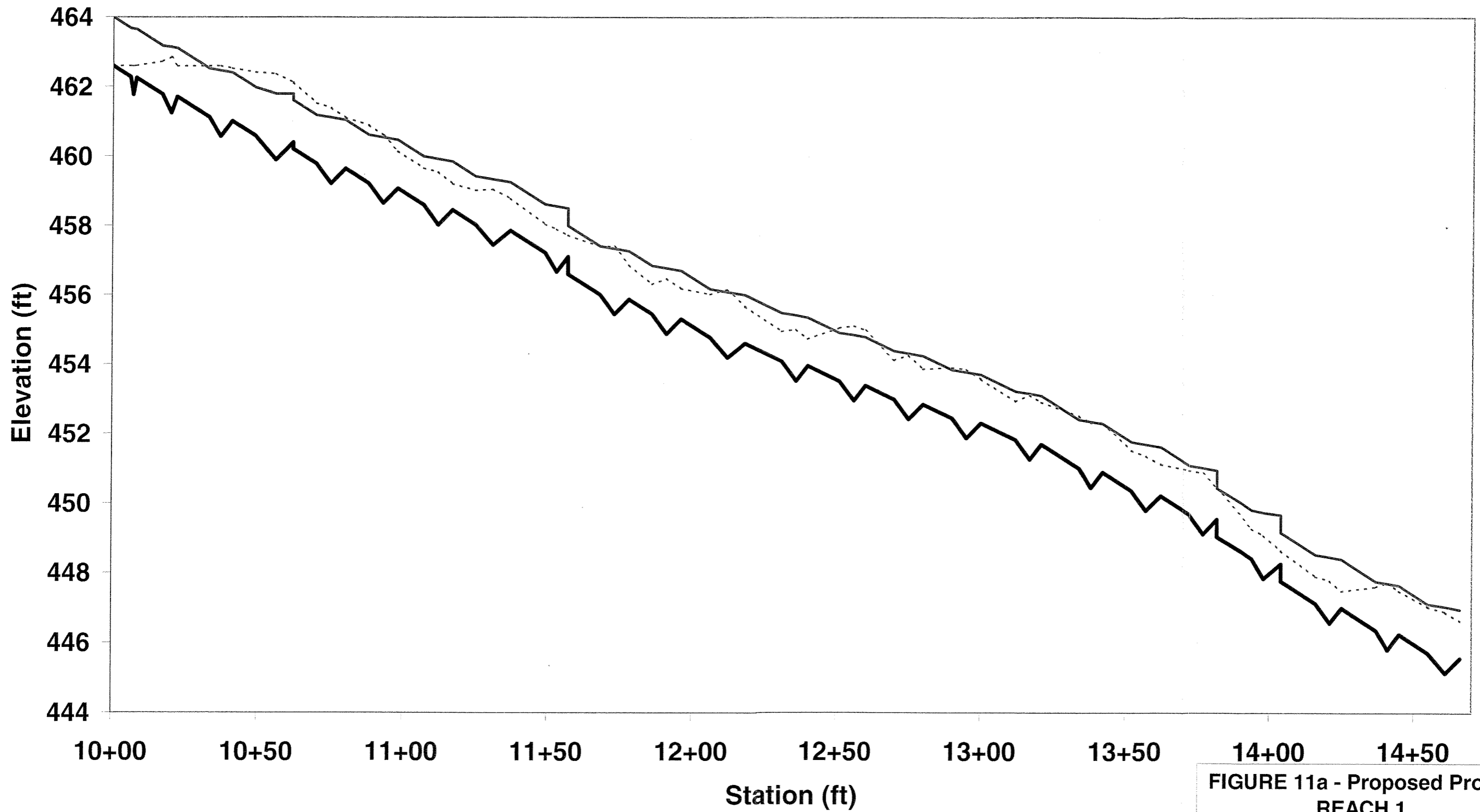
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Division of Highways  
Project Development and Environmental Analysis Branch

**FIGURE 10d  
PROPOSED STREAM RESTORATION PLAN  
REACH 3**

**TICK CREEK  
CHATHAM COUNTY**

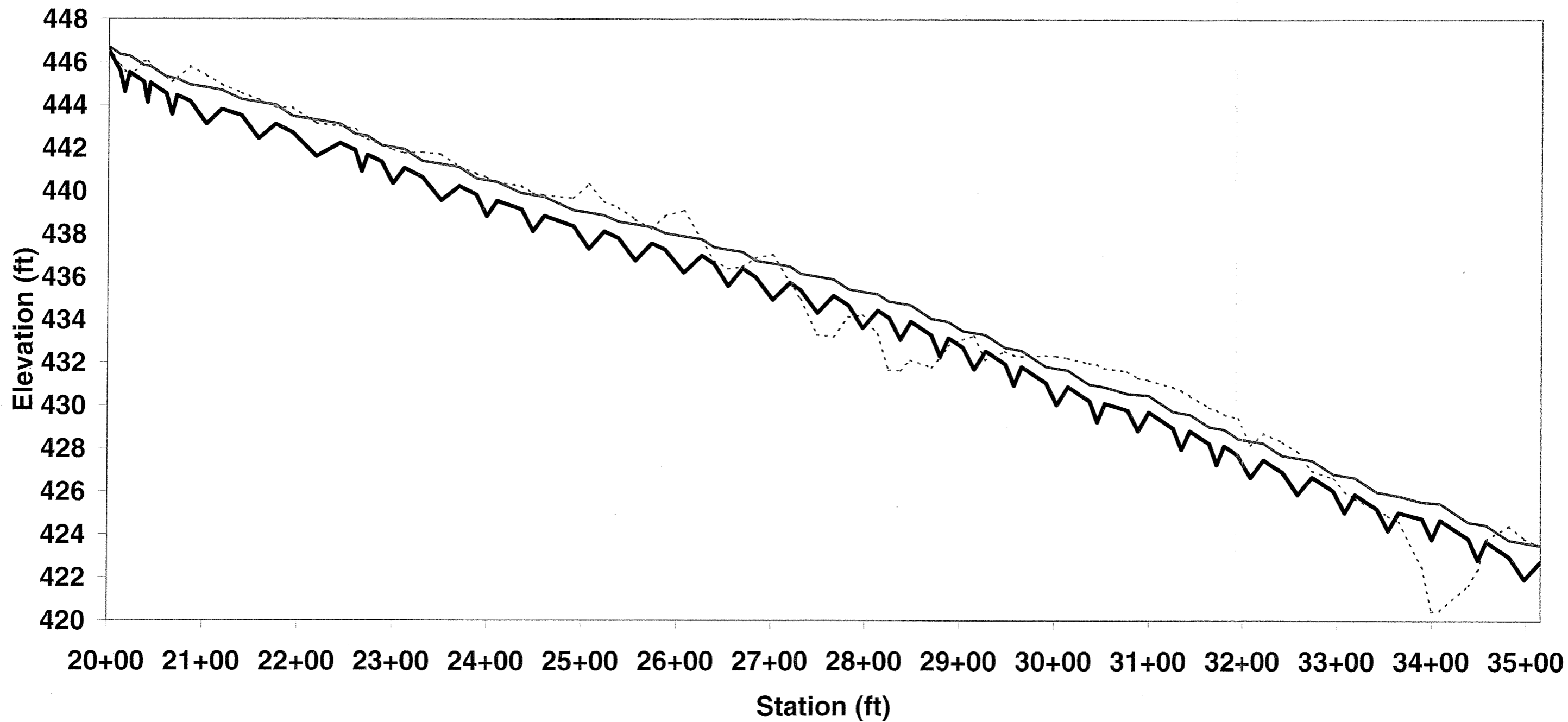






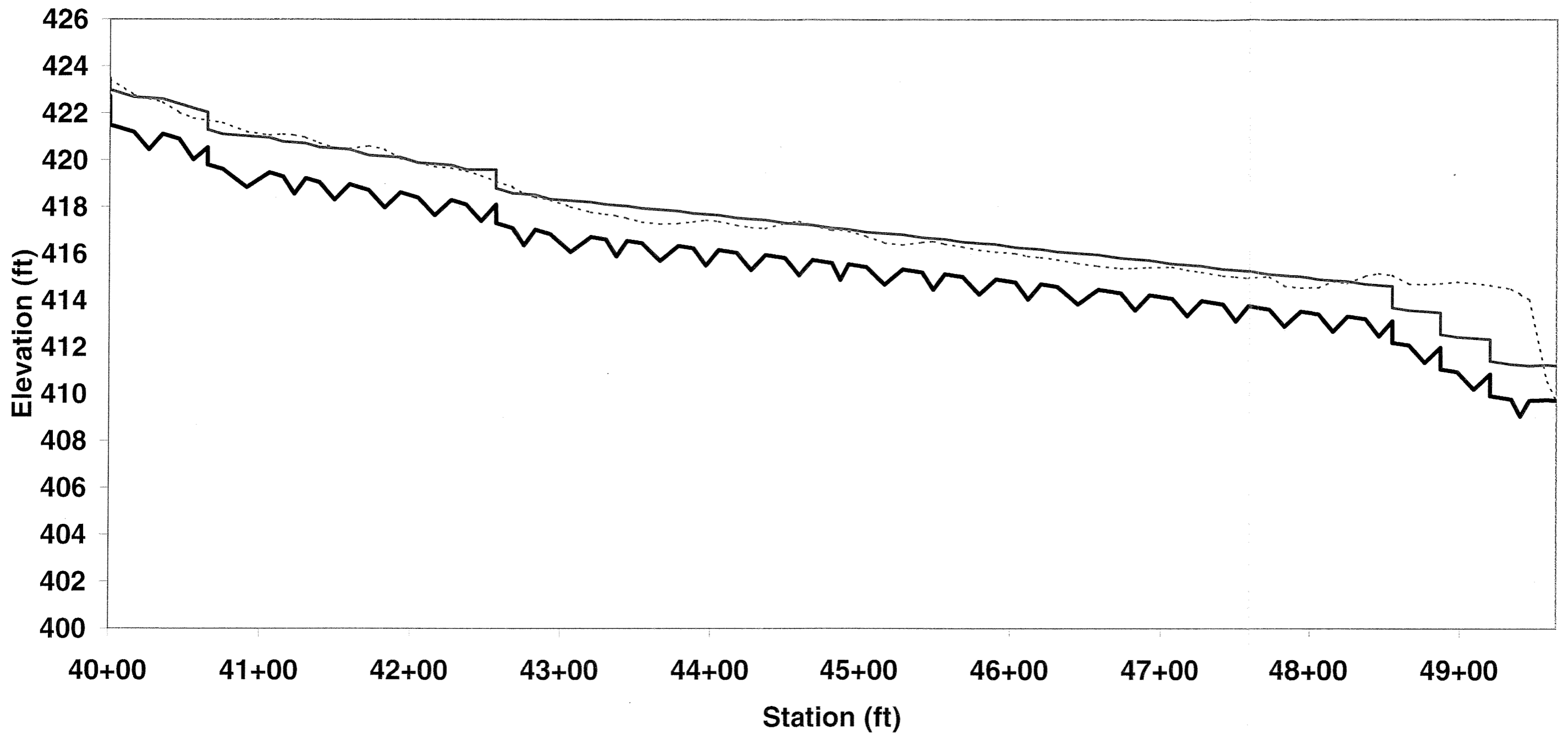
**FIGURE 11a - Proposed Profile  
REACH 1  
Tick Creek Restoration Plan  
Chatham County, North Carolina**

..... Existing Grade      — Proposed Bankfull      — Proposed Thalweg



**FIGURE 11b - Proposed Profile  
REACH 2  
Tick Creek Restoration Plan  
Chatham County, North Carolina**

..... Existing Grade      — Proposed Bankfull      — Proposed Thalweg



**FIGURE 11c - Proposed Profile  
REACH 3  
Tick Creek Restoration Plan  
Chatham County, North Carolina**

..... Existing Grade    — Proposed Bankfull    — Proposed Thalweg

## 4.2 SEDIMENT TRANSPORT

A stable stream has the capacity to move its sediment load without aggrading or degrading. The total load of sediment can be divided into wash load and bed load. Wash load is normally composed of fine sands, silts and clay and transported in suspension at a rate that is determined by availability and not hydraulically controlled. Bed load is transported by rolling, sliding, or hopping (saltating) along the bed. At higher discharges, some portion of the bed load can be suspended, especially if there is a sand component in the bed load. Bed material transport rates are essentially controlled by the size and nature of the bed material and hydraulic conditions (Hey 1997).

Shear stress was checked using Shield's Curve for a proposed riffle cross-section. The shear stress placed on the sediment particles is the force that entrains and moves the particles, given by:

$$\tau = \gamma R s$$

where,  $\tau$  = shear stress (lb/ft<sup>2</sup>)

$\gamma$  = specific gravity of water (62.4 lb/ft<sup>3</sup>)

R = hydraulic radius (ft)

s = water surface slope (ft/ft)

Hydraulic radius is calculated by:

$$R = \frac{A}{P}$$

where, R = hydraulic radius

A = cross-sectional area (ft<sup>2</sup>)

P = wetted perimeter (ft)

Thus,

$$R_{R1} = \frac{6 \text{ ft}^2}{8.6 \text{ ft}} = 0.70 \text{ ft}, R_{R2} = \frac{9 \text{ ft}^2}{13.5 \text{ ft}} = 0.67 \text{ ft}, R_{R3} = \frac{9 \text{ ft}^2}{11.4 \text{ ft}} = 0.79 \text{ ft},$$

Therefore,

$$\tau_{R1} = (62.4 \frac{\text{lb}}{\text{ft}^3})(0.70 \text{ ft})(0.037 \frac{\text{ft}}{\text{ft}}) = 1.6 \text{ lb} / \text{ft}^2$$

$$\tau_{R2} = (62.4 \frac{\text{lb}}{\text{ft}^3})(0.67 \text{ ft})(0.015 \frac{\text{ft}}{\text{ft}}) = 0.63 \text{ lb} / \text{ft}^2$$

$$\tau_{R3} = (62.4 \frac{\text{lb}}{\text{ft}^3})(0.79 \text{ ft})(0.011 \frac{\text{ft}}{\text{ft}}) = 0.54 \text{ lb} / \text{ft}^2$$

The critical shear stress for the proposed channel has to be sufficient to move the  $D_{84}$  of the bed material, which for the existing riffles is medium gravel. Based on a shear stresses calculated, the Shield's Curve predicts that these streams can move a particle that is, on average, greater than 55 mm, or coarse gravel. Because the existing bed material is gravel in the riffles, the proposed stream has the competency to move its bed load according to Shield's Curve and preliminary design calculations.

#### 4.3 FLOODING ANALYSIS

The Unnamed Tributary floodplain is not regulated by FEMA, and flooding analysis is not required. Flooding analysis will be performed during the design phase to insure that the floodplain is not raised significantly along the stream. The USGS Method for estimating the magnitude and frequency of floods in rural basins was used to estimate the 2, 5, 10, 25, 50, and 100-year peak discharges for the 0.15 square mile drainage area as follows:

$Q_2$	=	22 cfs
$Q_5$	=	36 cfs
$Q_{10}$	=	47 cfs
$Q_{25}$	=	63 cfs
$Q_{50}$	=	77 cfs
$Q_{100}$	=	93 cfs

The region-of-influence method described in the USGS publication estimates flood discharges at ungaged basins by deriving, for a given ungaged rural site, regression relations between the flood discharges and basin characteristics of a unique subset of gaged stations. The latitude and longitude ( $35^{\circ}40'39\text{N}$ ,  $79^{\circ}21'44\text{W}$ ) and drainage area for the Unnamed Tributary site is all the input that is required.

Once a Digital Terrain Model (DTM) is obtained for the project site, HEC-RAS, version 3.0, will be used to compute a flooding analysis for the existing and proposed conditions. This analysis will ensure that the project will not significantly change existing floodwater limits and that shear stresses are not unreasonable.

#### 4.4 HABITAT RESTORATION

Vegetation that quickly develops a canopy, has extensive rooting, and a substantial above-ground plant structure is needed to help stabilize the banks of a restored stream channel in order to reduce scour and runoff erosion. In natural riparian environments, pioneer plants that often provide these functions are alder, river birch, boxelder, silky dogwood, and willow. Once established, these trees and shrubs create an environment that allows for the succession of other riparian species including ashes, black walnuts, red maples, sycamores, oaks and other riparian species.

Revegetation efforts will emulate natural vegetation communities found along relatively undisturbed stream corridors. To quickly establish dense root mass along the channel

bank, a permanent native grass mixture will be seeded on the stream bank along with temporary seeding to provide immediate erosion control. Areas around structure installations will be revegetated with live stakes and transplants salvaged on-site. Live stakes will be installed on the outside of the meander bends to ensure a dense root mass in those areas of high stress. It may be necessary to line key sections of the channel bank with coir matting to provide cover until vegetation can be established. This will be determined further along in the design phase of the project.

Along the tops of the channel banks (riparian area), trees and shrubs will be planted. A mixture of live stakes, bare root or container nursery stock, and salvaged transplants will be utilized to stabilize the banks. In the areas where invasive and exotic species are found during construction and monitoring, control by removal or appropriate herbicides will be implemented to prevent competition with the revegetation efforts. All plant material should be native species collected or propagated from material within the Piedmont physiographic province and within 200 miles north or south latitude. The use of material that is genetically adapted to specific site conditions enhances long-term growth and survival and avoids contaminating the gene pool of the surrounding vegetation with non-adapted ecotypes. Vigorous growth of well-adapted ecotypes can also minimize problems with exotic invasive plants. Appropriate plant material is usually available upon request and can be obtained with planning and foresight. However, NCDOT occasionally must plant stock from wherever it can find it.

#### 4.4.1 Streambank Vegetation

On Tick Creek and the Unnamed Tributary, areas around structure installations will be revegetated with live stakes and transplants salvaged on-site. Outer meander bends will also be reinforced with live stakes. Temporary seeding will be applied for immediate erosion control on all newly excavated surfaces. Species that may be proposed for planting in these areas are listed below.

##### Live stakes and transplants

Tag alder (*Alnus serrulata*)  
Black willow (*Salix nigra*)\*  
Silky willow (*Salix sericea*)  
Silky dogwood (*Cornus amomum*)  
Elderberry (*Sambucus canadensis*)  
Spicebush (*Lindera benzoin*)

\*to be used only in outer meander bends

Woody vegetation will be planted between November and March to allow plants to stabilize during the dormant period and set roots during the spring season.

#### 4.4.2 Riparian Buffer

The riparian vegetation on the reach of Tick Creek under study is not in need of restoration. A mature and diverse canopy is present, and numerous seedlings and saplings indicate on-going regeneration. However, an infestation of Chinese privet and autumn olive presents a threat to the long-term health of the riparian buffer. Management actions should be undertaken to prevent the spread of these invasive exotic shrubs, especially in areas that will be disturbed by construction activities. The existing vegetation consists of a 200-foot wide, relatively healthy and diverse bottomland hardwood forest, which presumably extended throughout the floodplain into what is now pasture. Where construction activities on the Unnamed Tributary impact this forest, every effort should be made to salvage seedlings and saplings of appropriate shrub and tree species. In addition, suitable topsoil should be salvaged and stockpiled for spreading on the restoration area.

The Unnamed Tributary will be subject to more extensive stream channel engineering and will require more extensive revegetation to replace streambank and riparian vegetation lost to construction activities and to extend the riparian buffer to 50 feet along the entire reach.

For Reach 3 of the Unnamed Tributary, the target community to be planted is a Piedmont Bottomland Forest as described in Schafale and Weakley (1990). Abundant salvage material is available, including seedlings, saplings, shrubs, and seeds (nuts and acorns), but bare-root and/or container plantings will also be required. Species proposed for planting along the bank tops in the riparian buffer area are listed below. Their planting is dependent upon availability.

##### Piedmont Bottomland Forest

Yellow poplar (*Liriodendron tulipifera*)  
Swamp chestnut oak (*Quercus michauxii*)  
Hackberry (*Celtis laevigata*)  
American elm (*Ulmus americana*)  
Green ash (*Fraxinus pennsylvanica*)  
Shagbark hickory (*Carya ovata*)  
Bitternut hickory (*Carya cordiformis*)

Planting a mixture of the species listed above will best reflect the character of streambank vegetation typically found along small Piedmont streams such as UT Tick Creek. However, if sufficient quantities of the above species are not found after diligent planning and searching, the following species may be used to supplement the planting.

River birch (*Betula nigra*)  
Water oak (*Quercus nigra*)  
Willow oak (*Quercus phellos*)  
Sycamore (*Platanus occidentalis*)

The target community for the upper reaches, Reach 1 and 2, of the Unnamed Tributary is a Mesic Mixed Hardwood Forest as described in Schafale and Weakley (1990). Species proposed for planting are listed below. Their planting is dependent upon availability.

Mesic Mixed Hardwood Forest

White oak (*Quercus alba*)  
Northern red oak (*Quercus rubra*)  
Water oak (*Quercus nigra*)  
Beech (*Fagus grandifolia*)  
Yellow poplar (*Liriodendron tulipifera*)  
Black cherry (*Prunus serotina*)  
Southern sugar maple (*Acer barbatum*)  
Umbrella magnolia (*Magnolia tripetala*)  
Flowering dogwood (*Cornus florida*)  
Eastern hop-hornbeam (*Ostrya virginiana*)  
Buckeye (*Aesculus sylvatica*)  
American holly (*Ilex opaca*)

Areas that are currently vegetated with non-invasive trees or shrubs will remain undisturbed where possible and succession allowed to proceed naturally. Woody vegetation will be planted between November and March to allow plants to stabilize during the dormant period and set roots during the spring season. A minimum of 680 stems per acre will be planted in portions of the buffer that have been disturbed by construction activities. Planting will stop 50 foot from the top of bank along the Tributary, and 100 foot from the top of bank along Tick Creek. The plantings along Tick Creek will only be installed as needed.

## 5.0 MONITORING AND SUCCESS CRITERIA

The NCDOT will provide an "as-built" of the stream mitigation site within 90 days after construction has been completed. The "as-built" will include both profile and plan view of the completed stream project. The "as-built" will serve as the baseline during the monitoring phase. The "as-built" will consist of "red line" design plans which will also include the location of permanent photographic points and vegetation plots.

The mitigation project will be monitored biannually for three years. The NCDOT recommends this "preventive" review in order to identify early the potential problem areas that may develop along the stream reach. As part of the biannual review, the entire stream reach will be visually monitored for stability and vegetation establishment. The NCDOT believes this walkthrough will ensure that the entire stream reach remains in good condition and provides a thorough, preventive review of the stream. Permanent



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photographic reference points along the stream will be established a part of the biannual monitoring.

During the biannual review of the stream, the entire stream reach will be evaluated for any potential problem areas such as stream bank instability, in-stream structure failure or unsuccessful vegetation establishment. Beside permanent photographic points, photographs of good stable sections of the stream as well as potential problem areas will be taken. This will document the stability of the stream and the severity of the potential problem area(s) that may be encountered.

A yearly report documenting the biannual visits to the stream mitigation site will be prepared. The report will contain photographs and written documentation of the stream during the monitoring phase.

If during the biannual review a failure area of the stream reach is noted, the area will be evaluated in more detail to determine the corrective actions needed to resolve the problem. The NCDOT will take cross sections in these failure areas and compare them to the established as-built cross sections. If remediation of a failure area is required, a proposal will be submitted to the resource agencies for the needed work. Remedial actions will be taken as soon as possible barring any seasonal limitations at the site.

The NCDOT does not recommends taking cross sections under this proposal in order to avoid unnecessary survey work of areas that are not failing. The NCDOT believes surveying a large number of cross sections and reviewing them in the office will not provide conclusive evidence about where cross sections of the stream may be failing. A site visit would be needed to define whether the stream is actually failing.

Upon completion of monitoring the stream site for three successful growing seasons, a final report will be prepared and presented to the resource agencies prior to a "Final Review" of the project. If remedial action has been required during the monitoring period, an updated "as-built" section will be attached to the report. The stream mitigation site will be reviewed with the resource agencies for final approval of the stream reach. If the resource agencies require additional work to the stream, then the work will be performed as soon as possible barring any seasonal limitations of the site.

## **6.0 DISPENSATION OF PROPERTY**

NCDOT will hold a conservation easement on the property until all mitigation activities are completed and the site is determined to be successful. Although no plan for dispensation of the Tick Creek mitigation site has been developed, NCDOT will likely transfer the easement to a resource agency (public or private) acceptable to the appropriate regulatory agencies. In 2001, NCDOT approached the Triangle Land Conservancy to discuss holding a conservation easement on this mitigation project and is awaiting a letter from that organization stating its decision. Covenants and/or restrictions on the deed will insure adequate management and protection of the site in perpetuity.

NCDOT currently has an option of a conservation easement. The conservation easement will likely be signed before January 2003 upon completion of the design plans. The Triangle Land Conservancy has been offered the land surrounding the Tick Creek Restoration Site, which will serve as an additional buffer to the project. NCDOT will not install fencing around the project if the Triangle Land Conservancy accepts the offer.

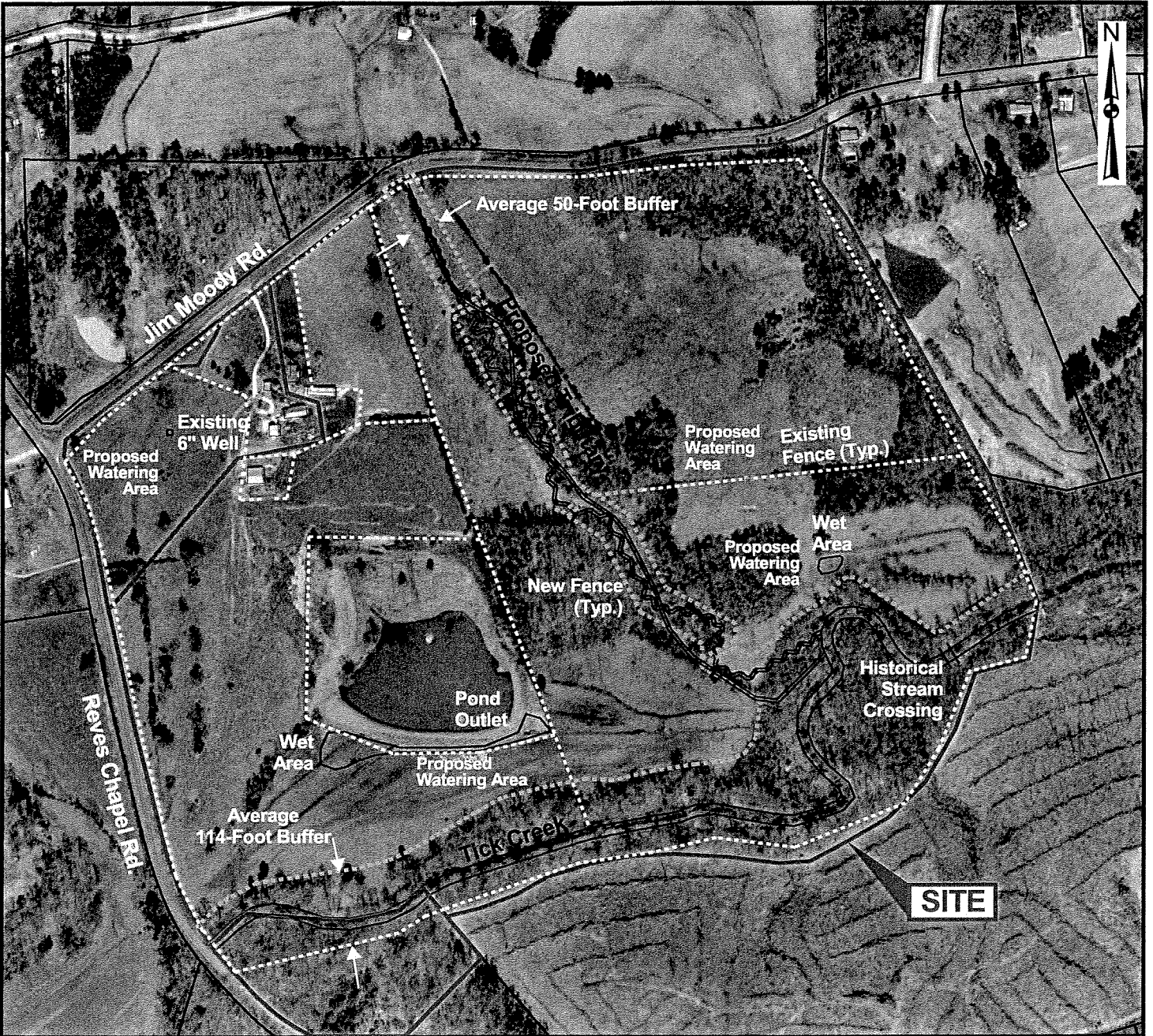
### 7.0 STREAM MITIGATION CREDIT

The entire Unnamed Tributary will be classified as stream restoration qualifying for 1:1 mitigation credit. The proposed stream will be about 2,946 feet in length, which is 349 feet longer than the existing stream. Final stream length will be determined during the design phase. As part of the stream restoration, a 50-foot vegetated buffer will be planted surrounding the stream channel (Figure 12). The total buffer acreage for the Unnamed Tributary will be approximately 6.0 acres.

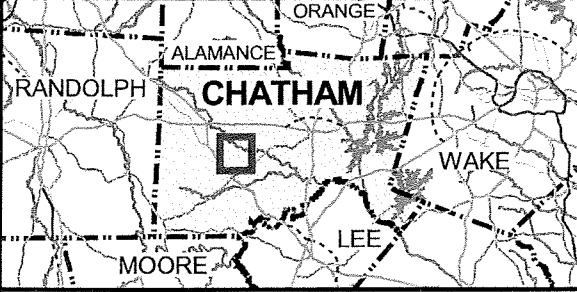
The entire reach of Tick Creek will be classified as preservation qualifying for 3:1 mitigation credit due to the diversity of freshwater mussels. Supporting letters from Ms. Judy Johnson Ratcliff and Ms. Sarah Kopplin stating the position of the NC Wildlife Resources Commission and the NC Natural Heritage Program on this restoration project are included in Appendix C. As part of the stream preservation, a 114-foot vegetated buffer will be planted surrounding the stream channel (Figure 12). The total buffer acreage for Tick Creek will be approximately 23 acres. Mitigation credits for the plan are listed below.

**Table 2. Mitigation Credits**

<b>Channel</b>	<b>Existing Stream Length</b>	<b>Proposed Stream Length</b>	<b>Mitigation Ratio</b>	<b>Mitigation Credits</b>
Tick Creek	3,733	3,733	3:1	1,244
Tributary	2,597	2,946	1:1	2,946
			<b>Total</b>	<b>4,190</b>



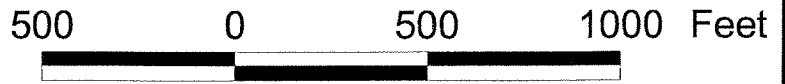
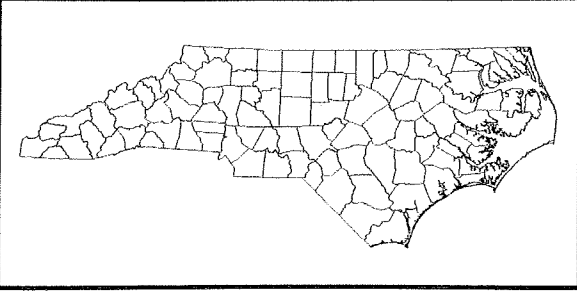
Aerial Source: Chatham County GIS, 2001



North Carolina - Department of Transportation  
 Division of Highways  
 Project Development and Environmental Analysis Branch

**FIGURE 12**  
**PROPOSED FENCING AND WATERING STRUCTURES**

RESTORATION PLAN  
 TICK CREEK  
 CHATHAM COUNTY



This project will meet the following goals and objectives:

1. Preserve 3,733 linear feet of Tick Creek (as measured along the thalweg) through a conservation easement on the stream.
2. Restore 2,597 linear feet (349 linear feet added) of an unnamed tributary to Tick Creek and protect the reach through a conservation easement.
3. Protect 200 feet of riparian corridor along Tick Creek (average of 114 feet on each sides) thereby:
  - Maintaining stream type, water temperature, food resources and instream habitat for aquatic resources, including freshwater mussels;
  - Conserving riparian habitat influencing habitat for the Cape Fear shiner three miles downstream in the Rocky River;
  - Conserving a viable and diverse freshwater mussel fauna (including one Federal Species of Concern and potential habitat for three other species);
  - Conserving habitat serving as a refugia for these species by maintaining species diversity in the Rocky River Subbasin.
4. Provide a stable stream channel for the Unnamed Tributary to Tick Creek that neither aggrades nor degrades while maintaining its dimension, pattern, and profile with the capacity to transport its watershed's water and sediment load.
5. Improve water quality and reduce erosion for Tick Creek and the Unnamed Tributary by stabilizing the stream banks.
6. Reconnect the Unnamed Tributary of Tick Creek to its floodplain.
7. Improve aquatic habitat with the use of natural material stabilization structures such as root wads, rock vanes, woody debris, and a riparian buffer.
8. Provide aesthetic value, wildlife habitat, and bank stability through the creation or enhancement of a riparian zone.

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## 8.0 REFERENCES

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**Preliminary Construction Cost Estimate**

Project: Condoret Property  
Restoration of Tributary and Preservation of Tick Creek

Description	Quantity	Unit Cost	Unit	Total
<b>Construction Survey</b>				
Fence Layout	1	\$12,000	LS	\$12,000
	<u>Length</u> 2,946	<u>Width</u> 110	<u>Area (AC)</u> 7	<u>Difficulty (1-10)</u> 5
	7,700			
<b>Clearing and Grubbing</b>				
	<u>Length</u> 2,946	<u>Width</u> 50	<u>Area (SF)</u> 147,300	
				3.4
				\$3,500
				AC
				\$11,835
<b>Unclassified Excavation</b>				
	<u>Length</u> 2,946	<u>Section Area</u> 11	<u>Vol (CF)</u> 32,406	
				1,200
				\$8.75
				CY
				\$10,502
<b>Instream Structures</b>				
Rock Structures (Cross & J-hook Vanes)	63	\$800	EA	\$50,400
Root Wads	37	\$100	EA	\$3,700
<b>Vegetation &amp; Erosion Control</b>				
Coir Fiber Matting	1,473	\$5	SY	\$7,363
Streambank Vegetation	0.3	\$2,300	AC	\$700
Riparian Vegetation	6.8	\$1,500	AC	\$10,145
Riparian Vegetation (1/3 of Tick Crk)	6	\$1,500	AC	\$8,613
Erosion Control	1.0	\$8,018	LS	\$8,658
				5% of subtotal
<b>Cattle Management</b>				
Fencing & Gates	7,700	\$1.75	LF	\$13,475
Stream Crossings	3	\$800	EA	\$2,400
Well	1	\$1,500	EA	\$1,500
Watering Structures	4	\$800	EA	\$3,200
<b>Preservation of Tick Creek</b>				
Fencing & Gates	3,400	\$1.75	LF	\$5,950

<b>SUBTOTAL</b>	<b>\$139,827</b>
<b>Mobilization &amp; Contingency (20%)</b>	<b>\$27,965</b>
<b>TOTAL</b>	<b>\$167,793</b>
<b>Cost per linear foot (3,879 ft)</b>	<b>\$43</b>





# Tick Creek Condoret Property, Chatham County

## SUMMARY OF CROSS SECTION DATA

Prepared By: Ben Goetz and Dan Clinton  
 River Basin: Cape Fear  
 Watershed: Tick Creek  
 Stream Reach: Tick Creek & Unnamed Tributary  
 DA (sq mi): 20.2 & 0.13  
 Date: 2002  
 Rural Regional Curve (sq. ft.):  
 Total Stream Length (l.f.):

### TICK CREEK

Cross Section #	1		2		3		4		5		6		Average
	Feature	Run	Riffle	Pool	Riffle	Pool	Riffle	Pool	Riffle	Pool	Run		
Cross Sect. Area, A (sq ft)	129.4	124.9	120.4	129.1	128.9	123.1	126.0						126.0
Bankfull Width, W(ft)	40.0	40.9	40.3	36.6	35.7	41.0	39.1						39.1
Maximum Depth, Dmax (ft)	4.5	3.6	3.4	4.1	5.3	4.1	4.2						4.2
Mean Depth, D (ft)	3.2	3.1	3.0	3.5	3.6	3.0	3.2						3.2
TOB X-Sect. Area, A (sq ft)	189.4	187.1	239.4	238.0	211.6	206.5	212.0						212.0

### TRIBUTARY

Cross Section #	1		2		3		4		5		6		7		8		9		Average
	Feature	Riffle	Pool	Riffle	Pool	Riffle	Pool	Riffle	Pool	Riffle	Pool	Riffle	Pool	Riffle	Pool	Riffle	Pool		
Cross Sect. Area, A (sq ft)	6.3	7.9	7.9	8.1	9.2	9.6	9.3	9.3	9.7	9.6	9.3	9.5	9.5	9.3	9.3	9.3	9.5	8.8	
Bankfull Width, W(ft)	7.3	8.6	8.6	7.0	8.0	7.3	7.9	7.9	7.9	7.9	7.3	7.9	7.9	7.9	7.9	7.9	7.9	7.5	
Maximum Depth, Dmax (ft)	1.5	1.5	1.5	1.6	1.6	1.7	1.9	1.9	1.5	1.5	1.7	1.9	2.1	1.9	1.9	1.9	2.1	1.7	
Mean Depth, D (ft)	0.9	0.9	0.9	1.2	1.1	1.3	1.2	1.2	1.2	1.2	1.3	1.2	1.7	1.2	1.2	1.2	1.7	1.2	
TOB X-Sect. Area, A (sq ft)	34.8	50.0	50.0	26.7	29.2	31.7	23.6	23.6	46.9	46.9	31.7	60.9	32.1	60.9	60.9	32.1	60.9	37.3	

Tick Creek  
Condoret Property, Chatham County

Field Crew: Ben Goetz, Jan Patterson  
 River Basin: Cape Fear  
 Watershed: Tick Creek  
 Stream Reach: Condoret - Reach 1  
 Drainage Area: 20.2 sq mi (13,060 ac)  
 Date: 2/26/2002  
 Station: N/A  
 Feature: Run CS#1

STATION (feet)	HI (feet)	FS (feet)	ELEVATION (feet)	NOTES
0+00.0	108.04	4.96	103.08	
0+05.0	108.04	5.60	102.44	LTOB
0+10.0	108.04	7.03	101.01	LBKF
0+15.0	108.04	9.40	99.64	
0+17.0	108.04	9.84	99.20	
0+22.0	108.04	9.76	99.28	
0+25.0	108.04	10.72	97.32	LEW
0+29.0	108.04	10.91	97.13	
0+34.0	108.04	11.31	96.73	
0+37.0	108.04	11.50	96.54	TW
0+40.0	108.04	11.46	96.56	
0+43.0	108.04	11.27	96.77	
0+46.0	108.04	10.91	97.13	REW
0+48.0	108.04	8.09	98.95	
0+48.5	108.04	8.29	99.75	
0+48.8	108.04	7.87	100.17	
0+50.0	108.04	7.03	101.01	RBKF
0+52.0	108.04	5.89	102.15	
0+55.0	108.04	3.63	104.41	RTOB
0+72.0	108.04	2.77	105.27	
0+85.0	108.04	0.79	107.25	

TOP OF BANK			
Hydraulic Geometry			
Width (Feet)	Depth (Feet)	Area (Sq. Ft.)	
0.0	0.0	0.0	
5.0	1.4	3.6	
5.0	3.8	13.1	
2.0	4.2	8.0	
5.0	4.2	21.0	
3.0	5.1	13.9	
4.0	5.3	20.9	
3.0	5.7	27.6	
3.0	5.9	17.4	
3.0	5.9	17.7	
3.0	5.7	17.3	
3.0	5.3	16.5	
2.0	3.5	8.8	
0.5	2.7	1.5	
0.3	2.3	0.7	
1.2	1.4	2.2	
2.0	0.3	1.7	
3.0	-2.0	-2.5	
TOTALS			50.0 188.4

SUMMARY DATA (TOB)			
A(BKF)	188.4		
W(BKF)	50.0		
Max d	5.9		
Mean d	3.8		

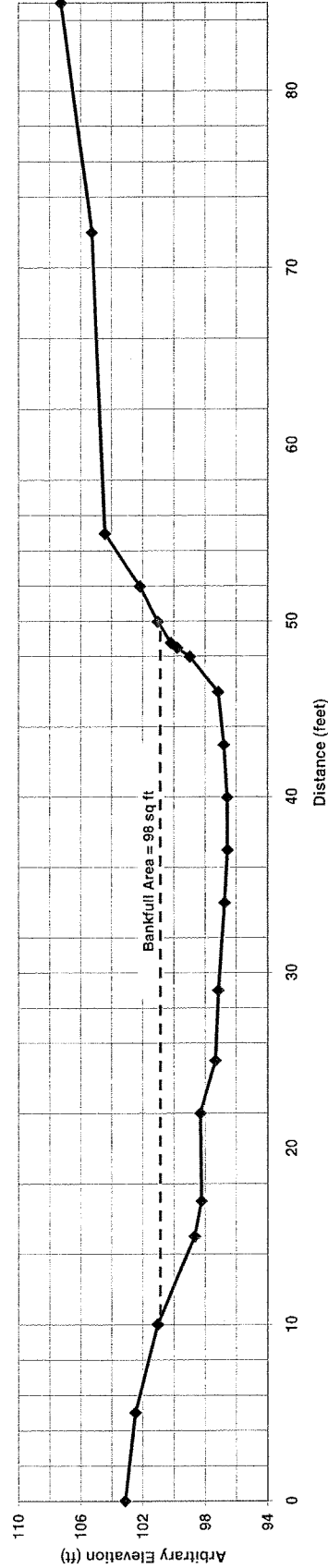
SUMMARY DATA (BANKFULL)			
A(BKF)	129.4	W(FPA)	90
W(BKF)	40.0	Slope	?
Max d	4.5	Shoosity	1.28
Mean d	3.2	Area= A	
W/D	12.4	Width= W	
Entrenchment	2.3	Depth= D	
Stream Type	C4	Bankfull= BKF	
Area from Rural Regional Curve			65-300

Bank Erosion Hazard Index (BEHI)			
Criteria	Value	Index	Bank Erosion Potential
Bank Ht/Bkf Ht	2.2	8.2	low
Root Depth/Bank Ht	1	1	very low
Root Density (%)	30	4	moderate
Bank Angle (Degrees)	51	3.5	low
Surface Protection (%)	15	8	very high
Bank Materials	Silt/Clay	0	
TOTALS			24.7
moderate			

Photo of Run CS#1 looking in the upstream direction.



Run Cross Section #1



Tick Creek  
Condoret Property, Chatham County

Field Crew: Ben Gietz, Jen Patterson  
 River Basin: Cape Fear  
 Watershed: Tick Creek  
 Stream Reach: Condoret - Reach 1  
 Drainage Area: 20.2 sq mi (13,080 ac)  
 Date: 2/26/2002  
 Station: N/A  
 Feature: Riffle CS#3

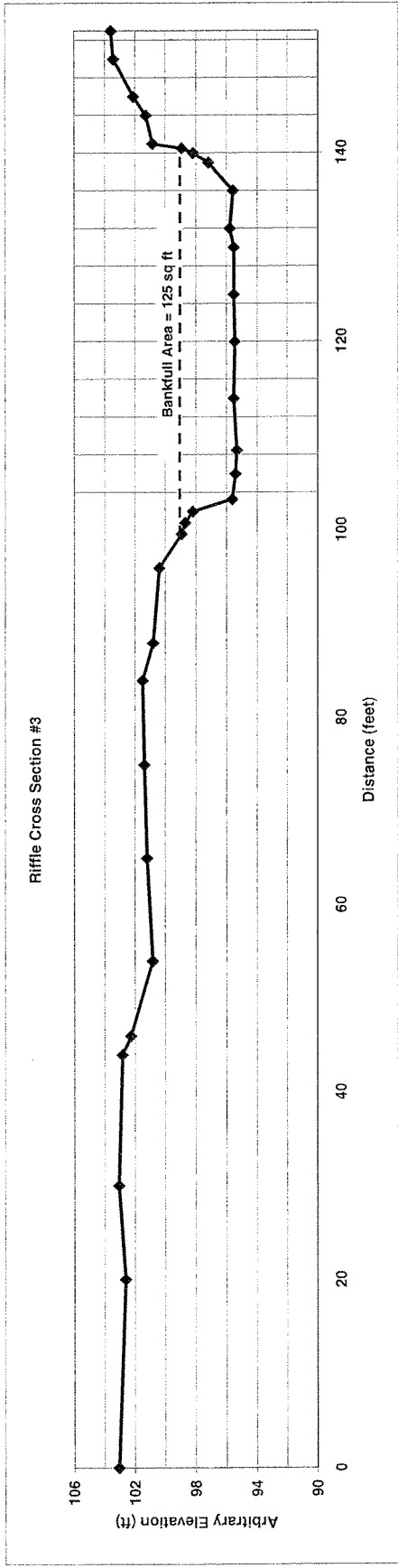
STATION (Feet)	HI (Feet)	FS (Feet)	ELEVATION (Feet)	NOTES
0+00.0	104.28	1.22	103.06	
0+20.0	104.28	1.65	102.63	
0+30.0	104.28	1.22	103.06	
0+44.0	104.28	1.44	102.84	
0+46.0	104.28	2.03	102.25	
0+54.0	104.28	3.45	100.83	
0+65.0	104.28	3.09	101.19	
0+75.0	104.28	2.92	101.36	
0+84.0	104.28	2.80	101.48	
0+88.0	104.28	3.49	100.79	
0+96.0	104.28	3.90	100.38	LTOB
0+99.6	104.28	5.36	98.92	LBKF
1+00.8	104.28	5.59	98.69	
1+02.0	104.28	6.10	98.18	
1+03.3	104.28	8.68	95.60	LEW
1+06.0	104.28	8.90	95.38	
1+08.5	104.28	9.00	95.28	TW
1+14.0	104.28	8.78	95.50	
1+20.0	104.28	8.85	95.43	
1+25.0	104.28	8.78	95.50	
1+30.0	104.28	8.79	95.49	
1+32.0	104.28	8.52	95.76	
1+36.0	104.28	8.72	95.56	REW
1+39.0	104.28	7.12	97.16	
1+40.0	104.28	6.10	98.18	
1+40.5	104.28	5.36	98.92	RBKF
1+41.0	104.28	3.45	100.83	RTOB
1+44.0	104.28	3.02	101.26	
1+46.0	104.28	2.20	102.08	
1+50.0	104.28	0.88	103.40	
1+53.0	104.28	0.72	103.56	

TOP OF BANK			BANKFULL		
Width (Feet)	Depth (Feet)	Area (Sq. Ft.)	Width (Feet)	Depth (Feet)	Area (Sq. Ft.)
0.0	0.0	0.0	0.0	0.0	0.0
3.6	1.5	2.6	1.2	0.2	0.1
1.2	1.7	1.9	1.2	0.7	0.6
1.2	2.2	1.3	3.3	3.3	2.6
1.3	4.8	4.5	2.7	3.5	9.3
2.7	5.0	13.2	2.5	3.6	9.0
2.5	5.1	12.6	5.5	3.4	19.4
5.5	4.9	27.4	6.0	3.5	20.7
6.0	4.9	29.5	5.0	3.4	17.3
5.0	4.9	24.8	5.0	3.4	17.1
5.0	4.9	24.4	2.0	3.2	6.6
2.0	4.6	9.5	4.0	3.4	13.0
4.0	4.8	18.9	3.0	1.8	7.7
3.0	3.2	12.1	0.5	0.7	1.3
1.0	2.2	2.7	0.5	0.0	0.2
TOTALS	45.0	187.1	40.9	0.0	124.9

SUMMARY DATA (TOB)			
A(BKF)	187.1	W(FPA)	100
W(BKF)	45.0	Slope	?
Max d	5.1	Simusity	1.28
Mean d	4.2	Area= A	
		Width= W	
		Depth= D	
		Bankfull= BKF	85-900
		Area from Rural Regional Curve	

SUMMARY DATA (BANKFULL)			
A(BKF)	124.9	W(FPA)	100
W(BKF)	40.9	Slope	?
Max d	3.6	Simusity	1.28
Mean d	3.1	Area= A	
W/D	13.4	Width= W	
Entrenchment	2.4	Depth= D	
Stream Type	C4	Bankfull= BKF	85-900
Area from Rural Regional Curve			

Bank Erosion Hazard Index (BEHI)				
Criteria	Value	Index	Potential	
Bank H/BKl Ht	1.9	7.4	high	
Bank Depth/Bank Ht	1	1	very low	
Root Density (%)	30	4	moderate	
Bank Angle (Degrees)	46	3.2	high	
Surface Protection (%)	15	8	very high	
Bank Materials	Silt/Clay	0		
		23.6		moderate



Tick Creek  
Condoret Property, Chatham County

Field Crew: Ben Goetz, Dan Clinton, Jane Almon  
 River Basin: Cape Fear  
 Watershed: Tick Creek  
 Stream Reach: Condoret - Reach 1  
 Drainage Area: 20.2 sq mi (13,060 ac)  
 Date: 8/9/2001  
 Station: N/A  
 Feature: Riffle CS#2

STATION (Feet)	HI (Feet)	FS (Feet)	ELEVATION (Feet)	NOTES
0+00.0	100.00	6.85	93.35	
0+13.0	100.00	6.69	93.31	
0+21.0	100.00	5.65	94.35	
0+33.0	100.00	5.90	94.10	
0+50.0	100.00	5.97	94.33	
0+58.0	100.00	5.46	94.54	TOB
0+65.0	100.00	5.84	94.16	TOB
0+69.0	100.00	7.01	92.99	TOB
0+69.4	100.00	6.20	91.60	
0+69.5	100.00	6.59	91.41	LBF
0+69.6	100.00	12.00	88.00	LEW
0+70.4	100.00	12.03	87.97	TW
0+72.2	100.00	11.76	88.24	
0+90.0	100.00	11.46	88.54	
0+97.0	100.00	11.77	88.23	
1+02.0	100.00	11.82	88.18	
1+04.0	100.00	11.97	88.03	
1+05.7	100.00	11.80	88.20	REW/WS
1+07.0	100.00	11.67	88.33	
1+09.8	100.00	8.69	91.41	RBKF
1+11.0	100.00	8.07	91.93	
1+12.0	100.00	7.01	92.99	TOB
1+13.0	100.00	5.90	94.10	TOB
1+14.7	100.00	5.31	94.69	
1+22.3	100.00	5.26	94.61	
1+25.3	100.00	5.20	94.60	
1+26.0	100.00	4.80	95.20	
1+33.0	100.00	2.35	97.65	

TOP OF BANK			
Hydraulic Geometry			
Width (Feet)	Depth (Feet)	Area (Sq. Ft.)	
0.0	0.0	0.0	
4.0	1.2	2.3	
0.4	2.4	0.7	
0.2	6.2	0.9	
0.6	6.2	4.9	
1.8	5.9	10.9	
17.8	5.6	102.7	
7.0	5.9	40.4	
5.0	6.0	29.8	
2.0	6.1	12.1	
1.7	6.0	10.3	
1.3	5.8	7.7	
2.8	2.8	12.0	
1.2	2.2	3.0	
1.0	1.2	1.7	
<b>TOTALS</b>	<b>47.0</b>	<b>239.4</b>	

SUMMARY DATA (TOB)			
A/BKF	W(BKF)	Mean d	
47.0	47.0	6.2	
1.0	5.1		

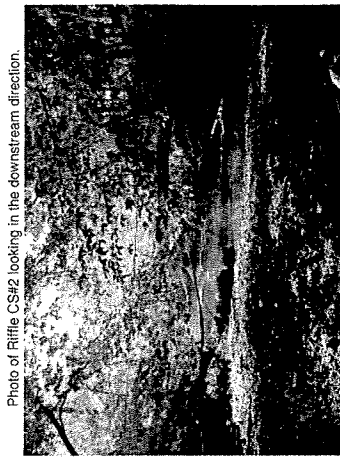
  

BANKFULL			
Hydraulic Geometry			
Width (Feet)	Depth (Feet)	Area (Sq. Ft.)	
0.0	0.0	0.0	
0.1	3.4	0.2	
0.8	3.4	2.7	
1.8	3.2	5.9	
17.8	2.9	53.8	
7.0	3.2	21.2	
5.0	3.2	16.0	
2.0	3.4	6.6	
1.7	3.2	5.6	
1.3	3.1	4.1	
2.8	0.0	4.3	
<b>TOTALS</b>	<b>40.3</b>	<b>120.4</b>	

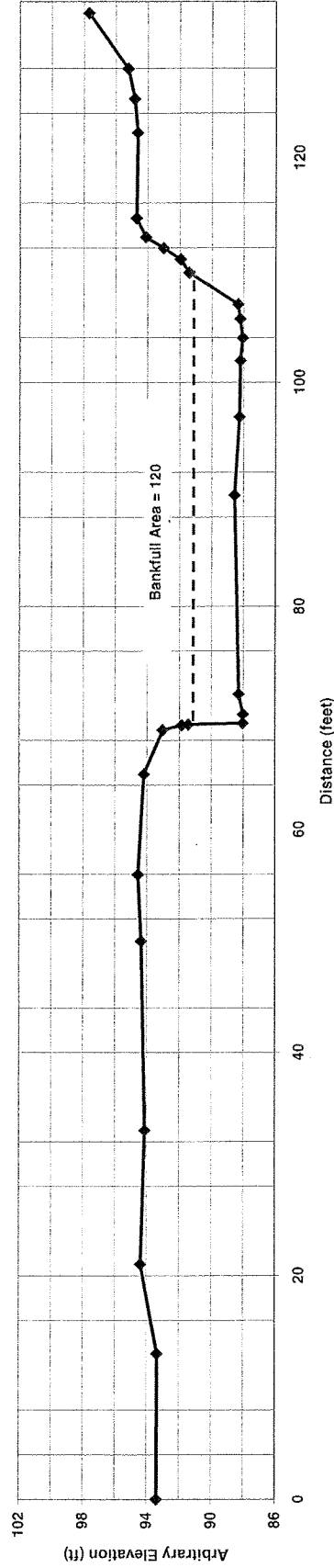
  

SUMMARY DATA (BANKFULL)			
A/BKF	W(BKF)	Slope	W(FPA)
40.3	40.3	?	150
3.4	3.4		
3.0	3.0		
13.5	13.5	Area= A	
3.7	3.7	Width= W	
C4	C4	Depth= D	
		Bankfull= BKF	
			85-300

Bank Erosion Hazard Index (BEHI)			
Criteria	Value	Index	Bank Erosion Potential
Bank-H/Bkf Ht	1.01	1.1	very low
Root Density (%)	29	5.9	moderate
Bank Angle (Degrees)	90	7.9	high
Surface Protection (%)	10	8	high
Bank Materials	Silt/Clay	0	very high
<b>TOTALS</b>		<b>30.8</b>	<b>High</b>



Riffle Cross Section #2



Tick Creek  
 Condoret Property, Chatham County

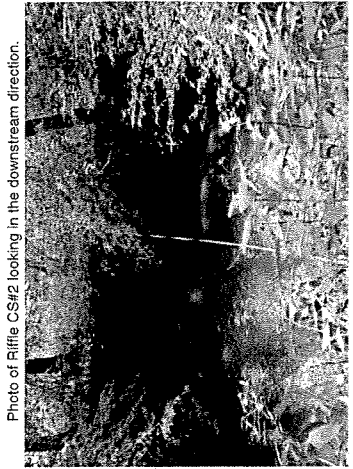
Field Crew: Ben Goetz, Jan Patterson, Jane Almon  
 River Basin: Cape Fear  
 Watershed: Tick Creek  
 Stream Reach: Condoret-Reach 1  
 Drainage Area: 20.4 sq mi (13,060 acres)  
 Date: 8/9/2001  
 Station: N/A  
 Feature: Riffle CS#1

STATION (Feet)	HI (Feet)	FS (Feet)	ELEVATION (Feet)	NOTES
0+00.0	100.00	4.94	84.23	
0+15.0	88.42	4.93	83.49	
0+27.0	88.42	4.30	84.12	
0+35.0	88.42	4.79	83.63	
0+41.0	88.42	5.02	83.40	LTOB
0+41.9	88.42	5.38	83.04	TOB
0+42.0	88.42	8.30	80.12	LBKF
0+42.5	88.42	9.13	79.29	
0+43.0	88.42	11.52	76.90	WSWE
0+46.0	88.42	12.23	76.19	
0+50.7	88.42	12.36	76.06	TW
0+59.0	88.42	12.27	76.15	
0+64.0	88.42	12.35	76.07	
0+66.0	88.42	11.96	76.46	
0+70.6	88.42	11.75	76.67	
0+72.8	88.42	11.63	76.79	
0+74.6	88.42	11.60	76.82	WS
0+76.0	88.42	11.31	77.11	
0+76.4	88.42	9.97	78.45	
0+77.9	88.42	9.13	79.29	
0+78.5	88.42	8.30	80.12	RBKF
0+78.8	88.42	6.46	81.96	
0+80.9	88.42	5.36	83.06	TOB
0+84.0	88.42	4.90	83.52	
0+81.7	88.42	5.10	83.32	
0+89.4	88.42	5.35	83.07	
1+08.7	88.42	5.43	82.99	
1+29.9	88.42	5.4	83.02	
1+35.3	88.42	5.78	82.64	
1+40.0	88.42	5.31	83.11	
1+43.0	88.42	5.00	83.42	

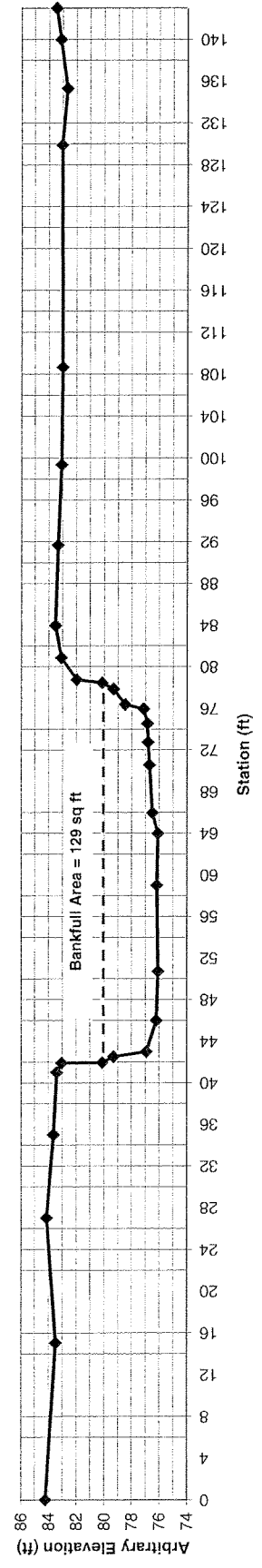
TOP OF BANK		
Width (Feet)	Depth (Feet)	Area (Sq. Ft.)
0.0	0.0	0.0
0.1	2.9	0.1
1.1	6.1	4.8
3.0	6.9	19.5
4.7	7.0	32.5
8.3	6.9	57.6
5.0	7.0	34.7
2.0	6.6	13.6
4.6	6.4	29.8
2.2	6.3	13.9
1.8	6.2	11.2
1.4	5.9	8.5
0.4	4.6	2.1
1.5	3.8	6.3
0.6	2.9	2.0
0.3	1.1	0.6
2.1	0.0	1.1
TOTALS		390
SUMMARY DATA (TOB)		238.0
A(BKF)	390	
W(BKF)	7.0	
Max d	7.0	
Mean d	6.1	

BANKFULL		
Width (Feet)	Depth (Feet)	Area (Sq. Ft.)
0	0	0
0.5	0.8	0.2
0.5	3.2	1.0
3.0	3.9	10.7
4.7	4.1	18.8
8.3	4.0	33.3
5.0	4.1	20.1
2.0	3.7	7.7
4.6	3.5	16.4
2.2	3.3	7.5
1.8	3.3	6.0
1.4	3.0	4.4
0.4	1.7	0.9
1.5	0.8	1.9
0.6	0.0	0.2
TOTALS		36.6
SUMMARY DATA (BANKFULL)		129.1
A(BKF)	36.6	
W(BKF)	4.1	
Max d	4.1	
Mean d	3.5	
W/D	10.3	
Entrenchment	E4	
Stream Type	E4	
Area from Rural Regional Curve		85-300

Bank Erosion Hazard Index (BEHI)		
Criteria	Value	Index
Bank H/Bkf Ht	1.04	1.4
Bank Depth/Bank Ht	0.14	8
Root Density (%)	15	6
Bank Angle (Degrees)	80	5.9
Surface Protection (%)	9	10
Bank Materials	Silt/Clay	0
TOTALS		31.3
Potential		high



Riffle Cross Section #1



Tick Creek  
Condoret Property, Chatham County

Field Crew: Ben Goelz, Jan Patterson, Jane Almon  
 River Basin: Cape Fear  
 Watershed: Tick Creek  
 Stream Reach: Condoret-Reach 1  
 Drainage Area: 20.4 sq mi (13,060 acres)  
 Date: 8/9/2001  
 Station: N/A  
 Feature: Pool CS#1

STATION (FEET)	REV. STA. (FEET)	HI (FEET)	FS (FEET)	ELEVATION (FEET)	NOTES
0+00.0	1+16.0	103.50	4.97	100.00	
0+08.0	1+08.0	103.50	5.14	98.36	
0+13.0	1+03.0	103.50	5.23	98.27	
0+15.0	1+01.0	103.50	5.52	97.98	RTOB
0+19.0	0+97.0	103.50	7.69	95.81	RBKF
0+27.0	0+89.0	103.50	10.12	93.38	
0+30.5	0+85.5	103.50	11.17	92.33	REW/WS
0+32.5	0+83.5	103.50	11.64	91.86	
0+36.5	0+79.5	103.50	12.49	91.01	
0+39.5	0+76.5	103.50	12.79	90.71	
0+42.0	0+74.0	103.50	13.00	90.50	TW
0+47.0	0+69.0	103.50	12.50	91.00	
0+49.0	0+67.0	103.50	12.05	91.45	
0+52.5	0+63.5	103.50	11.67	91.83	LEW
0+54.5	0+61.5	103.50	10.40	93.10	
0+54.7	0+61.3	103.50	7.69	95.81	LBKF
0+55.0	0+61.0	103.50	6.70	96.80	
0+56.0	0+60.0	103.50	5.15	98.35	LTOB
0+61.0	0+55.0	103.50	4.78	98.72	
0+66.0	0+50.0	103.50	5.12	98.38	
0+74.0	0+42.0	103.50	4.84	98.66	
0+84.0	0+32.0	103.50	5.81	97.69	TOE OF BERM
0+89.0	0+27.0	103.50	5.45	98.05	TOP OF BERM
0+93.0	0+23.0	103.50	3.73	99.77	TOP OF BERM
0+95.0	0+21.0	103.50	3.80	99.70	TOP OF BERM
0+99.0	0+17.0	103.50	5.49	98.01	TOE OF BERM
1+04.0	0+12.0	103.50	5.62	97.88	EDGE OF VEG
1+16.0	0+00.0	103.50	5.35	98.15	FIELD

TOP OF BANK			
Hydraulic Geometry			
Width (Feet)	Depth (Feet)	Area (Sq. Ft.)	
0.0	0.0	0.0	
4.0	2.2	4.3	
8.0	4.6	17.1	
3.5	5.7	17.9	
2.0	6.1	11.8	
4.0	7.0	26.2	
3.0	7.3	21.4	
2.5	7.5	18.4	
5.0	7.0	36.2	
2.0	8.5	13.5	
3.5	6.2	22.2	
2.0	4.9	11.0	
0.2	2.2	0.7	
0.3	1.2	0.5	
41.0	-0.4	211.6	
TOTALS 41.0 -0.4 211.6			

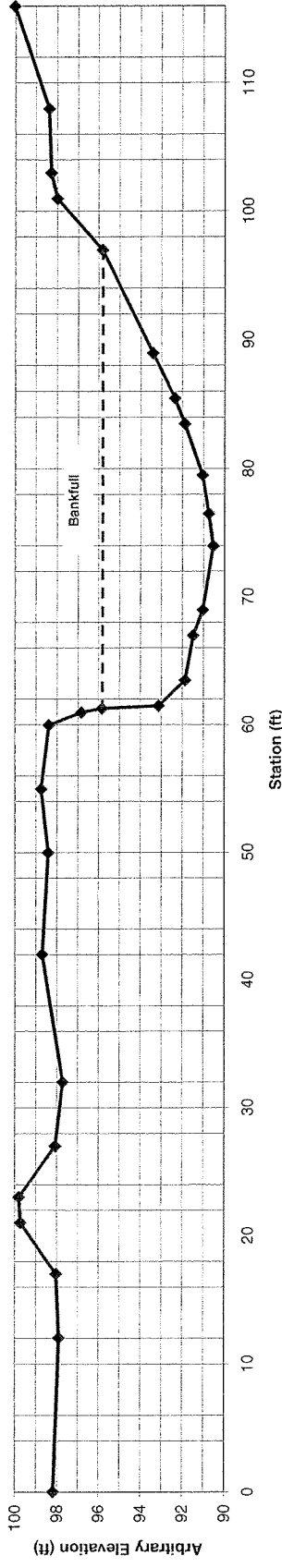
SUMMARY DATA (TOE)			
A(BKF)	W(BKF)	Max d	Mean d
211.6	41.0	7.5	5.2

Bank Erosion Hazard Index (BEHI)			
Criteria	Value	Index	Potential
Bank Ht/Bk Ht	1.02	1.2	very low
Root Depth/Bank Ht	0.49	4	moderate
Root Density (%)	40	4.8	moderate
Bank Angle (Degrees)	61	4	moderate
Surface Protection (%)	30	4	moderate
Bank Materials	silt/clay	0	
			LOW

Photo of Rifle CS#1 looking in the downstream direction.



Pool CS#1



Tick Creek  
 Condoret Property, Chatham County

Field Crew: Ben Goetz, Jan Patterson  
 River Basin: Cape Fear  
 Watershed: Tick Creek  
 Stream Reach: Condoret - Reach 1  
 Drainage Area: 20.2 sq mi (13,060 ac)  
 Date: 2/26/2002  
 Station: N/A  
 Feature: Run\_CS#2

STATION (Feet)	HI (Feet)	FS (Feet)	ELEVATION (Feet)	NOTES
0+00.0	102.60	4.49	98.11	
0+10.0	102.60	4.97	97.63	LTOB
0+13.0	102.60	5.85	96.75	
0+14.0	102.60	6.54	96.06	LBKF
0+15.3	102.60	6.81	95.79	
0+16.0	102.60	7.10	95.50	
0+17.0	102.60	7.40	95.20	
0+18.0	102.60	7.96	94.62	
0+20.0	102.60	8.41	94.19	
0+21.0	102.60	8.90	93.70	
0+22.0	102.60	9.47	93.13	
0+24.0	102.60	9.78	92.82	LEW
0+25.5	102.60	10.29	92.31	
0+31.0	102.60	10.62	91.98	
0+36.0	102.60	10.65	91.97	
0+40.0	102.60	10.84	91.96	
0+43.0	102.60	10.86	91.74	TW
0+46.0	102.60	10.82	91.78	
0+50.0	102.60	10.30	92.30	REW
0+52.0	102.60	9.28	93.32	
0+53.5	102.60	8.15	94.45	
0+55.8	102.60	7.19	95.41	RBKF
0+56.3	102.60	6.81	95.79	
0+59.0	102.60	5.80	96.80	RTOB
0+60.0	102.60	5.09	97.51	
0+65.0	102.60	4.73	97.87	

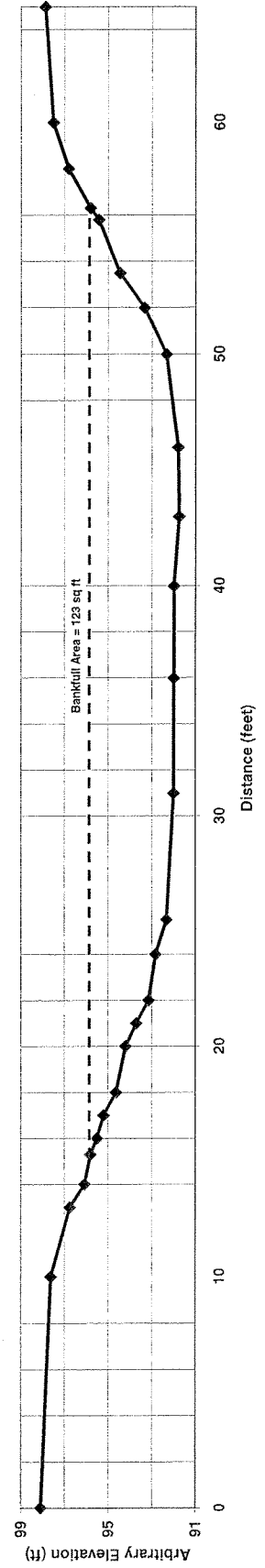
TOP OF BANK Hydraulic Geometry			BANKFULL Hydraulic Geometry		
Width (Feet)	Depth (Feet)	Area (Sq. Ft.)	Width (Feet)	Depth (Feet)	Area (Sq. Ft.)
3.0	0.0	0.0	0.0	0.0	0.0
3.0	0.9	1.3	0.7	0.3	0.1
1.0	1.6	1.2	1.0	0.6	0.4
1.3	1.8	2.2	1.0	1.2	0.9
0.7	2.1	1.4	2.0	1.6	2.8
1.0	2.4	2.3	1.0	2.1	1.8
1.0	3.0	2.7	1.0	2.7	2.4
2.0	3.4	6.5	2.0	3.0	5.6
3.0	3.9	3.7	1.5	3.5	4.8
1.0	4.5	4.2	5.5	3.8	20.0
2.0	4.8	9.3	5.0	3.8	19.1
1.5	5.3	7.6	4.0	3.8	15.3
5.5	5.7	30.2	4.0	4.1	11.8
5.0	5.7	28.3	3.0	4.0	12.1
4.0	5.7	22.7	4.0	3.5	15.0
3.0	5.9	17.3	2.0	2.5	6.0
3.0	5.8	17.6	1.5	1.3	2.9
4.0	4.3	9.6	2.3	0.4	2.0
2.0	3.2	5.6	0.5	0.0	0.1
1.5	3.2	6.2			
2.3	2.2	6.2			
0.5	1.8	1.0			
1.7	0.8	2.3			
2.0	0.1	1.0			
<b>TOTALS</b>	<b>50.0</b>	<b>206.5</b>	<b>41.0</b>	<b>0.0</b>	<b>123.1</b>

SUMMARY DATA (TOP)			SUMMARY DATA (BANKFULL)		
A(BKF)	W(BKF)	Mean d	A(BKF)	W(BKF)	Mean d
206.5	50.0	4.1	123.1	41.0	?
50.0	5.9	4.1	41.0	4.1	3.0
4.1			3.0	13.7	2.4
			2.4	2.4	2.4
			C4		
			Area from Rural Regional Curve		85-900

Bank Erosion Hazard Index (BEHI)			
Criteria	Value	Index	Bank Erosion Potential
Bank HyBkf Ht	1.4	5.3	moderate
Root Depth/Bank Ht	1	1	very low
Root Density (%)	35	4.4	high
Bank Angle (Degrees)	61	4	moderate
Surface Protection (%)	40	4.8	moderate
Bank Materials	Silt/Clay	0	
<b>TOTALS</b>		<b>19.5</b>	<b>low</b>



Run Cross Section #2



**Tick Creek**  
**Condoret Property, Chatham County**  
**PATTERN DATA FOR TICK CREEK**

Curve	Radius of C	Beltwidth	Wavelength
1	185	82	
2	400		
3	45	128	418
4	150	66	296
5	60	88	251
6	88	89	
7	80		
<b>Avg</b>	144	91	322
<b>Min</b>	45	66	251
<b>Max</b>	400	128	418



Tick Creek  
Condoret Property, Chatham County

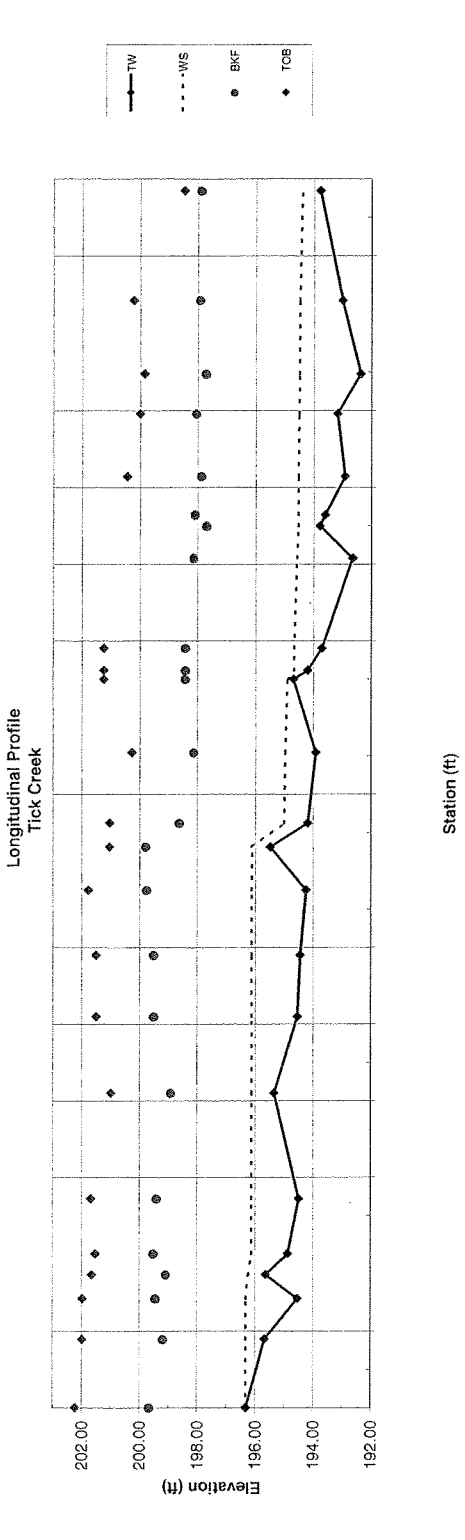
**LONGITUDINAL PROFILE**  
 River Basin: Cape Fear  
 Watershed: Tick Creek  
 Stream Reach: Tick Creek  
 DA (sq mi): 20 sq mi  
 Date: 3/6/2002

RECFPT	BS	EH	ZS	ELEV	NOTES
Sta	Sta	Sta	Sta	ft	pin at can
TP # 1	5.98	208.00	4.92	201.02	
TP # 2	3.37	207.32	4.05	203.95	
TP # 3	3.60	206.56	4.36	202.96	
TP # 4	4.44	205.99	5.01	201.55	
TP # 5	4.78	205.46	5.31	200.68	
TP # 6	5.38	206.22	5.62	199.84	
BH	0.00	200.00	6.22	200.00	Error=0.00

Tick Longitudinal Profile

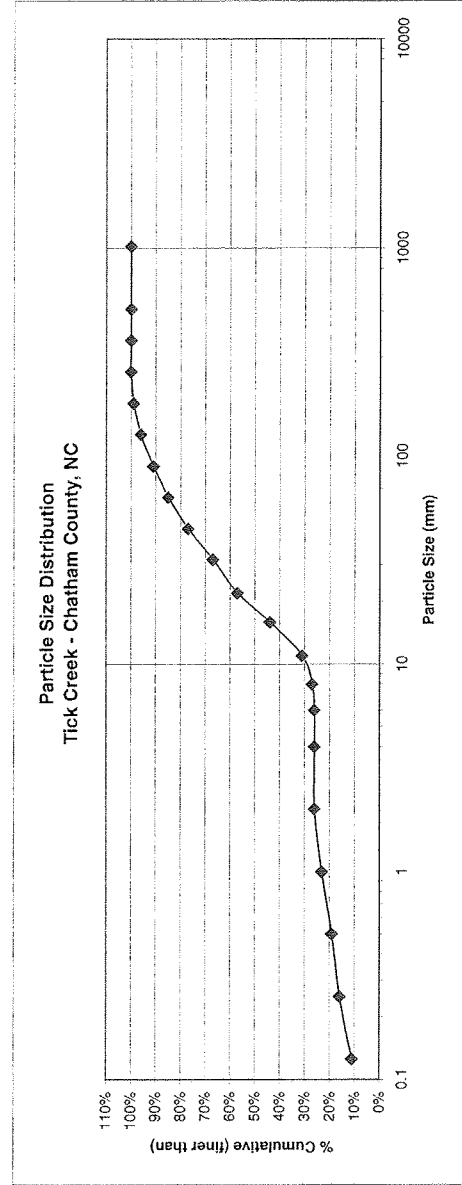
Station	REEFPT	BH	TW(ELEV)	TW	WS(ELEV)	WS	BK(ELEV)	BK	TOB(ELEV)	TOB	Notes	BL. MARK HL	P.P	Pool Length	Max Pool Depth	Pool Slope	Riffle Length	Riffle Slope		
0+50.0	TP # 1	208.00	11.71	185.29	11.71	185.30	8.57	195.63	5.70	202.21	Head of Riffle	1.8								
0+90.0	TP # 1	208.00	12.35	195.65	11.70	195.30	8.34	195.15	6.05	201.95	Head of Run	1.5								
1+42.0	TP # 1	208.00	13.49	194.51	11.70	195.30	8.58	195.42	6.05	201.95	Max Run	1.7			4.91	0.10	88.0	0.00		
1+73.0	TP # 1	208.00	12.40	195.60	11.78	196.22	8.94	199.05	6.37	201.63	Head of Riffle	1.4		84.0						
2+00.0	TP # 1	208.00	13.15	194.35	11.92	195.10	8.51	195.49	6.50	201.50	Head of Run	1.5					27.0	0.44		
2+72.0	TP # 1	208.00	13.54	194.46	11.90	195.10	8.61	199.39	6.34	200.97	Intermediate	1.6								
4+10.0	TP # 2	207.32	12.00	195.32	11.20	196.10	8.42	196.90	6.35	200.97	Intermediate	1.4								
4+40.0	TP # 2	207.32	12.00	195.32	11.20	196.10	8.42	196.90	6.35	200.97	Intermediate	1.4								
5+20.0	TP # 2	207.32	12.90	194.42	11.27	195.10	7.83	195.49	5.84	201.48	Max Pool	1.4	390.0							
6+75.0	TP # 3	206.56	12.34	194.22	10.46	195.10	6.83	195.73	4.81	201.75	Max Pool	1.4								
7+32.0	TP # 3	206.56	11.10	195.46	10.46	195.08	6.80	195.73	4.81	201.75	Head of Riffle	1.3		142.0						
7+83.0	TP # 3	206.56	12.40	194.18	11.58	194.99	7.95	198.61	5.55	201.01	Head of Run	1.5								
8+55.0	TP # 4	205.99	12.10	193.89	11.04	194.95	7.89	195.10	5.75	200.24	Intermediate	1.5								
9+51.0	TP # 4	205.99	11.32	194.67	11.11	194.88	7.59	196.40	4.76	201.23	Head of Riffle	1.8		188.0						
9+62.0	TP # 4	205.99	11.92	194.17	11.35	194.84	7.59	196.40	4.76	201.23	Head of Run	1.7								
9+91.0	TP # 4	205.99	12.30	193.69	11.35	194.64	7.89	198.40	4.76	201.23	Head of Pool	1.6								
10+50.0	TP # 4	205.99	12.30	193.69	11.35	194.64	7.89	198.40	4.76	201.23	Head of Pool	1.6								
11+50.0	TP # 4	205.99	12.93	193.75	11.48	194.51	8.31	197.63	8.31	197.63	Max Pool	1.0		159.0						
11+50.0	TP # 4	205.99	12.93	193.75	11.48	194.51	8.31	197.63	8.31	197.63	Max Pool	1.0								
12+15.0	TP # 5	205.46	12.41	192.89	10.95	194.51	7.91	196.08	7.91	200.42	Head of Pool	1.5								
12+46.0	TP # 5	205.46	12.30	192.16	10.97	194.49	7.43	195.03	5.47	199.99	Intermediate	1.4								
13+46.0	TP # 5	205.46	13.10	192.36	10.88	194.48	7.76	197.70	5.63	199.83	Max Pool	1.4								
14+43.0	TP # 5	205.46	12.48	192.98	11.00	194.46	7.56	197.90	5.28	200.20	Intermediate	1.5								
15+85.0	TP # 5	205.46	11.70	193.78	11.07	194.39	7.59	197.87	7.00	198.45	Head of Riffle	1.1		420.0						

Average Slope 0.12



# Tick Creek Condoret Property, Chatham County

PEBBLE COUNT											
Site: Condoret Property						3/4/2002					
Party: Ben Goetz, Jan Patterson						Tick Creek					
Inches	Particle	Silt/Clay	Millimeter	S/C	Particle Count				Total No.	Item %	% Cumulative
					Run	Riffle	Run	Riffle			
	Very Fine	<0.062	.062 - .125	S	2	2	0	0	6	6%	6%
	Fine	.125 - .25	.125 - .25	A	0	1	1	1	5	5%	11%
	Medium	.25 - .50	.25 - .50	N	0	0	2	0	5	5%	16%
	Coarse	.50 - 1.0	.50 - 1.0	D	0	1	2	2	3	3%	19%
.04 - .08	Very Coarse	1.0 - 2.0	1.0 - 2.0	S	0	0	1	2	4	4%	23%
.08 - .16	Very Fine	2.0 - 4.0	2.0 - 4.0	G	0	0	0	0	0	0%	26%
.16 - .22	Fine	4.0 - 5.7	4.0 - 5.7	R	0	0	0	0	0	0%	26%
.22 - .31	Fine	5.7 - 8.0	5.7 - 8.0	R	0	0	1	0	1	1%	27%
.31 - .44	Medium	8.0 - 11.3	8.0 - 11.3	A	1	1	0	1	4	4%	31%
.44 - .63	Medium	11.3 - 16.0	11.3 - 16.0	V	2	2	2	4	13	13%	44%
.63 - .89	Coarse	16.0 - 22.6	16.0 - 22.6	E	2	4	2	3	13	13%	57%
.89 - 1.26	Coarse	22.6 - 32.0	22.6 - 32.0	L	1	1	4	3	10	10%	67%
1.26 - 1.77	Very Coarse	32.0 - 45.0	32.0 - 45.0	S	3	2	2	1	2	10%	77%
1.77 - 2.5	Very Coarse	45.0 - 64.0	45.0 - 64.0	C	2	2	0	1	8	8%	85%
2.5 - 3.5	Small	64 - 90	64 - 90	C	2	2	0	0	6	6%	91%
3.5 - 5.0	Small	90 - 128	90 - 128	O	3	1	0	0	5	5%	96%
5.0 - 7.1	Large	128 - 180	128 - 180	B	0	0	2	1	3	3%	99%
7.1 - 10.1	Large	180 - 256	180 - 256	L	0	0	1	0	1	1%	100%
10.1 - 14.3	Small	256 - 362	256 - 362	B	0	0	0	0	0	0%	100%
14.3 - 20	Small	362 - 512	362 - 512	L	0	0	0	0	0	0%	100%
20 - 40	Medium	512 - 1024	512 - 1024	D	0	0	0	0	0	0%	100%
40 - 80	Lrg. - Very Lrg	1024 - 2048	1024 - 2048	R	0	0	0	0	0	0%	100%
	Bedrock			BDRK	0	0	0	0	0	0%	100%
<b>Totals</b>					<b>20</b>	<b>20</b>	<b>20</b>	<b>20</b>	<b>100</b>	<b>100%</b>	<b>100%</b>



Riffle Sample  
Tick Creek- Main Stream

Sieve Size (mm)	0.062	0.075	0.106	0.25	0.3	0.6	0.85	1.18	2	4.75	9.5	12.7	19	25	LP1	LP2
micro		75	106	250	300	600	850								240	225
Tare Weight(lbs)	0.81	0.74	0.76	0.81	0.82	0.87	0.95	1.91	1.3	2.27	2.42	2.46	2.56	2.57	weight	34.48

Sample Weight (lbs)  
Net Sample Weight(lbs)  
%  
% Cumulative

0.062	0.075	0.106	0.25	0.3	0.6	0.85	1.18	2	4.75	9.5	12.7	19	25	LP1	LP2
0.82	0.75	0.84	1.04	2.18	2.35	3.08	6.7	7.9	8.22	5.14	7.3	5.8	7.14	TOTAL	
0.01	0.01	0.08	0.23	1.36	1.48	2.13	4.79	6.6	5.95	2.72	4.84	3.24	4.57	38.01	lbs
0%	0%	0%	1%	4%	4%	6%	13%	17%	16%	7%	13%	9%	12%		
0%	0%	0%	1%	4%	8%	14%	27%	44%	60%	67%	79%	88%	100%		

D50 Subpavement  
D50 Riffle Pavement

Tc=  
Largest Particle

Slope  
Depth required

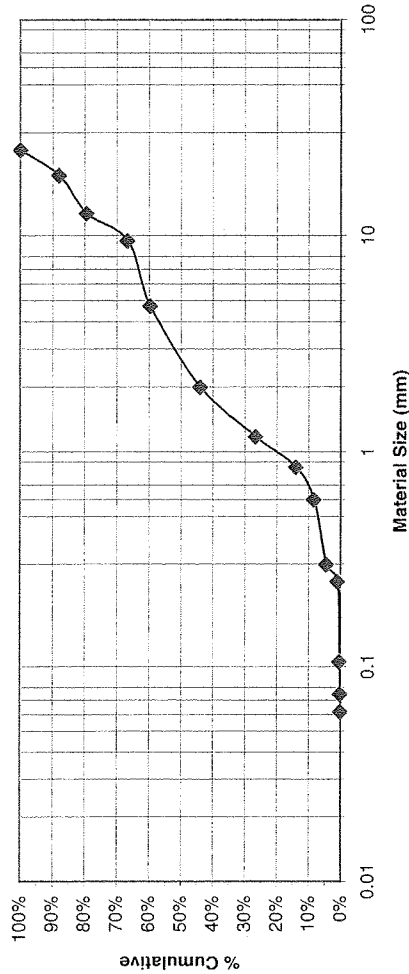
Area Required  
Width/Depth Ratio

Bankfull Width  
actual mean depth

Largest particle

Max Riffle Depth

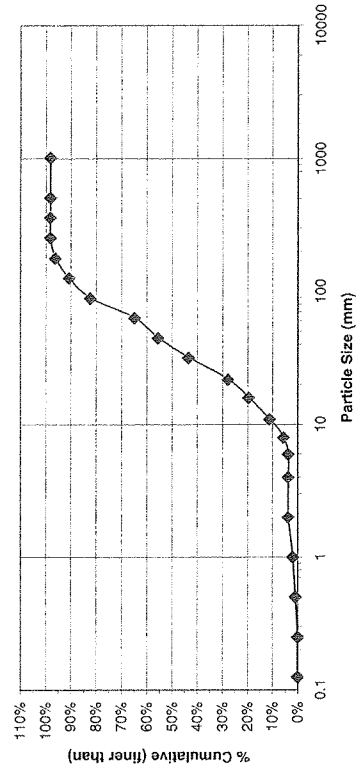
Bar Material Particle Size Distribution  
Tick Creek - Chatham County, NC



**Tick Creek  
Condoret Property, Chatham County**

PEBBLE COUNT									
Site: Condoret Property					3/4/2002				
Party: Ben Goetz, Jan Patterson					Tick Creek				
Inches	Particle Silt/Clay	Millimeter < 0.062	Riffle	Total No.	Particle Count Item %	% Cumulative			
	S/C								
.04 - .08	Very Fine	.062 - .125	S	0	0%	0%			
	Fine	.125 - .25	A	0	0%	0%			
	Medium	.25 - .50	N	1	1%	1%			
	Coarse	.50 - 1.0	D	1	1%	2%			
	Very Coarse	1.0 - 2.0	S	2	2%	4%			
.08 - .16	Very Fine	2.0 - 4.0	G	0	0%	4%			
	Fine	4.0 - 5.7	R	0	0%	4%			
	Fine	5.7 - 8.0	A	6	6%	10%			
	Medium	8.0 - 11.3	V	9	8%	19%			
	Medium	11.3 - 16.0	E	9	8%	28%			
	Coarse	16.0 - 22.6	L	17	16%	44%			
	Coarse	22.6 - 32.0	S	13	12%	56%			
	Very Coarse	32.0 - 45.0		10	9%	65%			
	Very Coarse	45.0 - 64.0		19	18%	82%			
2.5 - 3.5	Small	64 - 90	C	9	8%	91%			
3.5 - 5.0	Small	90 - 128	B	6	6%	96%			
5.0 - 7.1	Large	128 - 180	L	2	2%	98%			
7.1 - 10.1	Large	180 - 256		0	0%	98%			
10.1 - 14.3	Small	256 - 362	B	0	0%	98%			
14.3 - 20	Small	362 - 512	L	0	0%	98%			
20 - 40	Medium	512 - 1024	D	0	0%	98%			
40 - 80	Lrg- Very Lrg	1024 - 2048	R	0	0%	98%			
	Bedrock		BDRK	2	2%	100%			
<b>Totals</b>				<b>108</b>	<b>108</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>

**Particle Size Distribution  
Tick Creek - Chatham County, NC**



Tick Creek  
Condoret Property, Chatham County

Field Crew: Ben Goetz, Dan Clinton, Jan Almon, Phillip Todd  
 River Basin: Cape Fear  
 Watershed: Tick Creek  
 Stream Reach: Condoret - Tributary  
 Draining Area: 0.13 sq mi ( ac)  
 Date: 9/25/2001  
 Station: N/A  
 Feature: Riffle CS#1

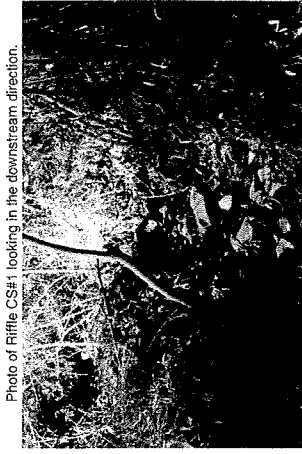
STATION	HI (Feet)	FS (Feet)	ELEVATION (Feet)	NOTES
0+00.0	100.00	1.02	98.98	
0+20.0	100.00	3.26	96.74	
0+25.0	100.00	3.54	96.46	
0+50.0	100.00	4.94	95.06	LTOB
0+55.0	100.00	5.12	94.88	
0+59.4	100.00	5.55	94.45	
0+62.5	100.00	6.44	93.56	LBKF
0+63.6	100.00	6.68	93.32	
0+64.3	100.00	7.07	92.93	
0+65.5	100.00	7.66	92.34	
0+65.9	100.00	7.76	92.24	LEW
0+66.4	100.00	7.74	92.26	
0+67.0	100.00	7.71	92.29	
0+67.5	100.00	7.82	92.18	
0+67.7	100.00	7.90	92.10	TW
0+68.7	100.00	7.76	92.24	REW/WS
0+69.3	100.00	6.61	93.39	
0+69.8	100.00	6.41	93.59	RBKF
0+70.8	100.00	6.64	93.36	
0+71.9	100.00	6.66	93.35	
0+74.6	100.00	6.35	93.65	
0+76.1	100.00	6.02	92.99	
0+79.0	100.00	5.36	94.64	
0+83.0	100.00	4.94	95.06	RTOB
0+84.0	100.00	4.82	95.18	
1+01.0	100.00	4.86	95.44	
1+12.0	100.00	3.26	96.74	
1+22.0	100.00	1.65	98.35	

TOP OF BANK			
Hydraulic Geometry			
Width (Feet)	Depth (Feet)	Area (Sq. Ft.)	
0.0	0.0	0.0	
4.4	0.4	0.9	
3.1	1.3	2.7	
1.1	1.6	1.6	
0.7	1.9	1.2	
1.2	2.5	2.7	
0.4	2.6	1.0	
0.5	2.6	1.3	
0.6	2.6	1.6	
0.5	2.7	1.3	
0.2	2.8	0.5	
1.0	2.6	2.7	
0.6	1.5	1.2	
0.5	1.3	0.7	
1.0	1.5	1.4	
1.1	3.1	2.5	
2.7	1.2	5.8	
1.5	1.9	2.3	
2.9	0.2	3.1	
<b>TOTALS</b>	<b>24.0</b>	<b>34.8</b>	

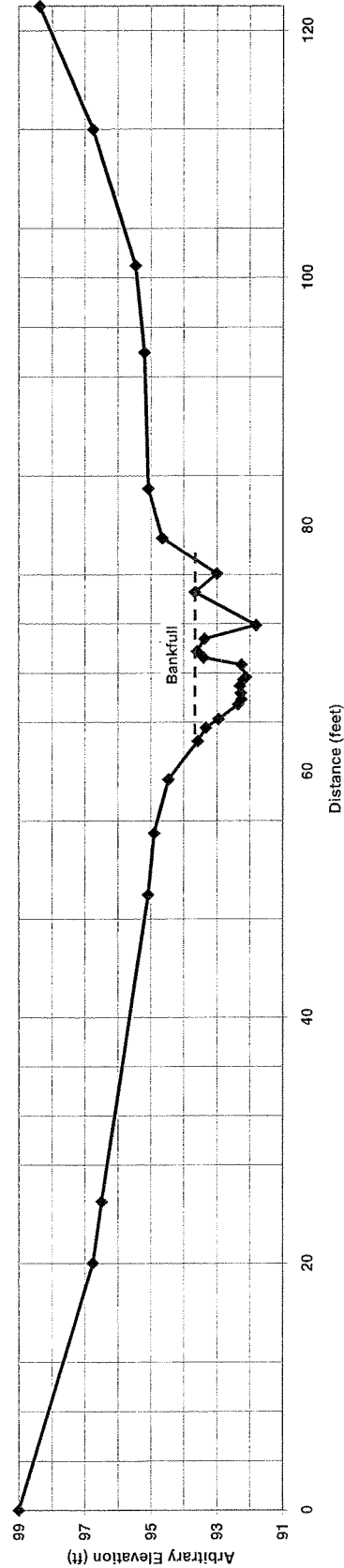
BANKFULL			
Hydraulic Geometry			
Width (Feet)	Depth (Feet)	Area (Sq. Ft.)	
0.0	0.0	0.0	
1.1	0.2	0.1	
0.7	0.6	0.3	
1.2	1.2	1.1	
0.4	1.3	0.5	
0.5	1.3	0.7	
0.6	1.3	0.8	
0.5	1.4	0.7	
0.2	1.5	0.3	
1.0	1.3	1.4	
0.6	0.2	0.4	
0.5	0.0	0.0	
<b>TOTALS</b>	<b>7.3</b>	<b>6.3</b>	

SUMMARY DATA (BANKFULL)			
A(BKF)	6.3	W(FPA)	33
W(BKF)	7.3	Slope	?
Max d	1.5	Sinuosity	1
Mean d	0.9	Area= A	
W/D	8.5	Width= W	
Entrenchment	4.5	Depth= D	
Stream Type	E4	Bankfull= BKF	
Area from Rural Regional Curve	2.5-10		

Bank Erosion Hazard Index (BEHI)			
Criteria	Value	Index	Bank Erosion Potential
Bank H/Bkfr Ht	2	7.9	high
Bank Depth/Bank Ht	0.6	3.4	low
Root Density (%)	80	1.9	very low
Bank Angle (Degrees)	25	2.2	low
Surface Protection (%)	80	1.9	very low
Bank Materials Silt/Clay	0		
		<b>17.3</b>	<b>low</b>



Riffle CS#1



Tick Creek  
Condoret Property, Chatham County

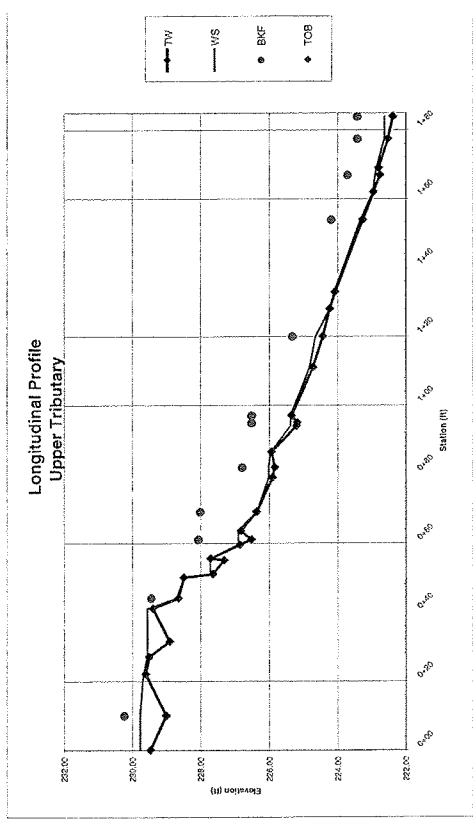
**LONGITUDINAL PROFILE**  
 River Basin: Cape Fear  
 Watershed: Tick Creek  
 Upper Tributary  
 Stream Reach: 0.13 sq mi  
 DA (84 mi): 2777002  
 Date:

REE PT	BS	HI	ES	ELEV	NOTES
BN	20.05	230.05		200.00	tree at neck
TP # 1	16.17	234.55	1.67	218.98	
TP # 2	2.66	231.69	10.03	211.00	
TP # 3	2.66	231.69	10.03	211.00	
TP # 4	0.35	230.03	13.22	200.03	Errors=0.03

Tributary Longitudinal Profile (Intermittent)

Station	REE PT	HI	TW(ES)	TW	WS(ES)	WS	BKE(ES)	BKE	TCB(ES)	TCB	Notes	30° FCH Invert(H)	P.P	Pool Length	Max Pool Depth	Pool Slope	Riffle Length	Riffle Slope	max	min	Max ratio	Min ratio	avg ratio	
0+00.00	TP # 1	234.55	5.69	229.46	4.78	228.77	4.31	230.24			Max Pool	1.24												
0+10.00	TP # 1	234.55	5.85	229.00	4.78	228.77	4.31	230.24			Head of Riffle		27.0	22.0	0.45	5.0	2.20	20.50	1.5	0.94	0.00009	0.1	0.2	0.23
0+20.00	TP # 1	234.55	4.85	229.60	4.89	229.67	4.31	230.24			Max Pool								2.20	0.94	0.00009	0.1	0.2	0.23
0+27.00	TP # 1	234.55	5.65	229.60	4.89	229.67	4.31	230.24			Head of Pool								2.20	0.94	0.00009	0.1	0.2	0.23
0+30.00	TP # 1	234.55	5.65	229.60	4.89	229.67	4.31	230.24			Max Pool								2.20	0.94	0.00009	0.1	0.2	0.23
0+41.00	TP # 1	234.55	5.16	229.39	5.00	229.55	5.12	229.43			Head of Riffle								2.20	0.94	0.00009	0.1	0.2	0.23
0+44.00	TP # 1	234.55	5.81	228.64	5.85	228.70	5.12	229.43			Intermediate								2.20	0.94	0.00009	0.1	0.2	0.23
0+50.00	TP # 1	234.55	6.07	228.48	6.07	228.48	5.12	229.43			Head of Pool								2.20	0.94	0.00009	0.1	0.2	0.23
0+51.00	TP # 1	234.55	5.92	227.63	6.03	227.72	5.12	229.43			Head of Riffle								2.20	0.94	0.00009	0.1	0.2	0.23
0+55.00	TP # 1	234.55	6.85	227.70	6.83	227.72	5.12	229.43			Head of Pool								2.20	0.94	0.00009	0.1	0.2	0.23
0+59.50	TP # 1	234.55	7.71	226.64	7.65	226.90	6.49	228.06			Max Pool								2.20	0.94	0.00009	0.1	0.2	0.23
0+61.00	TP # 1	234.55	8.04	226.51	7.65	226.90	6.49	228.06			Head of Riffle								2.20	0.94	0.00009	0.1	0.2	0.23
0+65.50	TP # 1	234.55	7.74	226.81	7.65	226.90	6.49	228.06			Head of Pool								2.20	0.94	0.00009	0.1	0.2	0.23
0+79.00	TP # 1	234.55	8.05	226.01	8.14	226.01	6.85	228.06			Head of Riffle								2.20	0.94	0.00009	0.1	0.2	0.23
0+82.00	TP # 1	234.55	8.73	226.83	8.54	226.91	7.78	226.77			Max Pool								2.20	0.94	0.00009	0.1	0.2	0.23
0+85.50	TP # 1	234.55	8.63	225.92	8.69	225.95	7.78	226.77			Head of Pool								2.20	0.94	0.00009	0.1	0.2	0.23
0+89.00	TP # 1	234.55	9.35	225.20	9.17	225.38	8.95	226.50			Head of Riffle								2.20	0.94	0.00009	0.1	0.2	0.23
0+97.00	TP # 1	234.55	8.21	225.94	8.17	226.38	8.95	226.50			Head of Pool								2.20	0.94	0.00009	0.1	0.2	0.23
1+11.00	TP # 1	234.55	8.83	224.72	9.73	224.82	9.24	225.31			Intermediate								2.20	0.94	0.00009	0.1	0.2	0.23
1+20.00	TP # 1	234.55	10.13	224.42	9.51	224.64	9.24	225.31			Intermediate								2.20	0.94	0.00009	0.1	0.2	0.23
1+28.00	TP # 1	234.55	10.33	224.22	10.33	224.22	9.24	225.31			Intermediate								2.20	0.94	0.00009	0.1	0.2	0.23
1+37.00	TP # 1	234.55	11.30	223.25	11.24	223.31	10.39	224.17			Intermediate								2.20	0.94	0.00009	0.1	0.2	0.23
1+45.00	TP # 1	234.55	11.62	222.53	11.60	222.55	10.39	224.17			Head of Pool								2.20	0.94	0.00009	0.1	0.2	0.23
1+47.00	TP # 1	234.55	11.80	222.75	11.86	222.89	10.86	223.69			Max Pool								2.20	0.94	0.00009	0.1	0.2	0.23
1+59.00	TP # 1	234.55	11.77	222.78	11.70	222.85	11.15	223.40			Head of Riffle								2.20	0.94	0.00009	0.1	0.2	0.23
1+64.00	TP # 1	234.55	12.18	222.37	11.85	222.60	11.15	223.40			Max Pool								2.20	0.94	0.00009	0.1	0.2	0.23

Average Slope: 3.90



Tick Creek  
 Condoret Property, Chatham County

Field Crew: Ben Goetz, Ian Patterson, Jane Almon, Phillip Todd  
 River Basin: Cape Fear  
 Watershed: Tick Creek  
 Stream Reach: Condoret Tributary  
 Drainage Area: 0.13 sq mi (acres)  
 Date: 9/25/2001  
 Station: N/A  
 Feature: Pool CS#1

STATION (FEET)	HI (FEET)	FS (FEET)	ELEVATION (FEET)	NOTES
0+00.0	103.50	2.48	100.00	
0+05.0	103.50	2.77	100.73	
0+07.5	103.50	3.35	100.15	
0+10.3	103.50	3.91	99.59	
0+12.3	103.50	4.95	98.55	TOB
0+14.0	103.50	6.05	97.45	
0+15.5	103.50	6.85	96.65	
0+17.3	103.50	7.46	96.04	
0+19.2	103.50	7.70	95.80	
0+20.7	103.50	7.93	95.57	LBKF
0+22.6	103.50	8.65	94.85	
0+24.0	103.50	9.00	94.50	
0+25.5	103.50	9.07	94.43	
0+26.6	103.50	9.30	94.20	
0+27.2	103.50	9.36	94.14	LEW/MS
0+28.0	103.50	9.43	94.07	
0+28.5	103.50	9.47	94.03	TW
0+29.3	103.50	8.67	94.83	
0+29.7	103.50	8.06	95.57	RBKF
0+30.0	103.50	6.85	96.65	
0+30.8	103.50	6.51	96.99	
0+44.0	103.50	4.95	98.55	TOB
0+56.0	103.50	5.57	97.93	
0+69.0	103.50	5.80	97.70	

Criteria	Value	Index	Bank Erosion Potential
Bank Ht/Bkt Ht	2.93	10	extreme
Bank Depth/Bank Ht	0.15	7.9	high
Root Density (%)	0.2	6.7	high
Bank Angle (Degrees)	58	3.8	low
Surface Protection (%)	20	6.7	high
Bank Materials	silt/clay	0	high
<b>TOTALS</b>		<b>35.1</b>	<b>high</b>

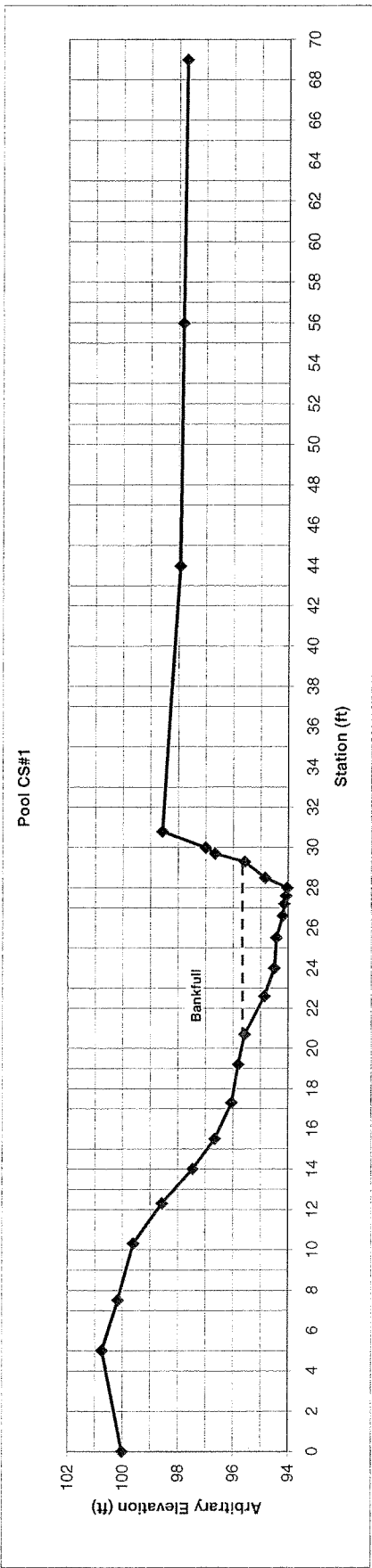


Hydraulic Geometry		
Width (Feet)	Depth (Feet)	Area (Sq. Ft.)
0.0	0.0	0.0
1.9	0.7	0.7
1.4	1.1	1.3
1.5	1.1	1.7
1.1	1.4	1.4
0.6	1.4	0.8
0.4	1.5	0.6
0.5	0.7	0.6
0.8	0.0	0.3
<b>TOTALS</b>	<b>8.6</b>	<b>7.9</b>

A(BKF)	7.9
W(BKF)	8.6
Max d	1.5
Mean d	0.9

Hydraulic Geometry		
Width (Feet)	Depth (Feet)	Area (Sq. Ft.)
0.0	0.0	0.0
1.7	1.1	0.9
1.5	1.9	2.2
1.8	2.5	4.0
1.9	2.8	5.0
1.5	3.0	4.3
1.9	3.7	6.3
1.4	4.1	5.4
1.5	4.1	6.1
1.1	4.3	4.7
0.6	4.4	2.6
0.4	4.5	1.8
0.4	4.5	1.8
0.5	3.7	2.1
0.8	3.0	2.7
<b>TOTALS</b>	<b>17.0</b>	<b>50.0</b>

A(TOB)	50.0
W(TOB)	17.0
Max d	4.5
Mean d	2.9



Tick Creek  
 Condoret Property, Chatham County

Field Crew: Ben Goetz, Dan Clinton, Jan Almon, Philip Todd  
 River Basin: Cape Fear  
 Watershed: Tick Creek  
 Stream Reach: Condorel - Tributary  
 Drainage Area: 0.13 sq mi (ac)  
 Date: 9/25/2001  
 Station: N/A  
 Feature: Riffle CS#2

STATION	HI	FS	ELEVATION	NOTES
(Feet)	(Feet)	(Feet)	(Feet)	
0+00.0	100.00	5.87	94.13	
0+06.0	100.00	5.91	94.09	
0+18.0	100.00	5.51	94.49	
0+27.0	100.00	5.40	94.60	
0+38.0	100.00	5.17	94.83	
0+43.0	100.00	4.90	95.10	LTOB
0+46.0	100.00	4.98	95.02	
0+45.5	100.00	5.25	94.75	
0+46.3	100.00	5.70	94.30	
0+46.8	100.00	6.16	93.84	
0+47.4	100.00	6.93	93.07	
0+48.0	100.00	7.25	92.75	
0+49.0	100.00	7.94	92.06	LBNF
0+49.5	100.00	8.38	91.62	
0+50.0	100.00	8.75	91.24	
0+50.2	100.00	8.85	91.15	LEW
0+50.7	100.00	8.92	91.08	
0+51.8	100.00	8.90	91.10	
0+52.0	100.00	8.95	91.05	TW
0+53.0	100.00	8.91	91.09	
0+53.5	100.00	8.94	91.06	
0+54.7	100.00	8.88	91.12	REW/WS
0+55.0	100.00	7.69	92.31	
0+55.3	100.00	7.25	92.75	RBNF
0+55.5	100.00	7.04	92.96	
0+56.6	100.00	5.82	94.18	
0+57.4	100.00	4.80	95.20	RTOB
0+60.0	100.00	4.98	95.02	
0+63.0	100.00	5.12	94.88	
0+67.0	100.00	5.58	94.42	
0+69.0	100.00	5.75	94.25	
0+74.0	100.00	5.65	94.35	
0+80.0	100.00	4.91	95.09	
0+90.0	100.00	4.94	95.06	
1+00.0	100.00	4.60	95.40	
1+07.0	100.00	4.40	95.60	
1+12.0	100.00	3.38	96.61	
1+18.0	100.00	3.30	96.70	

Bank Erosion Hazard Index (BEHI)	Value	Index	Bank Erosion Potential
Criteria			
Bank H/Bk-Ht	2.4	1.2	low
Root Density/Bank-Ht	0.1	8.6	very high
Bank Angle (Degrees)	10	3.4	very high
Surface Protection (%)	8	10	low
Bank Materials	Silt/Clay	0	very high
<b>TOTALS</b>		<b>31.8</b>	<b>High</b>

Photo of Riffle CS#2 looking in the downstream direction.

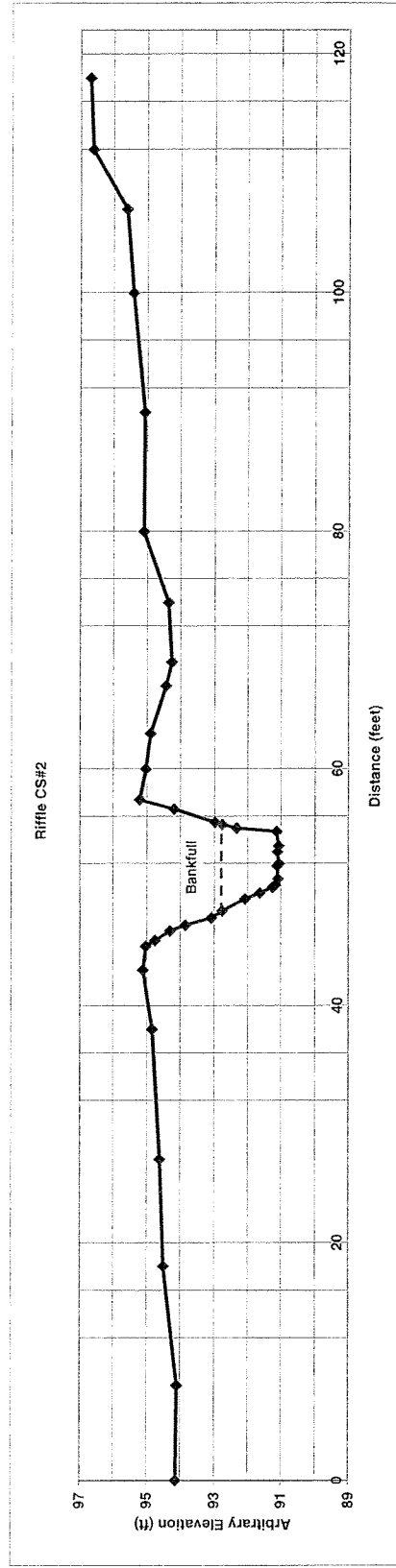


BANKFULL			
Hydraulic Geometry			
Width (Feet)	Depth (Feet)	Area (Sq. Ft.)	
0.0	0.0	0.0	
1.0	0.7	0.3	
0.5	1.1	0.5	
0.5	1.5	0.7	
0.2	1.6	0.3	
0.5	1.7	0.8	
1.1	1.7	1.8	
0.2	1.7	0.3	
1.0	1.7	1.7	
0.5	1.7	0.8	
1.2	1.6	2.0	
0.3	0.4	0.3	
0.3	0.0	0.1	
<b>TOTALS</b>	<b>7.3</b>	<b>9.6</b>	

SUMMARY DATA (BANKFULL)			
A/BKF	9.6	W(FPA)	11.9
W/BKF	7.3	Slope	7
Max d	1.7	Stimosity	1
Mean d	1.3	Area= A	
W/D	5.5	Width= W	
Enrichment	1.6	Depth= D	
Stream Type	G4	Bankfull= BKF	
Area from Rural Regional Curve			2.5-10

TOP OF BANK			
Hydraulic Geometry			
Width (Feet)	Depth (Feet)	Area (Sq. Ft.)	
0.0	0.0	0.0	
0.5	0.3	0.1	
0.8	0.7	0.4	
0.5	1.2	0.5	
0.6	2.0	0.9	
0.6	2.3	1.3	
1.0	3.0	2.6	
0.5	3.4	1.6	
0.5	3.8	1.8	
0.2	3.9	0.8	
0.2	3.9	2.0	
1.1	3.9	4.3	
0.2	4.0	0.8	
1.0	3.9	4.0	
0.5	4.0	2.0	
1.2	3.9	4.7	
0.3	2.7	1.0	
0.5	2.1	1.2	
1.1	0.8	1.6	
0.8	-0.2	0.3	
<b>TOTALS</b>	<b>12.4</b>	<b>31.7</b>	

SUMMARY DATA (TOB)			
A(TOB)	31.7		
W(TOB)	12.4		
Max d	4.0		
Mean d	2.6		





Tick Creek  
Condoret Property, Chatham County

Field Crew: Ben Goetz, Dan Clinton, Jan Almon, Phillip Todd  
 River Basin: Cape Fear  
 Watershed: Tick Creek  
 Stream Reach: Condoret - Tributary  
 Drainage Area: 0.13 sq mi ( ac)  
 Date: 9/25/2001  
 Station: N/A  
 Feature: Riffle CS#6

STATION (Feet)	HI (Feet)	FS (Feet)	ELEVATION (Feet)	NOTES
0+00.0	100.00	2.47	97.53	
0+04.0	100.00	3.21	96.79	
0+07.0	100.00	4.03	95.97	LTOB
0+08.0	100.00	5.19	94.81	
0+09.0	100.00	6.52	93.48	LKFF
0+09.5	100.00	7.38	92.62	TS
0+10.0	100.00	8.44	91.56	LEWWS
0+10.5	100.00	8.81	91.19	TW
0+13.0	100.00	9.97	91.03	TS
0+14.5	100.00	8.79	91.21	
0+15.5	100.00	7.84	92.16	
0+16.5	100.00	7.38	92.82	RBKF
0+17.5	100.00	7.08	92.92	
0+19.0	100.00	6.71	93.29	
0+21.0	100.00	5.54	94.46	FTOB
0+30.0	100.00	5.41	94.59	
0+40.0	100.00	5.01	94.99	

TOP OF BANK			
Hydraulic Geometry			
Width (Feet)	Depth (Feet)	Area (Sq. Ft.)	
0.0	0.0	0.0	
1.0	-0.4	-0.2	
1.0	1.0	0.3	
0.5	1.8	0.7	
0.5	2.9	1.2	
0.5	3.3	1.5	
2.5	3.4	8.4	
1.5	3.2	5.0	
1.0	2.3	2.8	
1.0	1.8	2.1	
1.5	1.2	2.0	
2.0	0.0	1.2	
TOTALS	14.0	26.7	

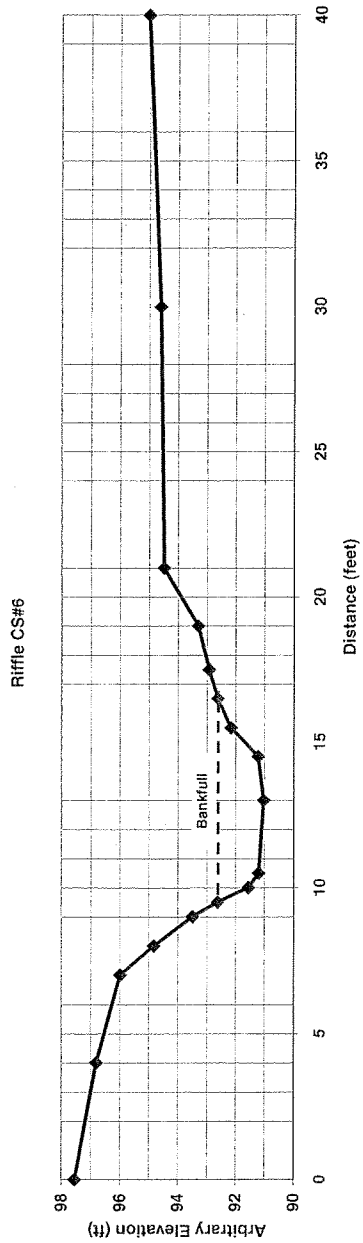
SUMMARY DATA (TOB)			
A(TOB)	26.7		
W(TOB)	14.0		
Max d	3.4		
Mean d	1.9		

BANKFULL			
Hydraulic Geometry			
Width (Feet)	Depth (Feet)	Area (Sq. Ft.)	
0.0	0.0	0.0	
0.5	1.1	0.3	
0.5	1.4	0.6	
2.5	1.6	3.8	
1.5	1.4	2.3	
1.0	0.5	0.9	
1.0	0.0	0.2	
TOTALS	7.0	8.1	

SUMMARY DATA (BANKFULL)			
A(BKF)	8.1	W(BKF)	7.0
Max d	1.6	Slope	?
Mean d	1.2	Area= A	50
W/D	6.1	Width= W	?
Entrenchment	7.1	Depth= D	1
Stream Type	E4	Bankfull= BKF	
Area from Rural Regional Curve			2.5-10

Bank Erosion Hazard Index (BEHI)			
Criteria	Value	Index	Bank Erosion Potential
Bank H/BK Ht	3.1	10	extreme
Root Depth/Bank Ht	1	1	very low
Root Density (%)	5	10	extreme
Bank Angle (Degrees)	56	3.8	low
Surface Protection (%)	5	10	extreme
Bank Materials	sand	6	
		<b>40.8</b>	<b>very high</b>

Photo of Riffle CS#6 looking in the downstream direction.



# Tick Creek Condoret Property, Chatham County

**Field Crew:** Ben Goetz, Dan Clinton, Jan Almon, Philip Todd  
**River Basin:** Cape Fear  
**Watershed:** Tick Creek  
**Stream Reach:** Condoret - Tributary  
**Drainage Area:** 0.13 sq mi ( ac)  
**Date:** 9/25/2001  
**Station:** N/A  
**Feature:** Riffle CS#7

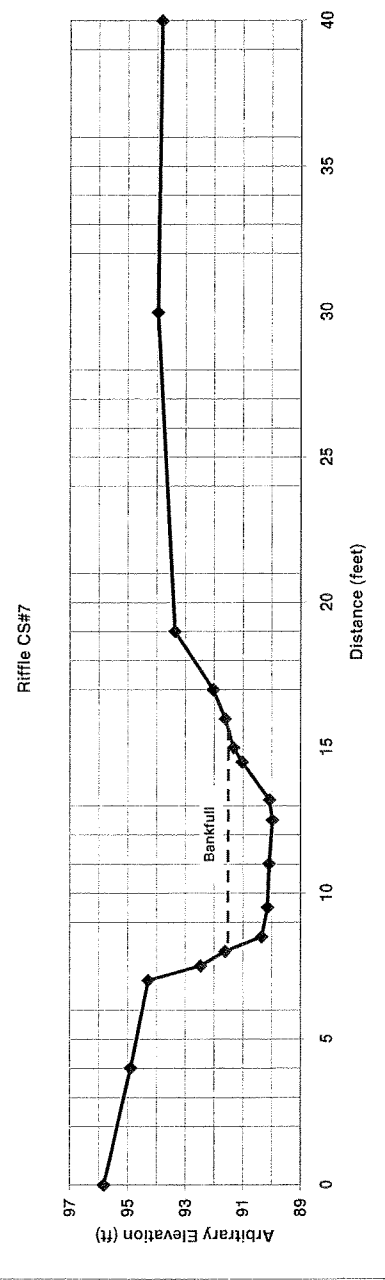
STATION (Feet)	HI (Feet)	FS (Feet)	ELEVATION (Feet)	NOTES
0+00.0	100.00	4.18	95.82	
0+04.0	100.00	5.11	94.89	
0+07.0	100.00	5.73	94.27	LTOB
0+07.5	100.00	7.54	92.46	
0+08.0	100.00	8.13	91.60	LBKF
0+08.5	100.00	9.68	90.32	
0+09.5	100.00	9.88	90.12	LEW
0+11.0	100.00	9.93	90.07	
0+12.5	100.00	10.04	89.86	TW
0+13.2	100.00	9.94	90.06	REW/WS
0+14.5	100.00	8.99	91.01	
0+15.0	100.00	8.69	91.31	
0+16.0	100.00	8.13	91.60	RBKF
0+17.0	100.00	7.97	92.03	
0+19.0	100.00	6.65	93.35	RTOB
0+30.0	100.00	6.06	93.94	
0+40.0	100.00	6.19	93.81	

TOP OF BANK				BANKFULL			
Hydraulic Geometry				Hydraulic Geometry			
Width (Feet)	Depth (Feet)	Area (Sq. Ft.)		Width (Feet)	Depth (Feet)	Area (Sq. Ft.)	
0.0	0.0	0.0		0.0	0.0	0.0	
0.5	0.9	0.2		1.3	1.3	0.3	
0.5	1.8	0.7		1.0	1.5	1.4	
0.5	3.0	1.2		1.5	1.5	2.3	
1.0	3.2	3.1		1.5	1.6	2.4	
1.5	3.3	4.9		0.7	1.5	1.1	
1.5	3.4	5.0		1.3	0.6	1.4	
0.7	3.3	2.3		0.5	0.3	0.2	
0.7	3.3	2.3		1.0	0.0	0.1	
1.3	2.3	3.7		8.0	0.0	9.2	
0.5	2.0	1.1					
2.0	1.3	3.4					
2.0	0.0	1.3					
TOTALS	12.7	29.2					

SUMMARY DATA (TOB)			
A(TOB)	29.2		
W(TOB)	12.7		
Max d	3.4		
Mean d	2.3		

SUMMARY DATA (BANKFULL)			
A(BKF)	9.2	W(FPA)	50
W(BKF)	8.0	Slope	?
Max d	1.6	Sinuosity	1
Mean d	1.1	Area= A	
W/D	7.0	Width= W	
Entrenchment	6.3	Depth= D	
Stream Type	E4	Bankfull= BKF	
Area from Flural Regional Curve			2.5-10

Bank Erosion Hazard Index (BEHI)			
Criteria	Value	Index	Bank Erosion Potential
Bank H/Bk Ht	2.8	8.8	very high
Bank Depth/Bank Ht	1	1	very low
Root Density (%)	9	14	very high
Bank Angle (Degrees)	70	5	moderate
Surface Protection (%)	10	10	extreme
Bank Materials	sand	6	
		<b>44.8</b>	<b>very high</b>



Tick Creek  
Condoret Property, Chatham County

Field Crew: Ben Goetz, Jan Patterson  
 River Basin: Cape Fear  
 Watershed: Tick Creek  
 Stream Reach: Condoret - Tributary  
 Drainage Area: 0.13 sq mi (ac)  
 Date: 2/28/2002  
 Station: N/A  
 Feature: Riffle CS#8

STATION (Feet)	HI (Feet)	FS (Feet)	ELEVATION (Feet)	NOTES
0+00.0	100.00	7.19	92.81	
0+04.0	100.00	7.19	92.81	
0+09.0	100.00	7.29	92.71	LTOB
0+10.0	100.00	7.72	92.28	
0+11.0	100.00	6.42	91.58	
0+12.3	100.00	9.59	90.41	
0+12.6	100.00	9.70	90.00	LBKF
0+13.0	100.00	10.95	89.65	
0+14.0	100.00	11.26	88.74	
0+14.5	100.00	11.44	88.56	LEW/MS
0+15.5	100.00	11.52	88.48	TW
0+17.0	100.00	11.46	88.54	
0+18.3	100.00	11.48	88.52	REW
0+19.5	100.00	11.50	88.50	
0+20.5	100.00	9.70	90.00	RBXF
0+21.5	100.00	8.25	91.75	
0+23.5	100.00	7.95	92.65	RTOB
0+28.0	100.00	7.19	92.81	
0+33.0	100.00	7.12	92.66	

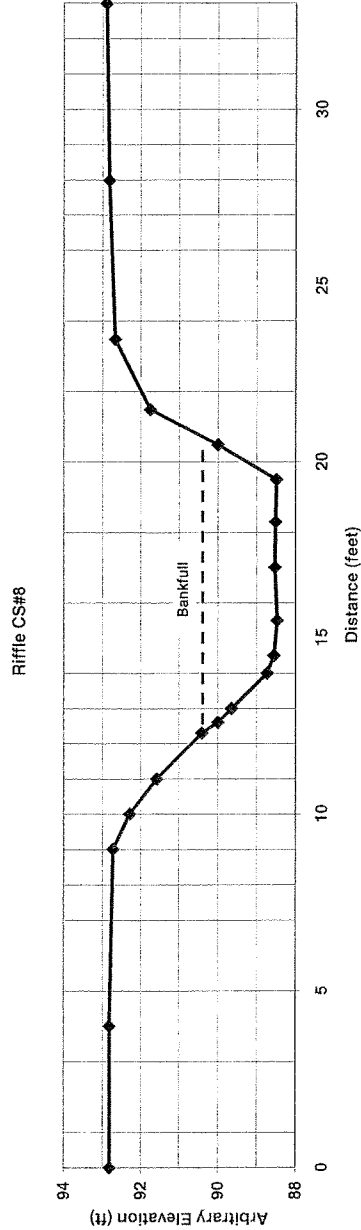
TOP OF BANK			
Hydraulic Geometry			
Width (Feet)	Depth (Feet)	Area (Sq. Ft.)	
0.0	0.0	0.0	
1.0	1.1	0.5	
1.0	1.8	1.4	
1.3	2.9	3.1	
0.7	3.7	2.3	
1.0	4.6	4.2	
0.5	4.8	2.4	
1.0	4.9	4.8	
1.5	4.8	7.3	
1.2	4.8	6.3	
1.2	4.8	5.8	
1.0	3.3	4.1	
1.0	1.6	2.5	
2.0	0.7	2.3	
<b>TOTALS</b>	<b>14.5</b>	<b>46.9</b>	

SUMMARY DATA (TOB)	
A(TOB)	46.9
W(TOB)	14.5
Max d	4.9
Mean d	3.2

BANKFULL			
Hydraulic Geometry			
Width (Feet)	Depth (Feet)	Area (Sq. Ft.)	
0.0	0.0	0.0	
0.4	0.3	0.1	
1.0	1.3	0.8	
0.5	1.4	0.7	
1.0	1.5	1.5	
1.5	1.5	2.2	
1.3	1.5	1.9	
1.2	1.5	1.8	
1.0	0.0	0.0	
<b>TOTALS</b>	<b>7.9</b>	<b>9.7</b>	

SUMMARY DATA (BANKFULL)	
A(BKF)	9.7
W(BKF)	7.9
Max d	1.5
Mean d	1.2
W/D	6.4
Entrenchment	1.5
Stream Type	G4
Bankfull= BKF	
Area from Rural Regional Curve	2.5-10

Bank Erosion Hazard Index (BEHI)				
Criteria	Value	Index	Index	Potential
Bank H/BK Ht	2.7	8.9	1	very high
Root Density/Bank Ht	1	1	4	very low
Root Density (%)	30	4	4	moderate
Bank Angle (Degrees)	60	3.9	4	low
Surface Protection (%)	54	4	4	moderate
Bank Materials Silt/Clay		0		
<b>TOTALS</b>		<b>21.8</b>		<b>moderate</b>



Tick Creek  
Condoret Property, Chatham County

Field Crew: Ben Goetz, Jan Patterson, Jane Almon, Phillip Todd  
 River Basin: Cape Fear  
 Watershed: Tick Creek  
 Stream Reach: Condoret-Tributary  
 Drainage Area: 0.13 sq mi (acres)  
 Date: 9/25/2001  
 Station: N/A  
 Feature: Pool CS#2

STATION (FEET)	HI (FEET)	FS (FEET)	ELEVATION (FEET)	NOTES
0+00.0	103.50	4.71	100.00	
0+14.0	103.50	4.72	98.78	
0+20.0	103.50	4.79	98.71	
0+27.0	103.50	4.85	98.65	
0+37.0	103.50	4.81	98.69	
0+38.0	103.50	4.80	98.70	
0+40.0	103.50	4.88	98.64	
0+40.3	103.50	5.09	98.41	LTOB
0+40.6	103.50	5.23	98.27	
0+41.2	103.50	5.40	98.10	
0+41.4	103.50	5.73	97.77	
0+42.0	103.50	6.00	97.50	
0+42.2	103.50	6.55	96.95	LBKF
0+42.3	103.50	8.14	96.36	LEW/W/S
0+43.0	103.50	8.23	95.27	
0+43.8	103.50	8.37	95.13	
0+44.4	103.50	8.43	95.07	TW
0+45.4	103.50	8.32	95.18	
0+45.8	103.50	8.18	95.32	
0+46.3	103.50	8.13	95.37	REW/W/S
0+46.9	103.50	7.91	95.59	
0+47.2	103.50	7.53	95.97	
0+48.0	103.50	6.96	96.54	
0+50.1	103.50	6.55	96.95	RBKF
0+51.2	103.50	6.04	97.46	
0+52.3	103.50	5.09	98.41	RTOB
0+53.3	103.50	4.85	98.85	
0+55.9	103.50	4.69	98.81	
0+56.8	103.50	4.49	99.01	
0+60.0	103.50	3.10	100.40	
0+71.0	103.50	5.50	98.00	
0+72.0	103.50	6.24	97.26	
0+90.0	103.50	6.54	96.96	

TOP OF BANK		
Width (Feet)	Depth (Feet)	Area (Sq. Ft.)
0.0	0.0	0.0
0.3	0.1	0.0
0.6	0.3	0.1
0.2	0.6	0.1
0.6	0.9	0.5
0.2	1.5	0.2
0.1	3.1	0.2
0.7	3.1	2.2
0.6	3.3	2.6
0.6	3.3	2.0
1.0	3.2	3.3
0.4	3.1	1.3
0.5	3.0	1.5
0.6	2.8	1.8
0.3	2.4	0.8
0.8	1.9	1.7
2.1	1.5	3.5
1.1	1.0	1.3
1.1	0.0	0.5
<b>TOTALS</b>	<b>12.0</b>	<b>23.6</b>

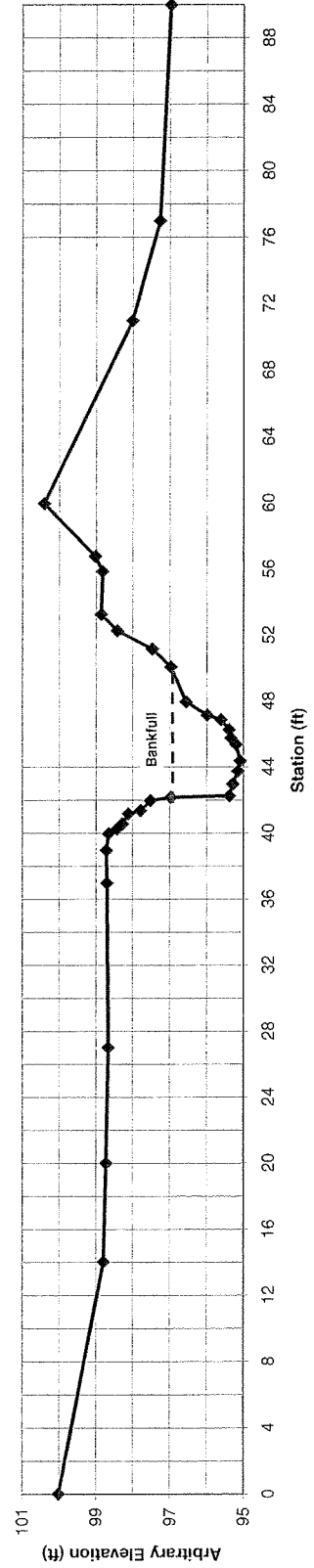
SUMMARY DATA (TOP)		
A(TOB)	W(TOB)	Mean d
23.6	12.0	2.0
Max d	3.3	

Bank Erosion Hazard Index (BEHI)		
Criteria	Value	Index
Bank H/BKf Ht	1.6	6
Bank Depth/Bank Ht	0.2	6.7
Root Density (%)	15	6
Bank Angle (Degrees)	90	7.9
Surface Protection (%)	10	8
Bank Materials	silt/clay	0
<b>TOTALS</b>		<b>34.6</b>

Photo of Riffle CS#1 looking in the downstream direction.



Pool CS#2



Tick Creek  
Condoret Property, Chatham County

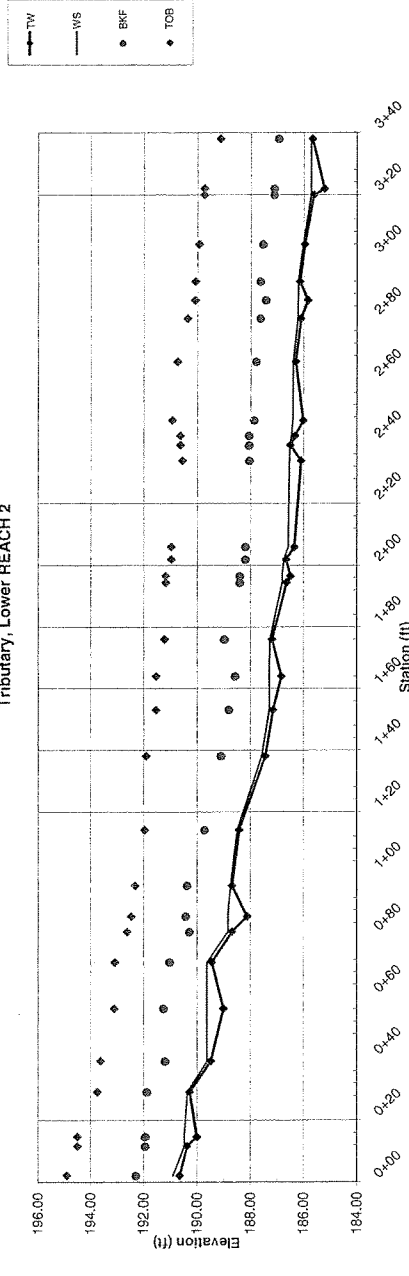
BM	BS	HI	ES	ELEV	NOTES
	1.85	201.86		200.00	
TP # 1	2.92	168.67	6.11	155.75	tree at nook
TP # 2	3.04	178.25	6.23	165.21	
TP # 3	0.74	182.44	3.88	191.70	
TP # 4	3.84	163.68	6.50	165.84	
TP # 5	4.27	187.36	6.59	183.09	
TP # 6	5.74	188.62	4.28	183.08	
TP # 7	1.82	182.25	1.82	180.43	
TP # 8	0.91	202.68	1.50	193.65	
BM		198.98	2.38	198.98	Error=0.02

Tributary Longitudinal Profile (Middle Woods)

Station	BS	HI	TS	TIW	TW	WS	BKFS	BKF	TOBS	TOB	Main	Pool Length	Max Pool Depth	Pool Slope	Riffle Length	Riffle Slope
0+00.0		198.67		198.67		198.67	6.33	192.29	7.35	194.49	Head of Riffle	33.0	1.83	0.00	6.5	4.42
0+11.5	TP # 1	198.07	8.30	199.37	8.19	199.48	6.73	191.94	4.18	194.49	Head of Pool					
0+14.5	TP # 1	198.67	8.66	199.01	8.19	199.48	6.73	191.94	4.18	194.49	Head of Pool					
0+29.0	TP # 1	198.67	8.40	199.27	6.31	199.36	6.60	191.87	4.93	193.74	Head of Riffle	17.5	0.69	10.0	7.30	
0+38.0	TP # 1	198.67	9.18	199.47	6.04	198.63	7.49	191.18	5.55	193.62	Head of Pool					
0+45.0	TP # 1	198.67	9.22	199.45	8.04	198.63	7.65	191.01	5.58	193.09	Head of Riffle	35.0	0.00	10.0	7.80	
0+71.0	TP # 1	198.67	9.97	199.70	9.22	198.85	8.40	190.27	6.04	192.63	Head of Pool					
0+86.0	TP # 1	198.67	10.55	199.12	9.82	198.85	8.26	190.41	6.20	192.47	Head of Pool	15.0	0.69			
0+86.0	TP # 1	198.67	9.97	198.70	9.91	198.76	8.31	190.36	6.35	192.32	Head of Riffle					
1+02.0	TP # 1	198.67	10.88	199.55	11.09	198.76	8.57	189.70	6.76	191.91	Intermediate					
1+39.0	TP # 1	198.67	11.23	197.44	11.09	197.59	9.57	188.10	6.76	191.91	Intermediate					
1+53.0	TP # 1	198.67	11.51	197.16	11.37	197.30	10.09	186.58	7.13	191.54	Head of Pool	1.74	0.13	57.0	2.56	
1+64.0	TP # 1	198.67	11.83	196.64	11.37	197.30	10.09	186.58	7.13	191.54	Head of Pool					
1+70.0	TP # 1	198.67	11.68	197.19	11.40	197.27	9.70	186.97	7.45	191.22	Head of Riffle	25.0		10.5	2.49	
1+79.0	TP # 1	198.67	12.12	196.52	11.77	196.81	10.98	185.39	4.41	191.17	Head of Pool					
1+86.5	TP # 2	195.58	9.98	196.50	8.77	196.81	7.19	188.39	4.41	191.17	Head of Pool	41.5		10.5	2.49	
2+06.0	TP # 2	195.58	9.23	196.35	9.00	196.58	7.40	188.18	4.61	190.97	Head of Riffle	11.5		4.0	4.50	
2+30.0	TP # 2	195.58	9.48	196.10	9.04	196.54	7.54	188.04	5.03	190.97	Head of Pool					
2+30.0	TP # 2	195.58	9.98	195.58	9.98	195.58	9.98	195.58	9.98	195.58	Head of Riffle					
2+02.0	TP # 2	195.58	9.98	195.58	9.98	195.58	9.98	195.58	9.98	195.58	Head of Pool	7.5	0.67	4.0	4.50	
2+10.0	TP # 2	195.58	9.98	195.58	9.98	195.58	9.98	195.58	9.98	195.58	Head of Riffle					
2+10.0	TP # 2	195.58	9.98	195.58	9.98	195.58	9.98	195.58	9.98	195.58	Head of Riffle					
2+17.0	TP # 2	195.58	9.98	195.58	9.98	195.58	9.98	195.58	9.98	195.58	Head of Pool	33.0	0.12	3.0	2.67	
2+66.0	TP # 2	195.58	9.27	196.31	9.18	196.40	7.60	187.78	4.85	190.73	Head of Riffle	1.84	0.25	14.0	1.21	
2+80.0	TP # 2	195.58	9.47	196.11	9.35	196.23	7.95	187.63	5.22	190.36	Head of Pool					
2+80.0	TP # 2	195.58	9.47	196.11	9.35	196.23	7.95	187.63	5.22	190.36	Head of Pool					
2+89.0	TP # 2	195.58	9.43	195.15	9.26	195.22	8.05	187.93	5.51	190.07	Head of Riffle	1.58	0.68	12.0	1.21	
3+04.0	TP # 2	195.58	9.81	195.97	9.55	196.03	8.05	187.93	5.51	190.07	Head of Riffle					
3+20.0	TP # 2	195.58	9.85	195.53	9.84	195.74	8.47	187.11	5.84	189.74	Head of Pool					
3+22.0	TP # 2	195.58	10.36	195.23	9.84	195.74	8.47	187.11	5.84	189.74	Head of Pool					
3+36.0	TP # 2	195.58	9.31	195.67	9.64	195.74	8.64	190.34	6.45	189.13	Head of Riffle	1.88	0.00	28.0	1.71	

Average Slope 1.51

Longitudinal Profile  
Tributary, Lower REACH 2



Tick Creek  
Condore Property, Chatham County

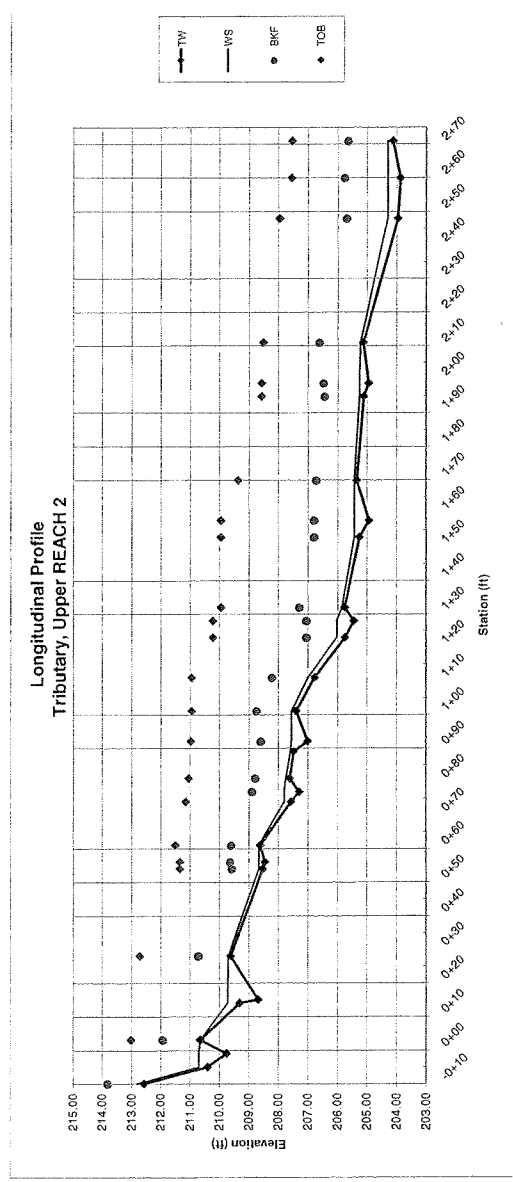
**LONGITUDINAL PROFILE**  
 River Basin: Chipm Fork  
 Watershed: Tick Creek  
 Stream Reach: Upper Tributary  
 Date: 2/27/2022

Station	BS	HI	ES	ELEV	NOTES
0+10.0	TP #2	221.04	6.48	212.56	9.25
0+05.0	TP #2	221.04	10.66	210.90	10.32
0+00.0	TP #2	221.04	14.84	209.24	11.39
0+14.0	TP #2	221.04	10.70	210.64	10.40
0+15.0	TP #2	221.04	11.75	209.29	11.33
0+20.0	TP #2	221.04	11.44	209.60	11.36
0+25.0	TP #2	221.04	11.36	209.74	11.39
0+30.0	TP #2	221.04	12.80	208.44	12.40
0+35.0	TP #2	221.04	12.44	208.60	12.40
0+40.0	TP #2	221.04	13.48	207.56	13.25
0+45.0	TP #2	221.04	13.76	207.28	13.25
0+50.0	TP #2	221.04	13.52	207.41	13.30
0+55.0	TP #2	221.04	13.52	207.41	13.30
0+60.0	TP #2	221.04	14.05	206.99	13.49
0+65.0	TP #2	221.04	13.66	207.38	13.50
0+70.0	TP #2	221.04	14.28	205.76	14.06
0+75.0	TP #2	221.04	15.32	204.72	15.00
0+80.0	TP #2	221.04	16.36	203.68	15.93
0+85.0	TP #3	213.69	7.95	205.73	7.86
0+90.0	TP #3	213.69	8.46	205.23	8.28
0+95.0	TP #3	213.69	8.78	204.91	8.28
1+00.0	TP #3	213.69	8.37	205.32	8.28
1+05.0	TP #3	213.69	8.74	204.94	8.46
1+10.0	TP #3	213.69	8.77	204.92	8.46
1+15.0	TP #3	213.69	8.59	205.10	8.49
1+20.0	TP #3	213.69	9.75	203.94	9.40
1+25.0	TP #3	213.69	9.84	203.85	9.40
1+30.0	TP #3	213.69	9.38	204.11	9.40

**Tributary Longitudinal Profile (Upper Woods)**

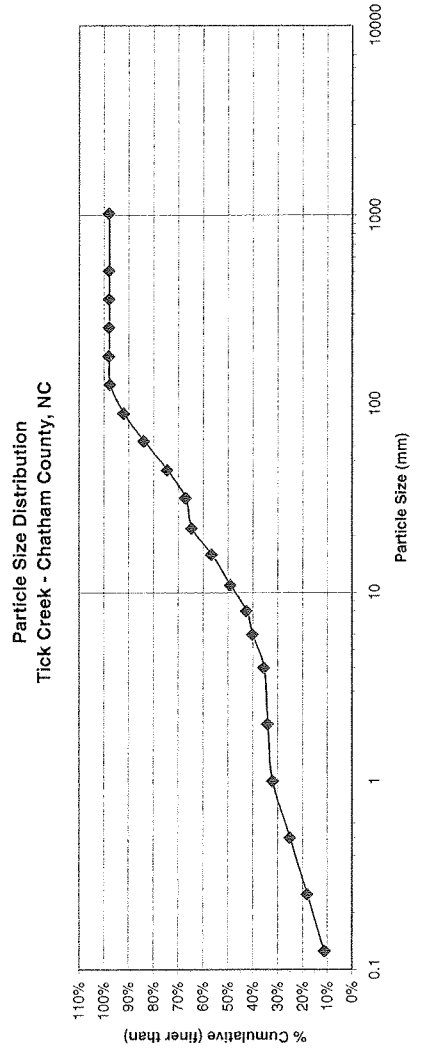
Station	REEPT	HI	IWSES	IW	WSSES	WS	BKSES	BKE	TOBSES	TOB	Notes
0+10.0	TP #2	221.04	6.48	212.56	9.25	212.79	7.24	213.90			bedrock, TR
0+05.0	TP #2	221.04	10.66	210.90	10.32	210.69					Head of Pool
0+00.0	TP #2	221.04	14.84	209.24	11.39	210.64					Head of Rifle
0+14.0	TP #2	221.04	10.70	210.64	10.40	210.64	9.12	211.92	8.04	213.00	Head of Pool
0+15.0	TP #2	221.04	11.75	209.29	11.33	209.71					Max Pool
0+20.0	TP #2	221.04	11.44	209.60	11.36	209.69	10.34	210.70	8.34	212.70	Head of Rifle
0+25.0	TP #2	221.04	11.36	209.74	11.39	209.74	11.45	209.59	9.20	211.49	Head of Pool
0+30.0	TP #2	221.04	12.80	208.44	12.40	208.64	11.45	209.59	9.55	211.49	Head of Rifle
0+35.0	TP #2	221.04	12.44	208.60	12.40	208.64	11.45	209.59	9.50	211.14	Head of Pool
0+40.0	TP #2	221.04	13.48	207.56	13.25	207.79	12.17	208.87		211.04	Head of Rifle
0+45.0	TP #2	221.04	13.76	207.28	13.25	207.74	12.28	208.76	10.00	211.04	Max Pool
0+50.0	TP #2	221.04	13.52	207.41	13.30	207.74					Max Pool
0+55.0	TP #2	221.04	13.52	207.41	13.30	207.74					Max Pool
0+60.0	TP #2	221.04	14.05	206.99	13.49	207.55	12.46	208.59	10.08	210.96	Max Pool
0+65.0	TP #2	221.04	13.66	207.38	13.50	207.54	12.32	208.72	10.11	210.93	Head of Rifle
0+70.0	TP #2	221.04	14.28	205.76	14.06	206.88	12.84	208.20	10.11	210.93	Intermediate
0+75.0	TP #2	221.04	15.32	204.72	15.00	205.01	14.01	207.00	10.33	210.21	Head of Pool
0+80.0	TP #2	221.04	16.36	203.68	15.93	204.31	15.01	206.00	9.76	209.53	Head of Pool
0+85.0	TP #3	213.69	7.95	205.73	7.86	205.83	6.42	207.27	3.76	209.93	Head of Rifle
0+90.0	TP #3	213.69	8.46	205.23	8.28	205.41	6.92	206.77	3.76	209.93	Head of Rifle
0+95.0	TP #3	213.69	8.78	204.91	8.28	205.41	6.92	206.77	3.76	209.93	Max Pool
1+00.0	TP #3	213.69	8.37	205.32	8.28	205.41	6.99	206.70	4.35	209.94	Head of Rifle
1+05.0	TP #3	213.69	8.74	204.94	8.46	205.41	7.04	206.59	5.14	209.55	Head of Pool
1+10.0	TP #3	213.69	8.77	204.92	8.46	205.23	7.24	206.45	5.14	208.55	Max Pool
1+15.0	TP #3	213.69	8.59	205.10	8.49	205.20	7.10	206.59	5.20	208.48	Head of Rifle
1+20.0	TP #3	213.69	9.75	203.94	9.40	204.29	9.02	205.67	5.75	207.94	Head of Pool
1+25.0	TP #3	213.69	9.84	203.85	9.40	204.29	7.85	205.74	6.15	207.54	Head of Pool
1+30.0	TP #3	213.69	9.38	204.11	9.40	204.29	8.08	205.81	6.16	207.53	Head of Rifle

Average Slope: 3.02



# Tick Creek Condolet Property, Chatham County

PEBBLE COUNT										
Site: Condolet Property		2/28/2002		Tributary (Upper Reach: Inter, Upper & Middle Woods)						
Party: Ben Goetz, Jan Patterson										
Inches	Particle	Millimeter	S/C	Riffle	Pool	Riffle	Pool	Total No.	Item %	% Cumulative
	Silt/Clay	<0.062		3	5	1	0	9	5%	5%
	Very Fine	.062 - .125	S	2	9	0	2	13	7%	11%
	Fine	.125 - .25	A	6	3	3	2	14	7%	18%
	Medium	.25 - .50	N	2	4	3	5	14	7%	25%
	Coarse	.50 - 1.0	D	3	9	1	1	14	7%	32%
.04 - .08	Very Coarse	1.0 - 2.0	S	0	1	1	2	4	2%	34%
.08 - .16	Very Fine	2.0 - 4.0		0	3	0	0	3	2%	36%
.16 - .22	Fine	4.0 - 5.7	G	1	3	3	2	9	5%	40%
.22 - .31	Fine	5.7 - 8.0	R	0	1	1	3	5	3%	43%
.31 - .44	Medium	8.0 - 11.3	A	3	1	5	4	13	7%	49%
.44 - .63	Medium	11.3 - 16.0	V	3	3	4	5	15	8%	57%
.63 - .89	Coarse	16.0 - 22.6	E	6	1	5	4	16	8%	65%
.89 - 1.26	Coarse	22.6 - 32.0	L	2	0	2	1	5	3%	67%
1.26 - 1.77	Very Coarse	32.0 - 45.0	S	6	1	7	1	15	8%	75%
1.77 - 2.5	Very Coarse	45.0 - 64.0		6	0	10	3	19	10%	84%
2.5 - 3.5	Small	64 - 90	C	5	1	7	3	16	8%	92%
3.5 - 5.0	Small	90 - 128	O	1	4	6	0	11	6%	98%
5.0 - 7.1	Large	128 - 180	B	1	0	0	0	1	1%	99%
7.1 - 10.1	Large	180 - 256	L	0	0	0	0	0	0%	99%
10.1 - 14.3	Small	256 - 362	B	0	0	0	0	0	0%	99%
14.3 - 20	Small	362 - 512	L	0	0	0	0	0	0%	99%
20 - 40	Medium	512 - 1024	D	0	0	0	0	0	0%	99%
40 - 80	Lrg. Very Lrg.	1024 - 2048	R	0	0	0	0	0	0%	99%
	Bedrock		BDRK	0	1	1	2	4	2%	100%
<b>Totals</b>				<b>50</b>	<b>50</b>	<b>60</b>	<b>40</b>	<b>200</b>	<b>100%</b>	<b>100%</b>



Tick Creek  
 Condoret Property, Chatham County

Field Crew: Ben Goetz, Jan Patterson, Jane Almon, Phillip Todd  
 River Basin: Cape Fear  
 Watershed: Tick Creek  
 Stream Reach: Condoret-Tributary  
 Drainage Area: 0.13 sq mi (acres)  
 Date: 9/25/2001  
 Station: N/A  
 Feature: Pool CS#3

STATION (FEET)	HI (FEET)	FS (FEET)	ELEVATION (FEET)	NOTES
0+00.0	103.50	5.00	100.00	
0+07.0	103.50	4.82	98.68	
0+14.0	103.50	4.59	98.91	
0+18.0	103.50	5.44	98.06	
0+22.0	103.50	5.49	98.01	
0+26.5	103.50	4.94	98.56	
0+28.0	103.50	4.83	98.57	
0+29.7	103.50	5.33	98.17	TOB
0+30.0	103.50	7.69	95.81	
0+31.3	103.50	8.52	94.98	
0+31.9	103.50	9.10	94.40	LBKF
0+32.4	103.50	9.62	93.88	
0+33.2	103.50	10.15	93.35	
0+33.8	103.50	10.38	93.12	
0+34.0	103.50	10.77	92.73	LEW/WS
0+34.5	103.50	10.96	92.52	TW
0+35.6	103.50	10.79	92.71	REW/WS
0+36.2	103.50	10.69	92.81	
0+37.3	103.50	10.31	93.19	
0+38.7	103.50	10.18	93.32	
0+39.8	103.50	9.10	94.40	RBKF
0+41.0	103.50	8.52	94.98	
0+44.0	103.50	7.34	96.16	
0+47.0	103.50	5.82	97.68	TOB
0+52.0	103.50	5.86	97.64	
0+66.0	103.50	5.56	97.94	

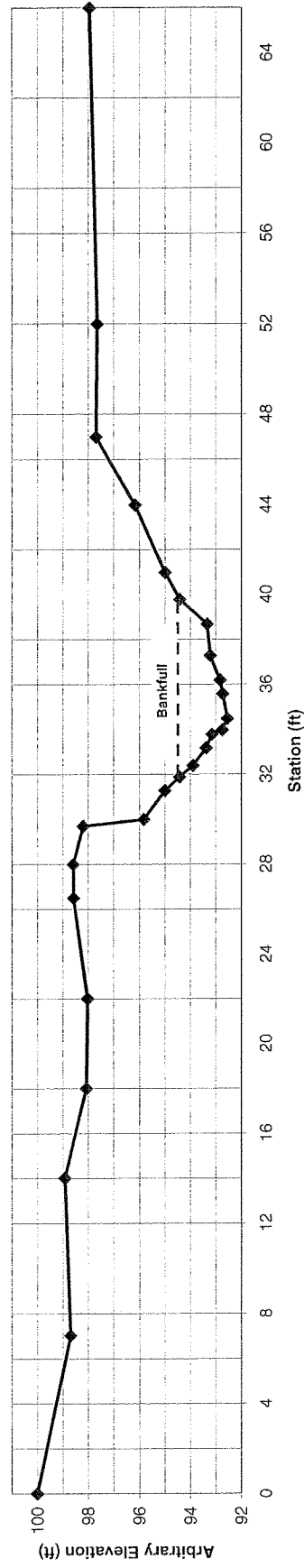
TOP OF BANK			
Width (Feet)	Depth (Feet)	Area (Sq. Ft.)	
0.0	0.0	0.0	
0.3	2.4	0.4	
1.3	3.2	3.6	
1.1	4.3	4.1	
0.8	4.8	3.6	
0.6	5.1	3.0	
0.2	5.4	1.0	
0.5	5.7	2.8	
1.1	5.5	6.1	
0.6	5.4	3.2	
1.1	5.0	5.7	
1.4	4.9	6.9	
1.1	3.8	4.7	
1.2	3.2	4.2	
3.0	2.0	7.8	
3.0	0.5	3.8	
TOTALS	17.3	60.9	

**SUMMARY DATA (TOB)**  
 A(TOB) 60.9  
 W(TOB) 17.3  
 Max d 5.7  
 Mean d 3.5

Bank Erosion Hazard Index (BEHI)			
Criteria	Value	Index	Bank Erosion Potential
Bank Ht/BKf Ht	3	10	extreme
Root Depth/Bank Ht	0.15	7.9	high
Root Density (%)	10	8.6	very high
Bank Angle (Degrees)	59	3.8	low
Surface Protection (%)	15	6	high
Bank Materials	silt/clay	0	
		36.3	high



Pool CS#3





Tick Creek  
Condoret Property, Chatham County

Field Crew:	Ben Goetz, Dan Clinton, Jan Almon, Phillip Todd
River Basin:	Cape Fear
Watershed:	Tick Creek
Stream Reach:	Condoret, Tributary
Drainage Area:	0.13 sq mi ( ac)
Date:	9/25/2001
Station:	N/A
Feature:	Riffle CS#9, backwards

STATION (Feet)	HI (Feet)	FS (Feet)	ELEVATION (Feet)	NOTES
0+00.0	100.00	4.99	95.01	
0+06.0	100.00	5.20	94.80	
0+10.5	100.00	5.72	94.28	RTOB
0+11.5	100.00	6.37	93.63	
0+12.5	100.00	7.36	92.64	
0+13.4	100.00	8.59	91.41	RBKF
0+13.5	100.00	8.83	91.17	
0+14.3	100.00	10.50	89.50	REW/MS
0+14.5	100.00	10.68	89.32	
0+15.5	100.00	10.65	89.35	
0+16.2	100.00	10.63	89.37	
0+17.3	100.00	10.70	89.30	TW
0+18.4	100.00	10.41	89.59	TS
0+18.6	100.00	8.83	91.17	
0+19.0	100.00	8.59	91.41	LBKF
0+21.0	100.00	5.88	94.12	LTOB
0+24.0	100.00	5.35	94.65	
0+29.0	100.00	5.91	94.09	
0+31.5	100.00	5.80	94.20	
0+38.0	100.00	5.46	94.52	
0+41.0	100.00	4.98	95.04	
0+45.0	100.00	4.12	95.88	

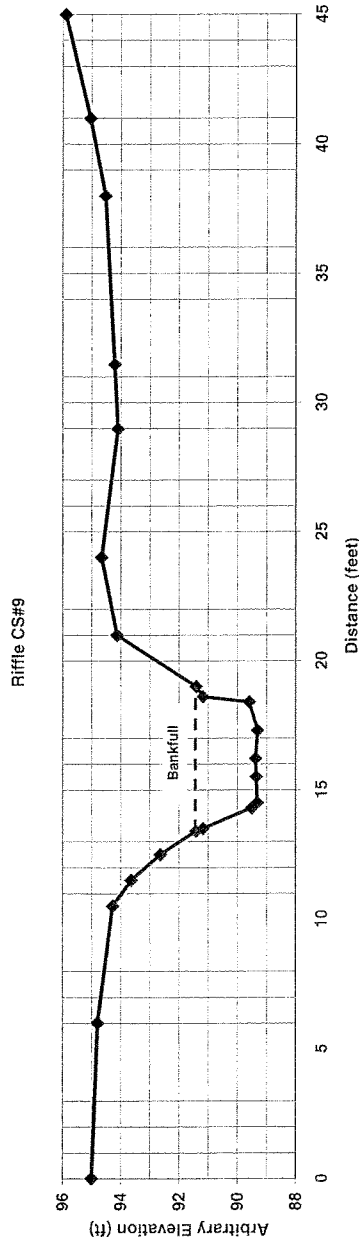
TOP OF BANK			
Hydraulic Geometry			
Width (Feet)	Depth (Feet)	Area (Sq. Ft.)	
0.0	0.0	0.0	
1.0	0.7	0.3	
1.0	1.6	1.1	
0.9	2.9	2.0	
0.1	3.1	0.3	
0.8	4.8	3.2	
0.2	5.0	1.0	
1.0	4.9	4.9	
0.7	4.9	3.4	
1.1	5.0	5.4	
1.1	4.7	5.3	
0.2	3.1	0.8	
0.4	2.9	1.2	
2.0	0.2	3.0	
10.5	0.2	32.1	
TOTALS	10.5	32.1	32.1

SUMMARY DATA (TOB)			
A(TOB)	32.1	W(TOB)	10.5
Max d	5.0	Stream Type	E4
Mean d	3.1	Area from Rural Regional Curve	2.5-10

SUMMARY DATA (BANKFULL)			
A(BKF)	9.5	W(FPA)	50
W(BKF)	5.6	Slope	?
Max d	2.1	Sinuosity	1
Mean d	1.7	Area= A	
W/D	3.3	Width= W	
Entrenchment	8.9	Depth= D	
Stream Type	E4	Bankfull= BKF	
Area from Rural Regional Curve	2.5-10		

Bank Erosion Hazard Index (BEHI)			
Criteria	Value	Index	Bank Erosion Potential
Bank Ht/Bk Ht	2.3	8.2	very high
Bank Depth/Bank Ht	0.6	6.8	high
Root Density (%)	29	7.9	high
Bank Angle (Degrees)	60	3.9	low
Surface Protection (%)	40	5.2	moderate
Bank Materials	SH/Clay	0	
TOTALS		32	high

Photo of Riffle CS#9 looking in the downstream direction.



Condoret Property, Chatham County

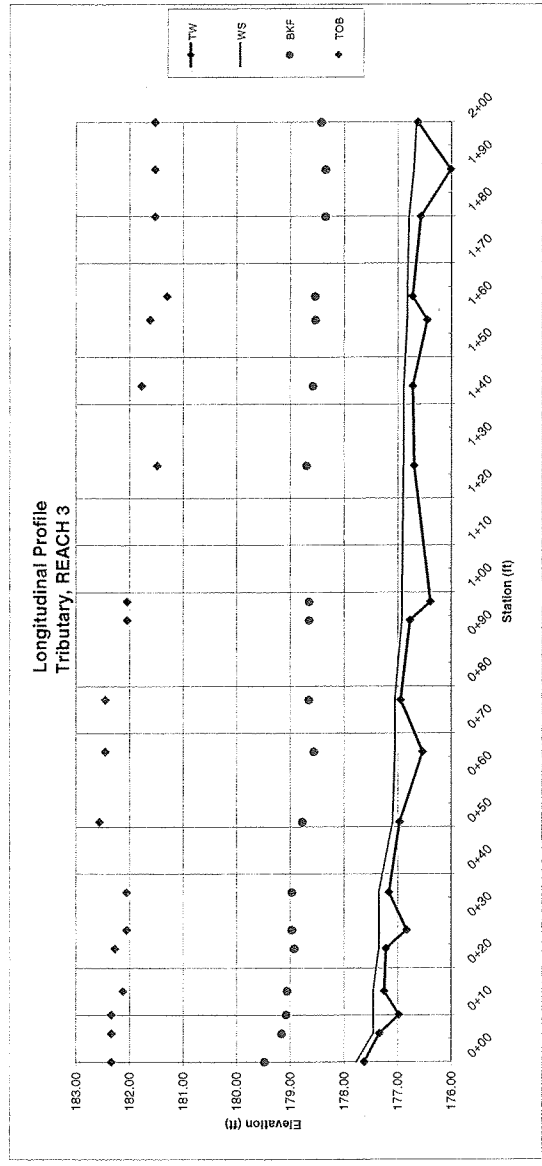
**LONGITUDINAL PROFILE**  
 River Basin: Cape Fear  
 Watershed: Tick Creek  
 Stream Reach: Middle Tributary  
 DA (sq mi): 0.13 sq mi  
 Date: 2/28/2002

BS	HI	ES	ELEV	NOTES
1.86	207.86	200.00	195.75	tree at fork
TP #1	198.57	6.11	195.75	
TP #2	195.59	6.32	192.35	
TP #3	192.44	3.88	191.70	
TP #4	189.88	6.60	185.84	
TP #5	187.36	4.28	183.08	
TP #6	184.55	2.25	186.57	
TP #7	182.36	1.50	193.05	
TP #8	189.89	2.98	199.89	Error=0.02

Tributary Longitudinal Profile (Lower Woods)

Station	REPT	HI	TW(ES)	TW	WS(ES)	WS	BK(ES)	BK	TOB(ES)	TOB	Notes
0+00.0	TP #5	187.36	9.75	177.61	177.76	177.76	7.30	179.46	5.03	182.33	Head of Rifle
0+10.0	TP #5	187.36	10.03	177.33	177.44	177.44	8.22	179.14	5.03	182.33	Head of Rifle
0+20.0	TP #5	187.36	10.40	176.96	177.44	177.44	8.30	179.06	5.03	182.33	Max Pool
0+30.0	TP #5	187.36	10.12	177.24	177.34	177.34	8.45	179.04	5.25	182.11	Head of Rifle
0+40.0	TP #5	187.36	10.41	176.95	177.34	177.34	8.41	179.05	5.32	182.04	Head of Rifle
0+50.0	TP #5	187.36	10.41	176.95	177.34	177.34	8.41	179.05	5.32	182.04	Max Pool
0+60.0	TP #5	187.36	10.41	176.95	177.34	177.34	8.41	179.05	5.32	182.04	Head of Rifle
0+70.0	TP #5	187.36	10.84	176.52	177.04	177.04	8.82	178.64	4.92	182.44	Max Pool
0+80.0	TP #5	187.36	10.43	176.93	177.04	177.04	8.72	178.64	4.92	182.44	Head of Rifle
0+90.0	TP #5	187.36	10.00	176.76	176.91	176.91	8.73	178.03	5.33	182.03	Head of Rifle
1+00.0	TP #5	187.36	10.99	176.37	176.91	176.91	8.79	178.63	5.33	182.03	Max Pool
1+10.0	TP #5	187.36	10.66	176.70	176.91	176.91	8.79	178.63	5.33	182.03	Head of Rifle
1+20.0	TP #5	187.36	10.66	176.70	176.91	176.91	8.79	178.63	5.33	182.03	Head of Rifle
1+30.0	TP #5	187.36	10.93	176.43	176.81	176.81	8.85	178.61	5.76	181.60	Max Pool
1+40.0	TP #5	187.36	10.65	176.71	176.81	176.81	8.84	178.52	6.08	181.28	Head of Rifle
1+50.0	TP #5	187.36	10.80	176.56	176.78	176.78	9.03	178.33	5.85	181.51	Head of Rifle
1+60.0	TP #5	187.36	11.36	176.00	176.89	176.89	9.09	178.33	5.85	181.51	Max Pool
1+70.0	TP #5	187.36	10.75	176.61	176.64	176.64	8.95	178.41	5.85	181.51	Head of Rifle

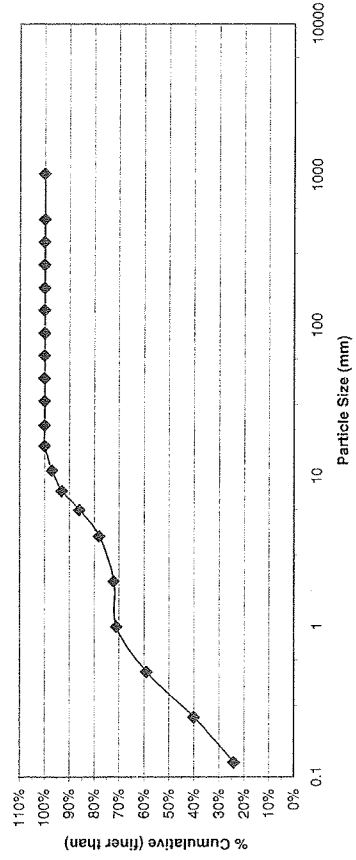
Average Slope: 0.59



**Tick Creek  
Condoret Property, Chatham County**

PEBBLE COUNT										
Site: Condoret Property		2/28/2002								
Party: Ben Goetz, Jan Patterson		Tributary (Lower Reach: Lower Woods)								
Inches	Particle Silt/Clay	Millimeter	S/C	Riffle	Pool	Total No.	Item %	% Cumulative		
	Very Fine	< 0.062	S	3	5	8	8%	8%		
	Fine	.062 - .125	A	5	11	16	16%	24%		
	Medium	.125 - .25	N	3	13	16	16%	40%		
	Coarse	.25 - .50	D	6	13	19	19%	59%		
.04 - .08	Very Coarse	.50 - 1.0	S	5	7	12	12%	71%		
.08 - .16	Very Fine	1.0 - 2.0	S	1	0	1	1%	72%		
.16 - .22	Fine	2.0 - 4.0	G	3	3	6	6%	78%		
.22 - .31	Fine	4.0 - 5.7	R	5	3	8	8%	86%		
.31 - .44	Medium	5.7 - 8.0	A	5	2	7	7%	93%		
.44 - .63	Medium	8.0 - 11.3	V	3	1	4	4%	97%		
.63 - .89	Coarse	11.3 - 16.0	E	1	2	3	3%	100%		
.89 - 1.26	Coarse	16.0 - 22.6	L	0	0	0	0%	100%		
1.26 - 1.77	Very Coarse	22.6 - 32.0	S	0	0	0	0%	100%		
1.77 - 2.5	Very Coarse	32.0 - 45.0	S	0	0	0	0%	100%		
2.5 - 3.5	Small	45.0 - 64.0	C	0	0	0	0%	100%		
3.5 - 5.0	Small	64 - 90	O	0	0	0	0%	100%		
5.0 - 7.1	Large	90 - 128	B	0	0	0	0%	100%		
7.1 - 10.1	Large	128 - 180	L	0	0	0	0%	100%		
10.1 - 14.3	Small	180 - 256	B	0	0	0	0%	100%		
14.3 - 20	Small	256 - 362	L	0	0	0	0%	100%		
20 - 40	Medium	362 - 512	D	0	0	0	0%	100%		
40 - 80	Lrg- Very Lrg	512 - 1024	R	0	0	0	0%	100%		
	Bedrock	1024 - 2048	R	0	0	0	0%	100%		
			<b>BDRK</b>	0	0	0	0%	100%		
			<b>Totals</b>	40	60	100	100%	100%		

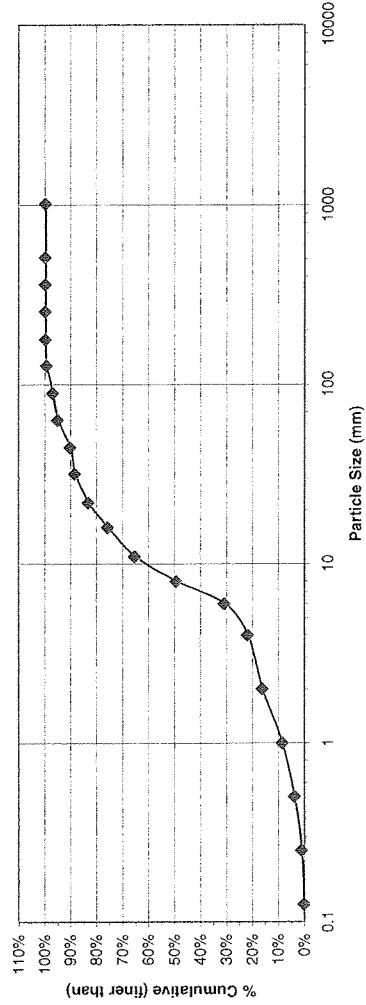
**Particle Size Distribution  
Tick Creek - Chatham County, NC**



**Tick Creek  
Condoret Property, Chatham County**

PEBBLE COUNT									
Site: Condoret Property		3/4/2002		Tributary					
Party: Ben Goetz, Jan Patterson									
Inches	Particle	Millimeter	S/C	Upper	Middle	Lower	Total No.	Item %	% Cumulative
	Silt/Clay	< 0.062		0	0	0	0	0%	0%
	Very Fine	.062 - .125	S	0	0	0	0	0%	0%
	Fine	.125 - .25	A	0	0	2	2	1%	1%
	Medium	.25 - .50	N	0	1	5	6	3%	4%
	Coarse	.50 - 1.0	D	1	3	6	10	5%	8%
.04 - .08	Very Coarse	1.0 - 2.0	S	5	6	5	16	8%	16%
.08 - .16	Very Fine	2.0 - 4.0		6	3	3	12	6%	22%
.16 - .22	Fine	4.0 - 5.7	G	11	4	4	19	9%	31%
.22 - .31	Fine	5.7 - 8.0	R	14	11	14	39	18%	49%
.31 - .44	Medium	8.0 - 11.3	A	7	16	11	34	16%	65%
.44 - .63	Medium	11.3 - 16.0	V	5	12	5	22	10%	75%
.63 - .89	Coarse	16.0 - 22.6	E	1	12	3	16	8%	83%
.89 - 1.26	Coarse	22.6 - 32.0	L	0	9	2	11	5%	88%
1.26 - 1.77	Very Coarse	32.0 - 45.0	S	0	4	0	4	2%	90%
1.77 - 2.5	Very Coarse	45.0 - 64.0		0	10	0	10	5%	95%
2.5 - 3.5	Small	64 - 90	C	0	4	0	4	2%	97%
3.5 - 5.0	Small	90 - 128	O	0	5	0	5	2%	99%
5.0 - 7.1	Large	128 - 180	B	0	1	0	1	0%	100%
7.1 - 10.1	Large	180 - 256	L	0	0	0	0	0%	100%
10.1 - 14.3	Small	256 - 362	B	0	0	0	0	0%	100%
14.3 - 20	Small	362 - 512	L	0	0	0	0	0%	100%
20 - 40	Medium	512 - 1024	D	0	0	0	0	0%	100%
40 - 80	Lrg- Very Lrg	1024 - 2048	R	0	0	0	0	0%	100%
	Bedrock		BDRK	0	1	0	1	0%	100%
<b>Totals</b>				<b>50</b>	<b>102</b>	<b>60</b>	<b>212</b>	<b>100%</b>	<b>100%</b>

**Particle Size Distribution  
Tick Creek - Chatham County, NC**



Riffle Sample  
Tick Creek- Trib Reach 1

Sieve Size (mm)	0.062	0.075	0.106	0.25	0.3	0.6	0.85	1.18	2	4.75	9.5	12.7	19	25	LP1	LP2	78
micro		75	106	250	300	600	850								dia	80	
Tare Weight(lbs)	0.81	0.74	0.76	0.81	0.82	0.87	0.95	1.91	1.3	2.27	2.42	2.46	2.56	2.57	weight	0.93	0.54

Sample Weight (lbs)  
Net Sample Weight(lbs)

6.23 TOTAL  
14.83 lbs

%  
% Cumulative

0%  
0%  
1%  
2%  
4%  
6%  
11%  
20%  
35%  
42%  
57%  
65%  
8%  
16%  
35%  
100%

D50 Subpavement  
D50 Riffle Pavement

11 mm  
8 mm  
0.727  
10

Tc=

0.1101

Largest Particle

60.00  
0.197 ft

Slope

0.039

Depth required

0.92 ft

Area Required

6 sq ft

Width/Depth Ratio

8 est

Bankfull Width

6.9 2.3 26

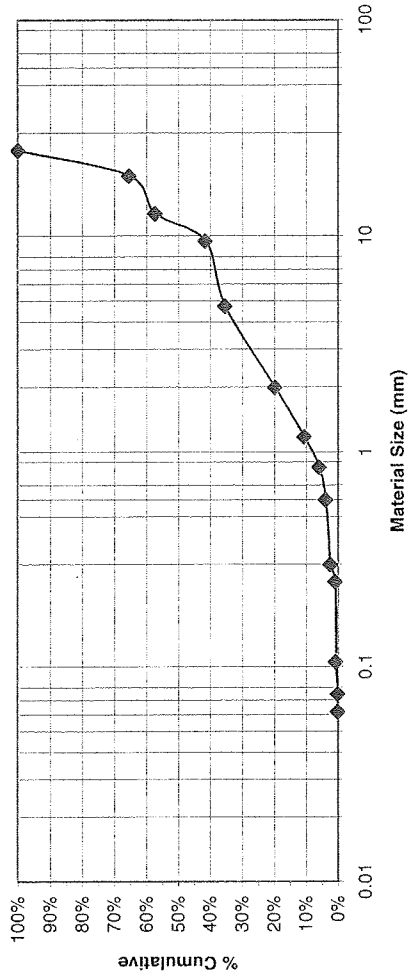
actual mean depth

0.87

Largest particle

Max Riffle Depth

Bar Material Particle Size Distribution  
Trib Reach 1 - Chatham County, NC



Riffle Sample  
Tick Creek- Main Stream

Sieve Size (mm)	0.062	0.075	0.106	0.25	0.3	0.6	0.85	1.18	2	4.75	9.5	12.7	19	25	LP1	LP2	
micro		75	106	250	300	600	850									70	67
Tare Weight(lbs)	0.81	0.74	0.76	0.81	0.82	0.87	0.95	1.91	1.3	2.27	2.42	2.46	2.56	2.57	dia	weight	1.33

Sample Weight (lbs)  
Net Sample Weight(lbs)

0.81	0.75	0.86	0.97	1.89	2.12	2.38	5.09	5.15	6.03	4.35	5.27	4.46	7.08	TOTAL
0.01	0.01	0.1	0.16	1.07	1.25	1.43	3.18	3.85	3.76	1.93	2.81	1.9	7.53	28.99 lbs

% Cumulative

0%	0%	0%	1%	4%	9%	14%	25%	38%	51%	58%	67%	74%	100%
0%	0%	0%	1%	5%	9%	14%	25%	38%	51%	58%	67%	74%	100%

D50 Subpavement  
D50 Riffle Pavement

4.5 mm	8 mm	1.778	8.75
--------	------	-------	------

Tc=

0.0505

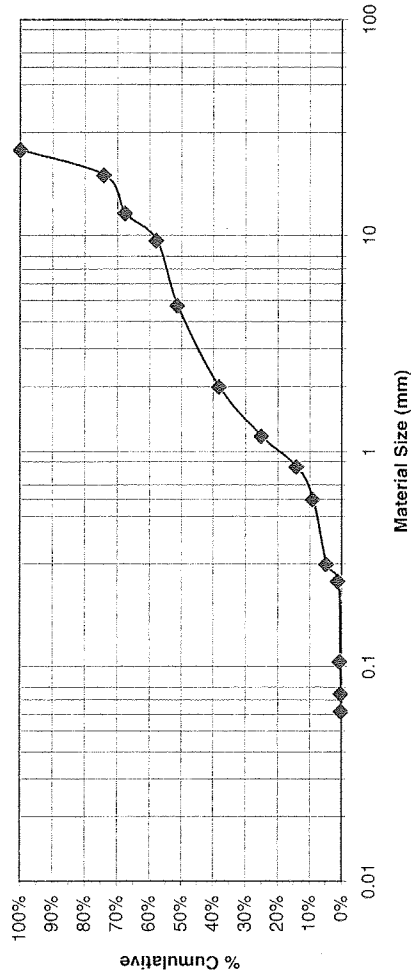
Largest Particle  
Slope

70.00 0.23 ft  
0.03

Depth required  
Area Required  
Width/Depth Ratio  
Bankfull Width  
actual mean depth

0.64 ft  
9.3 sq ft  
16 est  
12.2 2.4 26  
0.76

Bar Material Particle Size Distribution  
Tick Creek - Chatham County, NC



Max Riffle Depth

Riffle Sample  
Tick Creek- Main Stream

Sieve Size (mm)	0.062	0.075	0.106	0.25	0.3	0.6	0.85	1.18	2	4.75	9.5	12.7	19	25	LP1	LP2	43
micro		75	106	250	300	600	850										
Tare Weight(lbs)	0.81	0.74	0.76	0.81	0.82	0.87	0.95	1.91	1.3	2.27	2.42	2.46	2.56	2.57	weight	0.36	0.2

Sample Weight (lbs)	0.81	0.74	0.85	1	1.57	1.63	1.4	2.87	2.84	3.75	2.96	2.95	2.76	4.43	TOTAL		
Net Sample Weight(lbs)	0.01	0	0.09	0.19	0.75	0.76	0.45	0.96	1.54	1.48	0.54	0.49	0.2	2.42	9.88	lbs	
%	0%	0%	1%	2%	8%	8%	5%	10%	16%	15%	5%	5%	2%	24%			
% Cumulative	0%	0%	1%	3%	11%	18%	23%	32%	48%	63%	69%	73%	76%	100%			

D50 Subpavement 2 mm  
D50 Riffle Pavement 8 mm

Tc= 0.0249

Largest Particle 43.00 0.141 ft

Slope 0.006

Depth required 294.42 0.97 ft

Area Required 9.3 sq ft

Width/Depth Ratio 10 est

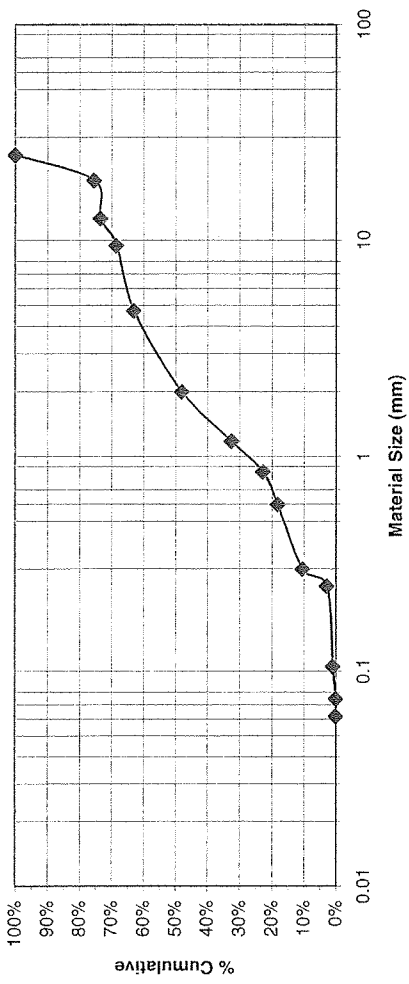
Bankfull Width 9.6 3.0 26

actual mean depth 0.96

Largest particle

Max Riffle Depth

Bar Material Particle Size Distribution  
Tick Creek - Chatham County, NC







# Appendix E DWQ Stream Habitat Evaluation Form

5/99 Revision 4

## Habitat Assessment Field Data Sheet Mountain/ Piedmont Streams

Directions for use of this Assessment: The observer is to survey a minimum of 100 meters of stream, preferably in an upstream direction starting above the bridge pool and the road right-of-way. The stream segment which is assessed should represent average stream conditions. In order to perform a proper habitat evaluation the observer needs to get into the stream. All meter readings need to be performed prior to walking the stream. When working the habitat index, select the description which best fits the observed habitats and then circle the score. If the observed habitat falls in between two descriptions, select an intermediate score. There are eight different metrics in this index and a final habitat score is determined by adding the results from the different metrics.

Stream Tick Creek Location/Road Jim Moody Rd. County Chatham

Date 9/25/01 CC# \_\_\_\_\_ Basin Cape Fear Subbasin 03-06-12

Observer(s) Jane Almon  
Ben Goetz Office Location Raleigh Agency Earth Tech

Type of Study: Fish Benthos Basinwide Special Study (Describe) Stream restoration

Latitude 35°40'N Longitude 79°21'W Ecoregion (circle one) MT  Distance Surveyed 800 meters  
2400 ft

Physical Characterization: Land use refers to immediate area that you can see from sampling location - include what you see driving thru the watershed in the remarks section. Also use the remarks section for such descriptions as "deeply incised" or "exposed bedrock" or other unusual conditions.

Land use: Forest 50% Active Pasture 50% Active Crops \_\_\_\_\_% Fallow Fields \_\_\_\_\_% Commercial \_\_\_\_\_%  
Industrial \_\_\_\_\_% Residential \_\_\_\_\_% Other \_\_\_\_\_%-Describe: \_\_\_\_\_

Width: (meters) Stream 2.3 Channel \_\_\_\_\_ Average Stream Depth: (m) 0.3 Velocity \_\_\_\_\_ m/sec  
7.5 ft 1.2 ft

Flow conditions (circle one): High Normal  Low

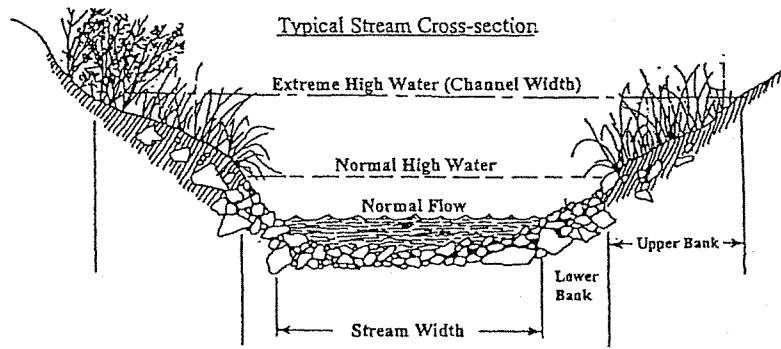
Manmade Stabilization: Y  N  Describe: straightened

Water Quality: Temperature \_\_\_\_\_°C Dissolved Oxygen \_\_\_\_\_ mg/l Conductivity \_\_\_\_\_ µmhos/cm pH \_\_\_\_\_

Turbidity: (circle) Clear  Slightly Turbid  Turbid  Tannic

Weather Conditions: hot, dry Photo # \_\_\_\_\_

Remarks: \_\_\_\_\_



- I. Channel Modification (Use topo map as an additional aid for this parameter)
- |  |              |
|--|--------------|
|  | <u>Score</u> |
| A. channel natural, frequent bends (good diversity of bends or falls)..... | 5            |
| B. channel natural, infrequent bends.....                                  | 4            |
| C. some channelization present.....  | 3            |
| D. more extensive channelization, >40% of stream disrupted.....            | 2            |
| E. no bends, completely channelized or rip rapped or gabioned, etc.....    | 0            |

Remarks \_\_\_\_\_ Subtotal 3

II. Instream Habitat: Consider the percentage of the reach that is favorable for benthos colonization or fish cover. Circle the habitats which occur (Rocks) (Macrophytes) (sticks and leaf packs) (snags and logs) (undercut banks or root mats) Definition: leafpacks consist of older leaves that are packed together and have begun to decay. Piles of leaves in pool areas are not considered leaf packs. EXAMPLE: If >70% of the reach is rocks, 1 type is present, circle the score of 17.

AMOUNT OF REACH FAVORABLE FOR COLONIZATION OR COVER

	>70%	40-70%	20-40%	<20%
	Score	Score	Score	Score
4 or 5 types present.....	20	16	12	8
3 types present.....	19	15	11	7
2 types present.....	18	14	10	6
1 type present.....	17	13	9	5
No types present.....	0			

Remarks \_\_\_\_\_ Subtotal 11

III. Bottom Substrate (silt, sand, detritus, gravel, cobble, boulder) look at entire reach for substrate scoring, but only look at riffle for embeddedness.

- |  |              |
|--|--------------|
| A. substrate with good mix of gravel cobble and boulders                         | <u>Score</u> |
| 1. embeddedness <20% (very little sand, usually only behind large boulders)..... | 15           |
| 2. embeddedness 20-40%.....  | 12           |
| 3. embeddedness 40-80%.....  | 8            |
| 4. embeddedness >80%.....  | 3            |
| B. substrate gravel and cobble   |              |
| 1. embeddedness <20%.....  | 14           |
| 2. embeddedness 20-40%.....  | 11           |
| 3. embeddedness 40-80%.....  | 6            |
| 4. embeddedness >80%.....  | 2            |
| C. substrate mostly gravel   |              |
| 1. embeddedness <50%.....  | 8            |
| 2. embeddedness >50%.....  | 2            |
| D. substrate homogeneous   |              |
| 1. substrate nearly all bedrock.....   | 3            |
| 2. substrate nearly all sand.....  | 3            |
| 3. substrate nearly all detritus.....  | 2            |
| 4. substrate nearly all silt/ clay.....  | 1            |

Remarks \_\_\_\_\_ Subtotal 2

IV. Pool Variety Pools are areas of deeper than average maximum depths with little or no surface turbulence. Water velocities associated with pools are always slow. Pools may take the form of "pocket water", small pools behind boulders or obstructions, in large high gradient streams.

	<u>Score</u>
A. Pools present	
1. Pools Frequent (>30% of 100m area surveyed)	
a. variety of pool sizes.....	10
b. pools same size.....	8
2. Pools Infrequent (<30% of the 100m area surveyed)	
a. variety of pool sizes.....	6
b. pools same size.....	④
B. Pools absent	
1. Runs present.....	3
2. Runs absent.....	0

Remarks \_\_\_\_\_ Page Total 4

V. Riffle Habitats

	<u>Riffles Frequent</u> <u>Score</u>	<u>Riffles Infrequent</u> <u>Score</u>
A. well defined riffle and run, riffle as wide as stream and extends 2X width of stream.....	16	12
B. riffle as wide as stream but riffle length is not 2X stream width .....	14	7
C. riffle not as wide as stream and riffle length is not 2X stream width .....	⑩	3
D. riffles absent.....	0	
		Subtotal <u>10</u>

VI. Bank Stability and Vegetation

	<u>Left Bank</u> <u>Score</u>	<u>Rt. Bank</u> <u>Score</u>
A. Banks stable		
1. no evidence of erosion or bank failure, little potential for erosion .....	7	7
B. Erosion areas present		
1. diverse trees, shrubs, grass; plants healthy with good root systems.....	6	6
2. few trees or small trees and shrubs; vegetation appears generally healthy.....	⑤	⑤
3. sparse vegetation; plant types and conditions suggest poorer soil binding.....	3	3
4. mostly grasses, few if any trees and shrubs, high erosion and failure potential at high flow	2	2
5. no bank vegetation, mass erosion and bank failure evident.....	0	0
		Total <u>10</u>

Remarks \_\_\_\_\_

VII. Light Penetration (Canopy is defined as tree or vegetative cover directly above the stream's surface. Canopy would block out sunlight when the sun is directly overhead).

	<u>Score</u>
A. Stream with good shading with some breaks for light penetration .....	10
B. Stream with full canopy - breaks for light penetration absent.....	⑧
C. Stream with partial shading - sunlight and shading are essentially equal.....	7
D. Stream with minimal shading - full sun in all but a few areas.....	2
E. No shading.....	0

Remarks \_\_\_\_\_ Subtotal 8

**VIII. Riparian Vegetative Zone Width**

Definition: A break in the riparian zone is any area which allows sediment to enter the stream. Breaks refer to the near-stream portion of the riparian zone (banks); places where pollutants can directly enter the stream.

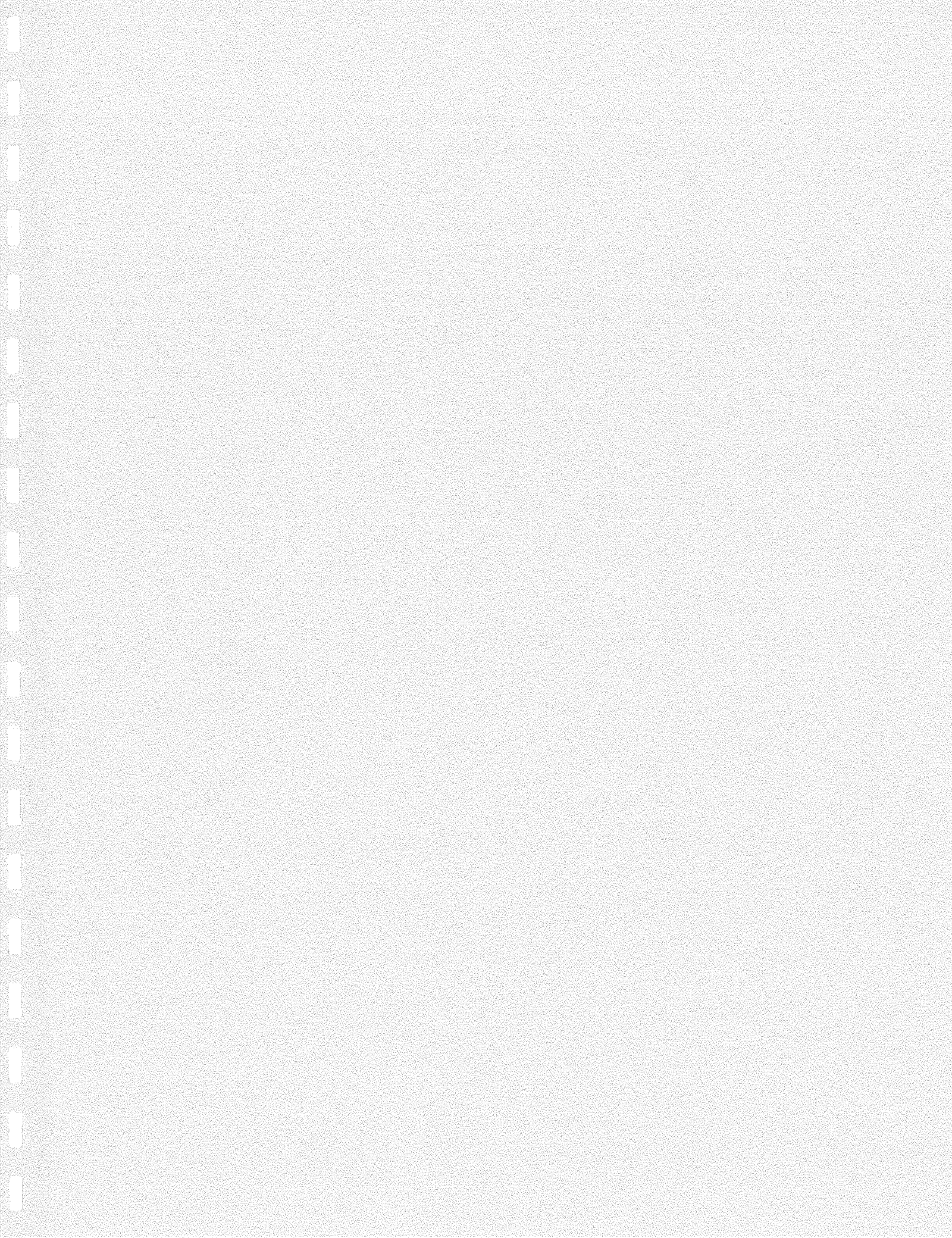
	Lft. Bank Score	Rt. Bank Score
A. Riparian zone intact (no breaks)		
1. zone width > 18 meters.....	5	5
2. zone width 12-18 meters.....	4	4
3. zone width 6-12 meters.....	3	3
4. zone width < 6 meters.....	2	2
B. Riparian zone not intact (breaks)		
1. breaks rare		
a. zone width > 18 meters.....	4	4
b. zone width 12-18 meters.....	3	3
c. zone width 6-12 meters.....	2	2
d. zone width < 6 meters.....	①	①
2. breaks common		
a. zone width > 18 meters.....	3	3
b. zone width 12-18 meters.....	2	2
c. zone width 6-12 meters.....	1	1
d. zone width < 6 meters.....	0	0

Remarks \_\_\_\_\_

Total 2

TOTAL SCORE 50

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Tributary to South Fork of Cane Creek  
Chatham County

Field Crew: Ben Goetz, Jan Patterson, Jane Almon  
 River Basin: Cape Fear  
 Watershed: Trib of the South Fork of Cane Creek  
 Reach: Trib of the South Fork of Cane Creek  
 DA: 0.41 sq mi (257 ac)  
 Date: 4/2/2002  
 Station: 2+79  
 Feature: CS #1, Pool

STATION (FEET)	HI (FEET)	FS (FEET)	ELEVATION (FEET)	NOTES
0+00.0	103.50	5.85	100.00	
0+11.0	103.50	5.91	97.59	
0+25.0	103.50	6.29	97.21	
0+27.0	103.50	6.39	97.11	
0+31.0	103.50	7.10	96.40	
0+34.5	103.50	8.23	95.27	LTOB
0+34.6	103.50	8.95	94.55	LBKF
0+34.6	103.50	10.32	93.18	
0+36.0	103.50	10.53	92.97	
0+38.0	103.50	10.80	92.70	TW
0+40.0	103.50	10.78	92.72	
0+42.0	103.50	10.52	92.98	
0+43.7	103.50	9.98	93.52	REW/WS
0+44.7	103.50	8.95	94.55	RBKF/TOB
0+46.0	103.50	8.76	94.74	
0+48.0	103.50	8.51	94.99	
0+50.0	103.50	8.24	95.26	
0+57.0	103.50	7.93	95.57	
0+76.0	103.50	7.66	95.84	
0+80.0	103.50	6.13	97.37	

BANKFULL			
Hydraulic Geometry			
Width (Feet)	Depth (Feet)	Area (Sq. Ft.)	
0.0	0.0	0.0	
0.0	1.4	0.0	
1.4	1.6	2.1	
2.0	1.8	3.4	
2.0	1.6	3.4	
1.7	1.0	2.2	
1.0	0.0	0.5	
<b>TOTALS</b>	<b>10.1</b>	<b>15.3</b>	

SUMMARY DATA (BANKFULL)	
A(BKF)	15.3
W(BKF)	10.1
Max d	1.8
Mean d	1.5

Bank Erosion Hazard Index (BEHI)			
Criteria	Value	Index	Bank Erosion Potential
Bank Ht/BK Ht	1	1	very low
Root Depth/Bank Ht	1	1	very low
Root Density (%)	60	2.4	low
Bank Angle (Degrees)	80	5.9	moderate
Surface Protection (%)	60	2.4	low
Bank Materials	silt, clay		
<b>TOTAL</b>		<b>12.7</b>	<b>low</b>

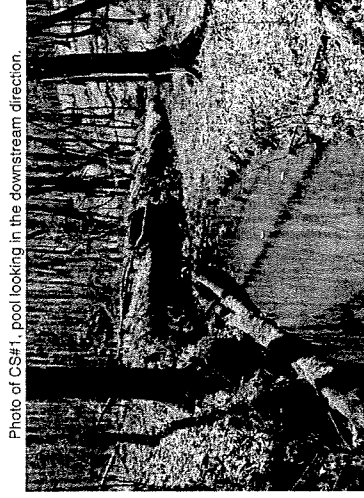
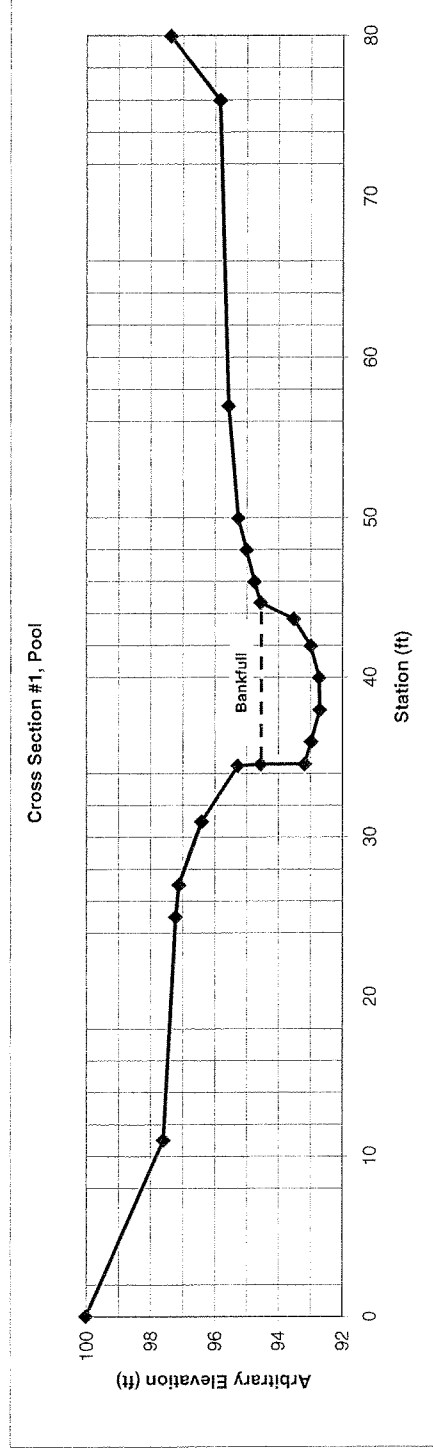


Photo of CS#1, pool looking in the downstream direction.



Tributary to South Fork of Cane Creek  
Chatham County

Field Crew: Ben Goetz, Jan Patterson, Jane Almon  
 River Basin: Cape Fear  
 Watershed: Trib of the South Fork of Cane Creek  
 Reach: Trib of the South Fork of Cane Creek  
 D/A: 0.41 sq mi (257 ac)  
 Date: 4/22/2002  
 Station: 3+56  
 Feature: CS #2, Riffle

STATION (Feet)	HI (Feet)	FS (Feet)	ELEVATION (Feet)	NOTES
0+00.0	105.18	6.55	98.63	
0+16.0	105.18	6.96	98.22	
0+25.0	105.18	7.40	97.78	
0+30.0	105.18	8.09	97.09	
0+33.0	105.18	8.46	96.72	LTOB
0+34.5	105.18	9.00	96.18	
0+36.0	105.18	9.64	95.54	LBKF
0+37.4	105.18	9.98	95.20	
0+38.0	105.18	10.72	94.46	LEW
0+39.0	105.18	10.86	94.32	
0+41.0	105.18	10.85	94.33	
0+42.6	105.18	10.93	94.25	
0+44.0	105.18	10.88	94.30	
0+45.5	105.18	11.00	94.18	TW
0+46.5	105.18	10.92	94.26	REW
0+46.7	105.18	9.82	95.36	
0+49.0	105.18	9.64	95.54	RBKF
0+50.0	105.18	9.74	95.44	
0+52.0	105.18	9.74	95.44	
0+53.0	105.18	9.26	95.92	
0+54.6	105.18	8.85	96.33	
0+56.0	105.18	7.37	97.81	

BANKFULL		
Hydraulic Geometry		
Width (Feet)	Depth (Feet)	Area (Sq. Ft.)
0.0	0.0	0.0
1.4	0.3	0.2
0.6	1.1	0.4
1.0	1.2	1.2
2.0	1.2	2.4
1.6	1.3	2.0
1.4	1.2	1.8
1.5	1.4	2.0
1.0	1.3	1.3
0.2	0.2	0.1
2.3	0.0	0.2
TOTALS		13.0
		11.6

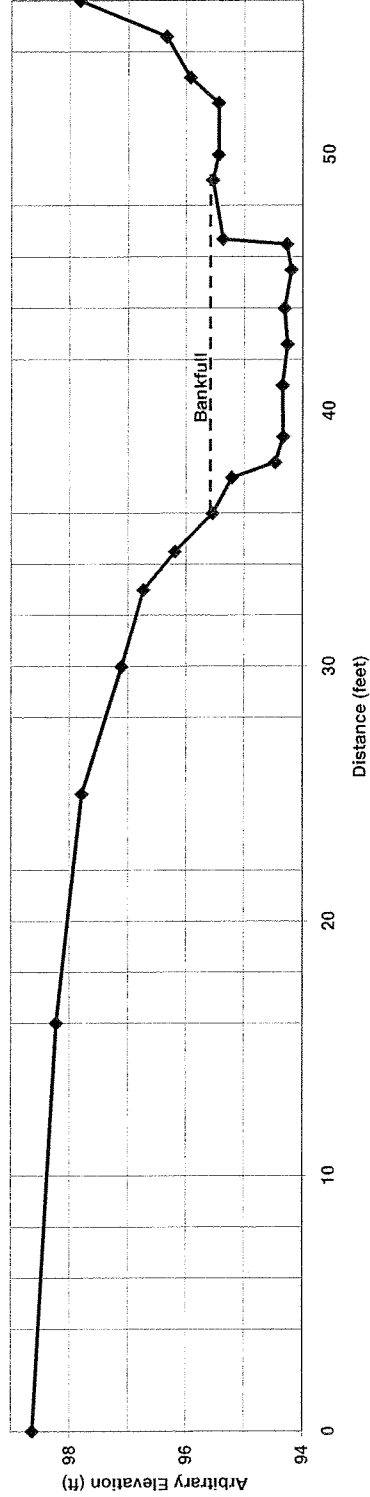
SUMMARY DATA (BANKFULL)	
A(BKF)	11.6
W(BKF)	13.0
Max d	1.4
Mean d	0.9
W/D	14.5
Entrenchment	2.0
Stream Type	C4
Area from Rural Regional Curve	12

Bank Erosion Hazard Index (BEHI)		
Criteria	Value	Index
Bank H/Bk Ht	1	1
Root Depth/Bank Ht	40	4.8
Bank Angle (Degrees)	10	1.4
Surface Protection (%)	80	5.9
Bank Materials	clay	0
		14.1
		low



Photo of CS#1, riffle looking in the downstream direction.

Cross Section #2, Riffle



Tributary to South Fork of Cane Creek  
Chatham County

Field Crew: Ben Goetz, Jan Patterson, Jane Almon  
 River Basin: Cape Fear  
 Watershed: Trib of the South Fork of Cane Creek  
 Reach: Trib of the South Fork of Cane Creek  
 DA: 0.41 sq mi (257 ac)  
 Date: 4/2/2002  
 Station: 4+52  
 Feature: CS #3, Riffle

STATION (Feet)	HI (Feet)	FS (Feet)	ELEVATION (Feet)	NOTES
0+00.0	102.60	4.52	98.08	
0+13.0	102.60	4.21	98.39	
0+25.0	102.60	4.91	97.69	
0+35.0	102.60	6.20	96.40	
0+39.0	102.60	6.54	96.06	
0+41.0	102.60	6.68	95.92	
0+43.6	102.60	6.92	95.68	LBFK/TOB
0+44.2	102.60	7.15	95.45	
0+44.4	102.60	8.13	94.47	LEW
0+46.4	102.60	8.21	94.39	
0+48.0	102.60	8.26	94.34	
0+49.3	102.60	8.30	94.30	TW
0+51.4	102.60	8.16	94.44	
0+53.0	102.60	8.15	94.45	REW
0+53.2	102.60	7.39	95.21	
0+54.0	102.60	7.09	95.51	
0+56.4	102.60	7.13	95.47	
0+56.7	102.60	6.92	95.68	RBKF
0+59.0	102.60	6.38	96.22	
0+60.3	102.60	5.88	96.72	RTOB
0+61.0	102.60	5.41	97.19	
0+61.8	102.60	4.83	97.77	
0+63.0	102.60	3.49	99.11	

BANKFULL			
Hydraulic Geometry			
Width (Feet)	Depth (Feet)	Area (Sq. Ft.)	
0.0	0.0	0.0	
0.6	0.2	0.1	
0.2	1.2	0.1	
2.0	1.3	2.5	
1.6	1.3	2.1	
1.3	1.4	1.8	
2.1	1.2	2.8	
1.6	1.2	2.0	
0.2	0.5	0.2	
0.8	0.2	0.3	
2.4	0.2	0.5	
0.3	0.0	0.0	
13.1		12.2	

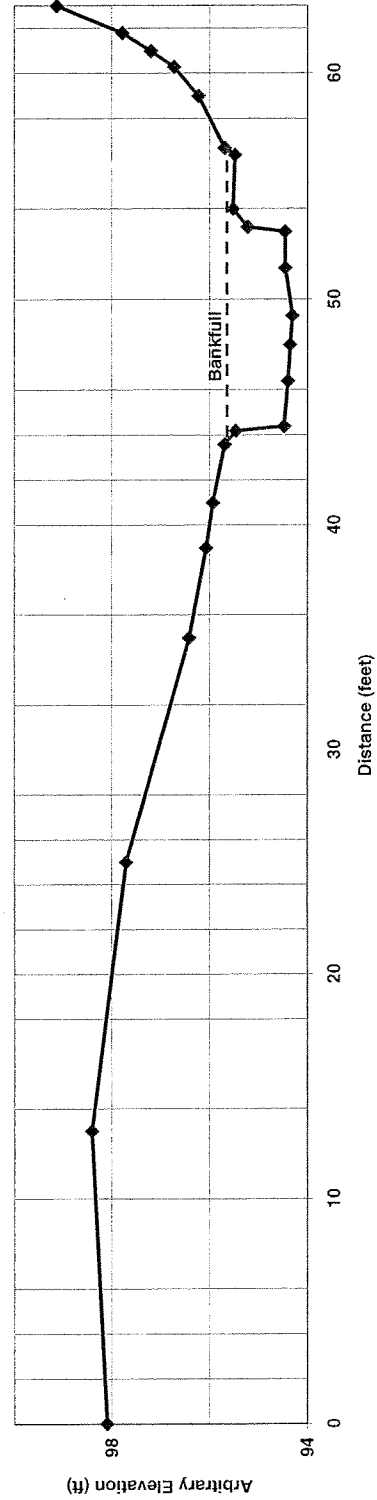
SUMMARY DATA (BANKFULL)			
A(BKF)	12.2	W(FPA)	36
W(BKF)	13.1	Slope	0.015
Max d	1.4	Sinuosity	1.2
Mean d	0.9	Area= A	
W/D	14.0	Width= W	
Entrenchment	2.7	Depth= D	
Stream Type	C4	Bankfull= BKF	
Area from Rural Regional Curve			12

Bank Erosion Hazard Index (BEHI)				
Criteria	Value	Index	Bank Erosion Potential	
Bank Ht/Bk Ht	1	1	very low	
Bank Depth/Bank Ht	1	1	very low	
Root Density (%)	70	3.2	moderate	
Bank Angle (Degrees)	10	1.4	very low	
Surface Protection (%)	80	5.9	very low	
Bank Materials	clay	0		
			12.5	LOW

Photo of Run CS#7 looking in the downstream direction.



Cross Section #3, Riffle





Tributary to South Fork of Cane Creek  
Chatham County

Field Crew: Ben Goetz, Jan Patterson, Jane Almon  
 River Basin: Cape Fear  
 Watershed: Trib of the South Fork of Cane Creek  
 Reach: Trib of the South Fork of Cane Creek  
 DA: 0.41 sq mi (257 ac)  
 Date: 4/2/2002  
 Station: 5+35  
 Feature: CS #4, Pool

STATION (FEET)	HI (FEET)	FS (FEET)	ELEVATION (FEET)	NOTES
0+00.0	103.50	5.43	96.07	
0+05.0	103.50	6.73	96.77	
0+15.0	103.50	6.65	96.85	
0+22.0	103.50	7.08	96.42	
0+23.5	103.50	7.28	96.22	
0+27.0	103.50	7.59	95.91	LBKFTOB
0+29.0	103.50	8.33	95.17	
0+32.0	103.50	8.35	95.15	
0+34.0	103.50	8.40	95.10	
0+35.4	103.50	8.87	94.63	LEWMS
0+37.0	103.50	9.38	94.12	
0+38.0	103.50	9.66	93.84	TW
0+39.4	103.50	9.52	93.98	
0+41.5	103.50	9.24	94.26	REW
0+42.0	103.50	7.59	95.91	RBKFTOB
0+45.0	103.50	7.29	96.21	
0+53.0	103.50	7.41	96.09	
0+60.0	103.50	7.65	95.85	
0+65.0	103.50	7.60	95.90	
0+82.0	103.50	8.02	95.48	
0+84.0	103.50	6.65	96.85	

Bank Erosion Hazard Index (BEHI)			
Criteria	Value	Index	Potential
Bank H/Bk: Ht	1	1	very high
Bank Depth/Bank Ht	1	1	very low
Root Density (%)	30	5.9	moderate
Bank Angle (Degrees)	80	5.9	moderate
Surface Protection (%)	9	10	extreme
Bank Materials	clay	0	
			23.8 moderate

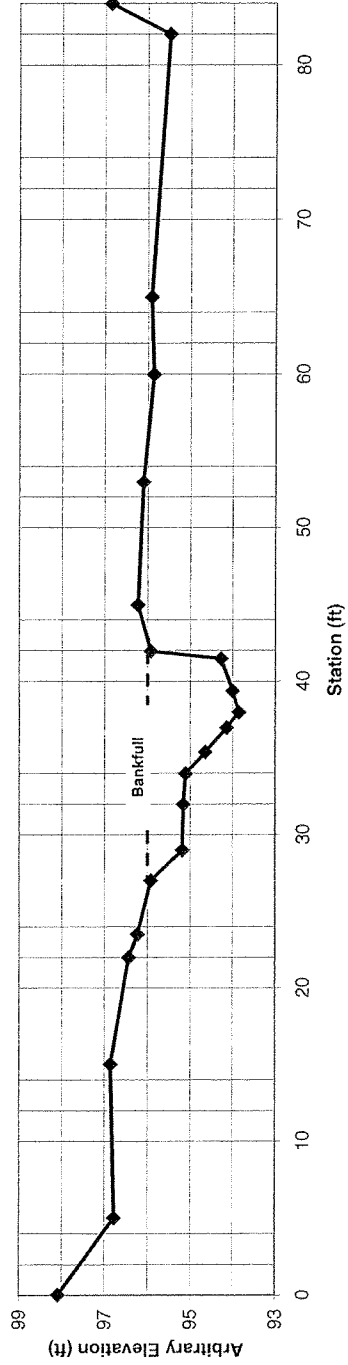


Photo of CS#6, pool looking in the downstream direction.

BANKFULL		
Width (Feet)	Depth (Feet)	Area (Sq. Ft.)
0.0	0.0	0.0
2.0	0.7	0.7
3.0	0.8	2.2
2.0	0.8	1.6
1.4	1.3	1.5
1.6	1.8	2.5
1.0	2.1	1.9
1.4	1.9	2.8
2.1	1.6	3.8
0.5	0.0	0.4
TOTALS		17.4

SUMMARY DATA (BANKFULL)	
A(BKF)	17.4
W(BKF)	15.0
Max d	2.1
Mean d	1.2

Cross Section #4, Pool



**Tributary to South Fork of Cane Creek  
Chatham County**

**PATTERN DATA FOR SOUTH FORK OF CANE CREEK**

Curve	Chord L	Mid	Radius of C	Beltwidth	Wavelength
1	21	2.7	22	30	58
2	21	2.9	20	15	39
3	21	2.3	25	14	32
4	20	2.2	24	15	
5	15	1.9	16		
6	21	2.4	24		
7	26	4	23		
<b>AVG</b>			22	19	43
<b>Min</b>			16	14	32
<b>Max</b>			25	30	58

Tributary to South Fork of Cane Creek  
Chatham County

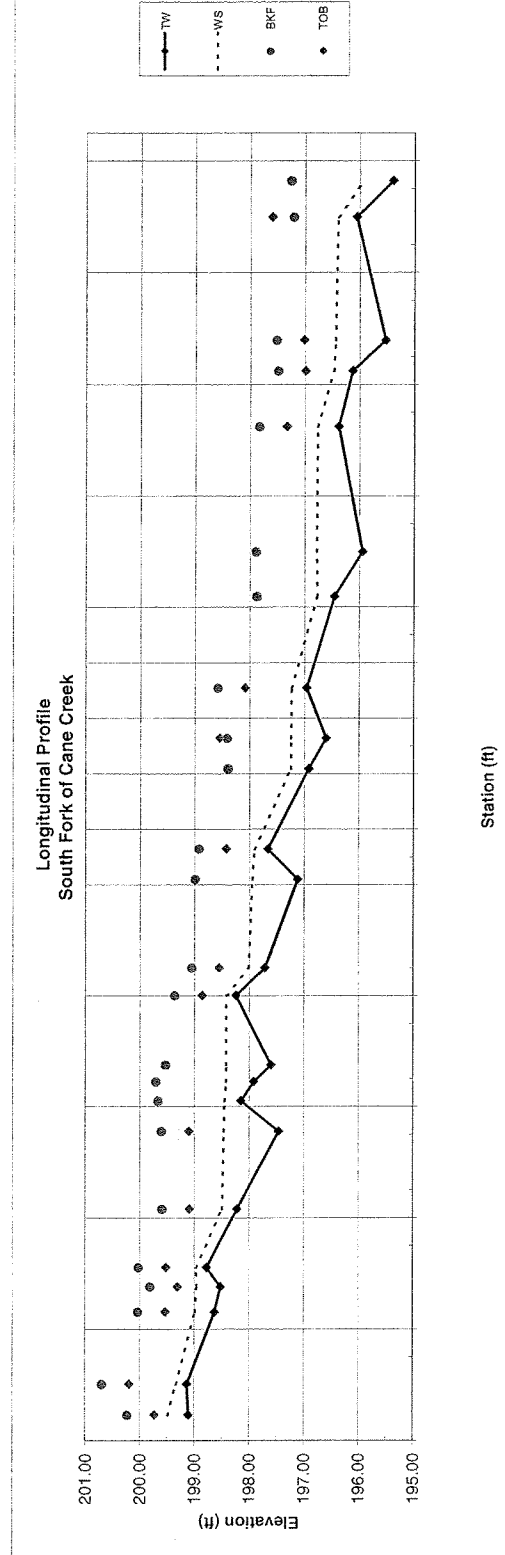
**LONGITUDINAL PROFILE**  
 River Basin: Cane Fear  
 Watershed: Tick Creek  
 Stream Reach: Tick Creek  
 DA (sq mi): 20 sq mi  
 Date: 3/6/2002

REF EPT	BS	HI	ES	ELEV	NOTES
BM (AM)	7.93	207.93	7.93	200.00	tree root
BM (AM)	4.78	200.00	4.78	200.00	Errors=0.00
BM (AM)	4.78	200.00	4.78	200.00	Errors=0.00
BM (PM)		200.00	4.78	200.00	Errors=0.00

Tick Longitudinal Profile

Station	REF EPT	BS	HI	TW(S)	TW	WS(S)	WS	BK(F/S)	BKF	TOB(S)	TOB	Notes	Bk Hght/Hk	P.P	Pool Length	Max Pool Depth	Pool Slope	Riffle Length	Riffle Slope	
0+39.0	BM (AM)	207.93	8.83	195.10	8.45	199.48	199.48	7.71	200.22	8.21	199.72	Head of Riffle	0.6							
1+00.0	BM (AM)	207.93	8.80	195.13	8.60	199.33	199.33	7.24	200.69	7.74	200.19	Intermediate	0.7					37.0	1.35	
1+26.0	BM (AM)	207.93	9.31	198.62	8.85	198.98	198.98	7.91	200.02	8.41	199.52	Head of Pool	0.6							
1+35.0	BM (AM)	207.93	9.42	198.51	8.89	198.95	198.95	8.13	199.80	8.63	199.30	Max Pool	0.6		16.0	1.29	0.13	21.0	2.29	
1+42.0	BM (AM)	207.93	9.16	198.77	8.87	198.95	198.95	7.92	200.01	8.42	199.51	Head of Riffle	0.6							
1+53.0	BM (AM)	207.93	9.12	198.21	9.45	198.48	198.48	8.35	199.58	8.85	199.08	Head of Pool	0.8		38.0	2.14	0.10	7.0	0.43	
2+00.0	BM (AM)	207.93	10.46	197.45	9.46	198.45	198.45	8.34	199.39	8.84	199.09	Max Pool	0.8							
2+02.0	BM (AM)	207.93	10.46	197.45	9.46	198.45	198.45	8.34	199.39	8.84	199.09	Max Pool	0.8							
2+09.0	BM (AM)	207.93	10.93	197.00	9.52	198.41	198.41	8.23	199.72	8.72	199.70	Head of Riffle	1.0							
2+15.0	BM (AM)	207.93	10.84	197.59	9.52	198.41	198.41	8.41	199.52	8.41	199.52	Max Pool	1.0		31.0	1.83	0.00	10.0	4.10	
2+50.0	BM (AM)	207.93	10.23	197.70	9.83	199.00	199.00	8.89	199.04	9.39	198.54	Head of Pool	0.6							
2+82.0	BM (AM)	207.93	10.82	197.11	10.00	197.93	197.93	8.95	198.98	9.55	198.98	Max Pool	1.0		43.0	1.87	0.26	29.0	2.28	
3+22.0	BM (AM)	207.93	11.02	196.91	10.70	197.23	197.23	9.55	199.38	9.55	199.38	Head of Pool	1.0		72.0					
3+35.0	BM (AM)	207.93	11.84	196.59	10.71	197.23	197.23	9.55	199.40	9.40	199.53	Max Pool	1.1		28.0	1.81	0.03	38.0	1.39	
3+51.0	BM (AM)	207.93	10.98	196.95	10.71	197.22	197.22	9.26	199.57	9.86	199.07	Head of Riffle	0.7							
3+58.0	BM (AM)	207.93	10.98	196.95	10.71	197.22	197.22	9.26	199.57	9.86	199.07	Head of Riffle	0.7							
4+00.0	BM (PM)	204.78	8.85	195.84	8.01	196.77	196.77	6.96	197.88	6.92	197.86	Head of Pool	1.0		61.0	1.95	0.00	20.0	1.50	
4+45.0	BM (PM)	204.78	8.85	195.84	8.01	196.77	196.77	6.96	197.88	6.92	197.86	Head of Pool	1.0							
4+65.0	BM (PM)	204.78	8.41	196.97	8.32	196.76	196.76	6.96	197.82	7.45	197.32	Head of Riffle	0.7							
4+76.0	BM (PM)	204.78	8.27	195.51	8.35	196.43	196.43	7.27	197.51	7.77	197.01	Max Pool	0.8		55.0	2.00	0.13	13.0	3.62	
5+20.0	BM (PM)	204.78	8.73	196.05	8.39	196.39	196.39	7.58	197.20	7.19	197.59	Head of Riffle	1.3							
5+33.0	BM (PM)	204.78	8.40	195.38	8.86	195.92	195.92	7.53	197.25	7.53	197.25	Head of Pool	1.0		68.0					
5+39.0	BM (PM)	204.78	9.72	195.06	8.86	195.92	195.92	7.53	197.25	7.53	197.25	Max Pool	1.0		16.0	2.19	0.13			
5+49.0	BM (PM)	204.78	9.11	195.67	8.89	195.90	195.90	7.55	197.23	7.30	197.48	Head of Riffle	1.2							
													max	81.0	61.0	2.2	0.2558		4.1000	
													min	37	16	1.29	0.0000		0.4286	
													avg	58.1	36.3	1.9	0.0953		2.1189	
													Max ratio	4.8	4.8	0.08	0.01		0.10	
													Min ratio	1.5	1.5	0.05	0.01		0.01	
													avg ratio	1.5	1.5	0.05	0.00		0.05	

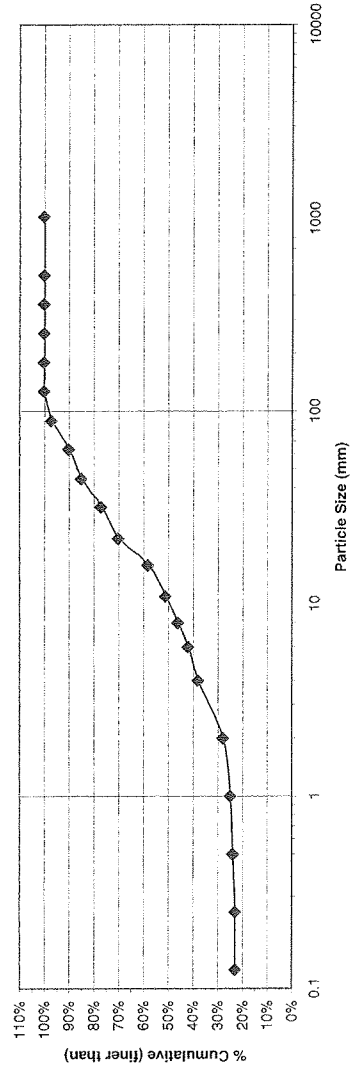
Average Slope: 42.93



Tributary to South Fork of Cane Creek  
Chatham County

PEBBLE COUNT												
Site: Little Beaver Creek					3/25/2002							
Party: Ben Goetz, Jan Patterson					Little Beaver Creek							
Inches	Particle Silt/Clay	Millimeter < 0.062	Particle Count						Total No.	Item %	% Cumulative	
			Riffle 1	Riffle 2	Pool 1	Riffle 1	Pool 2	Pool 2				
	Very Fine	.062 - .125	S							0	0%	23%
	Fine	.125 - .25	A							0	0%	23%
	Medium	.25 - .50	N							1	1%	24%
	Coarse	.50 - 1.0	D							1	1%	25%
.04 - .08	Very Coarse	1.0 - 2.0	S	1						3	3%	28%
.08 - .16	Very Fine	2.0 - 4.0		4						10	10%	38%
.16 - .22	Fine	4.0 - 5.7	G	1						4	4%	42%
.22 - .31	Fine	5.7 - 8.0	R	2	1					4	4%	46%
.31 - .44	Medium	8.0 - 11.3	A	2						5	5%	51%
.44 - .63	Medium	11.3 - 16.0	V	1						7	7%	58%
.63 - .89	Coarse	16.0 - 22.6	E	1						12	12%	70%
.89 - 1.26	Coarse	22.6 - 32.0	L	1						7	7%	77%
1.26 - 1.77	Very Coarse	32.0 - 45.0	S	2						8	8%	85%
1.77 - 2.5	Very Coarse	45.0 - 64.0		2						5	5%	90%
2.5 - 3.5	Small	64 - 90	C	1						7	7%	97%
3.5 - 5.0	Small	90 - 128	O	2						3	3%	100%
5.0 - 7.1	Large	128 - 180	B							0	0%	100%
7.1 - 10.1	Large	180 - 256	L							0	0%	100%
10.1 - 14.3	Small	256 - 362	B							0	0%	100%
14.3 - 20	Small	362 - 512	L							0	0%	100%
20 - 40	Medium	512 - 1024	D							0	0%	100%
40 - 80	Lrg. - Very Lrg.	1024 - 2048	R							0	0%	100%
	Bedrock		BDRK							0	0%	100%
<b>Totals</b>				25	25	25	25	25	100	100%	100%	100%

Particle Size Distribution  
Tick Creek - Chatham County, NC



**REFERENCE REACH SURVEY**

Stream Name: Spencer Creek in Uwaharrie

Location: Uwaharrie Nat. Park

Purpose: Longitudinal Profile and Cross-section measurements for Graduate Work

Date: ~~#####~~ 7/23/1998

Crew: Dan Clinton, Jan Patterson, Rhett Pace, Daniel Van Brunt

Ending Point LAT/LONG:

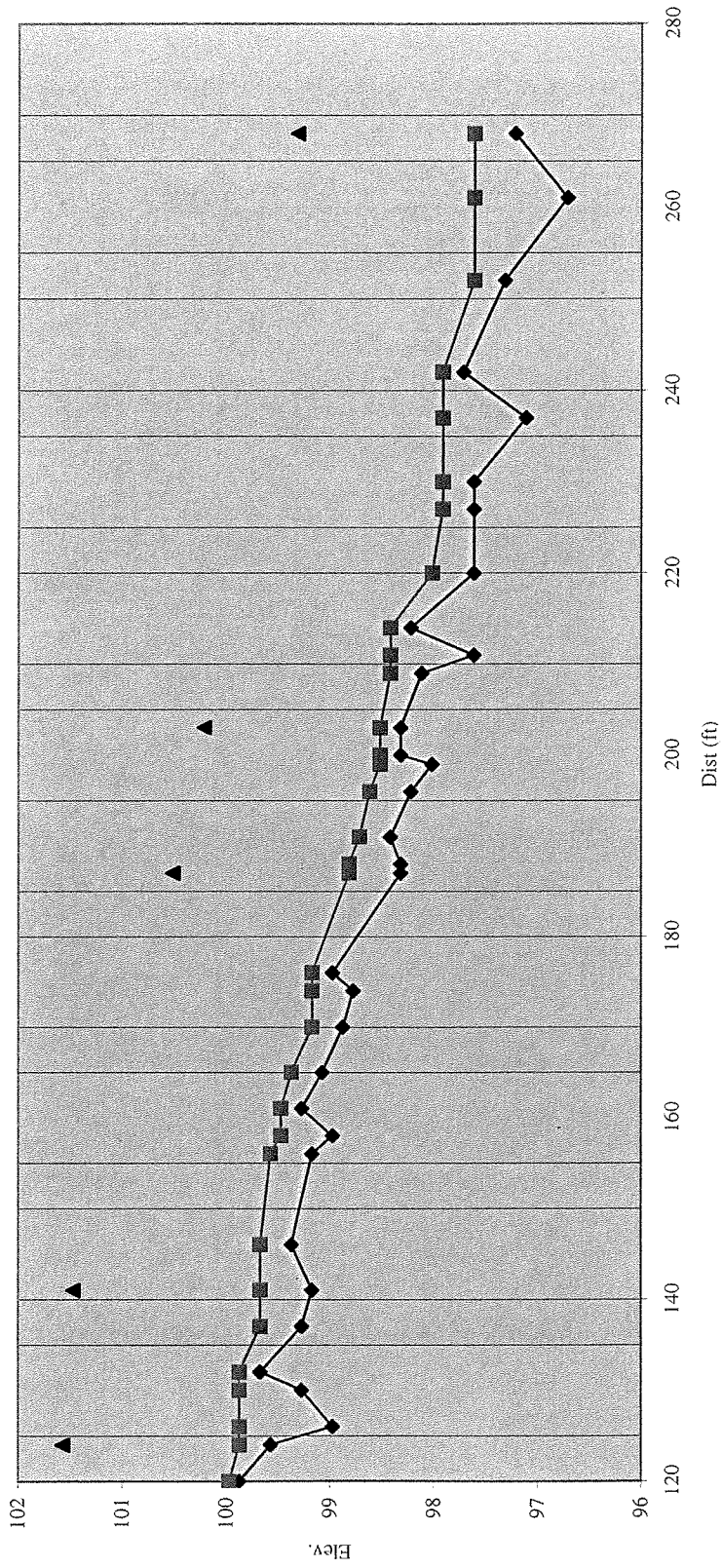
Watershed Area: 0.5 sq. mi.

**LONGITUDINAL PROFILE**

(Using Level)

Distance	Thawl Wag (FS)	Thawl Wag Elev.	Water Surface (FS)	Water Surface Elev.	BKF (FS)	BKF Elev.	Mid Feature location	Feature
Bench Mark #1= 100 ft. BM1 located on pine tree root ~210ft Down stream on rt. bank								
BS =	5.23	HI =	105.23	TP1 FS=	1.23	TP1 El=	104.00	
TP1 BS=	3.22	TP1 HI=	107.22	TP2 FS=	3.22	TP2 El=	104.00	
TP2 BS=	2.37	TP2 HI=	106.37	TP3 FS=	5.89	TP3 El=	100.48	
TP3 BS=	4.63	TP3 HI=	105.11					
				FS to BM=	5.11	BM El=	100.00	
						ERROR=	0.00	
Distance	Thawl Wag (FS)	Thawl Wag Elev.	Water Surface (FS)	Water Surface Elev.	BKF (FS)	BKF Elev.	Mid Feature location	Feature
2.0	6.3	100.9	6.1	101.1			7	R
5.0	6.3	100.9	6.2	101.0				
12.0	6.7	100.5	6.3	100.9			17.5	P
19.0	7.0	100.2	6.3	100.9				
23.0	6.8	100.4	6.3	100.9			27.75	G
32.5	6.6	100.6	6.3	100.9			37.75	Run
39.0	6.7	100.5	6.4	100.8	5.1	102.1		
43.0	6.7	100.5	6.4	100.8			49.5	R
48.0	6.9	100.3	6.6	100.6				
56.0	7.1	100.1	6.7	100.5			64	P
59.0	7.2	100.0	6.7	100.5				
63.0	7.3	99.9	6.7	100.5				
72.0	7.0	100.2	6.7	100.5	4.9	102.3	81	R
80.0	7.3	99.9	6.9	100.3	5.1	102.1		
90.0	7.6	99.6	7.2	100.0			97.5	P
98.0	6.7	99.7	6.3	100.1				
105.0	6.7	99.7	6.3	100.1			106.5	G
108.0	6.4	100.0	6.3	100.1			110	Run
112.0	7.0	99.4	6.4	100.0			114	P
116.0	6.7	99.7	6.4	100.0	4.7	101.7	118	G
120.0	6.5	99.9	6.4	100.0			122	R
124.0	6.8	99.6	6.5	99.9	4.8	101.6	127	P
126.0	7.4	99.0	6.5	99.9				
130.0	7.1	99.3	6.5	99.9			131	G
132.0	6.7	99.7	6.5	99.9			134.5	R
137.0	7.1	99.3	6.7	99.7			141.5	P
141.0	7.2	99.2	6.7	99.7	4.9	101.5		
146.0	7.0	99.4	6.7	99.7			151	R
156.0	7.2	99.2	6.8	99.6			158.5	P
158.0	7.4	99.0	6.9	99.5				
161.0	7.1	99.3	6.9	99.5			165.5	R
165.0	7.3	99.1	7.0	99.4				
170.0	7.5	98.9	7.2	99.2			173	P
174.0	7.6	98.8	7.2	99.2				
176.0	7.4	99.0	7.2	99.2			188	R
187.0	6.8	98.3	6.3	98.8	4.6	100.5		
188.0	6.8	98.3	6.3	98.8				
191.0	6.7	98.4	6.4	98.7				
196.0	6.9	98.2	6.5	98.6				
199.0	7.1	98.0	6.6	98.5				
200.0	6.8	98.3	6.6	98.5			204.5	Run
203.0	6.8	98.3	6.6	98.5	4.9	100.2		
209.0	7.0	98.1	6.7	98.4			211.5	P
211.0	7.5	97.6	6.7	98.4				
214.0	6.9	98.2	6.7	98.4			217	R
220.0	7.5	97.6	7.1	98.0			225	Run
227.0	7.5	97.6	7.2	97.9				
230.0	7.5	97.6	7.2	97.9			236	P
237.0	8.0	97.1	7.2	97.9				
242.0	7.4	97.7	7.2	97.9			247	R
252.0	7.8	97.3	7.5	97.6			260	P
261.0	8.4	96.7	7.5	97.6				
268.0	7.9	97.2	7.5	97.6	5.8	99.3		

Spencer Creek



# Pebble Count

Site: Spencer Creek in Uwharrie

Date: 7/28/1998

Party: DVB

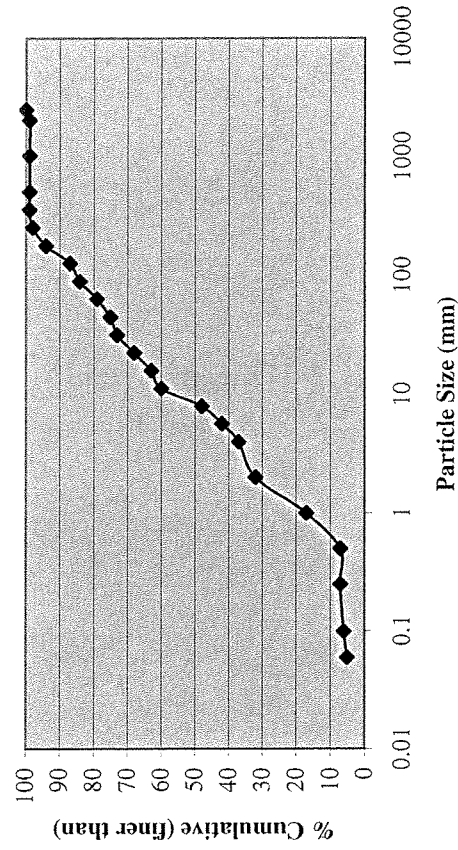
Particle Size(mm)	Total #	% Cum.
Silt/Clay <0.062	5	5
Very Fine 0.062-0.125	1	6
Fine 0.125-0.25	1	7
Medium 0.25-0.50	0	7
Course 0.50-1.0	10	17
Very Course 1.0-2.0	15	32
Very Fine 2-4	5	37
Fine 4-5.7	5	42
Fine 5.7-8	6	48
Medium 8-11.3	12	60
Medium 11.3-16	3	63
Course 16-22.6	5	68
Course 22.6-32	5	73
Very Course 32-45	2	75
Very Course 45-64	4	79
Small 64-90	5	84
Small 90-128	3	87
Large 128-180	7	94
Large 180-256	4	98
Small 256-362	1	99
Small 362-512	0	99
Medium 512-1024	0	99
Large-Vry Lrg 1024-2048	0	99
Bedrock >2048	1	100
	100	100

D16: 0.06 mm

D50: 8.6 mm

D84: 77 mm

Pebble Count @ Spencer Creek in Uwharrie



# Meander Geometry Data

Site: Spencer Creek  
 Date: 6/3/1998  
 Party: DRC

## RADIUS OF CURVATURE

Meander	Mid-Ordinate(M)	Cord Length(C)	Rad. Of Curvature
1	1.25	12	15.0
2	2.7	13.8	10.2
3	1.5	16	22.1
4	1.8	13	12.6
5	2.4	9	5.4
6	4	18	12.1
		Mean	12.9
		Median	12.4
		Min	5.4
		Max	22.1

Valley Length = 235 ft.

Meander Wavelength = 

54
196

 ft.  
 Mean: 

125
-----

Belt Width(approx.) = 

24
52

 ft.  
 Mean: 

38
----



X\_SECTION MEASUREMENTS  
 Rifle X-Section #1  
 Location : 2+03  
 HI= 102.98

Distance	FS	Elev	Notes	Depth		Area
				from BKF	Width	
0.0	-1.4	5.1	Lpin			
2.0	0.0	5.2	LTOB			
8	0.3	5.1	LBKF	0.0	0	0
11.0	1.7	5.3		0.2	3.0	0.3
11.5	2.5	5.4		0.3	0.5	0.1
11.6	3.1	6.8	LEW	1.7	0.1	0.1
13.0	3.8	6.8		1.7	1.4	2.4
15.0	4.8	6.9	TW	1.8	2.0	3.5
16.4	5.1	6.7	REW	1.6	1.4	2.4
17.0	5.4	5.9		0.8	0.6	0.7
19.0	5.5	5.4		0.3	2.0	1.1
20.3	5.9	5.1	RBKF	0.0	1.3	0.2
sum:				10.8	sq. ft.	

BKF Width = 12.3  
 Area = 10.8  
 Max. depth = 1.8  
 FPW = 228.5  
 ER = 18.6  
 Mean Depth = 0.9  
 Width/Depth Ratio = 14.0  
 Sinosity = 1.1  
 Slope = 0.0132  
 Stream Type = B4c

Riffle X-Section #2  
 Location : 0+73  
 HI= 106.3

Distance	FS	Elev	Notes	Depth from BKF	Width	Area
0.0	3.4	102.9	Lpin			
2.0	3.7	102.6				
2.7	3.8	102.5				
3.6	4.2	102.1	LBKF	0.0	0	0.0
5	4.7	101.6		0.5	1.4	0.4
5.7	5.1	101.2		0.9	0.7	0.5
6.0	6.0	100.3	LEW	1.8	0.3	0.4
6.8	6.1	100.2		1.9	0.8	1.5
7.4	6.0	100.3		1.8	0.6	1.1
7.9	5.9	100.4		1.7	0.5	0.9
8.1	6.1	100.2	TW	1.9	0.2	0.4
8.5	6.0	100.3		1.8	0.4	0.7
9.1	6.1	100.2		1.9	0.6	1.1
10.5	5.9	100.4	REW/W/S	1.7	1.4	2.5
10.8	5.8	100.5		1.6	0.3	0.5
11.0	4.9	101.4		0.7	0.2	0.2
12.0	4.3	102.0		0.1	1.0	0.4
12.3	4.2	102.1	RBKF			
15.5	4.0	102.3	Rpin	0.0	0.3	0.0

sum: 10.6 sq. ft.

BKF Width =	8.7
Area =	10.6
Max. depth =	1.9
FPW =	228.5
ER =	26.3
Mean Depth =	1.2
Width/Depth Ratio =	7.2
Stream Type =	E4

Pool X-Section #1  
 Location : 1+25  
 HI= 106.37

Distance	FS	Elev	Notes	Depth from BKF	Width	Area	
2.9	4.8	101.6	LBKF	0.0	0.0	0.0	
4	5.6	100.8		0.8	1.1	0.4	
4.2	6.2	100.2		1.4	0.2	0.2	
4.5	6.5	99.9	LEW/WS	1.7	0.3	0.5	
4.8	7.2	99.2		2.4	0.3	0.6	
5.3	7.3	99.1	TW	2.5	0.5	1.2	
6.9	6.9	99.5		2.1	1.6	3.7	
9.1	6.5	99.9	REW/WS	1.7	2.2	4.2	
9.8	6.4	100.0		1.6	0.7	1.2	
10.1	5.6	100.8		0.8	0.3	0.4	
10.8	5.1	101.3		0.3	0.7	0.4	
11.3	4.8	101.6	RBKF	0.0	0.5	0.1	
sum:						12.8	sq. ft.

BKF Width = 8.4  
 Area = 12.8  
 Max. depth = 2.5  
 Mean Depth = 1.5  
 Width/Depth Ratio = 5.5  
 Stream Type = E4