Little Troublesome Stream Restoration Site
Rockingham County, North Carolina

Stream Restoration Plan

Contract No. D07009S

North Carolina Ecosystem Enhancement Program

FINAL
June 2007

Prepared by: KCI Associates of North Carolina, P.A.
Landmark Center II, Suite 220
4601 Six Forks Road
Raleigh, NC 27609
Phone: (919) 783-9214
Fax: (919) 783-9266

Project Manager: April H. Davis
Email: adavis@kci.com

EXECUTIVE SUMMARY

The North Carolina Ecosystem Enhancement Program (NCEEP) intends to utilize the Little Troublesome Creek and associated tributaries and wetlands for a stream and wetland mitigation project. The proposed project includes the restoration of approximately 2,188 linear feet of LTC and an unnamed tributary (UT1). In addition, there are approximately 4.5 acres of wetland preservation, 1.9 acres of wetland enhancement opportunities and 2,754 linear feet of stream preservation (UT2) within the restoration site.

The site is located approximately 5 miles southeast of the Town of Reidsville, North Carolina in Rockingham County. The project site was identified for restoration in the NCEEP Local Watershed Plan (Upper Cape Fear Basin LWP). It is situated within the 03030002 (Upper Cape Fear 02) Watershed Cataloging Unit (8-digit HUC) and the 03030002010030 Local Watershed Unit (14-digit HUC) and drains approximately 7,740 acres including the southern portion of the Town of Reidsville. The NCEEP has identified this 14-digit HUC as a Targeted Local Watershed.

LTC exhibits characteristics of an unstable stream channel. Watershed growth, residential and commercial development and past channelization in the watershed have led to increased impervious area and runoff. The concerns have resulted in erosion and heavy sedimentation in LTC. The channel can be characterized as having poor streambed variability and habitat diversity as proven with an inconsistent profile throughout LTC.

Previous cattle access to the streams and excess nutrient inputs have resulted in eroding stream banks and degraded water quality. Currently the cattle have been removed from the stream, which has improved water quality. However, the channel is continuing to undergo change due to the large developing watershed.

The stream banks consist of highly erodible material consisting of silt/sand, and the majority of the stream banks are vertical. LTC is currently in Class V of the channel evolution sequence. Bed degradation and aggradation are evident throughout the project reach (their presence depends on the local slopes and channel dimensions, along with the presence of sand depositing along the stream bed). A riparian buffer along the stream banks was observed with woody vegetation, but it is very narrow, approximately only one tree width on the west side of LTC. Much of the vegetation observed existed on the top of bank with very little vegetation coverage from the top of bank to the bottom of bank (NCEEP, May 2004). Many of the trees along the stream banks have exposed roots and are falling into the channel due to the stream widening and active bank erosion. The widening of the channel poses the immediate threat to short term stability of the channel.

UT1 exhibits different symptoms than the main stem, mostly due to the smaller drainage area (approximately 0.10-square mile). The streambed has defined riffles and pools; however the channel is deeply incised with active bank erosion and widening of the channel. Many of the trees along the stream banks are falling into the channel as a result of undercutting banks. The major concern for UT1 is the loss of its hyporheic zone. The channel has degraded extensively to the point that the roots on the stream banks are exposed and the streambed has degraded several feet beneath the tree roots.

UT2 is classified as an intermittent stream for stream preservation. The stream enters the property at the northwestern corner of the project site. UT2 flows parallel to LTC for approximately 2,754 linear feet before the confluence at the bottom of the site near Mizpah Church Road.

Two reference streams were surveyed to facilitate the development of design criteria for the restoration of the LTC and UT1. A section of Collins Creek, located west of Chapel Hill, was identified and surveyed as a reference reach for the restoration of LTC. A section of an Unnamed Tributary to Wilkinson Creek, located southwest of Chapel Hill, was identified and surveyed as a reference reach for the restoration of UT1. These selections were based on: location in the same hydrophysiographic province, similar valley morphology, and similar sediment regime as the project streams.

The restoration goals for this project are as follows:

- Restore a stable channel morphology that is capable of moving the flows and sediment provided by its watershed.
- Improve water quality for an NCDWQ stream, classified as a Class C and Nutrient Sensitive Waters (NSW).
- Reduce land and riparian vegetation loss resulting from lateral erosion and bed degradation.
- Enhance aquatic and terrestrial habitat.
- Improve the functions of existing wetlands.
- Preserve existing wetlands and forested buffers.

The objectives that must be accomplished to reach these goals are:

- Restore 2,188 linear feet of stable stream channel with the appropriate pattern, profile, and dimension that can support a gravel transport system.
- Restore a natural riparian buffer; reduce nutrient inputs and sediment from bank erosion into the stream.
- Restore the natural hyporheic zone in the project streams and re-establish the natural stream features.
- Enhance hydrology and vegetation by plugging ditches to increase groundwater and planting vegetation to increase species diversity.

The restoration design of the LTC proposes constructing and restoring approximately 1,375 linear feet of a meandering "E4" channel and associated floodplain. The tributary (UT1) restoration will restore 813 linear feet of a "B4c" stream type.

Table 1. Project Restoration Structure and Objectives

Streams						
Reach	**Station Range**	**Restoration Type**	**Priority Approach**	**Stream Classification**	**Existing Linear Footage**	**Designed Linear Footage**
LTC	10+00 - 11+75	Restoration	P3	E4	175	175
LTC	11+75 –21+95	Restoration	P2	E4	975	1020
LTC	21+95 – 23+75	Restoration	P3	E4	179	180
LTC-TOTAL					1329	1375
UT1	50+00 - 58+13	Restoration	P3	B4c	*873	*813

Wetlands	**Acreage**	**Soil Type**	**Existing Community Type**	**Designed Community Type**
Enhancement Wetland #1	1.17	Wedhadkee Wedhadkee/ Variant	Grass/Pasture Community	Piedmont Alluvial Forest
Enhancement Wetland #2	0.74	Wedhadkee Wedhadkee/ Variant	Low Elevation Seep	Low Elevation Seep
Preservation Wetland	4.5	Wedhadkee	Piedmont Bottomland Hardwood	Piedmont Bottomland Hardwood

* There are three existing unstable, torturous bends in UT1, which have increased the stream length. In the proposed design, we are creating a stable, meandering channel, which will decrease the length of UT1.

TABLE OF CONTENTS

TABLES

FIGURES

PLAN SHEETS

Plan Sheet 1. Title Sheet
Plan Sheet 1A. General Notes and Project Legend
Plan Sheet 2. Details: Stabilization
Plan Sheet 2A. Details: Typical XS
Plan Sheet 4. Plan and Profile
Plan Sheet 5. Plan and Profile
Plan Sheet 6. Plan and Profile
Plan Sheet 10. Planting Plan

APPENDICES

Appendix A. Existing Site Photographs/ Recorded Easement Plat
Appendix B. NCDWQ Stream Classification Forms
Appendix C. Existing Conditions
Appendix D Reference Reach Data
Appendix E. USACE Wetland Determination Forms and Wetland Map

1.0 PROJECT SITE IDENTIFICATION AND LOCATION

The North Carolina Ecosystem Enhancement Program (NCEEP) intends to utilize the Little Troublesome Creek and associated tributaries and wetlands for a stream and wetland mitigation project. The proposed project includes the restoration of approximately 2,188 linear feet of LTC and an unnamed tributary (UT1). In addition, there are approximately 4.5 acres and 1.9 acres of wetland preservation and enhancement and 2,754 linear feet of stream preservation (UT2) within the restoration site (Figure 1. Little Troublesome Creek Study Area). This restoration plan presents information describing the existing site and watershed conditions, the restoration design criteria, the design summary, and the proposed monitoring protocol.

1.1 Directions to Project Site

The project site is located on two private properties owned by Neal Hall with approximately 20 acres on the west side of LTC and Jimmie Mitchell with approximately 10.2 acres on the east side of LTC. NCEEP has purchased the easement restrictions on the land necessary to undertake the project. The mitigation will be protected by a conservation easement, in perpetuity. The project site is located along LTC immediately upstream of Mizpah Church Road, and is approximately 5 miles southeast of the Town of Reidsville.

From Raleigh:
Proceed west on Interstate-40 (I-40). Continue on I-40 West/ I-85 South after they merge near Hillsborough. Take Exit 138 and turn right on NC-61. Proceed to Gibsonville and follow NC-61; make a right on NC-150. In the town of Williamsburg, make a left on NC-87 and proceed approximately 0.5 mile; make a left on Mizpah Church Road and proceed 0.5 mile to the project site. The LTC Site begins upstream of Mizpah Church Road (Figure 2. Little Troublesome Creek Vicinity Area).

1.2 USGS Hydrologic Unit Code and NCDWQ River Basin Designations

LTC is the primary hydrologic feature in the watershed. It is a third order stream that flows southeast on the project site for approximately 1,329 linear feet. UT1 is a first order stream that flows generally east to west for approximately 873 linear feet before joining LTC at the downstream end of the project reach at Mizpah Church Road.

The project site is situated within the Upper Cape Fear 02 watershed-cataloging unit (8-digit HUC: 03030002) and the 03030002010030 Local Watershed Unit (14-digit HUC). The site resides in the NCDWQ Subbasin 03-06-01. The NCEEP identifies this HUC as a Targeted Local Watershed. Targeted watersheds exhibit the need and opportunity for stream and riparian buffer restoration. The restoration would benefit water quality, aquatic habitat and other vital watershed functions (NCDENR, 2001).

2.0 WATERSHED CHARACTERIZATION

The LTC watershed and project site are both relatively narrow with a wide floodplain and small tributaries flowing off uplands (NCDENR, November 2002). The project site is located within the Northern Inner Piedmont Ecoregion of the Piedmont physiographic province. The watershed topography can be characterized as rolling hills with elevations ranging from 650 feet above mean sea level (AMSL) to 725 feet AMSL.

Little Troublesome Creek Watershed comprises the headwaters of the Haw River and further downstream the headwaters of the Cape Fear River basin. The watershed is characterized by sandy, erodible soils.

2.1 Drainage Area

The project watershed containing the study area, as seen in Figure 3 (Project Watershed), drains approximately 12.09 square miles (7,741 acres). The project site is located in the southern corner of the watershed. LTC is a headwater stream for the Haw River, which is located approximately 1 mile downstream of the project site. The project watershed is located to the east and west of NC-87 and the entire watershed is located in Rockingham County. Approximately 52% of the LTC drainage area is located within Reidsville, which coincides with approximately 50% of Reidsville's population in the drainage area (NCDENR, November 2002).

2.2 Surface Water Classification

The NCDWQ assigns surface waters a classification in order to help protect, maintain, and preserve water quality. The section of LTC associated with the project is designated as Class C and Nutrient Sensitive Waters (NSW) (NCDENR, 11/08/06).

- **Class C Waters** in North Carolina are protected for secondary recreation, fishing, wildlife, fish and aquatic life propagation and survival, agriculture, and other uses suitable for Class C. 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 or types of discharges (NCDENR, 2005).
- **Nutrient Sensitive Waters (NSW)** is a supplemental classification intended for waters needing additional nutrient management due to their being subject to excessive growth of microscopic or macroscopic vegetation. In general, management strategies for point and non-point source pollution control require control of nutrients (nitrogen and/or phosphorus usually) such that excessive growths of vegetation are reduced or prevented and there is no increase in nutrients over target levels. Management strategies are site-specific (NCDENR, 2005).

2.2.1 Water Quality

Section 303(d) of the Clean Water Act is a requirement for states to recognize waters not meeting current standards by listing them as impaired and/or by support rating. These ratings refer to whether the uses of water such as water supply, aquatic life protection and recreation are being met. LTC was listed as impaired for aquatic life. It is listed as supporting for recreation based on the 2005 status. Impervious runoff and human induced activities contributed to the low ratings of LTC. In 2001, the NCEEP developed a Local Watershed Planning initiative to protect and preserve the streams, wetlands and buffers within the Little Troublesome watershed (NCDENR, October 2005).

2.2.2 Point Source Discharge

Point source discharges in North Carolina are regulated under the National Pollutant Discharge Elimination System (NPDES). Any discharge to a water body is required to have a permit. A review of point source dischargers permitted through the NPDES identified one minor point source discharger within the project study area and two additional minor point source dischargers downstream of the project site (NCDENR, October 2005). All three minor point source dischargers are down gradient and should have no adverse effects on the project site. One major point source discharger is also located downstream of the project site at the Haw River. The permit was issued to the Reidsville Waste Water Treatment Plant in October 2005.

2.3 Geology and Soils

Local geology consists of biotite gneiss, schist, and metamorphosed intrusive rocks of the Milton Belt. (NCGS, 1985). The geology of the Milton Belt is "characterized by sandy, erodible soils formed in material weathered from acid, igneous, and metamorphic rock" (NCWRP, October 2002).

The project watershed is located within the Piedmont physiographic province and is part of the Northern Inner Piedmont Ecoregion. This hilly ecoregion has higher elevations and a more rugged topography than any other Piedmont area. (Ecoregions of North Carolina and South Carolina. Griffith, G.E., et al.).

The Rockingham County Soil Survey classifies the project area soils as Chewacla (Ck), Pacolet sandy clay loam (PcD2) and Cecil Sandy Clay Loam (CdB2). The Chewacla soils consist of very deep, moderately permeable, somewhat poorly drained soils on floodplains along bottoms, creeks, and rivers. The soil is produced from recent alluvium washed from soils formed in residuum from schist, gneiss, granite, phyllite, and other metamorphic and igneous rocks. They occur on nearly level floodplains along streams that drain from the mountains and the Piedmont. Also included with Chewacla soils are small areas of Wehadkee soils on slightly concave slopes at the contact between the floodplains and the uplands. The Pacolet sandy clay loam soils are well drained and located on long, narrow slopes. Permeability is moderate, and available water capacity is low or moderate. The Cecil Sandy Clay Loam consists of very deep, well drained moderately permeable soils on ridges and side slopes of the Piedmont uplands (USDA, 1992).

2.4 Historical Land Use and Development Trends

2.4.1 Historical Resources

Historical aerial photographs were obtained from the Rockingham County Natural Resources Conservation Service (NRCS) office in order to further access existing site conditions. The intent of the review was to understand the chronology of land disturbance, aid in the evaluation of the site, and develop an appropriate restoration strategy. Aerial photographs of the site were obtained from 1959, 1966, 1974, and 1988 (Figure 4. Historical Aerial Photographs). A current aerial photograph from the Rockingham County GIS was obtained for 2004.

In 1959 and 1966, the pond adjacent to the west of the project site is already in place. The open field to the west of LTC is visible. The pasture fields to the east of the project boundary also exist. LTC is visible and appears to resemble current conditions. Portions of UT1 and UT2 are also visible.

In 1974 and 1988, the subject property remains unchanged with the exception of a new residence to the west of the project boundary.

In 2004, LTC and adjacent areas appear to resemble current conditions; no significant differences are discernable at the scale and quality of the photo. Portions of UT2 appear to be a braided channel, while UT1 is not visible due to extensive forest cover.

Currently, the LTC stream channel appears to follow the pattern observable today. No changes in either the stream valley or stream channel were observed in the historical aerial photographs within the project area. Therefore, any alterations to the stream channel occurred prior to 1959. Currently, portions of UT2 exists as a braided channel, therefore it appears to have formed a braided channel since 1959 according to the aerial photography.

2.4.2 Land Use and Development Potential

The land cover evaluation indicates that the project watershed consists of: forest/wetland (49%), agriculture (21%), and developed or disturbed land (30%). There is approximately (21%) of impervious cover, primarily in the city limits of Reidsville (NCDENR, August 2004). The northern portion of the watershed encompasses the Town of Reidsville where residential, commercial, and industrial uses dominate (NCDENR, November 2002). The southern portion of the watershed is rural with minimal development and significant agricultural and residential uses. The project watershed is located approximately six (6) miles downstream from the Town of Reidsville. The area has been subjected to urban and suburban development and the watershed continues to experience moderate development pressure.

The primary land use on the subject property is forest and undeveloped land. LTC enters the property at the northeastern boundary and is centrally located on the subject property, while UT1 begins at the southeastern boundary

2.5 Endangered/Threatened Species

KCI conducted an informal file review at the North Carolina Natural Heritage Program's (NCNHP) office in order to help identify the potential for the presence of rare, threatened, or endangered species for Rockingham County (Williamsburg/Reidsville Quads).

To further evaluate the presence of threatened and endangered species on the subject property and the potential that the proposed project would impact them, KCI requested a formal review by the NCNHP. The formal review by the NCNHP stated that the site "has a record of the State Significantly Rare Carolina ladle crayfish (*Cambarus davidi*) from LTC at SR 2600". NCNHP concluded that "although stream restoration will likely be beneficial to the species in the long term, there could be impacts to it and other aquatic animals during the construction phase, and thus it is very important that proper sedimentation controls are in place to avoid impacts to the creek". Also, roughly a mile downstream is a series of U.S. Fish and Wildlife Service easements. The county significant Williamsburg Alluvial Forest also lies in the area just south of the confluence of LTC with the Haw River. These occurrences will not be affected by the proposed restoration project.

2.6 Cultural Resources

To evaluate the presence of significant cultural resources on the subject property and the potential that the proposed project would impact them, KCI requested a formal review by the North Carolina Department of Cultural Resources. The formal review by the State Historic Preservation Office (SHPO) is "aware of no historic resources that would be affected by the project." The formal review by the State Archeology Office also identified no potential sites on or around the subject property.

2.7 Potential Constraints

The presence of conditions or characteristics that have the potential to hinder restoration activities on the project site were evaluated. Existing information regarding project site constraints was acquired and reviewed. In addition, any site conditions that have the potential to restrict the restoration design and implementation were documented during the field investigation.

2.7.1 Property Ownership and Boundary

The project site is located on two private properties owned by Neal Hall with approximately 20 acres on the west side of LTC and Jimmie Mitchell with approximately 10.2 acres on the east side of LTC.

(Appendix A). NCEEP has purchased the easement restrictions on the land necessary to undertake the project. The mitigation will be protected by a conservation easement, in perpetuity.

2.7.2 Site Access

The project site can be accessed at the southern property boundary located on Mizpah Church Road.

2.7.3 Utilities

There is an existing utility line that runs parallel to UT1 along Mizpah Church Road; however this utility line is not included in the easement and therefore is not a part of the project site.

2.7.4 FEMA/Hydrologic Trespass

The project site is located within the 100-year floodplain. In addition, LTC is a designated floodway (Zone AE). As such, any modifications to the stream that would result in the increase of the 100-year flood elevation or cause a change in the floodway would require a Conditional Letter of Map Revision (CLOMR) and/or a Letter of Map Revision (LOMR). It is the intent of the restoration design to maintain the 100-year flood elevation and avoid any adverse alterations to the LTC floodplain/floodway. KCI will also contact the appropriate local floodplain administrator for the project site.

A conditional floodplain model was developed by updating the published hydraulic data with the detailed topographic survey used to prepare the construction drawings for the project site. The conditional model will be revised to reflect changes to the channel and floodplain as a result of the restoration (proposed model). A proposed hydrology and hydraulics (H&H) summary will be prepared and submitted as necessary indicating no anticipated impacts to the floodplain/floodway (No-Impact Certification).

The project site is contained entirely within the two private properties, Mr. Neal Hall and Mr. Jimmie Mitchell. The proposed restoration is not anticipated to produce hydrologic trespass conditions on any adjacent properties.

3.0 PROJECT SITE STREAMS (EXISTING CONDITIONS)

A site field assessment was conducted in September 2006 to document existing conditions and evaluate the stream restoration potential. Observations and collected data are summarized below, illustrated in Figure 5 (Existing Conditions Map), and documented in the site photographs (Appendix A). The site was revisited several times from September 2006 to February 2007 to take further measurements, to install stream gauges, and to collect hydrology data from the instruments (Figure 6. Project Site Hydrologic Features and Gauge Location Map).

3.1 General Site Description

The proposed project includes the restoration of approximately 2,188 linear feet of LTC and UT1. The LTC project reach begins at the northeastern property boundary at Station 10+00. The stream flows southeast for approximately 1,375 linear feet and the reach ends at Mizpah Church Road at approximate Station 23+75. The UT1 project reach begins downstream of a large steel culvert at Station 50+00. UT1 flows west parallel to Mizpah Church Road for approximately 813 linear feet before joining LTC at approximately Station 58+14.

LTC exhibits characteristics of an unstable stream channel. Watershed growth, residential and commercial development and past channelization in the watershed have led to increased impervious area and runoff. The concerns have resulted in erosion and heavy sedimentation in LTC. The channel can be

characterized as having poor streambed variability and habitat diversity as proven with an inconsistent profile throughout LTC.

Previous cattle access to the streams and nutrients inputs have resulted in eroding stream banks and degraded water quality. Currently the cattle have been removed from the stream which has improved water quality; however the channel is continuing to undergo change due to the large watershed.

The stream banks consist of highly erodible material consisting of silt/sand and the majority of the stream banks are vertical. LTC is currently in Class V of the channel evolution sequence. Bed degradation and aggradation are evident throughout the project reach (their presence depends on the local slopes and channel dimensions, along with the presence of sand depositing along the stream bed). A riparian buffer along the stream banks was observed with woody vegetation, but it is very narrow, approximately only one tree width on the west side of LTC. Much of the vegetation observed existed on the top of bank with very little vegetation coverage from the top of bank to the bottom of bank (NCEEP, May 2004). Many of the trees along the stream banks have exposed roots and are falling into the channel due to the stream widening and active bank erosion. The widening of the channel poses the immediate threat to short term stability of the channel.

Research shows that portions of LTC, both upstream and downstream of the project site, have been historically channelized during the 1900's due to agricultural practices. Channelization involved straightening, deepening, and widening of the channel (NCDENR, November 2002). The channelization of LTC has increased heavy sedimentation due to the downcutting and widening of the stream (NCWRP, October 2002). The straightening, deepening and widening of the channel adversely affects habitat quality and diversity as demonstrated by the existing conditions in LTC.

UT1 exhibits different symptoms than the main stem, mostly due to the smaller drainage area (approximately 0.10-square mile). The streambed has defined riffles and pools; however the channel is deeply incised with active bank erosion and widening of the channel. Many of the trees along the stream banks are falling into the channel as a result of undercutting banks. The major concern for UT1 is the loss of its hyporheic zone. The channel has degraded extensively to the point that the roots on the stream banks are exposed and the streambed has degraded several feet beneath the tree roots.

UT2 enters the property at the northwestern corner. The stream flows parallel to LTC for approximately 2,754 linear feet before the confluence. NCDWQ Stream Classification Forms were completed twice during September and December 2006 (Appendix B). Refer to Figure 6 for locations. During the September review, the site exhibited typical late summer drought conditions. The area was primarily dry and portions of the stream were classified as ephemeral due to hydrology being absent or weak. The secondary biology indicators were also absent.

During the December stream classification review, benthic macroinvertebrate sampling was performed on portions of UT2. During the sampling, the preservation area was completely saturated and UT2 showed signs of a distinct stream channel. The macroinvertebrate collection technique was a visual assessment and a sweep-net sampling method. A list of macroinvertebrates collected at the sample locations are provided in Appendix B. As a result of hydrology indicators and macroinvertebrates being present during normal hydrologic conditions, UT2 is being classified as an intermittent stream as part of the project site.

3.2 Channel Classification

The entire project reach for LTC is classified as a modified "E4" stream type. The stream begins as a moderately entrenched channel (2.0) with a low width-to-depth ratio (6.2). The start of the project is fairly wide with a bankfull width of 29 feet. Further downstream, the channel narrows and has a lower

width-to-depth ratio (4.2). Low width-to-depth ratios and high entrenchment ratios are typical of "E" type stable streams; however, channelization and other factors mentioned in Section 3.1 have caused LTC to become an unstable "E" channel. The stream is lacking a distinct pattern form, channel dimension, an inconsistent profile, and has vertical banks. The stream is actively widening and eroding.

The entire project reach for UT1 is classified as a "G4" stream type. The stream begins as a deeply entrenched channel (1.3) with a low width-to-depth ratio (5.1) and a high bank height ratio (5.3). Proceeding downstream, the channel becomes more entrenched (1.1) with a lower width-to-depth ratio of (4.0) and a higher bank height ratio (6.5). The channel remains deeply entrenched and severely incised until it joins LTC.

3.3 Channel Morphology (Pattern, Dimension, and Profile)

A Rosgen Level III assessment was conducted to gather existing stream dimension, pattern, and profile data and determine the degree of channel instability. Channel cross-sections and bed materials were surveyed at four representative locations along the LTC and a total of five locations along UT1. Data developed from these surveys are presented with a channel morphology summary in Appendix C.

3.4 Channel Stability Assessment

A qualitative stability assessment was performed to estimate the level of departure and determine the likely causes of the channel disturbance. This assessment facilitates the decision-making process with respect to restoration alternatives and establishing goals for successful restoration. Bank Erodibility Hazard Rating (BEHI) forms were prepared for reaches along LTC and UT1 (Appendix C).

LTC exhibits characteristics of an unstable stream channel; most notably the channel shows evidence of extensive erosion and watershed sedimentation. Further, the widening of the channel and bank erosion has exacerbated trees falling into the channel and subsequently eliminated root strength and cover protection. One BEHI rating form was performed for the entire LTC reach due to similar BEHI characteristics throughout the project reach. The LTC reach exhibited a moderate BEHI rating of 20.9.

UT1 is also an unstable stream channel. The channel has evidence of bed degradation, undercutting banks, and severe bank erosion. Based on the field measurements, further degradation and widening of the channel can be expected in this reach. One BEHI rating form was performed for the entire UT1 reach due to similar BEHI characteristics throughout. The UT1 reach exhibited an extreme BEHI rating of 49.8 with bank height ratios in the project reach consistently exceeding 5.0.

3.5 Bankfull Verification

The standard methodology used in natural channel design is based on the ability to select the appropriate bankfull discharge and generate the corresponding bankfull hydraulic geometry from a stable reference system(s). The determination of bankfull stage is the most critical component of the natural channel design process.

Bankfull can be defined as "the stage at which channel maintenance is most effective, that is, the discharge at which moving sediment, forming or removing bars, forming or changing bends and meanders, and generally doing work that results in the average morphologic characteristics of the channels," (Dunne and Leopold, 1978). Several characteristics that commonly indicate the bankfull stage include: incipient point of flooding, breaks in slope, changes in vegetation, highest depositional features (i.e. point bars), and highest scour line. A visual identification of bankfull stage in a degraded system, can be difficult to determine, therefore was not used to determine bankfull at the project site. Verification

measures were undertaken to facilitate the correct identification of the bankfull stage on the LTC and UT1.

The three methods used to verify bankfull stage at the project site were regional hydraulic geometry relationships (regional curves), a pressure transducer / data logger combination gauge that monitored actual water level in LTC throughout the study period and a hydrology/hydraulics model to evaluate flow and sediment transport.

Regional curves are typically utilized in ungauged areas to approximate bankfull discharge, area, width, and depth as a function of drainage area based on interrelated variables from other similar streams in the same hydrophysiographic province. Regional curves and corresponding equations from "Bankfull Hydraulic Geometry Relationships for North Carolina Streams" (Harman et al., 1999) were used to approximate bankfull in the project reach. Based on the regional curves, a bankfull discharge and cross-sectional area of 538 ft^3/s and 117 ft^2 would be anticipated.

Stream stage data (water levels) were collected from LTC. Data were collected for nine months (September through May) and water levels were correlated to an estimated discharge using a rating curve generated for the gauged section. During the gauging period, three significant storm events were recorded. The maximum discharge event recorded was 625 ft^3/s for a stage event of 6.80 feet on April 15th. The second largest event recorded was 557 ft^3/s for a stage event of 6.39 feet on February 14th. The third event recorded was 420 ft^3/s for a stage event of 5.49 feet on November 22nd. Continuous hydrographs were developed for LTC and are provided in Appendix C.

Stream stage data (water levels) were also collected from UT1. Data were collected for nine months (September through May) and the water levels are provided in Appendix C.

Information from the regional curves and from the hydrologic monitoring was used in conjunction with the Hydrologic Engineering Center River Analysis System (HEC-RAS) software to refine the bankfull determinations. The model allows for analysis of one-dimensional (1-D) steady state flow by solving for the energy equation. The approximate discharges calculated using the Manning open channel flow equation were run through the modeled reaches. The outputs corresponded well with the regional curve and to the subsequent calculations of the existing morphological variables. A summary data output developed from the model is provided below (Table 2).

Table 2. HEC-RAS Hydrologic Variables

Units	Station	Profile	Q	Bed Elev.	WS Elev.	Elev.	Slope	Velocity	Area	Width	F.N.
			cfs	ft AMSL	ft AMSL	ft AMSL	ft/ft	fps	sf	ft	
XS1	10+50	BKF	550.0	646.99	655.02	655.09	0.0003	2.14	647.76	559.53	0.15
XS2	12+50	BKF	550.0	647.17	654.89	654.98	0.0008	3.04	735.36	618.45	0.22
XS3	14+50	BKF	550.0	646.94	654.77	654.84	0.0004	2.39	565.50	572.01	0.17
XS4	17+00	BKF	550.0	646.79	654.66	654.75	0.0007	2.74	462.77	298.56	0.21
XS5	18+50	BKF	550.0	648.40	654.25	654.45	0.002	4.09	377.03	359.43	0.34
*XS6	20+50	BKF	550.0	648.02	652.08	653.39	0.019	9.19	59.83	22.84	1.00
XS7	22+55	BKF	550.0	644.62	650.40	650.54	0.0007	3.04	190.28	41.64	0.23

* XS6 is a narrow cross section with a length of 19 feet from top of bank to top of bank, compared to the other cross sections of 30-35 feet.

3.6 Vegetation

On August 23, 2006, Steven Stokes and April Helms from KCI conducted a field investigation of the project area (Figure 7. Existing Natural Communities). Five existing natural communities were classified in accordance with a "Classification of the Natural Communities of North Carolina, Third Approximation" (Schafale and Weakley, 1990). The field investigation focused on flora, fauna and overall habitat structure. The flora, including dominant species per stratum, were identified and recorded.

The first community was classified as Piedmont Bottomland Forest. This community is located in the western portion of the project in the preservation area. The dominant species observed in this community are as follows: Green ash *(Fraxinus pennsylvanica),* False nettle (*Boehmeria cylindrical*), Sweet gum *(Liquidambar styraciflua),* Pawpaw *(Asimina triloba),* Red maple (*Acer rubrum*), River birch *(Betula nigra), Polygamum sp.,* Silky dogwood (*Cornus amomum*), Sycamore (*Platanus occidentalis*), Swamp chestnut oak *(Quercus michauxii),* American elm *(Ulmus americana)*, Eastern hemlock (*Tsuga canadensis*), Black willow (*Salix nigra*), Common persimmon *(Diospyros virginiana L.*), Possumhaw (*Viburnum nudum*), Blackhaw, (*Viburnum prunifolium*), and Musclewood (*Carpinus caroliniana).* The invasive species included Vietnamese stilt grass *(Microstigium viminium)*, Multiflora rose *(Rosa multiflora),* and Japanese honeysuckle *(Lonicera japonica)*

The second community was classified as Piedmont Alluvial Forest. This community is located to the west of LTC and along the banks of UT1. The dominant species observed in the community are as follows: Green ash, River birch*,* False nettle, Possumhaw, Blackhaw, and Carolina horse-nettle (*Solanum carolinense*). The invasive species included Multiflora rose and Japanese honeysuckle.

The third community was classified as Piedmont Levee Forest. This community is located along the banks of LTC. The dominant species observed along the levee are as follows: Willow oak (*Quercus phellos*), Swamp chestnut oak, and White oak (*Quercus alba*).

The fourth community was classified as a grass community/pasture for cow grazing. This community is located along the northeastern portion of the project area. The dominant species observed in this community are as follows: Spotted jewel-weed (*Impatiens capensis*), Duck potato (*Sagittaria lancifolia*), *Polygonum sp.*, Green ash, Rush *(Juncus sp.*), Rice cutgrass (*Leersia oryzoides*), Woolgrass (*Scirpus cyperinus)*, Water mint (*Mentha aquatica*), Ironweed (*Vernonia altissima*), Cardinal flower (*Lobelia cardinalis*), Goldenrod (*Solidago sp.*), Black willow (*Salix nigra*), Sycamore, Common persimmon, deciduous Holly-possumhaw (*Ilex decidua),* and Eastern red cedar (*Juniperous virginiana*). The invasive species include Vietnamese stilt grass, Multiflora rose, and Tree-of-heaven (*Ailanthus altissima).*

The fifth community was classified as Low Elevation Seep. This community is located in the southeastern portion of the site and located east of LTC. The dominant species observed in this community are as follows: False nettle, Arrow arum (*Peltandra virginica*), Spotted jewel-weed, Green ash, Red maple*,* Black gum (*Nyssa sylvatica*), Virginia creeper (*Parthenocissus quinquefolia*), Poison ivy (*Toxicodendron radicans*), flowering dogwood (*Cornus florida*), deciduous Holly-possumhaw*,* and Sweet gum. The invasive species include Vietnamese stilt grass and Japanese honeysuckle

The investigation also considered the fauna observed throughout the project area. Techniques used to identify the presence of species included direct visual/audible observations and indirect observations such as the presence of tracks, cavities, nests, fecal material, and carcasses. During the field investigation, a box turtle was observed and a turkey feather was found.

4.0 REFERENCE STREAMS

A reference reach is a channel with a stable dimension, pattern, and profile within a particular valley morphology. The reference reach is used to develop dimensionless morphological ratios (based on bankfull stage) that can be extrapolated to disturbed/unstable streams to restore a stream of the same type and disposition as the reference stream (Rosgen, 1998).

4.1 Collins Creek Reference Site

A section of Collins Creek, located west of Chapel Hill, was identified and surveyed as a reference reach for the restoration of the project site. Collins Creek flows southwest through the southern portion of Orange County towards its confluence with the Haw River in Chatham County [Figure 8. Reference Site (Collins Creek) Vicinity Map]. It drains approximately 1,075 acres of low-density residential and forested lands [Figure 9. Reference Site (Collins Creek) Watershed Map]. This selection was based on: location in the same hydrophysiographic province, similar valley morphology, and similar sediment regime to the project stream.

Approximately 300 linear feet of Collins Creek were surveyed in December 2006 (Appendix D contains data and photographs from the field assessment). This reach of Collins Creek was classified as an "E4" channel type. The dimensionless hydraulic geometry relationships were developed from stable channel dimensions to facilitate the design of the proposed channel cross-sections for the LTC restoration reach.

4.2 UT to Wilkinson Reference Site

A section of Unnamed Tributary to Wilkinson Creek, located southwest of Chapel Hill, was identified and surveyed as a reference reach for the restoration of UT1. UT to Wilkinson Creek flows west through Chatham County towards its confluence with Wilkinson Creek [Figure 10. Reference Site (UT to Wilkinson) Vicinity Map]. It drains approximately 105 acres of low-density residential, agriculture, and forested lands [Figure 11. Reference Site (UT to Wilkinson) Watershed Map]. This selection was based on: location in the same hydrophysiographic province, similar valley morphology, and similar sediment regime to the project site

Approximately 205 linear feet of the UT to Wilkinson Creek were surveyed in May 2006 (Appendix D contains data and photographs from the field assessment). This reach of UT to Wilkinson Creek was classified as a "B4c" channel type. The dimensionless hydraulic geometry relationships were developed from stable channel dimensions to facilitate the design of the proposed channel cross-sections for UT1 restoration reach.

4.3 Watershed Characterization

4.3.1 Collins Creek Reference Site

Collins Creek is situated within the northeastern portion of the Piedmont physiographic province, which is typified by rolling topography with broad ridges, sharply indented stream valleys, and narrow, low-gradient floodplains. The Collins Creek watershed (USGS 14-digit Hydrologic Unit 03030002050060) is located within sub-basin 03-06-04 of the Cape Fear River Basin.

The portion of Collins Creek evaluated as the reference reach is located in the southwestern portion of Orange County, west of Chapel Hill. The headwaters of Collins Creek form to the southwest of Dodsons Crossroads and flows southwest to Orange Grove Road. The topographic relief within the reference reach watershed ranged from approximately 600 feet AMSL at the upstream limits to 530 feet AMSL at the downstream limits.

4.3.2 UT to Wilkinson Creek Reference Site

UT to Wilkinson is situated within the southeastern portion of the Piedmont physiographic province. The UT to Wilkinson Creek watershed (USGS 14-digit Hydrologic Unit 03030002050100) is located within sub-basin 03-06-04 of the Cape Fear River Basin.

The portion of the UT to Wilkinson Creek evaluated as the reference reach is located in the northern portion of Chatham County, southwest of Chapel Hill. Manns Chapel Road bounds the watershed to the east. The topographic relief within the project reach ranged from approximately 468 feet above mean sea level (AMSL) at the upstream limits to 445 feet AMSL at the downstream limits.

4.4 Vegetation

The Williamsburg Alluvial Forest community is located approximately one mile downstream of the project site and will be used for the stream reference vegetation community. The North Carolina Natural Heritage Program (NCNHP) listed the Williamsburg Alluvial Forest as a natural community located in the Williamsburg Quad. According to a site survey report documented from 05/10/96, there are two natural communities existing on this site, Piedmont Alluvial Forest (approximately 90 acres) and Mesic Mixed Hardwood Forest (approximately 60 acres).

The canopy species in the Piedmont Alluvial Forest include: Box elder (*Acer negundo*), Red maple (*Acer rubrum),* Slippery elm (*Ulmus rubra*), River birch (*Betula nigra*), and Sycamore (*Platanus occidentalis*). Species that dominated the understory were Musclewood (*Carpinus caroliniana)*, Winged elm (*Ulmus alata*), Black haw (*Viburnum prunifolium*), and Sweet bay (*Magnolia virginiana*).

The canopy species in the Mesic Mixed Hardwood Forest include: American beech (*Fagus grandifolia*) (beech), oaks (*Quercus* spp.), and Tulip poplar (*Liriodendron tulipifera*). Species that dominated the understory were Musclewood (*Carpinus caroliniana)*, sourwood (*Oxydendrum arboretum*), Hazel-nut (*Corylus Americana*), Deerberry (*Vaccinium stamineum*), and Mapleleaf arrowwood (*Viburnium acerifolium*).

5.0 PROJECT SITE WETLANDS (EXISTING CONDITIONS)

The project site wetlands exist on the floodplains of LTC. The wetland preservation is located to the west of LTC and the two wetland enhancement pockets are to the east of LTC. The land is currently forested with some pasture located in the northeastern portion of the project site. (Refer to Appendix A for existing site photographs).

5.1 Jurisdictional Wetlands

Existing wetlands were delineated in August-September 2006 using the methods outlined by the US Army Corps of Engineers (USACE, 1987). Wetland preservation and two enhancement wetland pockets were mapped in the project area (Figure 12. Project Site Wetland Delineation Map). There are approximately 4.5 acres of wetland preservation and 1.9 acres of wetland enhancement in the two identified pockets. The wetland preservation area is located to the west of LTC. Enhancement wetland #1 consists of approximately 1.17 acres and is located northeast of LTC. Enhancement wetland #2 consists of approximately 0.74 acres and is located to the southeast of LTC. A USACE representative and KCI's soil scientist visited the project site October 10, 2006 for a preliminary jurisdictional determination review. The wetlands at the project site are currently under review by the USACE for the jurisdictional determination (Appendix E).

Two drainage features exist in the wetland enhancement pockets. Drainage 1 connects to the left bank of LTC at the bottom of enhancement wetland #1, while drainage 2 connects to the left bank of LTC further downstream at the bottom of enhancement wetland #2 (Figure 5. Existing Conditions Map). Both features drain the hydrology of the wetlands directly into LTC.

5.2 Hydrological Characterization

Preservation Wetland
There are multiple braided channels that extend the length of the project through the forested preservation wetland. These braided channels transfer hydrology from its source throughout the wetland preservation area. An adjacent pond also provides hydrology to the wetland via a drainage feature from the outfall. A berm is located along the southwestern property boundary to intercept runoff along the toe of the slope, which prevents water from extending into the preservation wetland.

Enhancement Wetland #1
This wetland receives groundwater seepage from the gently, sloping hillside located to the east of the wetland that extends to NC-87. Also, occasional overbank flooding access to the floodplain contributes groundwater to the wetland area.

Enhancement Wetland #2
There is a small spring providing groundwater located off the project property line that connects to the wetland at the southeastern portion. Also, the wetland area is located in a depression which holds groundwater for longer periods. The occasional overbank flooding may also contribute hydrology to the wetland.

5.3 Soil Characterization

A soils investigation was conducted by a certified soil scientist from KCI to determine the extent and distribution of the hydric soils on the site and to classify the predominate soils to the soil series level. The investigation consisted of delineating the hydric soil boundaries with pink flagging in accordance with the US Army Corps of Engineers (1987). Areas that were identified as possible hydric soil mapping units were surveyed at a higher intensity until the edge of the mapping unit was identified. The boundary of the hydric and non-hydric soil mapping units were then followed by continual sampling and observations as the boundary line was identified and delineated. In those areas where the boundary was found to be a broad gradient rather than a distinct break, microtopography, landscape position, soil textural changes, redoximorphic features, and depleted matrices were additionally considered to identify the extent of the hydric soils.

5.3.1 Taxonomic Classification

According to the NRCS, Rockingham County Soil Survey, Chewacla (Ck) is the dominant soil type in the project area. However, after detailed field investigation, Steven Stokes, LSS mapped the dominant soil in the wetland preservation area as Wehadkee (We) (fine-loamy, mixed, active, nonacid, thermic Fluvaquentic Endoaquepts). The wetland enhancement area is mapped as Wehadkee and Wehadkee Variant with hydric inclusions of Chewacla.

The Wehadkee soils are very deep and very poorly drained and are found on nearly level floodplains along streams that drain from the mountains and the Piedmont. The Wehadkee soils commonly occur with Chewacla soils. They are more poorly drained, darker in color, and more intensely mottled than the Chewacla soils (USDA, SCS 1992).

5.3.2 Profile Description

The Rockingham County Soil Survey classifies the project area soils as Chewacla (Ck) and Pacolet sandy clay loam (PcD2) as described in Section 2.3 (Figure 13. Project Site NRCS Soil Survey Map).

5.4 Plant Community Characterization

The wetland community classification follows the existing project site communities described in more detail in Section 3.6. The wetland communities were classified in accordance with a "Classification of the Natural Communities of North Carolina, Third Approximation" (Schafale and Weakley, 1990).

Enhancement wetland #1 is classified as a grass community/pasture for cow grazing and is located in the northeastern portion of the of the project area. Enhancement wetland #2 is classified as a Low Elevation Seep and is located in the southeastern portion of the site. The preservation wetland community is classified as a Piedmont Bottomland Forest and is located in the western portion of the project.

6.0 REFERENCE WETLANDS

The reference wetland is the NCNHP listed Williamsburg Alluvial Forest located off NC150, approximately 1.3 miles south of Williamsburg. The community consists of an Alluvial floodplain located south of the Haw River. The location of the reference wetland is depicted in Figure 14. Reference Site Vegetative Communities Map.

6.1 Plant Community Characterization

The composition of plant species at the reference wetland is best described as a Piedmont Alluvial Forest (approximately 90 acres). This community is described in detail in Section 4.4 Vegetation.

7.0 PROJECT SITE RESTORATION PLAN

7.1 Restoration Project Goals and Objectives

LTC has received extensive sedimentation from new development in the watershed, eroding banks, and loss of stream habitat from past human disturbances. As a result, the ecological diversity and water quality value of the site have been adversely affected. Based on the existing and reference condition assessments, the restoration goals and objectives for the project site are as follows:

The restoration goals for this project are as follows:

- Restore a stable channel morphology that is capable of moving the flows and sediment provided by its watershed.
- Improve water quality for an NCDWQ stream, classified as a Class C and Nutrient Sensitive Waters (NSW).
- Reduce land and riparian vegetation loss resulting from lateral erosion and bed degradation.
- Enhance aquatic and terrestrial habitat.
- Improve the functions of existing wetlands.
- Preserve existing wetlands and forested buffers.

The objectives that must be accomplished to reach these goals are:

- Restore 2,188 linear feet of stable stream channel with the appropriate pattern, profile, and dimension that can support a gravel transport system.

- Restore a natural riparian buffer; reduce nutrient inputs and sediment from bank erosion into the stream.
- Restore the natural hyporheic zone in the project streams and re-establish the natural stream features.
- Enhance hydrology and vegetation by plugging ditches to increase groundwater and planting vegetation to increase species diversity.

Table 3. Mitigation Type and Extent

	Stream Restoration (lf)	**Stream Preservation (lf)**	**Wetland Enhancement (Acres)**	**Wetland Preservation (Acres)**
LTC Stream Restoration (Linear Feet)	1,375	0	0	0
UT1 Stream Restoration (Linear Feet)	813	0	0	0
UT2 Stream Preservation (Linear Feet)	0	2,754	0	0
Wetland Enhancement #1 (Acreage)	0	0	1.17	0
Wetland Enhancement #2 (Acreage)	0	0	0.74	0
Wetland Preservation (Acreage)	0	0	0	4.5
TOTAL	**2,188**	**2,754**	**1.9**	**4.5**

Functions that will be restored as a result of the mitigation include:

- Aquatic/Terrestrial Wildlife Habitat
- Water Quality
- Groundwater Recharge
- Nutrient Cycling
- Alluvial Forest and Wetland Enhancement Communities

7.1.1 Designed Channel Classification

Since the overall channel morphology for LTC is unstable, restoration is necessary to restore a stable channel dimension, pattern, and longitudinal profile. The restoration design of the project site is based on Priority Level II and III approaches, as described in "A Geomorphological Approach to Restoration of Incised Rivers," (Rosgen, 1997.) The design proposes constructing 1,375 linear feet of meandering "E4" channel and associated floodplain. The design for LTC begins upstream with approximately 175 linear feet of Level III. The design continues with approximately 1,020 linear feet of Level II and concludes at the downstream portion of LTC with approximately 180 linear feet of Level III restoration.

An ideal approach to restoring an unstable channel in a large watershed with highly erodible stream banks is the Priority Level II restoration option. The Level II restoration will establish a bankfull channel with a new floodplain, a channel bed approximately at its existing level, and the cross-section dimensions necessary to provide stable flow maintenance and sediment transport. The proposed stream will be moved offline to the west of LTC. The Level II restoration will design the new channel in virgin bank material and will also minimize the impact to the enhancement wetlands to the east side of LTC. For long-term stability, it is more effective and feasible to construct the channel offline with new material than to construct inside an existing unstable channel. Also, it is more difficult to restore the correct bed and profile due to asymmetrical bank erosion and bed instability in the existing channel.

The Level III approach will involve restoring the stream generally within the existing stream corridor/belt width through adjustments to the stream dimension and profile (this approach will be utilized in the most upstream portion of LTC on the project site).

The pattern data were developed from a summary of dimensionless ratios from similar "C" and "E" stream types in the North Carolina Piedmont. The middle value range for each pattern ratio was chosen, and then verified using the empirical relationships developed by (Williams, 1986). Refer to Table 4 and the attached plan sheet drawings.

The design also proposes constructing 813 linear feet of restored tributary channel (UT1) using a Priority Level III approach. This strategy will involve restoring "B4c" type stream. The UT to Wilkinson Reference Site provided the morphological criteria and hydraulic geometry relationships for the proposed stream dimension, pattern, and profile (Table 4).

In-stream structures, including offset rock cross vanes, riffle grade controls, and rock sills, will be used to stabilize the restored channels (Refer to Plan Sheet 2). These structures are designed to reduce bank erosion, influence secondary circulation in the near-bank region of stream bends, and provide grade control. The structures will also promote efficient sediment transport and produce/enhance in-stream habitat. Riffle areas will also be enhanced with graded gravel material to mimic existing stable riffle features. Coir fiber matting, seeding, and mulching will be used to provide temporary stabilization on the newly graded stream banks and live stakes will be planted to provide long term rooting strength.

7.1.2 Target Wetland and Buffer Communities

The design vegetative community for enhancement wetland #1 will be planted with species similar to a Piedmont Alluvial Forest as described by Schafale and Weakley (1990). Enhancement wetland #2 will remain consistent with its existing community of Low Elevation Seep. The wetland preservation consists of a Piedmont Bottomland Hardwood community. These community types fit into the natural topography of the project site. Refer to Section 3.6 for the dominant species in each community.

The target buffer communities consist of Piedmont Levee Forest and Piedmont Alluvial Forest. The Levee Forest will be located on the left bank of LTC and UT1. The Alluvial Forest is located on the right bank of LTC and UT1.

Table 4. Morphological Design Criteria

Variables		Project Site Existing Channel		Reference Reach		Restored Reach	
		Little Troublesome	UT1	Collins Creek	UT Wilkinson	Little Troublesome	UT1
Rosgen Stream Type		E4	G4c	E4	B4c	E4/C4	B4c
Drainage Area (mi^2)		12.09	0.10	1.68	0.15	12.09	0.10
Bankfull Width (W_{bkf}) (ft)		21.3-29.0	4.0-5.2	11.9-20.1	7.7-10.8	31.6	6.3
Bankfull Mean Depth (d_{bkf}) (ft)		4.7-5.0	0.7-0.9	1.6-2.7	0.7-0.9	3.7	0.6
Bankfull Cross Sectional area (A_{bkf}) (ft^2)		106-135.8	3.6-4.3	32.4-33.4	6.1-8.8	118	3.5
Width/depth Ratio (W_{bkf}/d_{bkf})		4.2-6.2	4.4-7.2	4.4-12.1	8.5-11.4	8.5	11.4
Maximum Depth (d_{mbkf}) (ft)		6.2-6.7	1.0-1.1	3.3-4.2	1.1-1.4	4.9	1.0
Width of flood prone area (W_{fpa}) (ft)		60-(>65)	6.0-8.0	>60	13-16	>60	11.7
Entrenchment Ratio (ER)		2.0-3.0	1.2-2.0	2.0-3.0	1.6-2.1	>3.0	1.9
Sinuosity (stream length/valley length) (K)		1.06	1.02	-	1.2	1.1	1.1
Dimension	Pool Depth (ft)	4.4-6.9	0.7-1.3	2.4	0.8-0.9	3.3-5.4	0.5-0.7
	Riffle Depth (ft)	4.7-5.0	0.7-0.9	1.7-2.7	0.7-0.9	3.7	0.6
	Pool Width (ft)	24.3	5.1-7.7	24.3	10.0-10.8	37.9-63.2	5.7-8.8
	Riffle Width (ft)	21.3-29.0	4.0-5.2	11.9-20.1	7.7-10.8	31.6	6.3
	Pool XS Area (sf)	108	5.5-5.8	57.9	8.6-8.8	118-210	3.5-4.9
	Riffle XS Area (sf)	106-135.8	3.6-4.3	32.4-33.4	6.1-8.8	118	3.5
	Pool depth/mean riffle depth	0.9-1.5	0.8-1.9	0.9-1.4	0.9-1.3	0.9-1.4	0.9-1.3
	Pool width/riffle width	0.8-1.1	1.0-1.9	1.2-2.0	0.9-1.4	0.9-1.4	0.9-1.4
	Pool area/riffle area	0.8-1.0	1.3-1.6	1.0-1.8	1.0-1.4	1.0-1.4	1.0-1.4
	Max pool depth/d_{bkf}	0-0	1.3-2.7	1.5-2.5	2.4 - 3.1	2.4 - 3.1	2.4-3.1
	Low bank height/max bankfull depth	1.0-1.2	5.3-6.5	1.0-1.1	-	1.0	1.0
	Mean Bankfull Velocity (V) (fps)	4.1-5.3	4.3-4.7	3.4-4.4	5.1-5.8	4.32	3.72
	Bankfull Discharge (Q) (cfs)	553-564.3	16.0-20.4	115-150	31-49	510-550	13-20
**Pattern*	Meander length (L_m) (ft)	-	62-115	*	49-59	*158-358	31.5-63.0
	Radius of curvature (Rd) (ft)	112	9-19	*	11-23	*72-126	12.6-31.5
	Belt width (W_{blt}) (ft)	25-40	15-35	*	22	*125	12.6
	Meander width ratio (w_{blt}/W_{bkf})	0.9-1.9	2.9-8.8	*	2.0-2.9	*3.9	2.0-2.9
	Radius of curvature/bankfull width	3.9-5.3	1.7-4.8	*	1.0-3.0	*2.3-4.0	2.0-5.0
	Meander length/bankfull width	-	11.9-28.8	*	4.5-7.7	*5.0-11.3	5.0-10.0
Profile	Valley slope	0.002	0.021	-	0.017	0.002	0.021
	Average water surface slope	0.002	0.019	0.003	0.0123	0.002	0.018
	Riffle slope	0.001-0.007	-	0.003-0.008	0.012-0.028	0.002-0.004	0.018-0.040
	Pool slope	0.002-0.004	-	0-0	0-0.0030	0-0	0.003-0.004
	Pool to pool spacing	-	-	32-80	-	50.3-212.4	0-0
	Pool length	10-20	-	13.0-21.2	5-9	20.4-56.3	2.91-11.37
	Riffle slope/avg water surface slope	0.50-3.50	0-0	1.0-2.7	1.0-2.3	1.0-2.7	1.0-2.3
	Pool slope/avg water surface slope	1-2	0-0	0-0	0.16-0.24	-	0.16-0.24
	Run slope/avg water surface slope	-	-	-	-	-	0-0
	Run depth/d_{bkf}	-	-	-	-	-	0-0
	Pool length/bankfull width	0.34-0.94	0-0	0.6-1.8	0.46-1.80	0.6-1.8	0.46-1.80
	Pool to pool spacing/bankfull width	-	0-0	1.6-6.7	-	1.6-6.7	0-0

* Pattern data developed from summary of dimensionless ratios for similar stream types in North Carolina Piedmont. Empirical data from Williams, 1986 used to verify these relationships.

7.2 Sediment Transport Analysis

With respect to sediment transport in fluvial systems, there is a threshold level of bedload movement that will result in a noticeable change in the channel bed. The flow associated with this threshold movement is the reference condition on which sediment transport analysis is based. In natural streambeds, there are particles of a wide range of sizes. At low flow levels, only the smallest particles will move, with the larger particles resisting the flow of the stream. This is the condition of partial sediment transport. As the stream flow increases, eventually every particle on the streambed will show threshold movement; this is the condition of full sediment transport.

Entrainment is the condition that initiates the movement of a selected particle size in the presence of a mix grade channel bed. If the largest particle that moves during a bankfull event can be identified, then the flow conditions that produced this movement can be determined and this flow condition (the channel competency) is used in the design of the restored stream channel. The preferred method of determining this particle size and flow condition is by direct measurement; however, a stream gage, scour chains, and sediment traps can be installed to measure the depth of scour and bedload transport (captured in the traps) associated with specific storm events.

The bar sampling method was utilized at the project site. In addition, the channel was sampled by the pebble count method at several sites for trend analysis. The mean channel shear stress and shear velocity were calculated for the existing conditions and then the proposed conditions in LTC. Determinations of the design shear stress were then made based on the sediment distribution from the surface, subsurface, and depositional feature sampling.

These shear stresses were validated for the design riffle cross-sections and channel gradient using the equation:

$$\tau = \gamma R s$$

Where: τ = shear stress (lbs/ft^2)
γ = specific gravity of water (62.4 lbs/ft^3)
R = hydraulic radius (ft)
s = average water slope (ft/ft)

The target shear stress values (0.43 lbs/ft^2) converted to shear-velocities for the design riffle cross-section was u* = 0.14 m/s. These velocities are sufficient to move the sampled d_{84} particle size (2.7 mm) and provide adequate channel maintenance (based on the collected sediment data), while maintaining the vertical stability of the LTC.

7.3 Hydrologic Modification

Hydrologic modifications will focus on enhancing surface water retention to the two wetland enhancement systems. Currently, there are ditches in both wetlands draining the surface water directly into LTC. The ditches prevent surface water from remaining on-site and recharging groundwater. These ditches will be plugged and stabilized to allow longer retention times and reduce/eliminate shallow groundwater loss from the wetland systems.

7.3.1 Narrative of Modifications

Hydrologic enhancement efforts will focus on installing ditch plugs and stabilizing two drainage ditches to improve wetland hydrology.

Enhancement Wetland #1
Currently, the existing wetland has adequate wetland hydrology and an intact shrub community. However, the wetland has been modified by a deep, head-cutting ditch located at the bottom of the wetland pocket, which drains a significant amount of water. Filling the ditch will increase groundwater levels in this wetland system.

Enhancement Wetland #2
Currently, the existing wetland has adequate wetland hydrology and an intact hardwood canopy. However, the wetland hydrology has been impacted by a shallow ditch located at the lower end of the wetland pocket. This ditch drains surface and groundwater during high saturation periods, thus decreasing retention time in the wetland.

No hydrologic alterations will take place in the preservation wetland on the west side of the project area.

7.4 Natural Plant Community Restoration

Restoring natural vegetation will focus primarily on the Alluvial Forest and Levee Forest planting areas in stream and riparian areas, the project site floodplain and the two enhancement wetlands. These areas will receive species consistent with a Piedmont Alluvial Forest and typical wetland species. The typical Piedmont Alluvial Forest is seasonally or intermittently flooded. Vegetation consists of forest with open to dense understory or shrub layer and sparse to dense diverse herb layer (Schafale and Weakley 1990). The two enhancement wetlands will also receive targeted hardwood species to increase species diversity among the existing vegetation.

7.4.1 Planting Zones

Five planting zones will be incorporated into the planting plan. Zone A is classified as a Stream Zone Area, which consists of the LTC and UT1 stream banks. Zone B is classified as a Floodplain Planting Area, which consist of the LTC floodplain and will be planted with higher moisture species. Zone C is classified as an Alluvial Forest Area, which consists of the existing Alluvial Forest Area adjacent to LTC and UT1. Zone D and E are classified as Wetland Enhancement Planting Areas with Zone D containing 456 stems/acre whereas Zone E contains 100 stems/acre. Plan Sheet 10 illustrates the five zones that will be used to target the riparian vegetation planting.

7.4.2 Plant List

Plantings shall consist of native species, which are available during the time of planting. In general, the five planting zones will consist of the following species groupings as availability allows.

Zone A: Stream Zone : (Livestakes)

Black Willow	*Salix nigra*	OBL
Elderberry	*Sambucus canadensis*	FACW-
Silky Willow	*Salix sericea*	OBL
Silky Dogwood	*Cornus amomum*	FACW+

Zone B: Floodplain Planting Area

Boxelder	*Acer negundo*	FACW
Willow Oak	*Quercus phellos*	FACW-
American Sycamore	*Platanus occidentalis*	FACW-
River Birch	*Betula nigra*	FACW
Swamp Chestnut Oak	*Quercus michauxii*	FACW-

Zone C: Alluvial Forest Planting Area

Spicebush	*Lindera benzoin*	FACW
Willow Oak	*Quercus phellos*	FACW-
Persimmon	*Diospyros virginiana*	FAC
Green Ash	*Fraxinus pennsylvanica*	FACW
American Sycamore	*Platanus occidentalis*	FACW-
Sugarberry	*Celtis laevigata*	FACW
River Birch	*Betula nigra*	FACW
Swamp Chestnut Oak	*Quercus michauxii*	FACW-

Zone D & E: Wetland Enhancement Planting Area

Boxelder	*Acer negundo*	FACW
Willow Oak	*Quercus phellos*	FACW-
American Sycamore	*Platanus occidentalis*	FACW-
River Birch	*Betula nigra*	FACW
Swamp Chestnut Oak	*Quercus michauxii*	FACW-

Herbaceous vegetation shall consist of a native grass mix that may include:

Bluestem	*Andropogon glomeratus*
Deertongue	*Panicum clandestinum*
Orchardgrass	*Dactylis glomerata*
Switchgrass	*Panicum virgatum*
Virginia wildrye	*Elymus virginicus*

Rye grain (*Secale cereale*) and/or brown top millet (*Pennisetum glaucum*) will be used for temporary stabilization.

Woody vegetation planting shall take place during the dormant season (November – March).

7.4.3 On-site Invasive Species Management

The project site has been affected by several nonnative plant species in the Piedmont Bottomland Forest area, Alluvial Forest area, and the grass community. The most significant invaders are Japanese honeysuckle (*Lonicera japonica*) and multiflora rose (*Rosa multiflora*).

Invasive species management will take place in November, which is an ideal time to target these species, and will focus on removing *Lonicera japonica* and *Rosa multiflora.* These species will be marked and treated with a glyphosate herbicide. Japanese grass (*Microstegium vimineum)* is also a pervasive nonnative plant in the project site. As much native grass cover will be retained during the construction process as possible to minimize the amount of bare soil available to invasive plants.

8.0 PERFORMANCE CRITERIA

Monitoring shall consist of the collection and analysis of wetlands and stream stability and riparian/stream bank vegetation survivability data to support the evaluation of the project in meeting established restoration objectives. Specifically, project success will be assessed utilizing measurements of stream dimension, pattern, and profile, site photographs, and vegetation sampling.

8.1 Streams

The purpose of monitoring is to evaluate the stability of the restored stream. Following the procedures established in the USDA Forest Service Manual, *Stream Channel Reference Sites* (Harrelson, et.al, 1994) and the methodologies utilized in the Rosgen stream assessment and classification system (Rosgen, 1994 and 1996), data collected will consist of detailed dimension and pattern measurements, longitudinal profiles, and bed materials sampling.

Dimension – Five permanent cross-sections, three riffle and two pools, will be established and used to evaluate stream dimension for LTC. Four permanent cross-sections, three riffle and one pool, will be established and used to evaluate stream dimension for UT1. Permanent monuments will be established by conventional survey. The cross-section surveys shall provide a detailed measurement of the stream and banks to include points on the adjacent floodplain, at the top of bank, bankfull, at all breaks in slope, the edge of water, and thalweg. Subsequently, width/depth ratios and entrenchment ratios will be calculated for each cross-section.

Cross-section measurements should show little or no change from the as-built cross-sections. If changes do occur, they will be evaluated to determine whether they are minor adjustments associated with settling and increased stability or whether they indicate movement toward an unstable condition.

Pattern - Measurements associated with the restored channel pattern shall be taken on the section of the stream included in the longitudinal profiles. These will include belt width, meander length, and radius of curvature. Subsequently, sinuosity, meander width ratio, radius of curvature, and meander length/bankfull width ratios will be calculated.

Profile – Longitudinal profiles will be conducted on the entire length for both LTC and UT1. Measurements will include slopes (average, pool, riffle) as well as calculations of pool-to-pool spacing. Annual measurements should indicate stable bedform features with little change from the as-built survey. The pools should maintain their depth with lower water surface slopes, while the riffles should remain shallower and steeper.

Bed Materials - Pebble counts will be conducted at each representative cross-section for the purpose of repeated classification and to evaluate sediment transport.

Photograph Reference Points - Six photograph reference points (PRP) will be established to assist in characterizing the site and to allow qualitative evaluation of the site conditions. The location and bearing/orientation of each photo point will be permanently marked in the field and documented to allow for repeated use.

Cross-section Photograph Reference Points - Each cross-section will be photographed to show the form of the channel with the tape measure stretched over the channel for reference in each photograph. Effort will be made to consistently show the same area in each photograph.

Longitudinal Photograph Reference Points - Additional PRPs will be located, as needed to document the condition of specific in-stream structures such as cross vanes, rock sills, and enhanced riffles.

8.2 Stream Riparian Vegetation

The success of the riparian buffer plantings for project site will be evaluated using eight (5% of the total buffer area) ten by ten meter (10m x 10m) vegetative sampling plots for LTC and three vegetative sampling plots for UT1. The corners of each monitoring plot will be permanently marked in the field. The monitoring will consist of a physical inventory within each plot and a subsequent statistical analysis in order to determine the following: composition and number of surviving species and total number of stems per acre. Additionally, a photograph will be taken of each plot that will be replicated each monitoring year. Riparian vegetation must meet a minimum survival success rate of 320 stems/acre after five years. If monitoring indicates that the specified survival rate is not being met, appropriate corrective actions will be developed to include invasive species control, the removal of dead/dying plants, and replanting.

8.3 Wetland Hydrology

Groundwater elevations will be monitored to evaluate the attainment of jurisdictional wetland hydrology. Verification of wetland hydrology will be determined by automatic recording well data collected within the two enhancement wetlands. One automatic recording gauge will be established in each wetland to cover a density of one automatic well per four acres. Daily data will be collected from the automatic gauges over the five year monitoring period following wetland construction.

Wetland hydrology success will be considered established if well data from the site indicate that groundwater is within 12 inches of the soil surface for a continuous 5% of the growing season during normal weather conditions. The growing season was taken from NRCS climatic data for Rockingham County, which has the closest meteorological station to the project site (REIDSVILLE 2 NW, NC7202). According to the NRCS, the growing season is considered to be the period with a 50% probability that the daily minimum temperature is higher than 28° F. The growing season for Rockingham County extends from March 25 to November 6 for a total of 226 days (USDA, NRCS 2002). Based on this growing season, success will be achieved at the project site if the water table is within 12 inches

8.4 Wetland Vegetation

The success criteria for the planted species in the wetland enhancement areas will be based on survival and growth.

8.5 Schedule/Reporting

The first scheduled monitoring will be conducted during the first full growing season following project completion. Monitoring shall subsequently be conducted annually for a total period of five (5) years.

Annual monitoring reports will be prepared and submitted after all monitoring tasks for each year are completed. Each report will provide the new monitoring data and compare the new data against previous findings. The monitoring report will follow the format described in the EEP document entitled “Content, Format, and Data Requirements for EEP Monitoring Reports.”

9.0 REFERENCES

Dunne, T. and L.B. Leopold. 1978. Water in Environmental Planning. New York: W.H. Freeman and Company.

G.E., Omernik, J.M., Comstock, J.A., Schafale, M.P., McNab, W.H., Lenat, D.R., MacPherson, T.F., Glover, J.B., and Shelburne, V.B. 2002. Ecoregions of North Carolina and South Carolina, (color poster with map, descriptive text, summary tables, and photographs): Reston, Virginia, U.S. Geological Survey (map scale 1:1,500,000).

Harman, W.A., G.D. Jennings, J.M. Patterson, D.R. Clinton, L.O. Slate, A.G. Jessup, J. R. Everhart, and R.E. Smith. 1999. Bankfull Hydraulic Geometry Relationships for North Carolina Streams Wildland Hydrology. AWRA Symposium Proceedings. Edited by D.S. Olsen and J.P. Potyondy. American Water Resources Association. June 30 – July 2, 1999. Bozeman, MT.

Harrelson, C.C., C.L. Rawlins, and J.P. Potyondy. 1994. Stream Channel Reference Sites: An Illustrated Guide To Field Technique. Gen. Tech. Rep. RM-245. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 61 p.

NCDENR, Division of Water Quality Planning Branch. November 2002. Assessment Report: Biological Impairment in the Little Troublesome Creek Watershed. Cape Fear River Basin, Rockingham County, NC.

NCDENR, Division of Water Quality. Report Date 11/08/06. North Carolina Waterbodies Listed by Subbasin. http://h2o.enr.state.nc.us/bims/reports/basinsandwaterbodies/03-01-01.pdf

NCDENR, Division of Water Quality. October 2005. Cape Fear River Basinwide Water Quality Plan. http://h2o.enr.state.nc.us/basinwide/draftCPFApril2005.htm.

NCDENR. Division of Water Quality, Wetlands Restoration Program, 2001. "Guidelines for Riparian Buffer Restoration." Raleigh, NC.

NCDENR, Division of Water Quality. 2005. Surface Water Classification. http://h2o.enr.state.nc.us/csu/swc.html.

NCDENR, North Carolina Ecosystems Enhancement Program (NCEEP), 2001. Watershed Restoration Plan for the Cape Fear River Basin. http://www.nceep.net/services/restplans/cape_fear_2001.pdf

NCDENR, North Carolina Ecosystems Enhancement Program (NCEEP), May 2004. Upper Cape Fear Basin Local Watershed Plan Targeting of Management Report. http://www.nceep.net/services/lwps/Troublesome_Creek/target.pdf

NCDENR, North Carolina Ecosystems Enhancement Program (NCEEP), August 2004. Troublesome Creek & Little Troublesome Creek Local Watershed Plan Summary. http://www.nceep.net/services/lwps/Troublesome_Creek/trouble-summ.pdf

NC Floodplain Mapping Program. FIRM Panel 8856

NCGS. 1985. Geologic Map of North Carolina

NCWRP (North Carolina Wetlands Restoration Program). October 2002. Preliminary Findings Report: Troublesome Creek Watershed and Little Troublesome Creek Watershed

Rockingham County GIS, 2004. Aerial Photography.

Rosgen, D.L. 1994. A Classification of Natural Rivers. Catena 22: 169-199.

Rosgen, D.L. 1996. Applied River Morphology. Pagosa Springs, CO: Wildland Hydrology Books.

Rosgen, D.L. 1997. A Geomorphological Approach to Restoration of Incised Rivers. In: Wang, S.S.Y., E.J. Langendoen, and F.D. Shields, Jr. (Eds.). Proceedings of the Conference on Management of Landscapes Disturbed by Channel Incision. pp. 12-22.

Rosgen, D.L. 1998. The Reference Reach – a Blueprint for Natural Channel Design. Presented at ASCE Conference, Denver, CO – June, 1998.

Williams, 1986. Reference Reach Field Book. Wildland Hydrology, Inc. March, 2005.

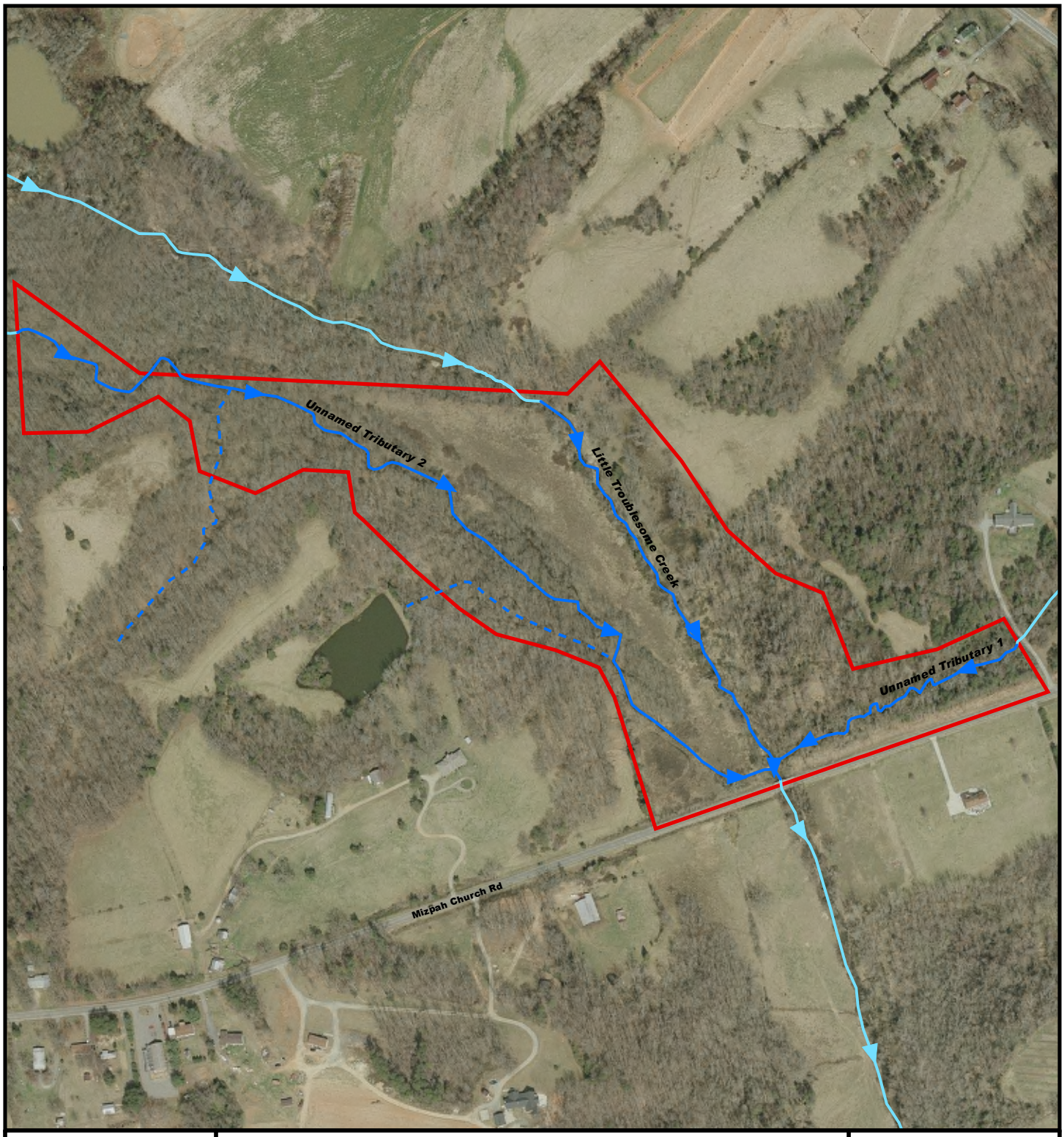
Schafale, M.P. and A.S. Weakley. 1990. Classification of the Natural Communities of North Carolina, 3rd Approximation. North Carolina Natural Heritage Program, NCDEHNR, Division of Parks and Recreation. Raleigh, NC.

USACE, 1987. Corps of Engineers Wetland Delineation Manual.

USDA, NRCS, 2002. National Water and Climate Center, Climate Information for Rockingham County in the State of North Carolina. USDA, Soil Conservation Service. 1992. Soil Survey of Rockingham County, North Carolina.

U.S. Department of Agriculture, Soil Conservation Service. Historical Aerial Photographs. 1959, 1966, 1974, and 1988.

FIGURES



KCI ASSOCIATES OF NC

Figure 1. Little Troublesome Creek Study Area

Project Streams

Other Streams

Additional Drainage Features

Project Easement Boundary

N
W E
S

1:4,800

1 inch equals 400 feet

400 200 0 400 Feet

Ecosystem Enhancement PROGRAM

Image Source: Rockingham County GIS, Orthoimagery March 2004

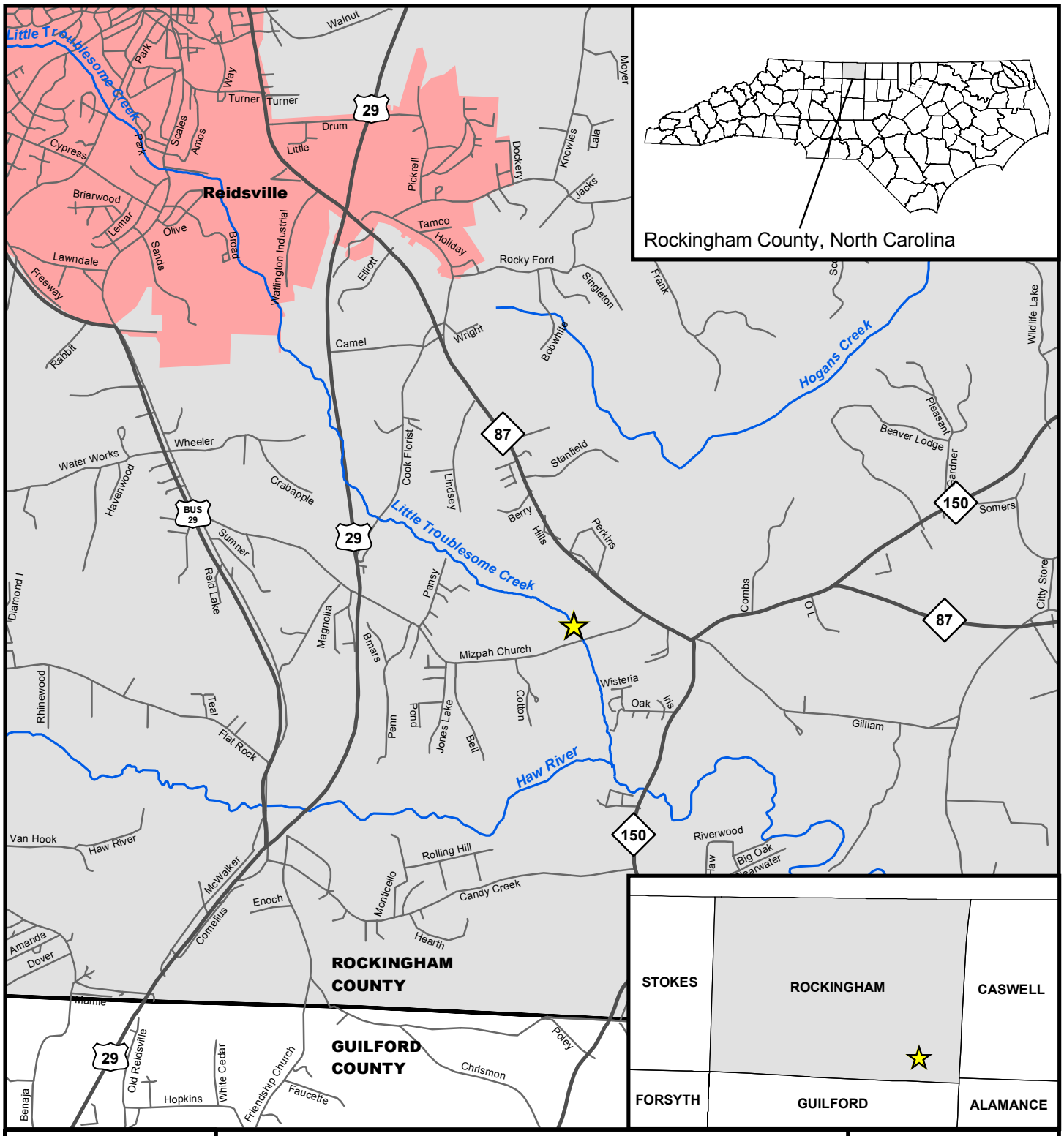


Figure 2. Little Troublesome Creek Vicinity Area

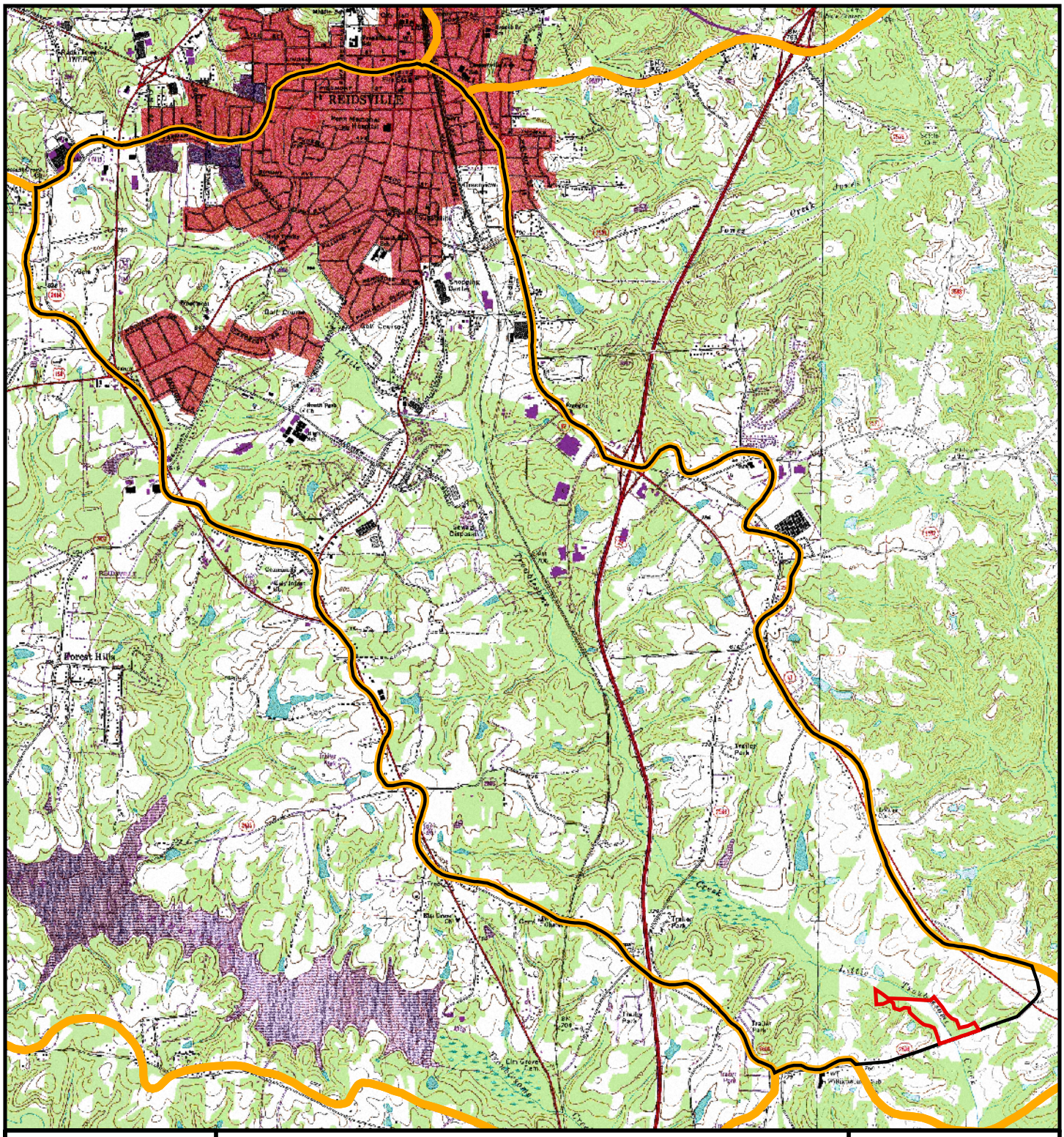
- Project Site Location
- Major Streams and Rivers
- Major Roads
- Other Roads
- Cities and Towns
- County Boundaries

1:63,360
1 inch equals 1 miles

1 0.5 0 1 Miles

KCI ASSOCIATES OF NC

Ecosystem Enhancement PROGRAM



KCI ASSOCIATES OF NC

Figure 3. Project Watershed

Project Easement Boundary

Project Watershed (12.1 sq miles)

14-digit HUC Boundaries

N
W E
S

1:48,000

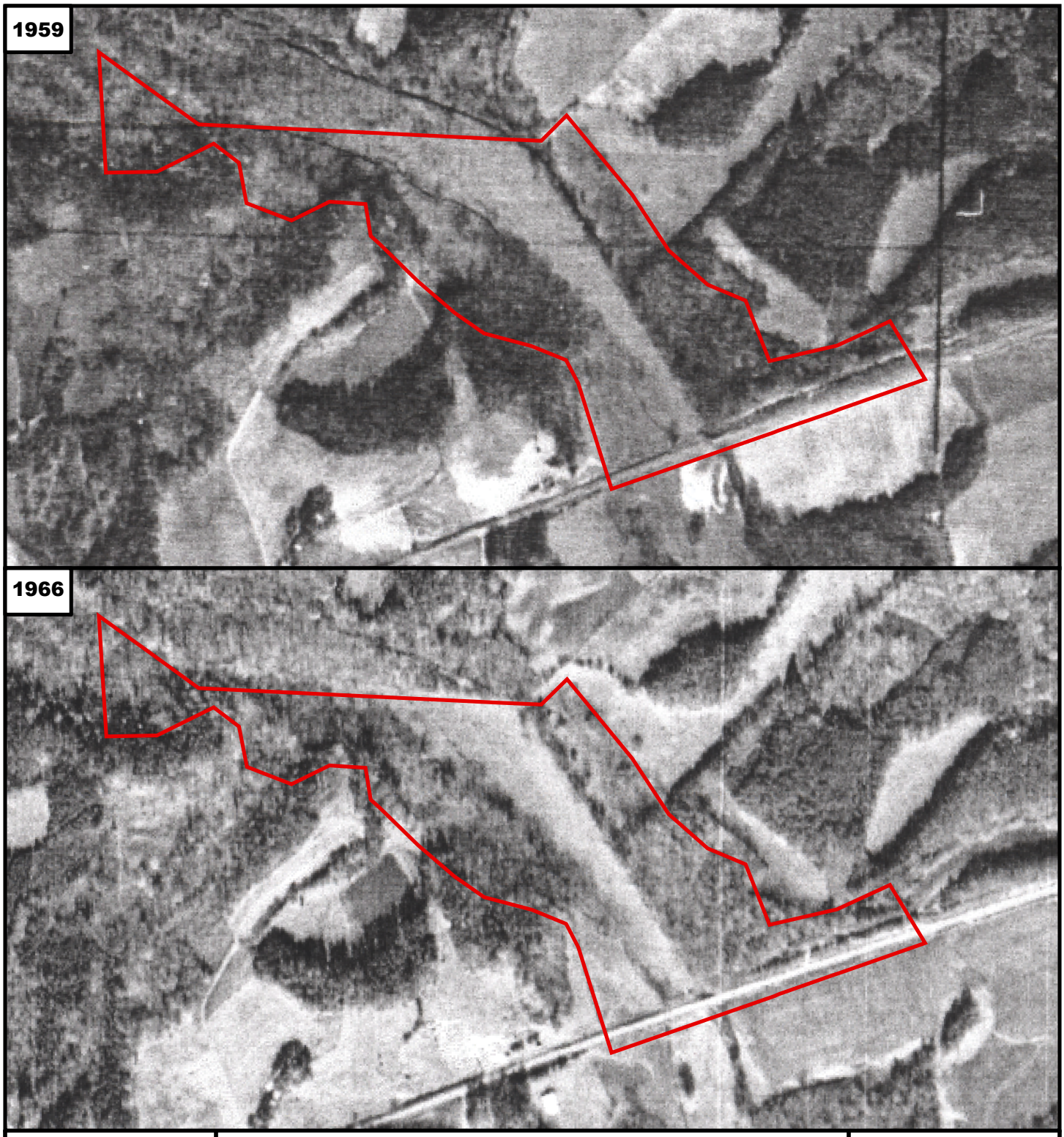
1 inch equals 4,000 feet

4,000 2,000 0 4,000

Feet

Source: USGS Topographic Quadrangles, Reidsville and Williamsburg, 1972

Ecosystem Enhancement PROGRAM



KCI ASSOCIATES OF NC

Figure 4A. Historic Aerial Photographs - 1959 and 1966

Project Easement Boundary

N
W E
S

1:6,000

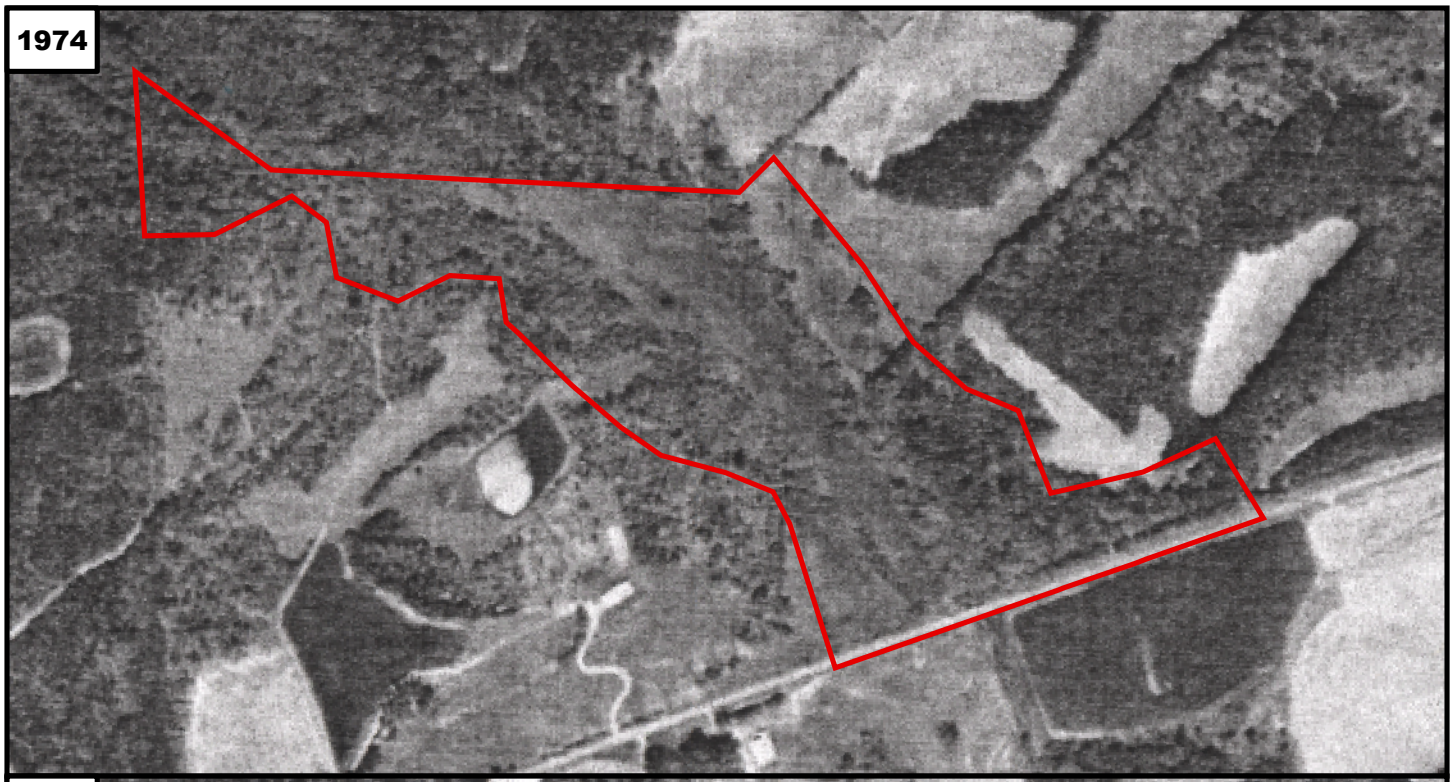
1 inch equals 500 feet

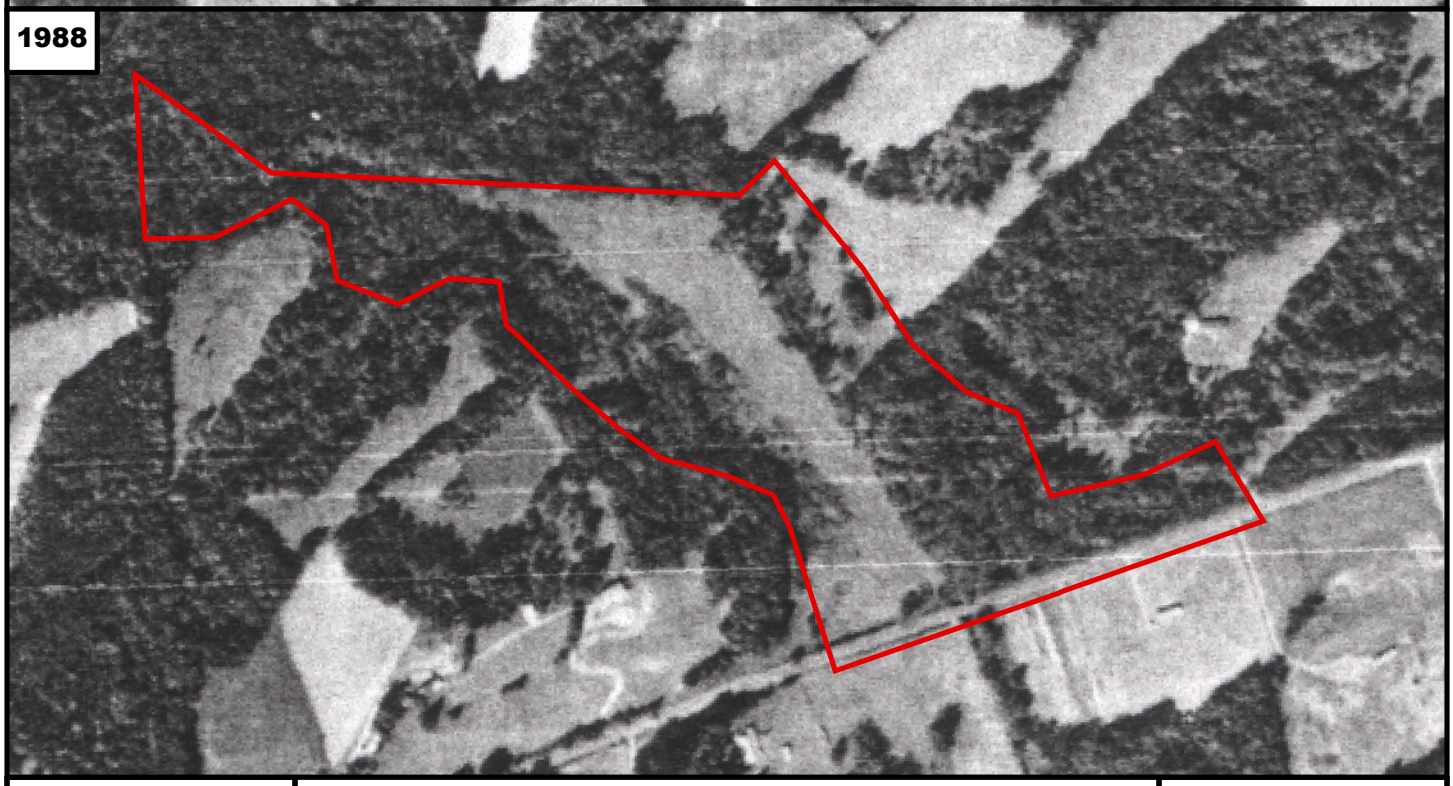
500 250 0 500

Feet

Source: Rockingham County NRCS

Ecosystem Enhancement PROGRAM





KCI ASSOCIATES OF NC

Figure 4B. Historic Aerial Photographs - 1974 and 1988

Project Easement Boundary

N
W E
S

1:6,000

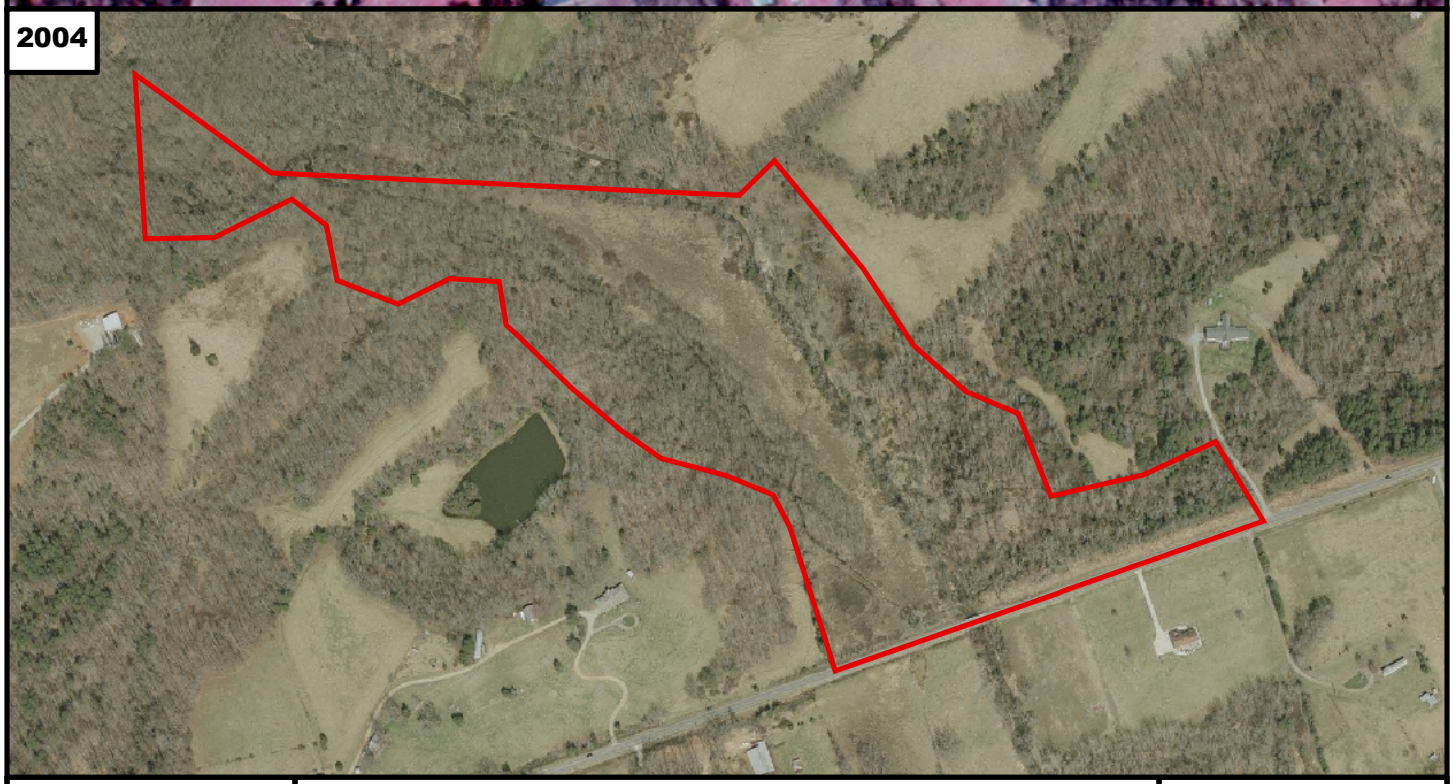
1 inch equals 500 feet

500 250 0 500

Feet

Source: Rockingham County NRCS

Ecosystem Enhancement PROGRAM



KCI ASSOCIATES OF NC

Figure 4C. Historic Aerial Photographs - 1998 and 2004

Project Easement Boundary

N
W E
S

1:6,000

1 inch equals 500 feet

500 250 0 500

Feet

Source: USGS DOQQs, Williamsburg 1998 and Rockingham County GIS, Orthoimagery March 2004

Ecosystem Enhancement PROGRAM

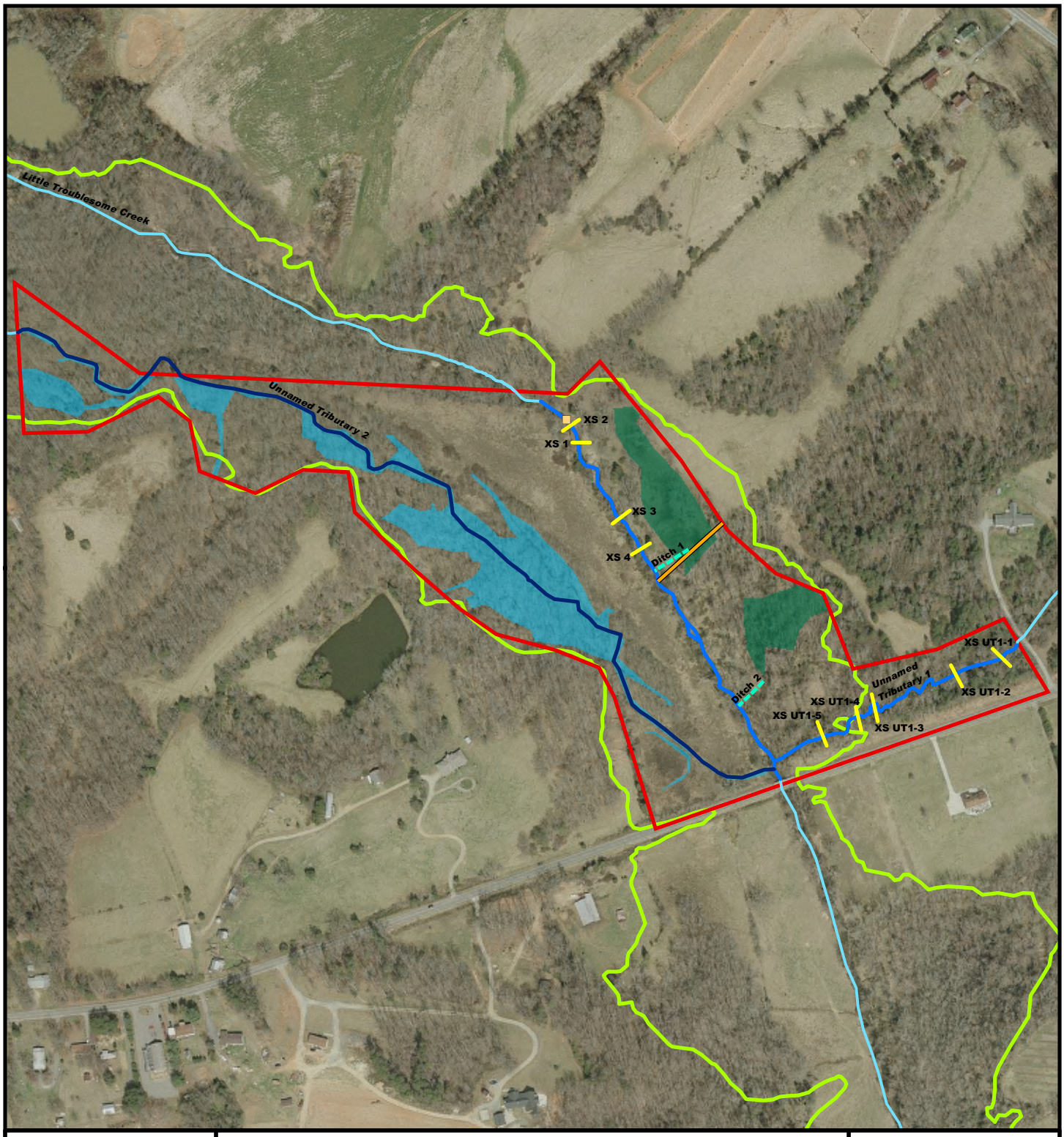


Figure 5. Existing Conditions Map

- Project Easement Boundary
- Restoration Stream
- Preservation Stream
- Other Streams
- Wetland Enhancement
- Wetland Preservation
- Ditch
- FEMA Flood Hazard Zone AE
- Fence
- Cross-Section
- Cattle Access

N W E S

1:4,800
1 inch equals 400 feet

400 200 0 400 Feet

Image Source: Rockingham County GIS, Orthoimagery March 2004

KCI ASSOCIATES OF NC

Ecosystem Enhancement PROGRAM

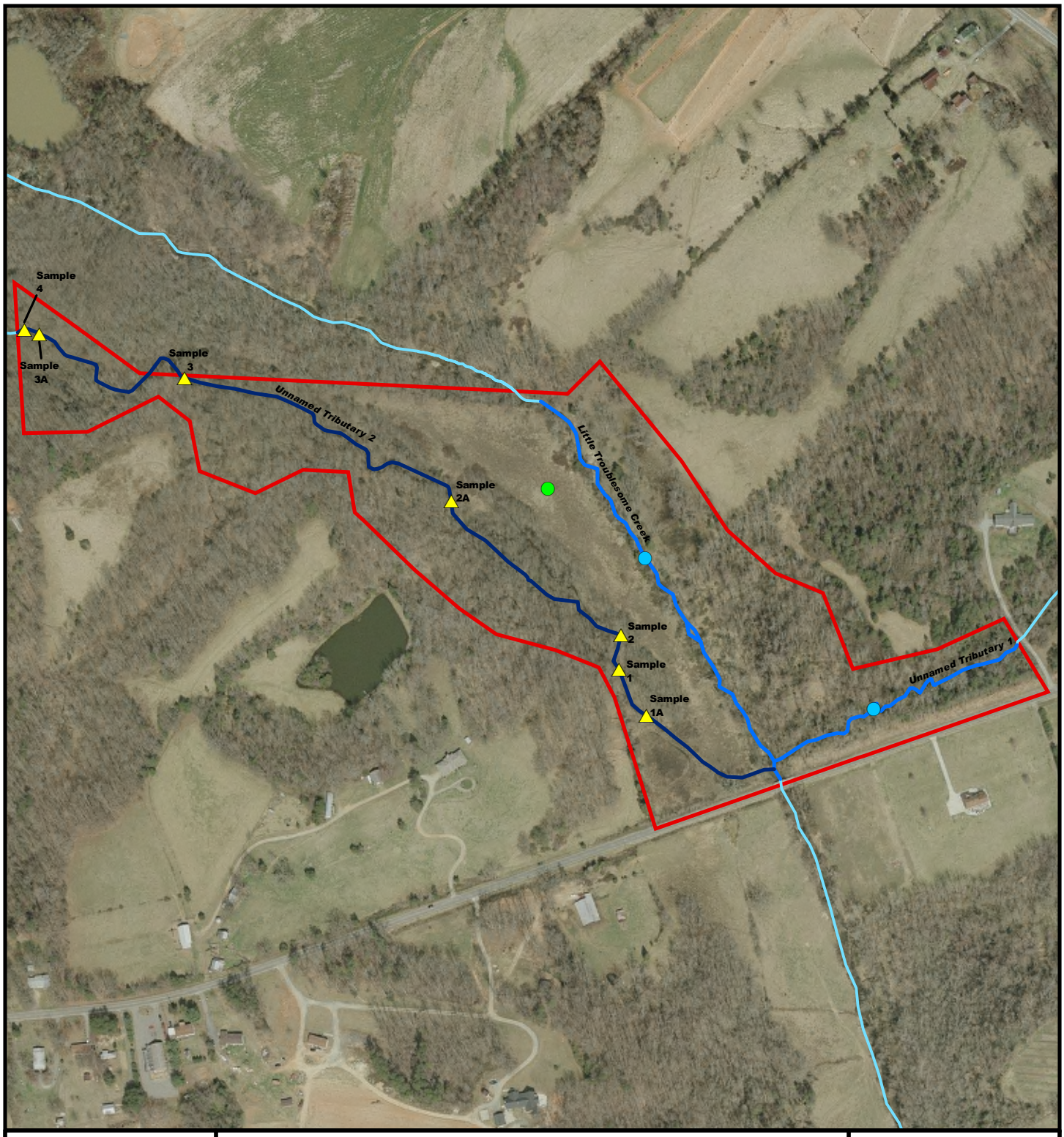


Figure 6. Project Site Hydrologic Features and Gauge Location Map

Project Easement Boundary
Restoration Stream
Preservation Stream
Other Streams
Rain Gauge
Stream Gauge
Stream Classification Form Samples

N
W E
S

1:4,800
1 inch equals 400 feet

400 200 0 400
Feet

Image Source: Rockingham County GIS, Orthoimagery March 2004

KCI ASSOCIATES OF NC

Ecosystem Enhancement PROGRAM

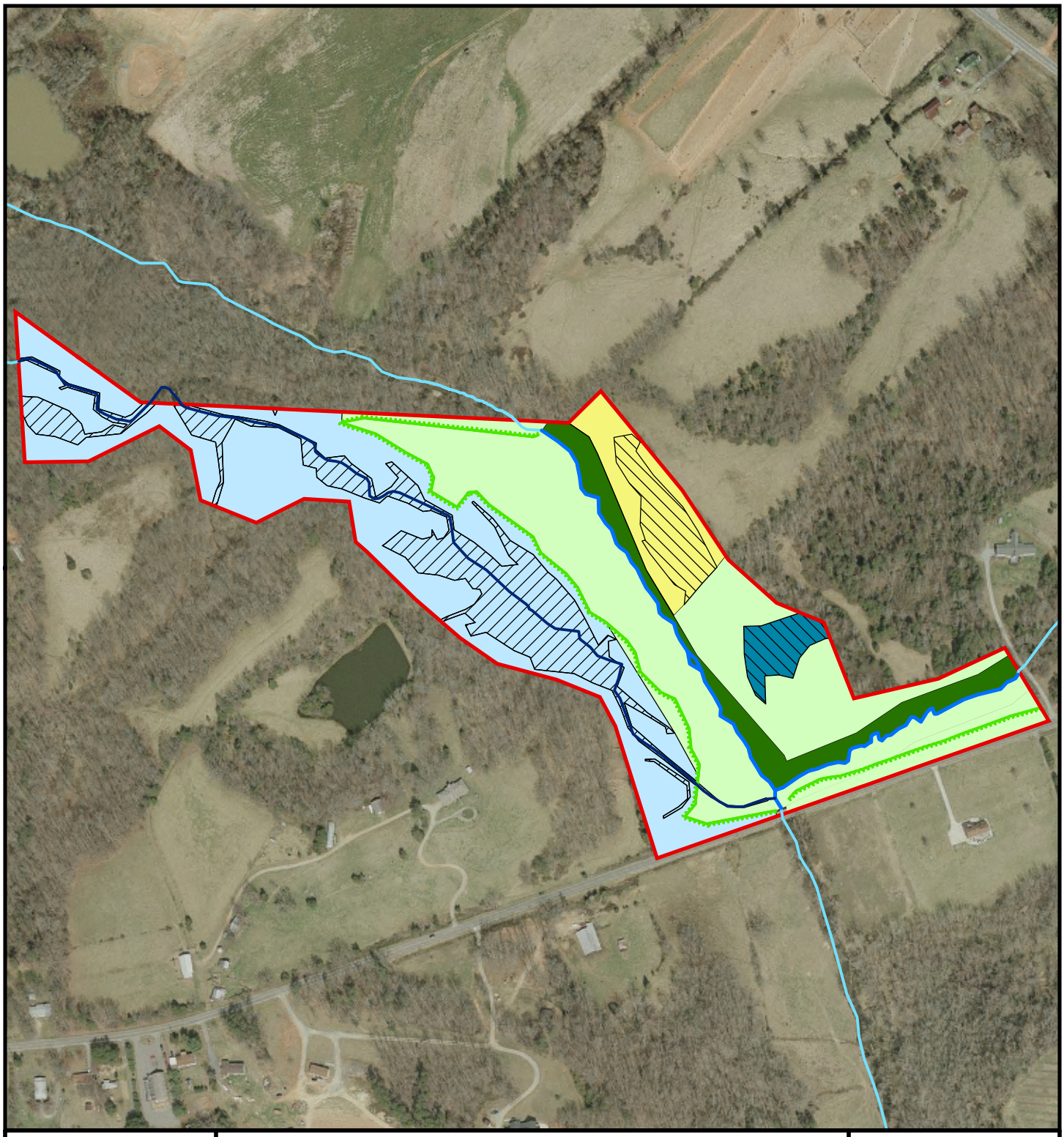


Figure 7. Existing Natural Communities

Natural Communities

- Piedmont Bottomland Forest
- Piedmont Alluvial Forest
- Piedmont Levee Forest
- Grass Community
- Low Elevation Seep

- Project Easement Boundary
- Existing Treeline
- Restoration Streams
- Preservation Stream
- Other Streams

- Wetland Enhancement
- Wetland Preservation

1:4,800
1 inch equals 400 feet

400 200 0 400 Feet

Image Source: Rockingham County GIS, Orthoimagery March 2004

KCI ASSOCIATES OF NC

Ecosystem Enhancement PROGRAM

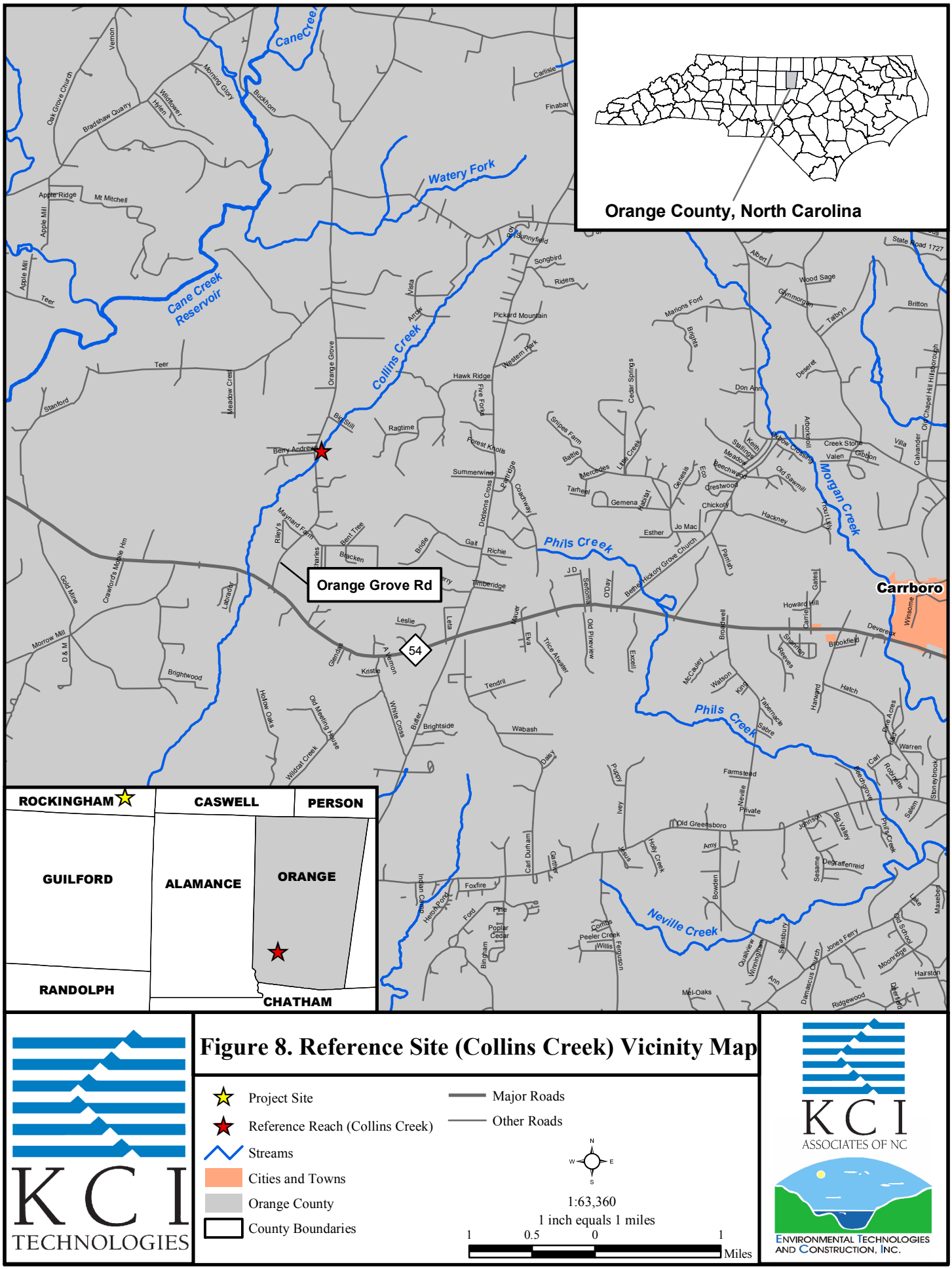


Figure 8. Reference Site (Collins Creek) Vicinity Map

- Project Site
- Reference Reach (Collins Creek)
- Streams
- Cities and Towns
- Orange County
- County Boundaries
- Major Roads
- Other Roads

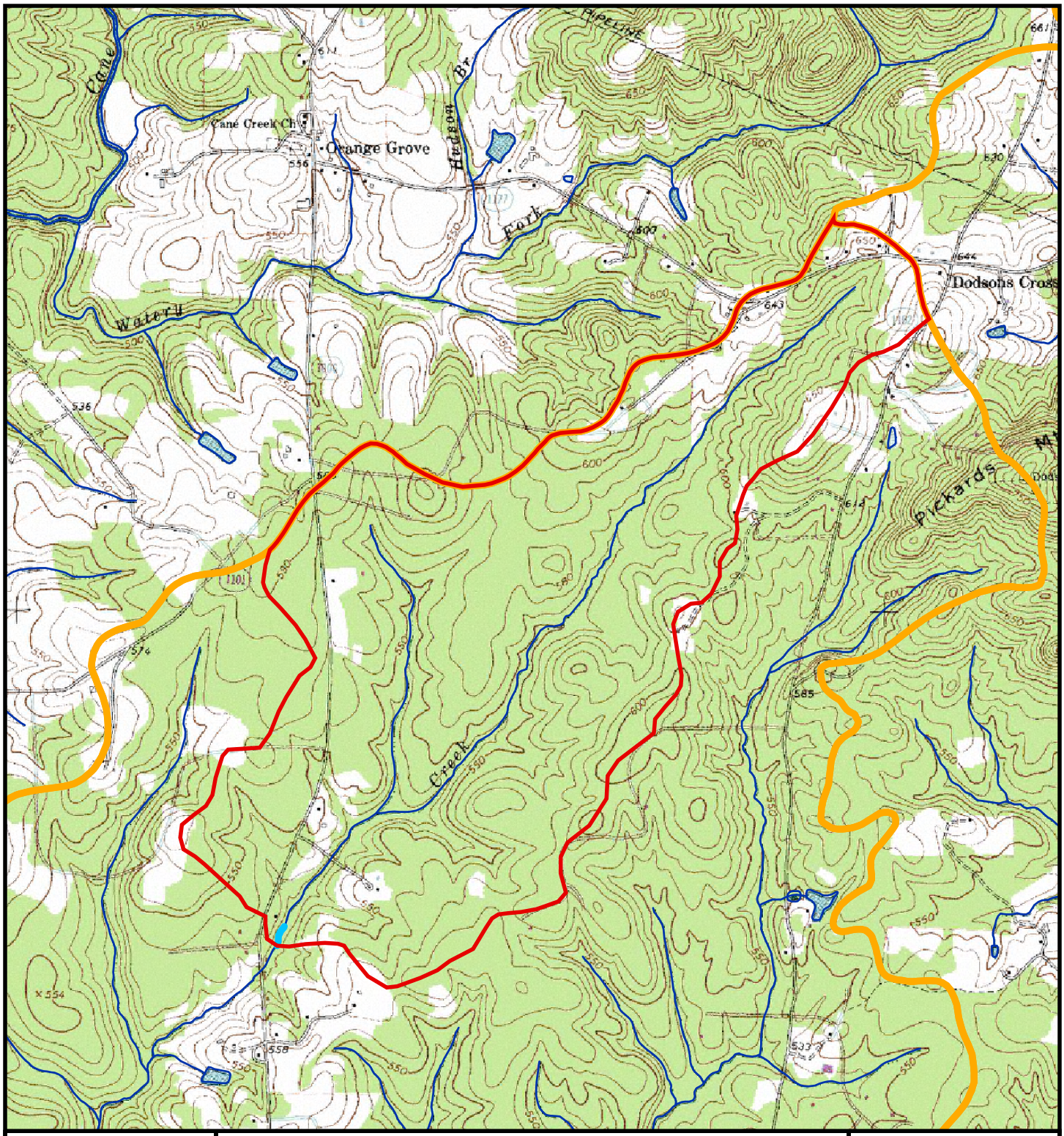
1:63,360
1 inch equals 1 miles

1 0.5 0 1 Miles

KCI TECHNOLOGIES

KCI ASSOCIATES OF NC

ENVIRONMENTAL TECHNOLOGIES AND CONSTRUCTION, INC.



KCI TECHNOLOGIES

Figure 9. Reference Site (Collins Creek) Watershed Map

Reference Reach Watershed (1.68 sq. miles)

Reference Reach (Collins Creek)

Other Streams

14-digit HUC Boundaries

N
W E
S

1:24,000

1 inch equals 2,000 feet

2,000 1,000 0 2,000 Feet

KCI ASSOCIATES OF NC

ENVIRONMENTAL TECHNOLOGIES AND CONSTRUCTION, INC.

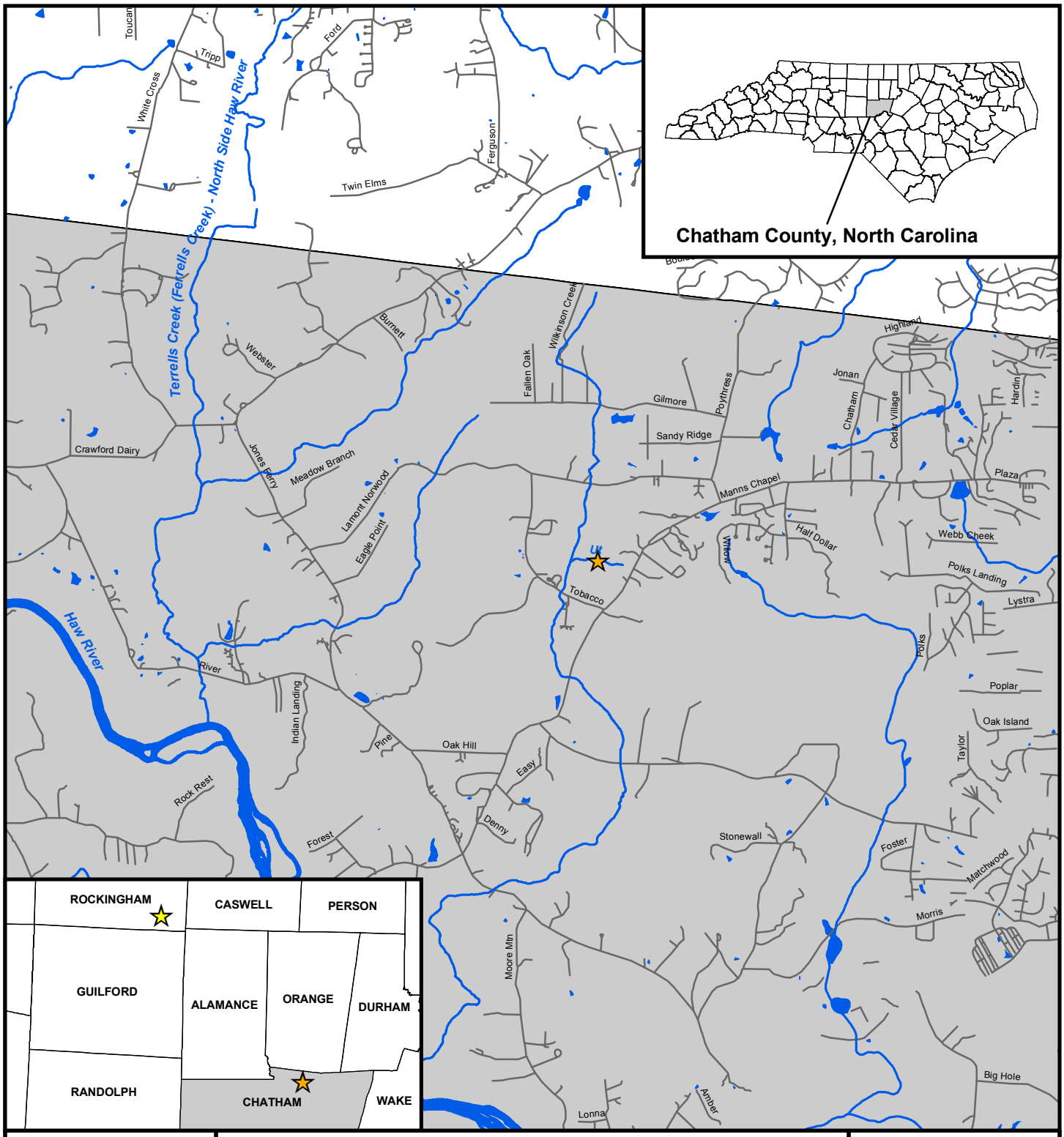


Figure 10. Reference Site (UT to Wilkinson) Vicinity Map

- Project Site
- Reference Reach (UT to Wilkinson)
- Streams
- Lakes and Reservoirs
- Roads
- Chatham County
- County Boundaries

1:63,360
1 inch equals 1 miles
1 0.5 0 1 Miles

KCI ASSOCIATES OF NC

Ecosystem Enhancement PROGRAM

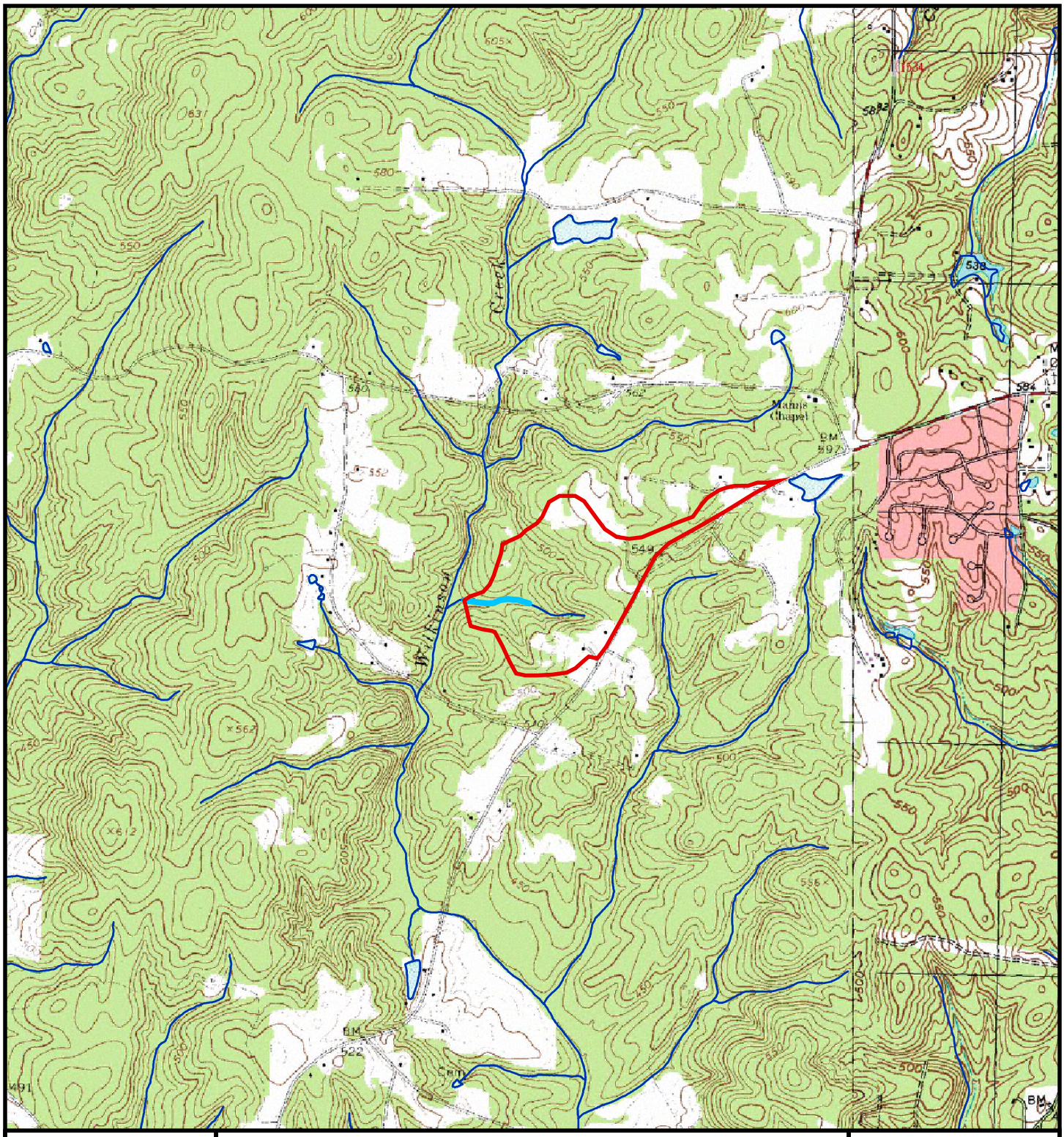


Figure 11. Reference Site (UT to Wilkinson) Watershed Map

Reference Reach Watershed (0.16 sq. mile)

Reference Reach (UT to Wilkinson Creek)

Other Streams

N
W E
S

1:24,000

1 inch equals 2,000 feet

2,000 1,000 0 2,000

Feet

Source: USGS Topographic Quadrangles Bynum (1968) and Farrington (1981)

KCI ASSOCIATES OF NC

Ecosystem Enhancement PROGRAM

KCI ASSOCIATES OF NC

Figure 12. Project Site Wetland Delineation Map

Project Easement Boundary

Existing Wetland - 1.91 acres of enhancement

Existing Wetland - 4.48 acres of preservation

N
W E
S

1:4,800

1 inch equals 400 feet

400 200 0 400 Feet

Image Source: Rockingham County GIS, Orthoimagery March 2004

Ecosystem Enhancement PROGRAM

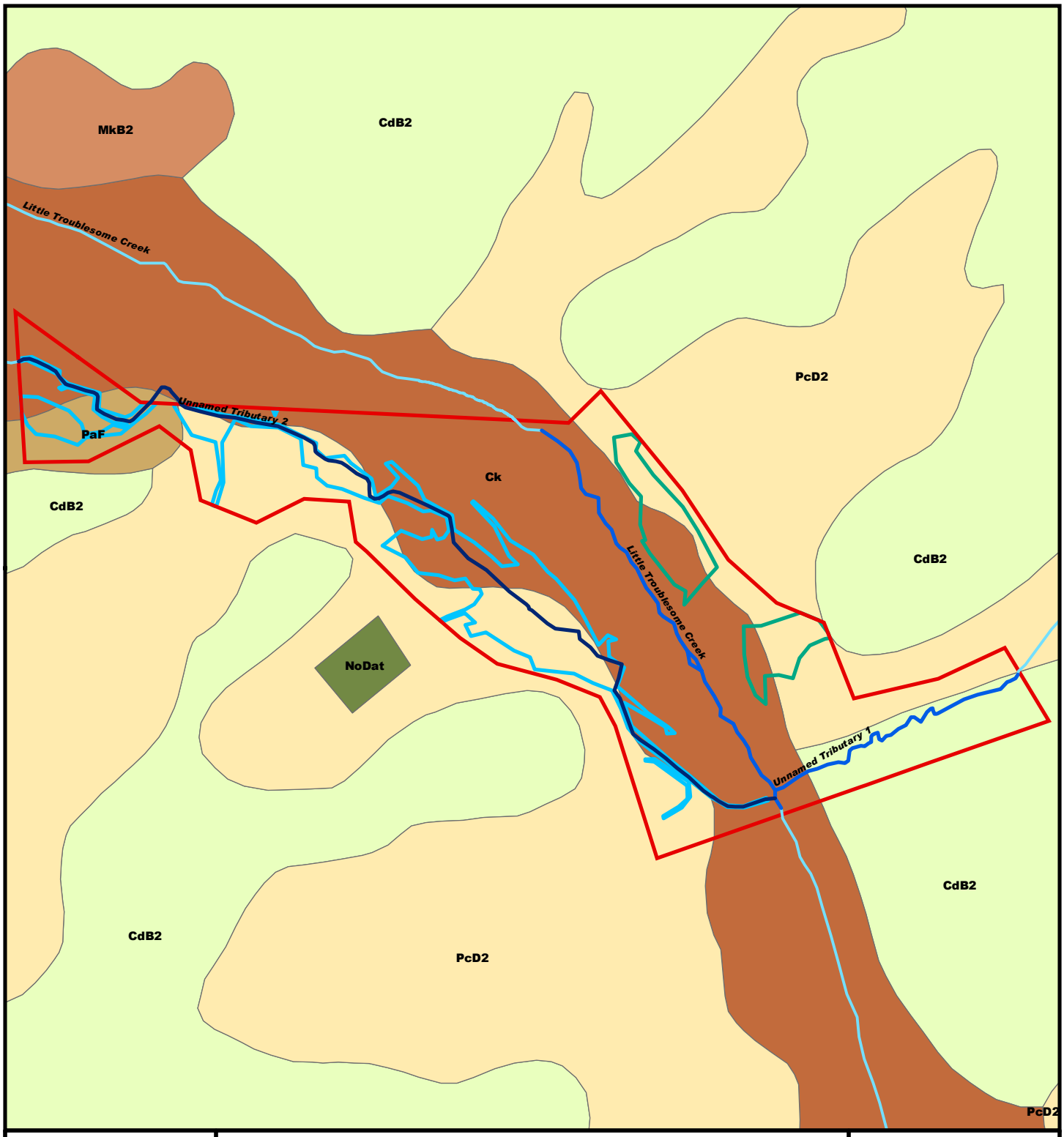


Figure 13. Project Site NRCS Soil Survey Map

Soil Series

- Cecil Sandy Clay Loam, 2 To 8 Percent Slopes, Eroded (CdB2)
- Chastain Silty Clay Loam (Ch)
- Chewacla Loam (Ck)
- Mecklenburg Sandy Clay Loam, 2 To 8 Percent Slopes, Eroded (MkB2)
- No Data
- Pacolet Sandy Clay Loam, 8 To 15 Percent Slopes, Eroded (PcD2)
- Pacolet Sandy Loam, 25 To 40 Percent Slopes (PaF)

- Project Easement Boundary
- Stream Restoration
- Stream Preservation
- Other Streams
- Wetland Enhancement
- Wetland Preservation

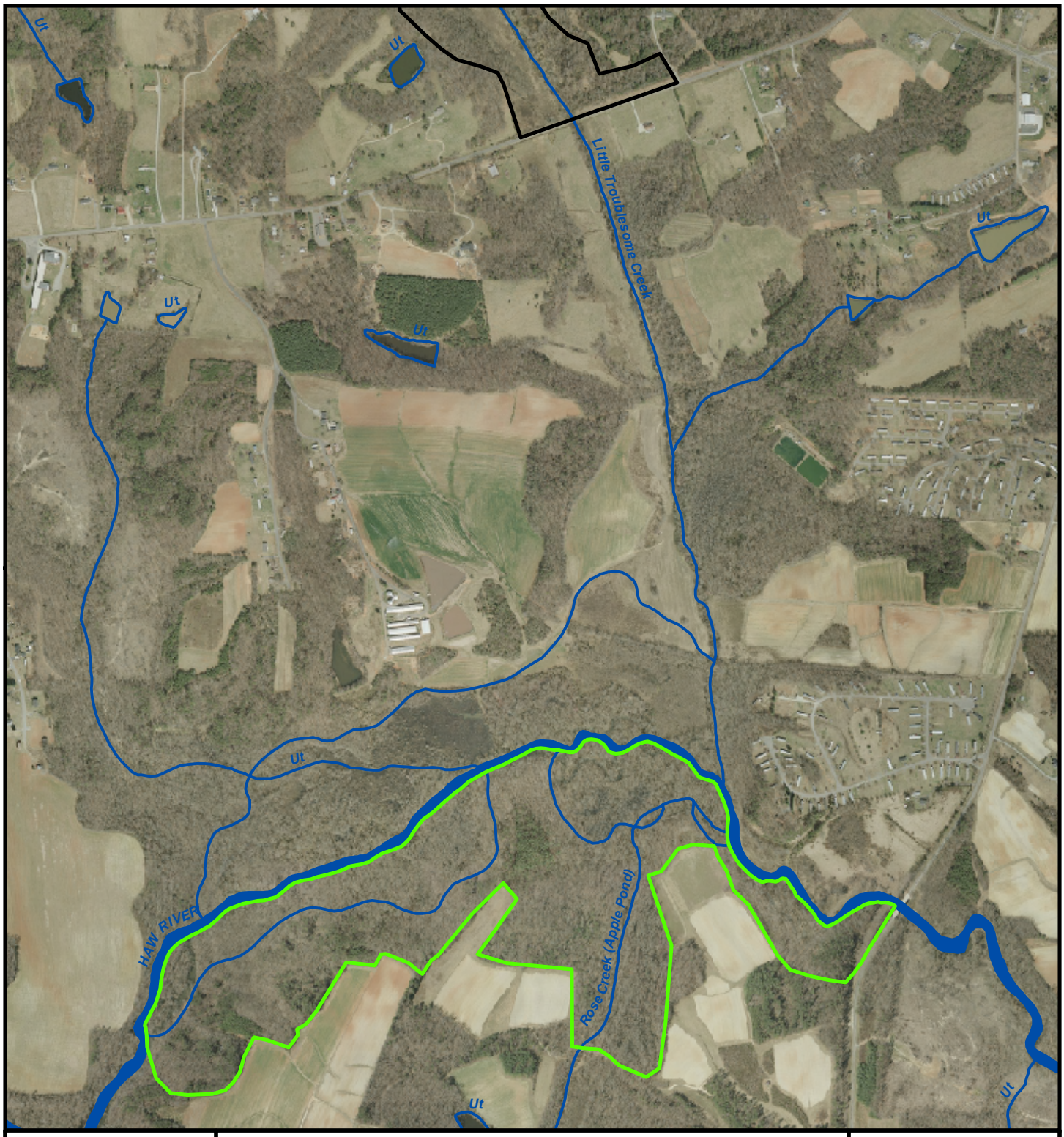
1:4,800
1 inch equals 400 feet

400 200 0 400 Feet

Source: Soil Survey of Rockingham County, USDA NRCS 1992

KCI ASSOCIATES OF NC

Ecosystem Enhancement PROGRAM



KCI ASSOCIATES OF NC

Figure 14. Reference Site Vegetative Communities Map

Project Easement Boundary

Reference Wetland

Streams

N
W E
S

1:12,000

1 inch equals 1,000 feet

1,000 500 0 1,000 Feet

Ecosystem Enhancement PROGRAM

Image Source: Rockingham County GIS, Orthoimagery March 2004

PLAN SHEETS

KCI JOB# : 120537436

CONTRACT #: D07009S

VICINITY MAP
NOT TO SCALE

STATE OF NORTH CAROLINA
ECOSYSTEM ENHANCEMENT PROGRAM

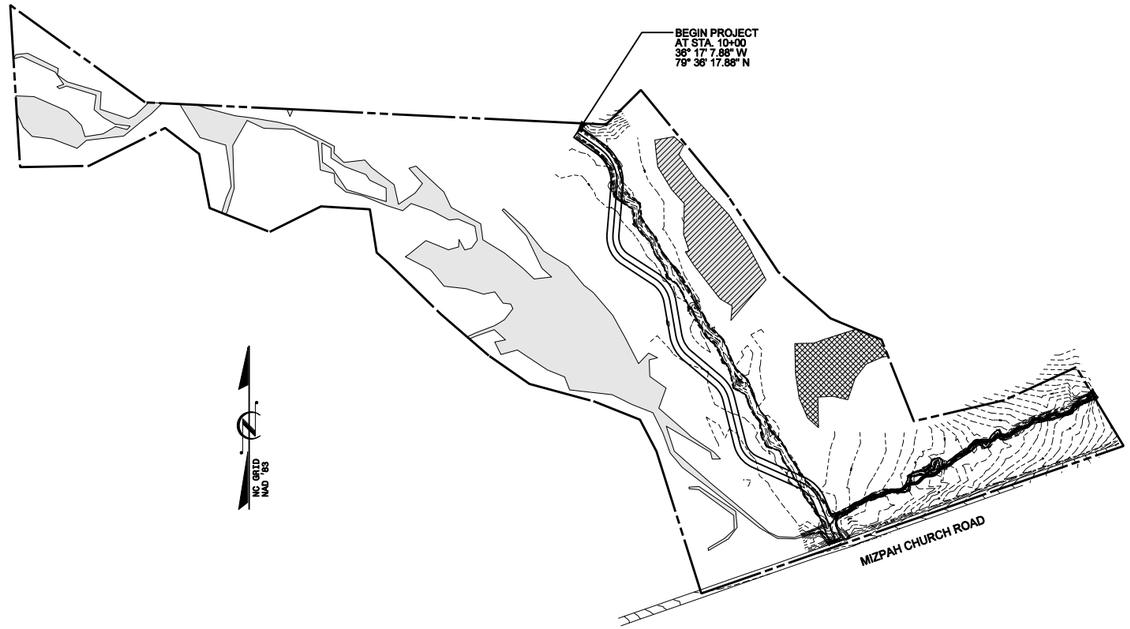
STATE	CONTRACT NUMBER	SHEET NO.	TOTAL SHEETS
N.C.	D07009S	1	15

A	SUBMITTED WITH CONCEPTUAL PLANS (30%)	JAN 2007	
B	SUBMITTED WITH RESTORATION PLAN (60%)	FEB 2007	
C	SUBMITTED WITH RESTORATION PLAN REVISIONS (60%)	JUN 2007	
SYM.	DESCRIPTION	DATE	APPROVED
REVISIONS			

ROCKINGHAM COUNTY

LOCATION: LITTLE TROUBLESOME CREEK
REIDSVILLE, NORTH CAROLINA

TYPE OF WORK: STREAM RESTORATION AND WETLAND ENHANCEMENT AND PRESERVATION



INDEX OF SHEETS

* INCLUDED IN RESTORATION PLAN

GRAPHIC SCALES

PLANS: –30 –15 0 30 60

PROFILE (HORIZONTAL): –30 –15 0 30 60

PROFILE (VERTICAL): –4 –2 0 4 8

PROJECT DATA

STREAM RESTORATION LENGTH = 2,188 FEET

WETLAND PRESERVATION = 4.4 ACRES

WETLAND ENHANCEMENT = 1.9 ACRES

Prepared in the Office of:

KCI Associates of North Carolina, P.A.
SUITE 220 LANDMARK CENTER II, 4601 SIX FORKS RD., RALEIGH, NC
ENGINEERS • PLANNERS • ECOLOGISTS

LETTING DATE:

GARY M. MRYNCZA, P.E.
PROJECT ENGINEER

ALEX FRENCH / APRIL HELMS
NATURAL CHANNEL DESIGN

PROJECT ENGINEER

SIGNATURE: P.E.

Prepared for:

Ecosystem Enhancement PROGRAM

PERRY SUGG
NCEEP PROJECT MANAGER

SALAM MURTADA
NCEEP REVIEW COORDINATOR

GENERAL NOTES

GENERAL NOTES:

BEARING AND DISTANCES:
ALL BEARINGS ARE NAD 1983 GRID BEARINGS.
ALL DISTANCES AND COORDINATES SHOWN ARE HORIZONTAL (GROUND) VALUES.
ALL INFORMATION IS BASED ON THE FOLLOWING KCI CONTROL POINTS.

GPS#1	N=922346.1638	E=1819828.0300	ELEV.=661.73′
GPS#2	N=922529.8350	E=1820356.7900	ELEV.=673.50′

GRADING:
-ALL EXCAVATED MATERIALS, INCLUDING NATURAL STONE MEETING SIZE LIMITATIONS, ARE TO BE SALVAGED FOR REUSE WITHIN THE PROJECT AT THE DISCRETION OF THE ENGINEER.
-ALL INFLECTION POINTS BETWEEN SLOPE ANGLES SHALL BE ROUNDED SLIGHTLY IN ORDER TO PROVIDE FOR SMOOTH TRANSITIONS AND A MORE NATURAL APPEARANCE.

UTILITY/SUBSURFACE PLANS:
-NO SUBSURFACE PLANS ARE AVAILABLE ON THIS PROJECT. EXISTING UNDERGROUND UTILITIES HAVE NOT BEEN VERIFIED. THE CONTRACTOR IS RESPONSIBLE FOR CONTACTING A UTILITY LOCATOR AND ESTABLISHING THE EXACT LOCATION OF ANY AND ALL EXISTING UTILITIES IN THE PROJECT REACH.

PROJECT LEGEND

STREAM RESTORATION

Proposed Thalweg w/Approximate Bankfull Limits ..... 22+00 33+00

Proposed Offset Rock Cross Vane .....

Proposed Channel Block .....

Proposed Riffle Grade Control .....

Proposed Riffle Enhancement .....

VEGETATION

Existing Woods Line .....

Single Tree .....

TOPOGRAPHY

Minor Contour Line .....

Major Contour Line 720

MISCELLANEOUS

Existing Barbed Wire Fencing .....

A	SUBMITTED WITH CONCEPTUAL PLAN (30%)	JAN 2007	
B	SUBMITTED WITH RESTORATION PLAN (60%)	FEB 2007	
C	SUBMITTED WITH RESTORATION PLAN REVISIONS (60%)	JUN 2007	
SYM.	DESCRIPTION	DATE	APPROVED

REVISIONS

Ecosystem Enhancement Program

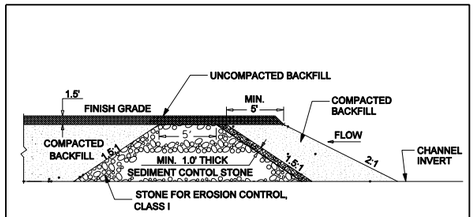
KCI ASSOCIATES OF NC
ENGINEERS • PLANNERS • SCIENTISTS
4601 SIX FORKS ROAD
RALEIGH, NORTH CAROLINA 27609

LITTLE TROUBLESOME CREEK
STREAM RESTORATION AND WETLAND ENHANCEMENT AND PRESERVATION
REIDSVILLE, ROCKINGHAM COUNTY, NORTH CAROLINA

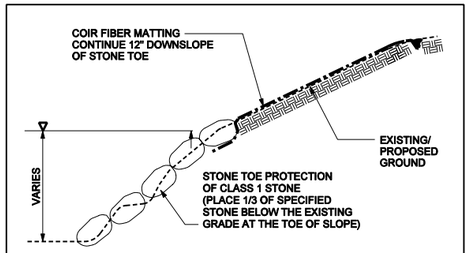
DATE: FEB 2007
SCALE: N.T.S.

GENERAL NOTES & PROJECT LEGEND

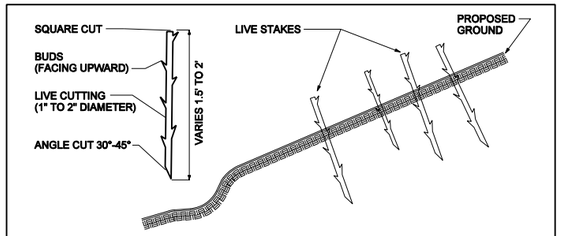
SHEET 1A OF 13



CHANNEL BLOCK
SCALE: NTS



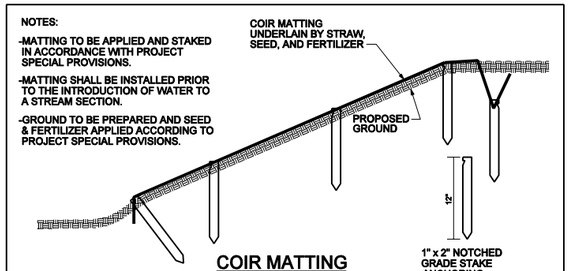
STONE TOE STABILIZATION
SCALE: NTS



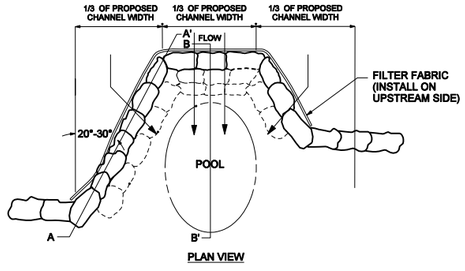
LIVE STAKES
SCALE: NTS

NOTE: LIVE STAKES TO BE INSTALLED IN ACCORDANCE WITH PROJECT SPECIAL PROVISIONS AND AS DIRECTED BY THE ENGINEER.

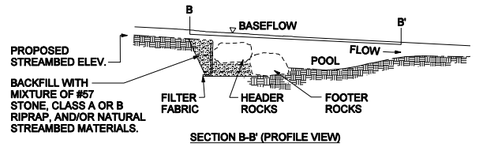
NOTES:
-MATTING TO BE APPLIED AND STAKED IN ACCORDANCE WITH PROJECT SPECIAL PROVISIONS.
-MATTING SHALL BE INSTALLED PRIOR TO THE INTRODUCTION OF WATER TO A STREAM SECTION.
-GROUND TO BE PREPARED AND SEED & FERTILIZER APPLIED ACCORDING TO PROJECT SPECIAL PROVISIONS.



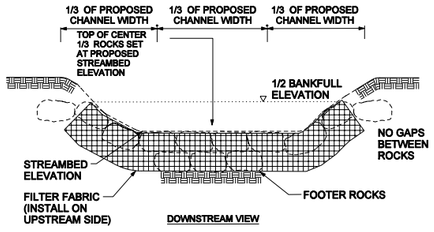
COIR MATTING
SCALE: NTS



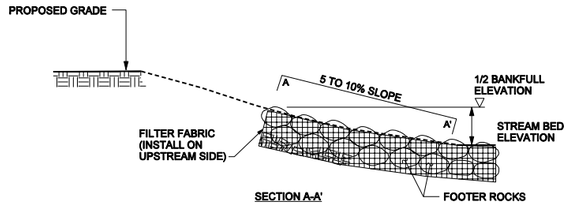
PLAN VIEW



SECTION B-B' (PROFILE VIEW)



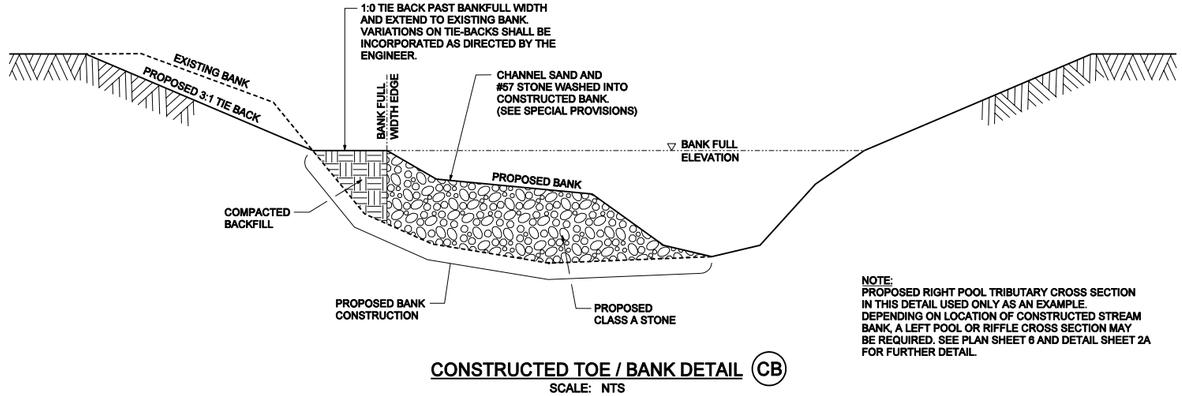
DOWNSTREAM VIEW



SECTION A-A'

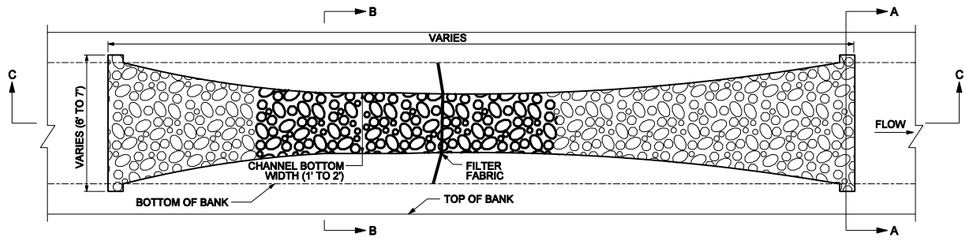
OFFSET ROCK CROSS VANE
SCALE: NTS

NOTE: (1) ALL ROCKS OR STONES IN THE VANE STRUCTURE ARE STONE BOULDERS.
(2) SHORT CROSS VANE ARM TO BE HALF THE SLOPE OF THE FULL ARM SLOPE.

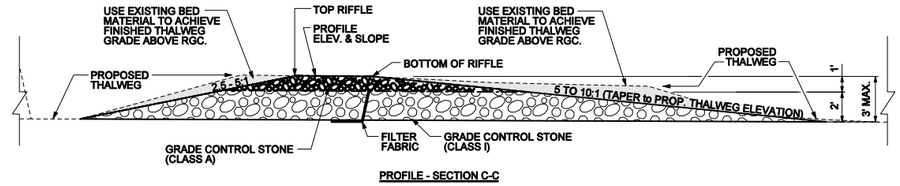


CONSTRUCTED TOE / BANK DETAIL (CB)
SCALE: NTS

NOTE:
PROPOSED RIGHT POOL TRIBUTARY CROSS SECTION IN THIS DETAIL USED ONLY AS AN EXAMPLE. DEPENDING ON LOCATION OF CONSTRUCTED STREAM BANK, A LEFT POOL OR RIFFLE CROSS SECTION MAY BE REQUIRED. SEE PLAN SHEET 6 AND DETAIL SHEET 2A FOR FURTHER DETAIL.

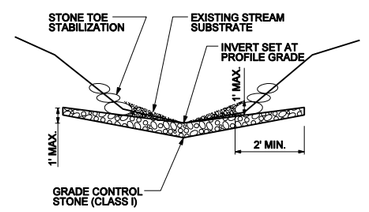


PLAN VIEW

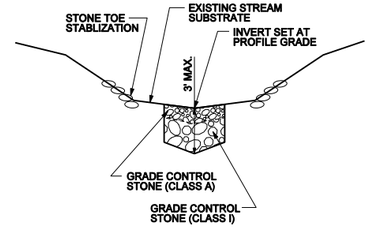


PROFILE - SECTION C-C

RIFFLE GRADE CONTROL
SCALE: NTS



SECTION A-A



SECTION B-B

A	SUBMITTED WITH CONCEPTUAL PLAN (30%)	JAN 2007		
B	SUBMITTED WITH RESTORATION PLAN (60%)	FEB 2007		
C	SUBMITTED WITH RESTORATION PLAN REVISIONS (60%)	JUN 2007		
SYM.	DESCRIPTION	DATE	APPROVED	

REVISIONS

Ecosystem Enhancement Program

KCI ASSOCIATES OF NC
ENGINEERS • PLANNERS • SCIENTISTS
4601 SIX FORKS ROAD
RALEIGH, NORTH CAROLINA 27609

LITTLE TROUBLESOME CREEK
STREAM RESTORATION AND WETLAND
ENHANCEMENT AND PRESERVATION
REIDSVILLE, ROCKINGHAM COUNTY, NORTH CAROLINA

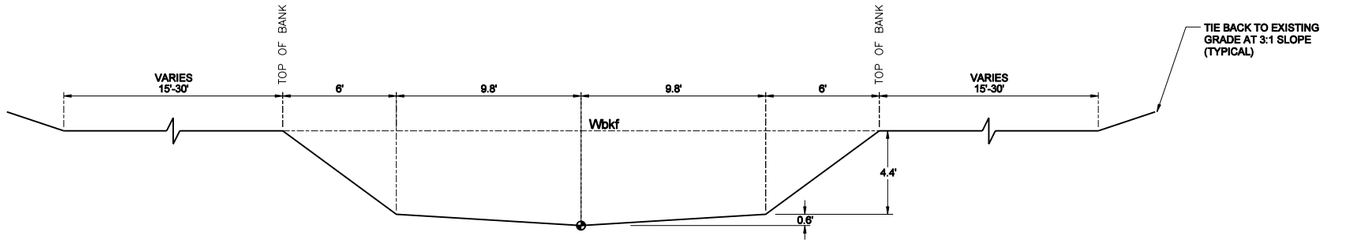
DATE: FEB 2007
SCALE:

DETAILS:
STABILIZATION

SHEET 2 OF 13

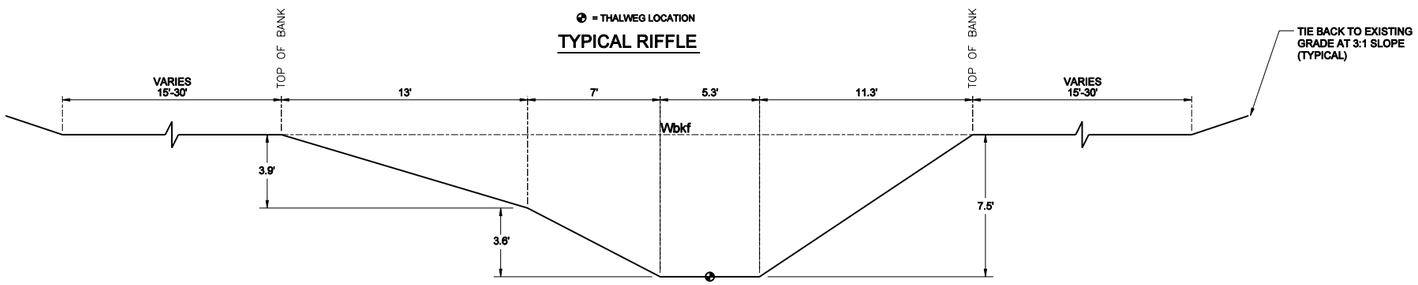
MAIN CHANNEL
TYPICAL CROSS-SECTIONS
"E4" STREAM TYPE

GRAPHIC SCALE
–4 –2 0 4 8



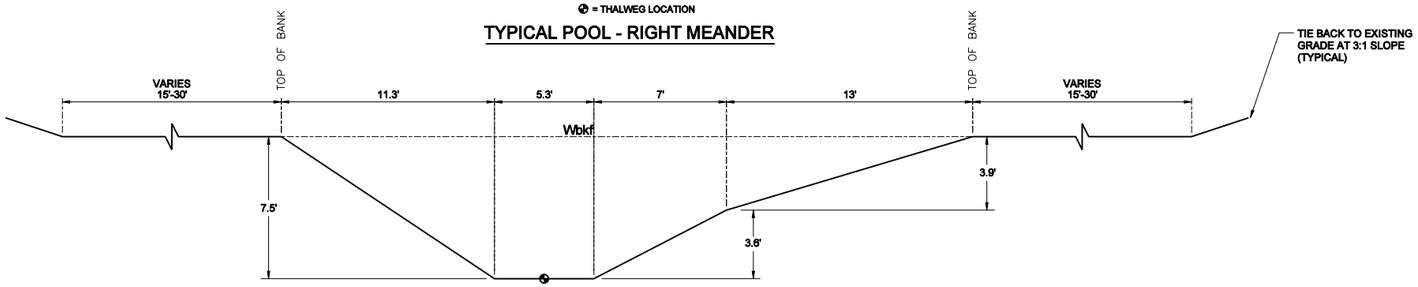
⊕ = THALWEG LOCATION

TYPICAL RIFFLE



⊕ = THALWEG LOCATION

TYPICAL POOL - RIGHT MEANDER

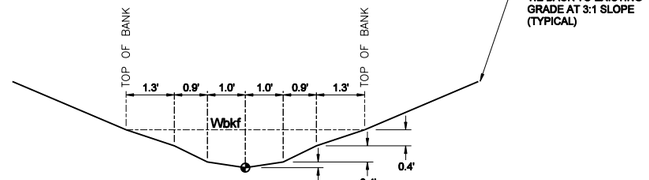


⊕ = THALWEG LOCATION

TYPICAL POOL - LEFT MEANDER

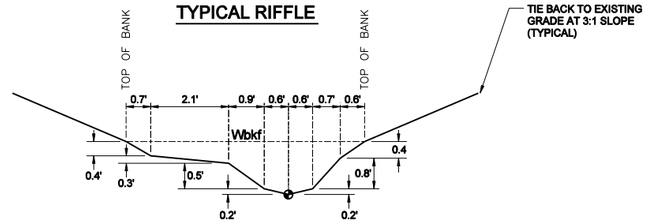
TRIBUTARY
TYPICAL CROSS-SECTIONS
"B4c" STREAM TYPE

GRAPHIC SCALE
–2 –1 0 2 4



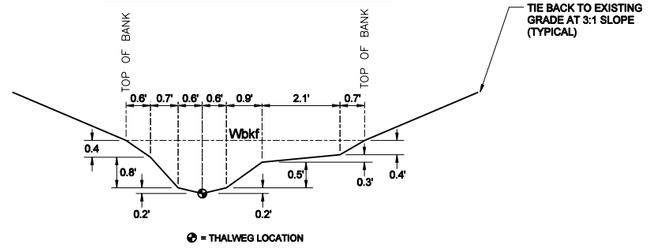
⊕ = THALWEG LOCATION

TYPICAL RIFFLE



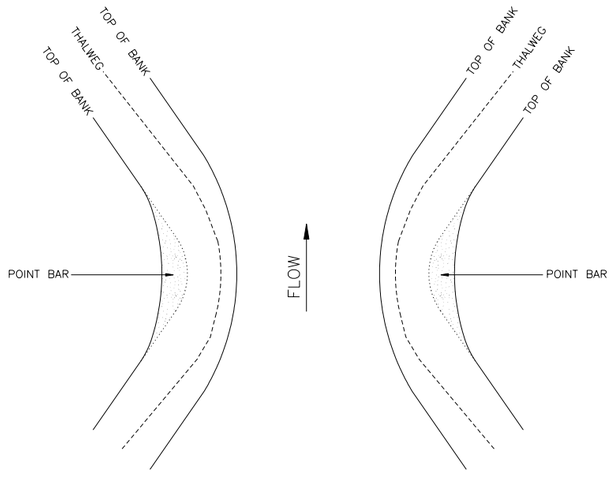
⊕ = THALWEG LOCATION

TYPICAL POOL - RIGHT MEANDER



⊕ = THALWEG LOCATION

TYPICAL POOL - LEFT MEANDER



RIGHT MEANDER
NOT TO SCALE

LEFT MEANDER
NOT TO SCALE

	DESCRIPTION	DATE
A	SUBMITTED WITH CONCEPTUAL PLAN (30%)	JAN 2007
B	SUBMITTED WITH RESTORATION PLAN (60%)	FEB 2007
C	SUBMITTED WITH RESTORATION PLAN REVISIONS (60%)	JUN 2007
SYM.	REVISIONS	APPROVED

Ecosystem Enhancement Program

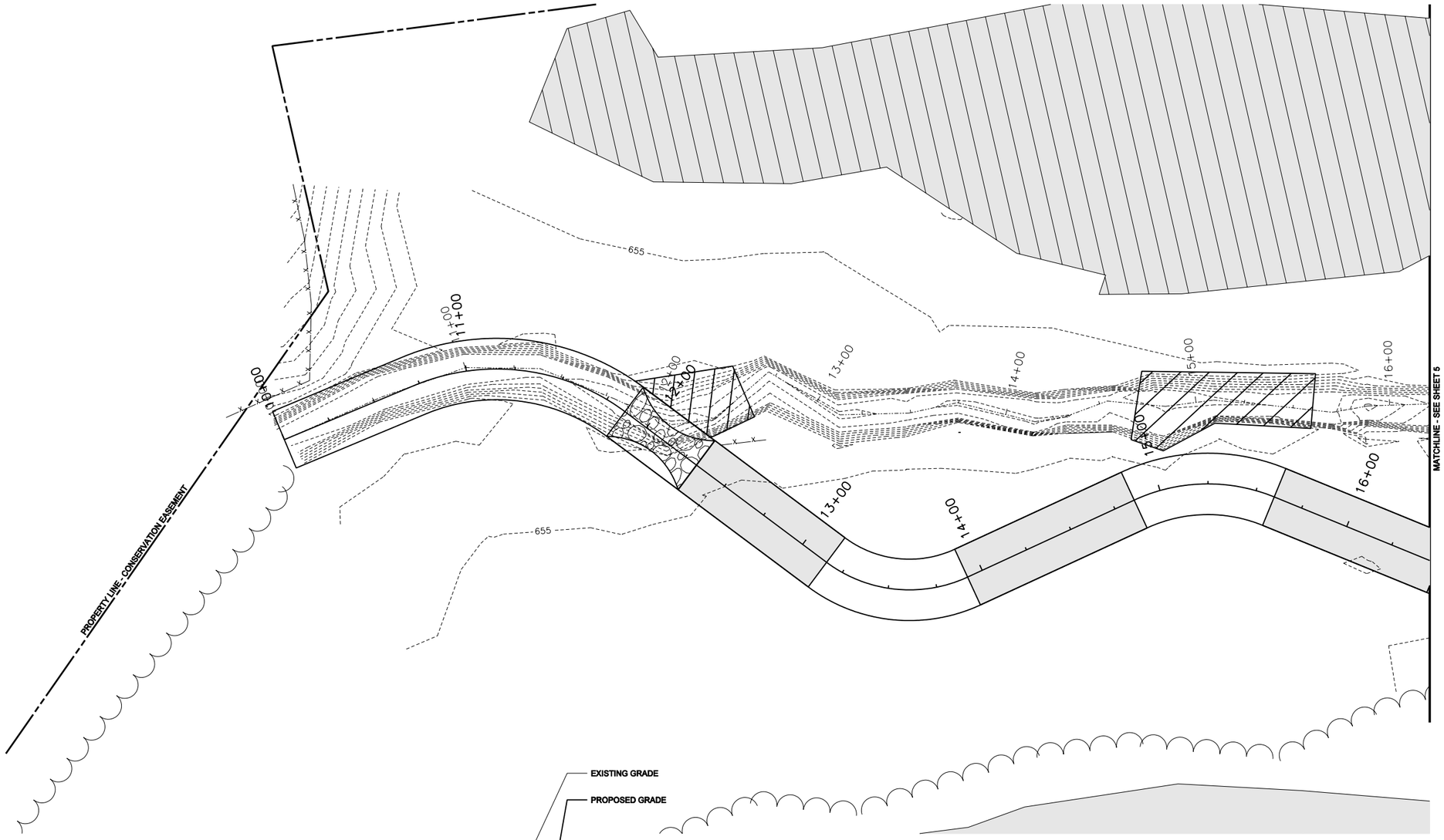
KCI ASSOCIATES OF NC
ENGINEERS • PLANNERS • SCIENTISTS
4601 SIX FORKS ROAD
RALEIGH, NORTH CAROLINA 27609

LITTLE TROUBLESOME CREEK
STREAM RESTORATION AND WETLAND ENHANCEMENT AND PRESERVATION
REIDSVILLE, ROCKINGHAM COUNTY, NORTH CAROLINA

DATE: FEB 2007
SCALE: N.T.S.

DETAILS: TYPICAL XS

SHEET 2A OF 13



A	SUBMITTED WITH CONCEPTUAL PLAN (30%)	JAN 2007
B	SUBMITTED WITH RESTORATION PLAN (60%)	FEB 2007
C	SUBMITTED WITH RESTORATION PLAN REVISIONS (60%)	JUN 2007

SYM.	DESCRIPTION	DATE	APPROVED
	REVISIONS		

Ecosystem Enhancement Program

KCI ASSOCIATES OF NC
ENGINEERS • PLANNERS • SCIENTISTS
4601 SW FORKS ROAD
RALEIGH, NORTH CAROLINA 27609

LITTLE TROUBLESOME CREEK STREAM RESTORATION AND WETLAND ENHANCEMENT AND PRESERVATION

REIDSVILLE, ROCKINGHAM COUNTY, NORTH CAROLINA

STATION 10+00 TO STATION 16+46

DATE: FEB 2007
SCALE: 1"=30'

PLAN AND PROFILE

SHEET 4 OF 13

NC GRID
NAD 83

–30 –15 0 30 60
GRAPHIC SCALE

MATCHLINE - SEE SHEET 5

17+00 18+00 19+00 20+00 21+00 22+00 23+00 24+00

655

56+00 57+00 58+00

FLARE STREAM BANKS AT CONFLUENCE TO REDUCE EDDY EROSION

CONSTRUCT ROCK SILL WITH FOOTERS (STONE, BOULDERS) FINISH TOP ELEVATION = EXISTING BED ELEVATION

PROPERTY LINE - CONSERVATION EASEMENT

EXISTING GRADE

PROPOSED GRADE

656
652
648
644
640
636

VPI STA. 16+49.68
ELEVATION 647.69

VPI STA. 16+62.30
ELEVATION 645.47

VPI STA. 16+88.03
ELEVATION 645.45

VPI STA. 17+13.76
ELEVATION 647.64

VPI STA. 18+17.39
ELEVATION 647.53

VPI STA. 18+45.57
ELEVATION 645.01

VPI STA. 18+59.85
ELEVATION 644.98

VPI STA. 18+73.74
ELEVATION 647.48

VPI STA. 19+86.52
ELEVATION 646.99

VPI STA. 20+28.74
ELEVATION 644.47

VPI STA. 20+44.85
ELEVATION 644.45

VPI STA. 20+60.96
ELEVATION 646.94

VPI STA. 21+86.20
ELEVATION 648.40

VPI STA. 22+29.59
ELEVATION 643.88

VPI STA. 22+46.79
ELEVATION 643.86

VPI STA. 22+63.98
ELEVATION 648.35

645.90

16+00 17+00 18+00 19+00 20+00 21+00 22+00 23+00 24+00

A	SUBMITTED WITH CONCEPTUAL PLAN (30%)	JAN 2007
B	SUBMITTED WITH RESTORATION PLAN (60%)	FEB 2007
C	SUBMITTED WITH RESTORATION PLAN REVISIONS (60%)	JUN 2007

SYM.	DESCRIPTION	DATE	APPROVED
	REVISIONS		

Ecosystem Enhancement Program

KCI ASSOCIATES OF NC
ENGINEERS • PLANNERS • SCIENTISTS
4601 SIX FORKS ROAD
RALEIGH, NORTH CAROLINA 27609

LITTLE TROUBLESOME CREEK STREAM RESTORATION AND WETLAND ENHANCEMENT AND PRESERVATION

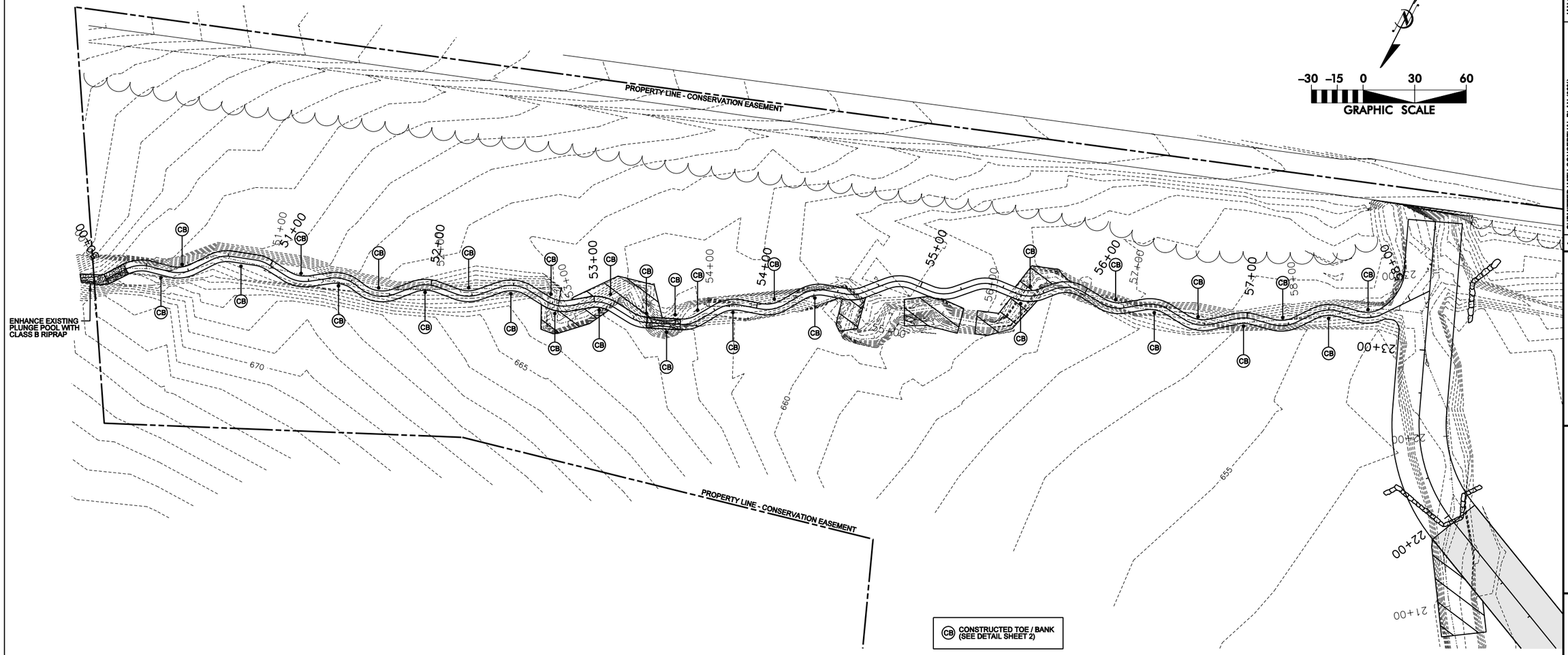
REIDSVILLE, ROCKINGHAM COUNTY, NORTH CAROLINA

STATION 16+46 TO STATION 23+75

DATE: FEB 2007
SCALE: 1"=30'

PLAN AND PROFILE

SHEET 5 OF 13



	DESCRIPTION	DATE	APPROVED
A	SUBMITTED WITH CONCEPTUAL PLAN (30%)	JAN 2007	
B	SUBMITTED WITH RESTORATION PLAN (60%)	FEB 2007	
C	SUBMITTED WITH RESTORATION PLAN REVISIONS (60%)	JUN 2007	
SYM.	REVISIONS		

Ecosystem Enhancement Program

KCI ASSOCIATES OF NC
ENGINEERS • PLANNERS • SCIENTISTS
4601 SIX FORKS ROAD
RALEIGH, NORTH CAROLINA 27609

LITTLE TROUBLESOME CREEK STREAM RESTORATION AND WETLAND ENHANCEMENT AND PRESERVATION

REIDSVILLE, ROCKINGHAM COUNTY, NORTH CAROLINA

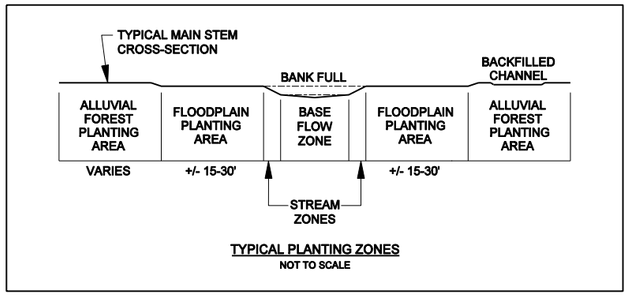
STATION 50+00 TO STATION 58+13

DATE: FEB 2007

SCALE: 1"=30'

PLAN AND PROFILE

SHEET 6 OF 13



TYPICAL PLANTING ZONES
NOT TO SCALE

PLANTING PLAN AND SPECIES COMPOSITION

ZONE A

STREAM ZONE = 0.56 - ACRE (24,225 SQ.FT.)

LIVE STAKES: 1.5' TO 2' LENGTHS, 1/2" TO 2" DIAMETER, 3' CENTER SPACING, RANDOM SPECIES PLACEMENT

COMMON NAME	SCIENTIFIC NAME
BLACK WILLOW	SALIX NIGRA
SILKY WILLOW	SALIX SERICEA
SILKY DOGWOOD	CORNUS AMOMUM
ELDERBERRY	SAMBUCUS CANADENSIS

NOTE: NO SINGLE LIVE STAKING SPECIES SHALL COMPOSE MORE THAN 40% OF THE 3,100 TOTAL NUMBER OF LIVE STAKES TO BE INSTALLED

ZONE B

FLOODPLAIN PLANTING AREA = 1.35 ACRES

18" - 24" BARE ROOT MATERIAL
436 STEMS/ACRE (10' X 10' SPACING), RANDOM SPECIES PLACEMENT

COMMON NAME	SCIENTIFIC NAME	% OF TOTAL	# OF PLANTS
BOXELDER	ACER NEGUNDO	20	118
WILLOW OAK	QUERCUS PHELLOS	20	118
SYCAMORE	PLATANUS OCCIDENTALIS	20	118
RIVER BIRCH	BETULA NIGRA	20	118
SWAMP CHESTNUT OAK	QUERCUS MICHAUXII	20	118
		100	590

* UNDISTURBED FORESTED AREAS WITHIN PLANTING ZONE WILL NOT BE PLANTED

ZONE C

ALLUVIAL FOREST PLANTING AREA = 8.39 ACRES

18" - 24" BARE ROOT MATERIAL
436 STEMS/ACRE (10' X 10' SPACING), RANDOM SPECIES PLACEMENT

COMMON NAME	SCIENTIFIC NAME	% OF TOTAL	# OF PLANTS
SPICEBUSH	LINDERA BENZOIN	5	183
WILLOW OAK	QUERCUS PHELLOS	5	183
PERSIMMON	DIOSPYROS VIRGINIANA	5	183
GREEN ASH	FRAXINUS PENNSYLVANICA	5	183
SYCAMORE	PLATANUS OCCIDENTALIS	20	732
SUGARBERRY	CELTIS LAEVIGATA	20	732
RIVER BIRCH	BETULA NIGRA	20	732
SWAMP CHESTNUT OAK	QUERCUS MICHAUXII	20	732
		100	3660

* UNDISTURBED FORESTED AREAS WITHIN PLANTING ZONE WILL NOT BE PLANTED

PLANTING PLAN AND SPECIES COMPOSITION

ZONE D

WETLAND ENHANCEMENT PLANTING AREA #1 = 1.17 ACRES

18" - 24" BARE ROOT MATERIAL
436 STEMS/ACRE (10' X 10' SPACING), RANDOM SPECIES PLACEMENT

COMMON NAME	SCIENTIFIC NAME	% OF TOTAL	# OF PLANTS
SUGARBERRY	CELTIS LAEVIGATA	20	102
WILLOW OAK	QUERCUS PHELLOS	20	102
SYCAMORE	PLATANUS OCCIDENTALIS	20	102
RIVER BIRCH	BETULA NIGRA	20	102
SWAMP CHESTNUT OAK	QUERCUS MICHAUXII	20	102
		100	510

* UNDISTURBED FORESTED AREAS WITHIN PLANTING ZONE WILL NOT BE PLANTED

ZONE E

WETLAND ENHANCEMENT PLANTING AREA #2 = 0.74 - ACRE

18" - 24" BARE ROOT MATERIAL
100 STEMS/ACRE (10' X 10' SPACING), RANDOM SPECIES PLACEMENT

COMMON NAME	SCIENTIFIC NAME	% OF TOTAL	# OF PLANTS
SUGARBERRY	CELTIS LAEVIGATA	20	15
WILLOW OAK	QUERCUS PHELLOS	20	15
SYCAMORE	PLATANUS OCCIDENTALIS	20	15
RIVER BIRCH	BETULA NIGRA	20	15
SWAMP CHESTNUT OAK	QUERCUS MICHAUXII	20	15
		100	75

* UNDISTURBED FORESTED AREAS WITHIN PLANTING ZONE WILL NOT BE PLANTED

WETLAND PERSERVATION

EXISTING TREE LINE

NAD 1983 NC

-100 -50 0 100 200
GRAPHIC SCALE

A	SUBMITTED WITH CONCEPTUAL PLAN (30%)	JAN 2007		
B	SUBMITTED WITH RESTORATION PLAN (60%)	FEB 2007		
C	SUBMITTED WITH RESTORATION PLAN REVISIONS (60%)	JUN 2007		
	DESCRIPTION	DATE	APPROVED	

REVISIONS

Ecosystem Enhancement PROGRAM

KCI ASSOCIATES OF NC
ENGINEERS • PLANNERS • SCIENTISTS
4601 SIX FORKS ROAD
RALEIGH, NORTH CAROLINA 27609

LITTLE TROUBLESOME CREEK STREAM RESTORATION AND WETLAND ENHANCEMENT AND PRESERVATION

REIDSVILLE, ROCKINGHAM COUNTY, NORTH CAROLINA

DATE: FEB 2007
SCALE: 1"=30'

PLANTING PLAN

SHEET 10 OF 13

...\CADD\10_ltrCPL.dgn 6/26/2007 2:06:58 PM

APPENDICES

Appendix A

Existing Site Photographs

Recorded Easement Plat

Existing Photos (Little Troublesome Creek)

Photo 01: (8/30/06) Start of project reach.

Photo 02: (9/14/06) Day after a heavy rain event, LTC is at top of bank.

Photo 03: (9/14/06) Day after a heavy rain event.

Photo 04, 05, 06: (8/23/06) Upstream section of the project reach, heavy cattle access area.

Photo 07: (8/23/06) Upstream section of the project reach, Bank has eroded and the tree has fallen in the stream.

Photo 08: (8/30/06) Looking downstream at LTC.

Photo 09, 10: (8/30/06) Looking downstream at LTC.

Photo 11: (8/30/06) Looking downstream at LTC.

Photo 12: (2/5/07) Ditch 1 located in the wetland enhancement 1 area . The ditch is draining the wetland.

Photo 13: (2/5/07) Ditch 1 located in the wetland enhancement 1 area .

Photo 14: (2/5/07) Ditch 2 located in the wetland enhancement 2 area .

Photo 15: (8/30/06) End of project reach looking downstream toward Mizpah Church Road.

Photo 16: (9/14/06) End of project reach looking upstream. Day after heavy rain event.

Photo 17: (9/14/06) End of project reach looking upstream. Day after heavy rain event.

Photo 18: (9/14/06) End of project reach looking upstream. Day after heavy rain event.

Existing Photos (UT1)

Photo 01: (2/6/07) Start of project reach at culvert drop off.

Photo 02: (8/30/06) Upstream section of UT1 looking downstream.

Photo 03, 04, 05, 06, 07, 08, 09, 10, 11, 12: (8/30/06) UT1 looking downstream.

Photo 13, 14: (8/30/06) Downstream section of UT1 looking downstream.

Photo 15: (8/30/06) End of project reach at the confluence of LTC.

Existing Photos (Preservation Area)

Photo 01, 02, 03, 04: (8/23/06) Northwestern portion of the preservation area.

Photo 05, 06, 07: (9/14/06) Day after heavy rain event.

Photo 08: (8/23/06) Southwestern portion of the preservation area.

Photo 09: (9/14/06) Southwestern portion of the preservation area after a heavy rain event. Same vicinity area as photo 09 and 10.

Photo 10: (2/5/07) Southwestern portion of the preservation area. Same vicinity area as photo 08 and 09.

Photo 11: (8/23/06) Southwestern portion of the preservation area.

Photo 12: (8/23/06) Southwestern portion of the preservation area at confluence of LTC.

Existing Photos (Wetland Enhancement 1)

Photo 01, 02, 03: (2/5/07) Wetland Enhancement area 1.

Photo 04: (2/5/07) Wetland Enhancement area 1. View of drainage ditch 1 draining the wetland.

Existing Photos (Wetland Enhancement II)

Photo 01, 02, 03, 04: (2/5/07) Wetland Enhancement area 2.

Existing Photos (Little Troublesome Creek)

01.JPG

02.JPG

03.JPG

04.JPG

05.JPG

06.JPG

Existing Photos (Little Troublesome Creek)

07.JPG

08.JPG

09.JPG

10.JPG

11.JPG

12.JPG

Existing Photos (Little Troublesome Creek)

13.JPG

14.JPG

15.JPG

16.JPG

17.JPG

18.JPG

Existing Photos (UT1)

07.JPG

08.JPG

09.JPG

10.JPG

11.JPG

12.JPG

Existing Photos (UT1)

01.JPG

02.JPG

03.JPG

04.JPG

05.JPG

06.JPG

Existing Photos (UT1)

13.JPG

14.JPG

15.JPG

Existing Photos (Preservation Area)

01.JPG

02.JPG

03.JPG

04.JPG

05.JPG

06.JPG

Existing Photos (Preservation Area)

07.JPG

08.JPG

09.JPG

10.JPG

11.JPG

12.JPG

Existing Photos (Wetland Enhancement 1)

01.JPG

02.JPG

03.JPG

04.JPG

Existing Photos (Wetland Enhancement 2)

01.JPG

02.JPG

03.JPG

04.JPG

59-82

59-82

LEGEND
E.I.S. = EXISTING IRON STAKE
I.S. = IRON STAKE
MON. = CONCRETE MONUMENT
℄ = CENTER LINE
M.H. = MAN HOLE
R/W = RIGHT-OF-WAY
O.H. ELEC. = OVERHEAD ELECTRIC
U.G. ELEC. = UNDERGROUND ELECTRIC
PT. = POINT
F.H. = FIRE HYDRANT
NOTE: THIS SURVEY HAS BEEN PREPARED WITHOUT THE BENEFIT OF A TITLE REPORT AND, THEREFORE, DOES NOT NECCESSARILY INDICATE ALL ENCUMBRANCES ON THE PROPERTY.
SUBJECT TO ANY EASEMENTS, AGREEMENTS OR RIGHTS-OF-WAYS OF RECORD WHICH WERE NOT VISIBLE AT THE TIME OF INSPECTION.
NOTE: THIS SURVEY IS OF ANOTHER CATEGORY, SUCH AS THE RECOMBINATION OF EXISTING PARCELS, A COURT-ORDERED SURVEY OR OTHER EXCEPTION TO THE DEFINITION OF SUBDIVISION.
C. E. ROBERTSON, PLS L-1421
SITE
"VICINITY MAP" NO SCALE
NC HWY. 87
S.R. 2600
60' R/W
MIZPAH CHURCH ROAD
ROCKINGHAM COUNTY BOARD OF EDUCATION D.B.1110-P.622 "PARCEL ONE"
RONALD NORMAN PERKINS CHARLES WILLIAM PERKINS D.B.1220-P.1921
RONALD NORMAN PERKINS CHARLES WILLIAM PERKINS D.B.776-P.2494
JAMES G. MITCHELL PAMELA MITCHELL & OTHERS D.B.367-P.32 W.B.94E-P.003
JAMES G. MITCHELL PAMELA MITCHELL & OTHERS D.B.651-P.384 W.B.94E-P.003
JAMES G. MITCHELL PAMELA MITCHELL D.B.748-P.740
DOUGLAS E. COFFER D.B.1110-P.722
NEAL EDWARD HALL D.B.892-P.2041
CURTIS STERLING CHILTON & GERALDINE STANLEY CHILTON D.B.875-P.1098 D.B.937-P.729
MICHAEL LEE ROBERTSON & PAMELA GOODWIN ROBERTSON D.B.931-P.1147
"CONSERVATION EASEMENT A" D.B.892-P.2041
20.264 Ac. (TOTAL)
-0.265 Ac. (IN R/W)
19.999 Ac. (NET)
BY D.M.D
"CONSERVATION EASEMENT B"
10.006 Ac. BY D.M.D
D.B.651-P.384
D.B.367-P.32
LITTLE TROUBLESOME CREEK
OLD TRACT LINE
LINE AA
LINE BB
SURVEY MEANDER LINE IS FOR THE PURPOSE OF CLOSING THE SUBJECT BOUNDARIES. PROPERTY LINE IS WITH THE CENTERLINE OF LITTLE TROUBLESOME CREEK AS IT MEANDERS.
APPROXIMATE LOCATION OF TRIBUTARY STREAMS AS SHOWN ON GIS INFORMATION AS PROVIDED BY THE ECOSYSTEM ENHANCEMENT PROGRAM
AREA TO BE RETAINED BY JAMES G. MITCHELL & OTHERS
"CONTROL CORNER"
N81°16'12"E 1745.2726' (GRID) (COMBINED FACTOR: 0.99976090)
N45°03'07"E 1477.16' (TIE LINE)
N30°30'34"W 1302.31' (TIE LINE)
S84°10'23"E 439.04'
S87°17'54"E 447.47'
S87°12'52"E (616.05') 578.02'
S87°12'52"E 155.04'
N53°04'50"W 51.33'
N88°28'39"W 38.03'
N60°07'27"W 73.51'
N48°04'07"W 24.87'
N30°04'15"W 34.46'
N14°46'39"E 26.29'
N18°55'29"W 37.87'
N47°07'12"W 66.26'
N15°26'54"W 44.82'
N38°11'30"W 87.54'
N23°48'53"W 87.72'
S88°54'52"W 181.29'
N52°40'46"W 113.04'
N88°38'51"W 129.08'
N48°29'34"W 41.79'
N27°28'06"W 94.23'
N70°43'41"E 380.82'
S70°43'41"W
N70°43'41"E 201.79'
N17°59'08"W 57.70'
N34°25'22"W 20.40'
N34°25'22"W 31.08'
S57°11'05"W 54.80'
S70°43'41"W 29.51'
N70°39'58"E 17.24' arc 17.24' ch.
N70°43'16"E 32.74' arc 32.74' ch.
N70°50'18"E 316.83'
N70°36'15"E 195.00'
S70°46'14"W 707.76'
N78°32'36"E 246.04'
12.74'
0.87'
30.01'
40.03'
ELEC. POLE
SEE MAP FOR CURTIS S. CHILTON BY C.E. MOORE JR. ON APRIL 6, 1995 D.B.937-P.731
SEE MAP FOR MICHAEL LEE ROBERTSON BY DAVID E. WILSON SEPTEMBER, 1995 D.B.931-P.1149
SEE MAP FOR JAMES G. MITCHELL & PAMELA M. MITCHELL BY C.E. MOORE JR. ON SEPTEMBER 29, 1992
NOTE: UP TO TWO FUTURE DRIVEWAY CROSSINGS, EACH NO MORE THAN 30 FEET WIDE, ARE RESERVED BETWEEN LINES AA AND BB.
NOTE: DISTANCES SHOWN ARE HORIZONTAL GROUND DISTANCES UNLESS OTHERWISE NOTED.
NORTH CAROLINA ROCKINGHAM COUNTY
I, C. E. ROBERTSON, CERTIFY THAT THIS PLAT WAS DRAWN UNDER MY SUPERVISION FROM AN ACTUAL SURVEY MADE UNDER MY SUPERVISION (DEED DESCRIPTION RECORDED IN BOOK 892 PAGE 2041, BOOK 651 PAGE 348, & BOOK 367 PAGE 32, ETC.), THAT THE BOUNDARIES NOT SURVEYED ARE SHOWN AS BROKEN LINES, THAT THE RATIO OF PERCISION AS CALCULATED IS 1:10,000, THAT THIS PLAT WAS PREPARED IN ACCORDANCE WITH G.S. 47-30 AMENDED. WITNESS MY ORIGINAL SIGNATURE, REGISTRATION NUMBER, AND SEAL THIS 11th DAY OF APRIL A.D. 2006.
SURVEYOR
LICENSE NUMBER L-1421
STATE OF NORTH CAROLINA COUNTY OF ROCKINGHAM
Frankie G. Lazaus, REVIEW OFFICER OF Rockingham County, CERTIFY THAT THE MAP OR PLAT TO WHICH THIS CERTIFICATION IS AFFIXED MEETS ALL STATUTORY REQUIREMENTS FOR RECORDING.
REVIEW OFFICER
7-13-2006
DATE
NORTH CAROLINA ROCKINGHAM COUNTY
FILED FOR REGISTRATION AT 10:29:21 O'CLOCK A.M. ON THE 13 DAY OF July 2006 AND RECORDED IN BOOK 59 PAGE 82
REBECCA B. CIPRIANI, REGISTER OF DEEDS
ASST/DEPUTY REGISTER OF DEEDS
REVISED 7-11-06 TO SHOW LOCATION OF ELECTRIC POLES AND ELECTRIC LINE AND TO SHOW CHANGE IN CONSERVATION EASEMENT B.
REVISED 6-23-06 TO SHOW APPROXIMATE LOCATON OF ELECTRIC POLES AND ELECTRIC LINE.
PREVIOUSLY RECORDED IN MB.58-P.45.
CONSERVATION EASEMENT FOR
NC ECOSYSTEM ENHANCEMENT PROGRAM ON THE PROPERTY OF: MR. NEAL HALL (SPO#079-AAG) AND MR. JAMES G. MITCHELL (SPO#079-AAI)
WILLIAMSBURG TWSP. ROCKINGHAM CO.
NORTH CAROLINA
APRIL 11, 2006
REVISED 6-23-06, 7-11-06
SCALE 1"= 150'
150 0 150 300 450
SCALE
C.E. ROBERTSON & ASSOCIATES
PROFESSIONAL LAND SURVEYOR L-1421
P.O. BOX 584
EDEN, NC 27289
PH. (336) 627-0498
JOBNAME: STATE EASEMENT

Appendix B
NCDWQ Stream Classification Forms

NCDWQ Stream Classification Form

Project Name: **Little Troublesome-Preservation area-1**
River Basin: **Cape Fear** County: **Rockingham** Evaluator: **AH**
DWQ Project Number: Nearest Named Stream: Latitude: Signature:
Date: **September 6, 2006** USGSQUAD: **Williamsburg** Longitude: Location/Directions:

Please Note:** ***If evaluator and landowner agree that the feature is a man-made ditch, then use of this form is not necessary. Also, if in the best professional judgement of the evaluator, the feature is a man-made ditch and not a modified natural stream—this rating system should not be used*

Primary Field Indicators: *(Circle One Number Per Line)*

I. Geomorphology	Absent	Weak	Moderate	Strong
1) Is There A Riffle-Pool Sequence?	(0)	1	2	3
2) Is The USDA Texture In Streambed Different From Surrounding Terrain?	0	(1)	2	3
3) Are Natural Levees Present?	(0)	1	2	3
4) Is The Channel Sinuous?	(0)	1	2	3
5) Is There An Active (Or Relic) Floodplain Present?	0	1	2	(3)
6) Is The Channel Braided?	(0)	1	2	3
7) Are Recent Alluvial Deposits Present?	(0)	1	2	3
8) Is There A Bankfull Bench Present?	(0)	1	2	3
9) Is A Continuous Bed & Bank Present?	0	(1)	2	3
*(*NOTE: If Bed & Bank Caused By Ditching And **WITHOUT** Sinuosity Then Score=0*)*				
10) Is A 2nd Order Or Greater Channel (As Indicated On Topo Map ***And/Or*** In Field) Present?		***Yes*** = 3	***No*** = (0)	

Primary Geomorphology Indicator Points:__5__

II. Hydrology	Absent	Weak	Moderate	Strong
1) Is There A Groundwater Flow/Discharge Present?	(0)	1	2	3

Primary Hydrology Indicator Points:__0__

III. Biology	Absent	Weak	Moderate	Strong
1) Are Fibrous Roots Present In Streambed?	(3)	2	1	0
2) Are Rooted Plants Present In Streambed?	3	2	1	(0)
3) Is Periphyton Present?	(0)	1	2	3
4) Are Bivalves Present?	(0)	1	2	3

Primary Biology Indicator Points:____3___

Secondary Field Indicators: *(Circle One Number Per Line)*

I. Geomorphology	Absent	Weak	Moderate	Strong
1) Is There A Head Cut Present In Channel?	(0)	.5	1	1.5
2) Is There A Grade Control Point In Channel?	(0)	.5	1	1.5
3) Does Topography Indicate A Natural Drainage Way?	0	(.5)	1	1.5

Secondary Geomorphology Indicator Points:__.5__

II. Hydrology	Absent	Weak	Moderate	Strong
1) Is This Year's (Or Last's) Leaf litter Present In Streambed?	1.5	1	.5	(0)
2) Is Sediment On Plants (Or Debris) Present?	0	.5	1	(1.5)
3) Are Wrack Lines Present?	(0)	.5	1	1.5
4) Is Water In Channel ***And*** >48 Hrs. Since Last ***Known*** Rain? *(*NOTE: If Ditch Indicated In #9 Above Skip This Step And #5 Below*)*	(0)	.5	1	1.5
5) Is There Water In Channel During Dry Conditions ***Or*** In Growing Season)?	(0)	.5	1	1.5
6) Are Hydric Soils Present In Sides Of Channel (Or In Headcut)?		***Yes*** = (1.5)	***No*** = 0	

Secondary Hydrology Indicator Points:__3__

III. Biology	Absent	Weak	Moderate	Strong		
1) Are Fish Present?	(0)	.5	1	1.5		
2) Are Amphibians Present?	(0)	.5	1	1.5		
3) Are Aquatic Turtles Present?	(0)	.5	1	1.5		
4) Are Crayfish Present?	(0)	.5	1	1.5		
5) Are Macro benthos Present?	(0)	.5	1	1.5		
6) Are Iron Oxidizing Bacteria/Fungus Present?	(0)	.5	1	1.5		
7) Is Filamentous Algae Present?	(0)	.5	1	1.5		
8) Are Wetland Plants In Streambed?	SAV	Mostly OBL	Mostly FACW	Mostly FAC	Mostly FACU	Mostly UPL
(**NOTE:** If Total Absence Of All Plants In Streambed As Noted Above Skip This Step **UNLESS** SAV Present*).*	2	(1)	.75	.5	0	0

Secondary Biology Indicator Points: *1*

TOTAL POINTS ***(Primary + Secondary)*** = *12.5* ***(If ≥ 19 points the stream is at least intermittent)***

NCDWQ Stream Classification Form

Project Name: **Little Troublesome-Preservation area-2**
River Basin: **Cape Fear** County: **Rockingham** Evaluator: **AH**
DWQ Project Number: Nearest Named Stream: Latitude: Signature:
Date: **September 11, 2006** USGSQUAD: **Williamsburg** Longitude: Location/Directions:

Please Note:** ***If evaluator and landowner agree that the feature is a man-made ditch, then use of this form is not necessary. Also, if in the best professional judgement of the evaluator, the feature is a man-made ditch and not a modified natural stream—this rating system should not be used*

Primary Field Indicators: *(Circle One Number Per Line)*

I. Geomorphology	Absent	Weak	Moderate	Strong
1) Is There A Riffle-Pool Sequence?	(0)	1	2	3
2) Is The USDA Texture In Streambed Different From Surrounding Terrain?	0	(1)	2	3
3) Are Natural Levees Present?	(0)	1	2	3
4) Is The Channel Sinuous?	0	(1)	2	3
5) Is There An Active (Or Relic) Floodplain Present?	0	1	2	(3)
6) Is The Channel Braided?	(0)	1	2	3
7) Are Recent Alluvial Deposits Present?	(0)	1	2	3
8) Is There A Bankfull Bench Present?	(0)	1	2	3
9) Is A Continuous Bed & Bank Present?	0	(1)	2	3
*(*NOTE: If Bed & Bank Caused By Ditching And **WITHOUT** Sinuosity Then Score=0*)*				
10) Is A 2nd Order Or Greater Channel (As Indicated On Topo Map ***And/Or*** In Field) Present?		***Yes*** = 3	***No*** = (0)	

Primary Geomorphology Indicator Points:__6__

II. Hydrology	Absent	Weak	Moderate	Strong
1) Is There A Groundwater Flow/Discharge Present?	0	(1)	2	3

Primary Hydrology Indicator Points:__1__

III. Biology	Absent	Weak	Moderate	Strong
1) Are Fibrous Roots Present In Streambed?	(3)	2	1	0
2) Are Rooted Plants Present In Streambed?	(3)	2	1	0
3) Is Periphyton Present?	(0)	1	2	3
4) Are Bivalves Present?	(0)	1	2	3

Primary Biology Indicator Points:____6___

Secondary Field Indicators: *(Circle One Number Per Line)*

I. Geomorphology	Absent	Weak	Moderate	Strong
1) Is There A Head Cut Present In Channel?	(0)	.5	1	1.5
2) Is There A Grade Control Point In Channel?	(0)	.5	1	1.5
3) Does Topography Indicate A Natural Drainage Way?	0	(.5)	1	1.5

Secondary Geomorphology Indicator Points:__.5__

II. Hydrology	Absent	Weak	Moderate	Strong
1) Is This Year's (Or Last's) Leaf litter Present In Streambed?	1.5	1	(.5)	0
2) Is Sediment On Plants (Or Debris) Present?	0	(.5)	1	1.5
3) Are Wrack Lines Present?	(0)	.5	1	1.5
4) Is Water In Channel ***And*** >48 Hrs. Since Last ***Known*** Rain? *(*NOTE: If Ditch Indicated In #9 Above Skip This Step And #5 Below*)*	0	.5	(1)	1.5
5) Is There Water In Channel During Dry Conditions ***Or*** In Growing Season)?	(0)	.5	1	1.5
6) Are Hydric Soils Present In Sides Of Channel (Or In Headcut)?		***Yes*** = (1.5)	***No*** = 0	

Secondary Hydrology Indicator Points:__3.5__

III. Biology	Absent	Weak	Moderate	Strong
1) Are Fish Present?	0	.5	1	1.5
2) Are Amphibians Present?	0	.5	1	1.5
3) Are Aquatic Turtles Present?	0	.5	1	1.5
4) Are Crayfish Present?	0	.5	1	1.5
5) Are Macro benthos Present?	0	.5	1	1.5
6) Are Iron Oxidizing Bacteria/Fungus Present?	0	.5	1	1.5
7) Is Filamentous Algae Present?	0	.5	1	1.5

8) Are Wetland Plants In Streambed?	SAV	Mostly OBL	Mostly FACW	Mostly FAC	Mostly FACU	Mostly UPL
(**NOTE:** If Total Absence Of All Plants In Streambed As Noted Above Skip This Step **UNLESS** SAV Present*).*	2	1	.75	.5	0	0

Secondary Biology Indicator Points:___0___

TOTAL POINTS *(Primary + Secondary)* = __17__ *(If ≥ 19 points the stream is at least intermittent)*

NCDWQ Stream Classification Form

Project Name: **Little Troublesome-Preservation area-3**
River Basin: **Cape Fear** County: **Rockingham** Evaluator: **AH**
DWQ Project Number: Nearest Named Stream: Latitude: Signature:
Date: **September 11, 2006** USGSQUAD: **Williamsburg** Longitude: Location/Directions:

Please Note:** ***If evaluator and landowner agree that the feature is a man-made ditch, then use of this form is not necessary. Also, if in the best professional judgement of the evaluator, the feature is a man-made ditch and not a modified natural stream—this rating system should not be used*

Primary Field Indicators: *(Circle One Number Per Line)*

I. Geomorphology	Absent	Weak	Moderate	Strong
1) Is There A Riffle-Pool Sequence?	(0)	1	2	3
2) Is The USDA Texture In Streambed Different From Surrounding Terrain?	(0)	1	2	3
3) Are Natural Levees Present?	(0)	1	2	3
4) Is The Channel Sinuous?	0	(1)	2	3
5) Is There An Active (Or Relic) Floodplain Present?	0	1	(2)	3
6) Is The Channel Braided?	(0)	1	2	3
7) Are Recent Alluvial Deposits Present?	(0)	1	2	3
8) Is There A Bankfull Bench Present?	(0)	1	2	3
9) Is A Continuous Bed & Bank Present?	0	(1)	2	3
*(*NOTE: If Bed & Bank Caused By Ditching And **WITHOUT** Sinuosity Then Score=0*)*				
10) Is A 2nd Order Or Greater Channel (As Indicated On Topo Map ***And/Or*** In Field) Present?		***Yes*** = 3	***No*** = (0)	

Primary Geomorphology Indicator Points:__4__

II. Hydrology	Absent	Weak	Moderate	Strong
1) Is There A Groundwater Flow/Discharge Present?	0	(1)	2	3

Primary Hydrology Indicator Points:__1__

III. Biology	Absent	Weak	Moderate	Strong
1) Are Fibrous Roots Present In Streambed?	(3)	2	1	0
2) Are Rooted Plants Present In Streambed?	3	2	(1)	0
3) Is Periphyton Present?	(0)	1	2	3
4) Are Bivalves Present?	(0)	1	2	3

Primary Biology Indicator Points:____4___

Secondary Field Indicators: *(Circle One Number Per Line)*

I. Geomorphology	Absent	Weak	Moderate	Strong
1) Is There A Head Cut Present In Channel?	(0)	.5	1	1.5
2) Is There A Grade Control Point In Channel?	(0)	.5	1	1.5
3) Does Topography Indicate A Natural Drainage Way?	(0)	.5	1	1.5

Secondary Geomorphology Indicator Points:__0__

II. Hydrology	Absent	Weak	Moderate	Strong
1) Is This Year's (Or Last's) Leaf litter Present In Streambed?	1.5	1	.5	(0)
2) Is Sediment On Plants (Or Debris) Present?	0	(.5)	1	1.5
3) Are Wrack Lines Present?	(0)	.5	1	1.5
4) Is Water In Channel ***And*** >48 Hrs. Since Last ***Known*** Rain? *(*NOTE: If Ditch Indicated In #9 Above Skip This Step And #5 Below*)*	0	(.5)	1	1.5
5) Is There Water In Channel During Dry Conditions ***Or*** In Growing Season)?	(0)	.5	1	1.5
6) Are Hydric Soils Present In Sides Of Channel (Or In Headcut)?		***Yes*** = *1.5*	***No*** = (0)	

Secondary Hydrology Indicator Points:__1__

III. Biology	Absent	Weak	Moderate	Strong
1) Are Fish Present?	0	.5	1	1.5
2) Are Amphibians Present?	0	.5	1	1.5
3) Are Aquatic Turtles Present?	0	.5	1	1.5
4) Are Crayfish Present?	0	.5	1	1.5
5) Are Macro benthos Present?	0	.5	1	1.5
6) Are Iron Oxidizing Bacteria/Fungus Present?	0	.5	1	1.5
7) Is Filamentous Algae Present?	0	.5	1	1.5

8) Are Wetland Plants In Streambed?	SAV	Mostly OBL	Mostly FACW	Mostly FAC	Mostly FACU	Mostly UPL
(**NOTE:** If Total Absence Of All Plants In Streambed As Noted Above Skip This Step **UNLESS** SAV Present*).*	*2*	1	.75	.5	0	0

Secondary Biology Indicator Points:___0___

TOTAL POINTS ***(Primary + Secondary)*** = ***__10__*** ***(If ≥ 19 points the stream is at least intermittent)***

NCDWQ Stream Classification Form

Project Name: **Little Troublesome-Preservation area-4**
River Basin: **Cape Fear** County: **Rockingham** Evaluator: **AH**
DWQ Project Number: Nearest Named Stream: Latitude: Signature:
Date: **September 11, 2006** USGSQUAD: **Williamsburg** Longitude: Location/Directions:

Please Note:** ***If evaluator and landowner agree that the feature is a man-made ditch, then use of this form is not necessary. Also, if in the best professional judgement of the evaluator, the feature is a man-made ditch and not a modified natural stream—this rating system should not be used*

Primary Field Indicators: *(Circle One Number Per Line)*

I. Geomorphology	Absent	Weak	Moderate	Strong
1) Is There A Riffle-Pool Sequence?	(0)	1	2	3
2) Is The USDA Texture In Streambed Different From Surrounding Terrain?	0	(1)	2	3
3) Are Natural Levees Present?	(0)	1	2	3
4) Is The Channel Sinuous?	0	(1)	2	3
5) Is There An Active (Or Relic) Floodplain Present?	0	1	2	(3)
6) Is The Channel Braided?	(0)	1	2	3
7) Are Recent Alluvial Deposits Present?	(0)	1	2	3
8) Is There A Bankfull Bench Present?	0	(1)	2	3
9) Is A Continuous Bed & Bank Present?	0	1	(2)	3
*(*NOTE: If Bed & Bank Caused By Ditching And **WITHOUT** Sinuosity Then Score=0*)*				
10) Is A 2nd Order Or Greater Channel (As Indicated On Topo Map ***And/Or*** In Field) Present?		***Yes*** = (3)	***No*** = 0	

Primary Geomorphology Indicator Points:__11__

II. Hydrology	Absent	Weak	Moderate	Strong
1) Is There A Groundwater Flow/Discharge Present?	0	1	2	(3)

Primary Hydrology Indicator Points:__3__

III. Biology	Absent	Weak	Moderate	Strong
1) Are Fibrous Roots Present In Streambed?	(3)	2	1	0
2) Are Rooted Plants Present In Streambed?	(3)	2	1	0
3) Is Periphyton Present?	(0)	1	2	3
4) Are Bivalves Present?	(0)	1	2	3

Primary Biology Indicator Points:____6___

Secondary Field Indicators: *(Circle One Number Per Line)*

I. Geomorphology	Absent	Weak	Moderate	Strong
1) Is There A Head Cut Present In Channel?	(0)	.5	1	1.5
2) Is There A Grade Control Point In Channel?	(0)	.5	1	1.5
3) Does Topography Indicate A Natural Drainage Way?	0	.5	(1)	1.5

Secondary Geomorphology Indicator Points:__1__

II. Hydrology	Absent	Weak	Moderate	Strong
1) Is This Year's (Or Last's) Leaf litter Present In Streambed?	(1.5)	1	.5	0
2) Is Sediment On Plants (Or Debris) Present?	(0)	.5	1	1.5
3) Are Wrack Lines Present?	(0)	.5	1	1.5
4) Is Water In Channel ***And*** >48 Hrs. Since Last ***Known*** Rain? *(*NOTE: If Ditch Indicated In #9 Above Skip This Step And #5 Below*)*	0	.5	1	(1.5)
5) Is There Water In Channel During Dry Conditions ***Or*** In Growing Season)?	0	.5	1	(1.5)
6) Are Hydric Soils Present In Sides Of Channel (Or In Headcut)?		***Yes*** = *1.5*	***No*** = (0)	

Secondary Hydrology Indicator Points:__4.5__

III. Biology	Absent	Weak	Moderate	Strong
1) Are Fish Present?	(0)	.5	1	1.5
2) Are Amphibians Present?	0	.5	(1)	1.5
3) Are Aquatic Turtles Present?	(0)	.5	1	1.5
4) Are Crayfish Present?	(0)	.5	1	1.5
5) Are Macro benthos Present?	(0)	.5	1	1.5
6) Are Iron Oxidizing Bacteria/Fungus Present?	(0)	.5	1	1.5
7) Is Filamentous Algae Present?	(0)	.5	1	1.5

8) Are Wetland Plants In Streambed?	SAV	Mostly OBL	Mostly FACW	Mostly FAC	Mostly FACU	Mostly UPL
(**NOTE:** If Total Absence Of All Plants In Streambed As Noted Above Skip This Step **UNLESS** SAV Present*).*	*2*	1	.75	.5	0	0

Secondary Biology Indicator Points:___1___

TOTAL POINTS ***(Primary + Secondary)*** = ***__26.5__*** ***(If ≥ 19 points the stream is at least intermittent)***

NCDWQ Stream Classification Form

Project Name: **Little Troublesome-Preservation area-1A**
River Basin: **Cape Fear** | County: **Rockingham** | Evaluator: **SS, KK**
DWQ Project Number: | Nearest Named Stream: | Latitude: | Signature:
Date: **December 4, 2006** | USGSQUAD: **Williamsburg** | Longitude: | Location/Directions:

Please Note:** ***If evaluator and landowner agree that the feature is a man-made ditch, then use of this form is not necessary. Also, if in the best professional judgement of the evaluator, the feature is a man-made ditch and not a modified natural stream—this rating system should not be used*

Primary Field Indicators: *(Circle One Number Per Line)*

I. Geomorphology	Absent	Weak	Moderate	Strong
1) Is There A Riffle-Pool Sequence?	0	(1)	2	3
2) Is The USDA Texture In Streambed Different From Surrounding Terrain?	0	(1)	2	3
3) Are Natural Levees Present?	(0)	1	2	3
4) Is The Channel Sinuous?	(0)	1	2	3
5) Is There An Active (Or Relic) Floodplain Present?	0	(1)	2	3
6) Is The Channel Braided?	(0)	1	2	3
7) Are Recent Alluvial Deposits Present?	0	(1)	2	3
8) Is There A Bankfull Bench Present?	0	(1)	2	3
9) Is A Continuous Bed & Bank Present?	(0)	1	2	3
*(*NOTE: If Bed & Bank Caused By Ditching And WITHOUT Sinuosity Then Score=0*)*				
10) Is A 2nd Order Or Greater Channel (As Indicated On Topo Map ***And/Or*** In Field) Present?		***Yes*** = (3)	***No*** = 0	

Primary Geomorphology Indicator Points: *8*

II. Hydrology	Absent	Weak	Moderate	Strong
1) Is There A Groundwater Flow/Discharge Present?	(0)	1	2	3

Primary Hydrology Indicator Points: *0*

III. Biology	Absent	Weak	Moderate	Strong
1) Are Fibrous Roots Present In Streambed?	(3)	2	1	0
2) Are Rooted Plants Present In Streambed?	(3)	2	1	0
3) Is Periphyton Present?	(0)	1	2	3
4) Are Bivalves Present?	0	1	(2)	3

Primary Biology Indicator Points: *8*

Secondary Field Indicators: *(Circle One Number Per Line)*

I. Geomorphology	Absent	Weak	Moderate	Strong
1) Is There A Head Cut Present In Channel?	0	.5	(1)	1.5
2) Is There A Grade Control Point In Channel?	0	(.5)	1	1.5
3) Does Topography Indicate A Natural Drainage Way?	0	.5	1	(1.5)

Secondary Geomorphology Indicator Points: *3*

II. Hydrology	Absent	Weak	Moderate	Strong
1) Is This Year's (Or Last's) Leaf litter Present In Streambed?	1.5	1	(.5)	0
2) Is Sediment On Plants (Or Debris) Present?	0	(.5)	1	1.5
3) Are Wrack Lines Present?	(0)	.5	1	1.5
4) Is Water In Channel ***And*** >48 Hrs. Since Last ***Known*** Rain? *(*NOTE: If Ditch Indicated In #9 Above Skip This Step And #5 Below*)*	0	.5	1	1.5
5) Is There Water In Channel During Dry Conditions ***Or*** In Growing Season)?	0	.5	1	1.5
6) Are Hydric Soils Present In Sides Of Channel (Or In Headcut)?		***Yes*** = (1.5)	***No*** = 0	

Secondary Hydrology Indicator Points: *2.5*

III. Biology	Absent	Weak	Moderate	Strong		
1) Are Fish Present?	(0)	.5	1	1.5		
2) Are Amphibians Present?	(0)	.5	1	1.5		
3) Are Aquatic Turtles Present?	(0)	.5	1	1.5		
4) Are Crayfish Present?	(0)	.5	1	1.5		
5) Are Macro benthos Present?	0	.5	1	(1.5)		
6) Are Iron Oxidizing Bacteria/Fungus Present?	(0)	.5	1	1.5		
7) Is Filamentous Algae Present?	(0)	.5	1	1.5		
8) Are Wetland Plants In Streambed?	**SAV**	**Mostly OBL**	**Mostly FACW**	**Mostly FAC**	**Mostly FACU**	**Mostly UPL**
(**NOTE:** If Total Absence Of All Plants In Streambed As Noted Above Skip This Step **UNLESS** SAV Present*).*	*2*	1	.75	.5	0	0

Secondary Biology Indicator Points: *1.5*

TOTAL POINTS *(Primary + Secondary)* = *23* *(If ≥ 19 points the stream is at least intermittent)*

NCDWQ Stream Classification Form

Project Name: **Little Troublesome-Preservation area-2A**
River Basin: **Cape Fear** County: **Rockingham** Evaluator: **SS, KK**
DWQ Project Number: Nearest Named Stream: Latitude: Signature:
Date: **December 4, 2006** USGSQUAD: **Williamsburg** Longitude: Location/Directions:

Please Note:** ***If evaluator and landowner agree that the feature is a man-made ditch, then use of this form is not necessary. Also, if in the best professional judgement of the evaluator, the feature is a man-made ditch and not a modified natural stream—this rating system should not be used*

Primary Field Indicators: *(Circle One Number Per Line)*

I. Geomorphology	Absent	Weak	Moderate	Strong
1) Is There A Riffle-Pool Sequence?	(0)	1	2	3
2) Is The USDA Texture In Streambed Different From Surrounding Terrain?	0	(1)	2	3
3) Are Natural Levees Present?	(0)	1	2	3
4) Is The Channel Sinuous?	0	(1)	2	3
5) Is There An Active (Or Relic) Floodplain Present?	0	(1)	2	3
6) Is The Channel Braided?	(0)	1	2	3
7) Are Recent Alluvial Deposits Present?	(0)	1	2	3
8) Is There A Bankfull Bench Present?	0	(1)	2	3
9) Is A Continuous Bed & Bank Present?	0	(1)	2	3

*(*NOTE: If Bed & Bank Caused By Ditching And WITHOUT Sinuosity Then Score=0*)*

10) Is A 2nd Order Or Greater Channel (As Indicated On Topo Map ***And/Or*** In Field) Present? *Yes* = (3) *No* = 0

Primary Geomorphology Indicator Points:__8__

II. Hydrology	Absent	Weak	Moderate	Strong
1) Is There A Groundwater Flow/Discharge Present?	(0)	1	2	3

Primary Hydrology Indicator Points:__ 0__

III. Biology	Absent	Weak	Moderate	Strong
1) Are Fibrous Roots Present In Streambed?	(3)	2	1	0
2) Are Rooted Plants Present In Streambed?	(3)	2	1	0
3) Is Periphyton Present?	(0)	1	2	3
4) Are Bivalves Present?	0	1	2	(3)

Primary Biology Indicator Points:__9___

Secondary Field Indicators: *(Circle One Number Per Line)*

I. Geomorphology	Absent	Weak	Moderate	Strong
1) Is There A Head Cut Present In Channel?	(0)	.5	1	1.5
2) Is There A Grade Control Point In Channel?	(0)	.5	1	1.5
3) Does Topography Indicate A Natural Drainage Way?	0	.5	(1)	1.5

Secondary Geomorphology Indicator Points:_1___

II. Hydrology	Absent	Weak	Moderate	Strong
1) Is This Year's (Or Last's) Leaf litter Present In Streambed?	1.5	1	.5	(0)
2) Is Sediment On Plants (Or Debris) Present?	(0)	.5	1	1.5
3) Are Wrack Lines Present?	0	(.5)	1	1.5
4) Is Water In Channel ***And*** >48 Hrs. Since Last ***Known*** Rain? *(*NOTE: If Ditch Indicated In #9 Above Skip This Step And #5 Below*)*	0	.5	1	1.5
5) Is There Water In Channel During Dry Conditions ***Or*** In Growing Season)?	0	.5	1	1.5

6) Are Hydric Soils Present In Sides Of Channel (Or In Headcut)? *Yes* = (1.5) *No* = 0

Secondary Hydrology Indicator Points:_2__

III. Biology	Absent	Weak	Moderate		Strong	
1) Are Fish Present?	(0)	.5	1		1.5	
2) Are Amphibians Present?	0	.5	1		(1.5)	
3) Are Aquatic Turtles Present?	(0)	.5	1		1.5	
4) Are Crayfish Present?	(0)	.5	1		1.5	
5) Are Macro benthos Present?	0	.5	1		(1.5)	
6) Are Iron Oxidizing Bacteria/Fungus Present?	(0)	.5	1		1.5	
7) Is Filamentous Algae Present?	(0)	.5	1		1.5	
8) Are Wetland Plants In Streambed?	SAV	Mostly OBL	Mostly FACW	Mostly FAC	Mostly FACU	Mostly UPL
(NOTE: If Total Absence Of All Plants In Streambed As Noted Above Skip This Step UNLESS SAV Present*).*	*2*	1	.75	.5	0	0

Secondary Biology Indicator Points: 3

TOTAL POINTS (*Primary + Secondary*) = 23 *(If ≥ 19 points the stream is at least intermittent)*

NCDWQ Stream Classification Form

Project Name: **Little Troublesome-Preservation area-3A**
River Basin: **Cape Fear** | County: **Rockingham** | Evaluator: **SS, KK**
DWQ Project Number: | Nearest Named Stream: | Latitude: | Signature:
Date: **December 4, 2006** | USGSQUAD: **Williamsburg** | Longitude: | Location/Directions:

Please Note:** ***If evaluator and landowner agree that the feature is a man-made ditch, then use of this form is not necessary. Also, if in the best professional judgement of the evaluator, the feature is a man-made ditch and not a modified natural stream—this rating system should not be used*

Primary Field Indicators: *(Circle One Number Per Line)*

I. Geomorphology	Absent	Weak	Moderate	Strong
1) Is There A Riffle-Pool Sequence?	(0)	1	2	3
2) Is The USDA Texture In Streambed Different From Surrounding Terrain?	0	(1)	2	3
3) Are Natural Levees Present?	(0)	1	2	3
4) Is The Channel Sinuous?	0	(1)	2	3
5) Is There An Active (Or Relic) Floodplain Present?	0	(1)	2	3
6) Is The Channel Braided?	(0)	1	2	3
7) Are Recent Alluvial Deposits Present?	(0)	1	2	3
8) Is There A Bankfull Bench Present?	0	(1)	2	3
9) Is A Continuous Bed & Bank Present?	0	(1)	2	3

*(*NOTE: If Bed & Bank Caused By Ditching And WITHOUT Sinuosity Then Score=0*)* caused by ditching

10) Is A 2nd Order Or Greater Channel (As Indicated On Topo Map ***And/Or*** In Field) Present? *Yes* = (3) *No* = 0

Primary Geomorphology Indicator Points: *8*

II. Hydrology	Absent	Weak	Moderate	Strong
1) Is There A Groundwater Flow/Discharge Present?	(0)	1	2	3

Primary Hydrology Indicator Points: *0*

III. Biology	Absent	Weak	Moderate	Strong
1) Are Fibrous Roots Present In Streambed?	(3)	2	1	0
2) Are Rooted Plants Present In Streambed?	(3)	2	1	0
3) Is Periphyton Present?	(0)	1	2	3
4) Are Bivalves Present?	0	1	2	(3)

Primary Biology Indicator Points: *9*

Secondary Field Indicators: *(Circle One Number Per Line)*

I. Geomorphology	Absent	Weak	Moderate	Strong
1) Is There A Head Cut Present In Channel?	(0)	.5	1	1.5
2) Is There A Grade Control Point In Channel?	(0)	.5	1	1.5
3) Does Topography Indicate A Natural Drainage Way?	0	.5	(1)	1.5

Secondary Geomorphology Indicator Points: *1*

II. Hydrology	Absent	Weak	Moderate	Strong
1) Is This Year's (Or Last's) Leaf litter Present In Streambed?	1.5	1	.5	(0)
2) Is Sediment On Plants (Or Debris) Present?	(0)	.5	1	1.5
3) Are Wrack Lines Present?	0	(.5)	1	1.5
4) Is Water In Channel ***And*** >48 Hrs. Since Last ***Known*** Rain? *(*NOTE: If Ditch Indicated In #9 Above Skip This Step And #5 Below*)*	0	.5	1	1.5
5) Is There Water In Channel During Dry Conditions ***Or*** In Growing Season)?	0	.5	1	1.5

6) Are Hydric Soils Present In Sides Of Channel (Or In Headcut)? *Yes* = (1.5) *No* = 0

Secondary Hydrology Indicator Points: *2*

III. Biology	Absent	Weak	Moderate	Strong		
1) Are Fish Present?	(0)	.5	1	1.5		
2) Are Amphibians Present?	0	.5	1	(1.5)		
3) Are Aquatic Turtles Present?	(0)	.5	1	1.5		
4) Are Crayfish Present?	(0)	.5	1	1.5		
5) Are Macro benthos Present?	0	.5	1	(1.5)		
6) Are Iron Oxidizing Bacteria/Fungus Present?	(0)	.5	1	1.5		
7) Is Filamentous Algae Present?	(0)	.5	1	1.5		
8) Are Wetland Plants In Streambed?	SAV	Mostly OBL	Mostly FACW	Mostly FAC	Mostly FACU	Mostly UPL
(NOTE: If Total Absence Of All Plants In Streambed As Noted Above Skip This Step UNLESS SAV Present*).*	*2*	1	.75	.5	0	0

Secondary Biology Indicator Points: 3

TOTAL POINTS ***(Primary + Secondary)*** = 23 ***(If ≥ 19 points the stream is at least intermittent)***

Benthic Macroinvertebrate Sampling Results

December 4, 2006

Sample 1A – UT2
Approximately 200' downstream of barbed wire fence
Sowbug (Order Isopoda) – very abundant (greater than 10)
Scud (Order Amphipod)– very abundant (greater than 10)
Clam (Class bivalvia) – 2
Mayfly – (Class Ephemeroptera) – very abundant (greater than 10)
Damselfly (Suborder Zugoptera) – 1
Snail (Class Gastropoda) – 1
Aquatic worms (Class Oligochaeta) – 1
Crane fly (Suborder meatocera) – 1

Sample 2A – UT2
30' downstream from W1-38; good flow in channel
Clam (Class bivalvia) – very abundant (greater than 10)
Scud (Order Amphipod)– 5
Sowbug (Order Isopoda) – very abundant (greater than 10)
Aquatic worms (Class Oligochaeta) – 2
Salamanders – 3
Snail (Class Gastropoda) – 2

Sample 3A – UT2
Sampled at W5-29
Clam (Class bivalvia) – very abundant (greater than 10)
Scud (Order Amphipod)– very abundant (greater than 10)
Sowbug (Order Isopoda) – very abundant (greater than 10)
Aquatic worms (Class Oligochaeta) – 2
Salamanders – 3
Snail (Class Gastropoda) – 1
Crane fly (Suborder Nematocera) – 1

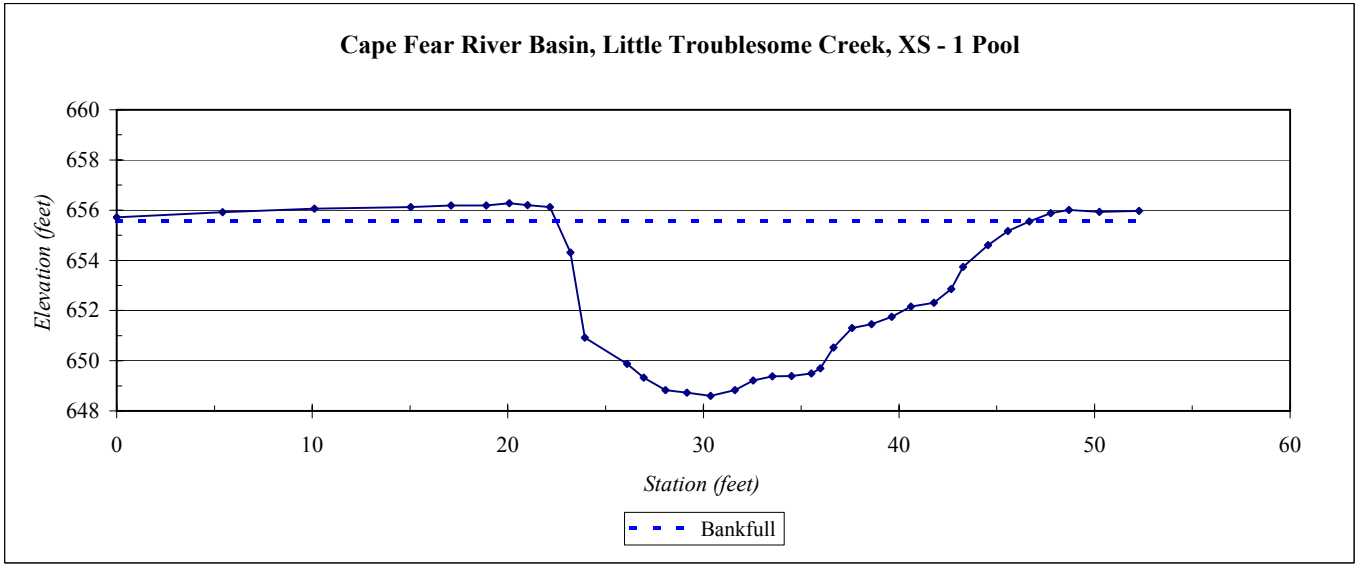
Appendix C
Existing Conditions

LTC Existing Data

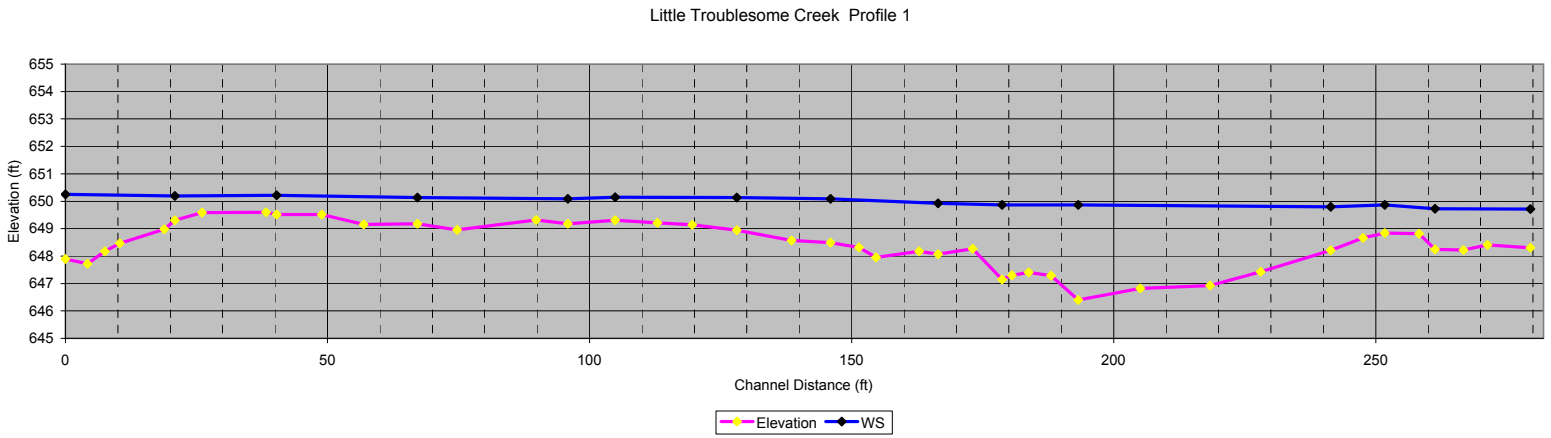
River Basin:	Cape Fear
Watershed:	Little Troublesome Creek
XS ID	XS - 1 Pool
Drainage Area (sq mi):	12.1
Date:	9/27/2006
Field Crew:	A. Helms, A. French

Station	Elevation
0.0	655.72
5.4	655.92
10.1	656.06
15.0	656.13
17.1	656.19
18.9	656.19
20.1	656.27
21.0	656.20
22.1	656.13
23.2	654.31
23.9	650.91
26.1	649.88
27.0	649.33
28.1	648.83
29.2	648.73
30.4	648.60
31.6	648.82
32.5	649.21
33.5	649.38
34.5	649.39
35.5	649.49
36.0	649.69
36.6	650.52
37.6	651.31
38.6	651.45
39.6	651.74
40.6	652.16
41.8	652.31
42.7	652.86
43.3	653.74
44.6	654.61
45.6	655.17
46.7	655.55
47.8	655.88
48.7	656.01
50.3	655.94
52.3	655.97

SUMMARY DATA	
Bankfull Elevation:	655.6
Bankfull Cross-Sectional Area:	107.9
Bankfull Width:	24.3
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	6.9
Mean Depth at Bankfull:	4.4
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	-
Water Surface Slope (ft/ft):	0.002



Slope Profile



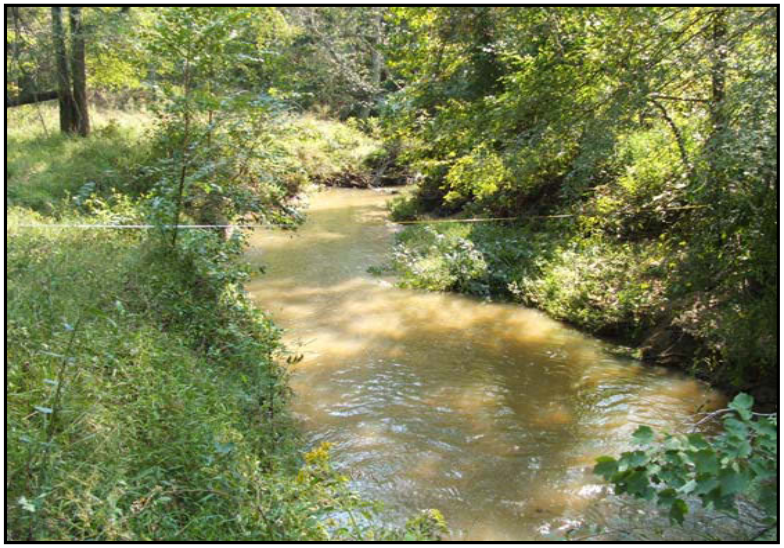
Elevation BM: 100

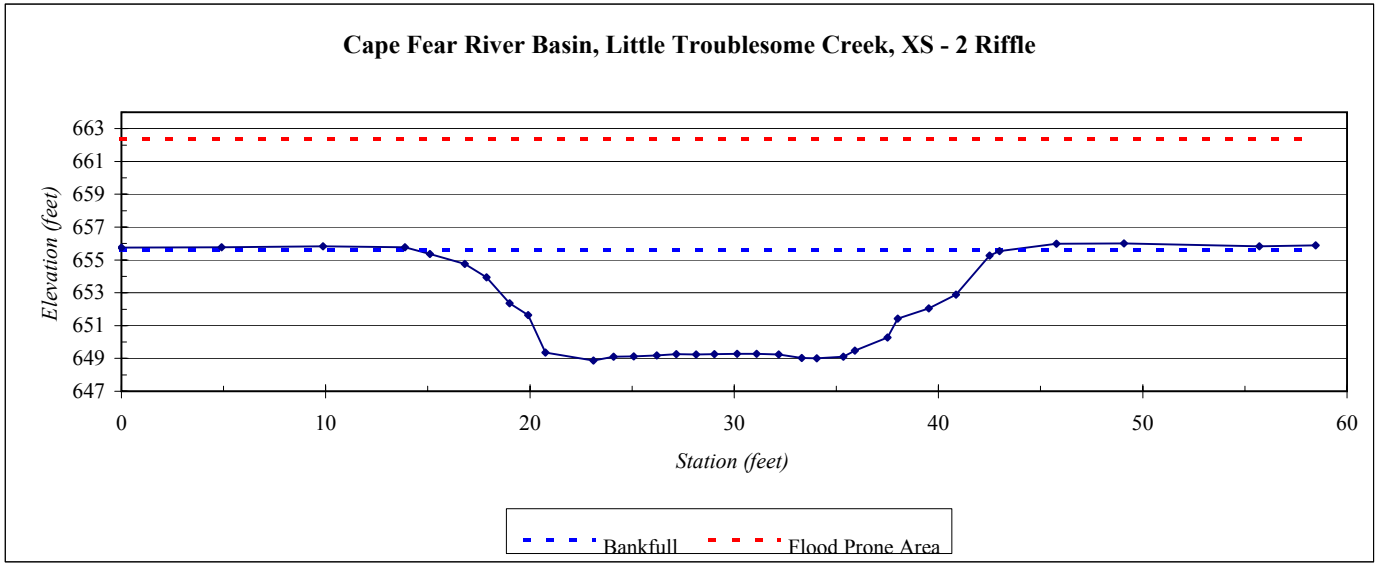
notes	inc distance	station	BS 0	HI 100	FS TP	FS bed	depth water	FS LB	FS RB	FS BKF	FS WS	AZ azimuth	ELEV bed	ELEV water srf	ELEV LF	ELEV RB	ELEV BKF	ELEV WS
BEGIN POOL		0.0		100									647.90					650.25
POOL	4.2	4.2		100									647.71					
	3.3	7.5		100									648.17					
	2.9	10.4		100									648.46					
	8.5	18.9		100									648.98					
BEGIN RIFFLE	2.0	20.9		100									649.31					650.19
RIFFLE	5.2	26.0		100									649.58					
RIFFLE	12.3	38.3		100									649.60					
END RIFFLE	2.0	40.3		100									649.52					650.22
	8.7	48.9		100									649.51					
	7.9	56.9		100									649.15					
	10.3	67.1		100									649.18					650.13
	7.6	74.7		100									648.96					
	15.1	89.8		100									649.32					
BEGIN POOL	6.0	95.9		100									649.17					650.09
	9.0	104.9		100									649.30					650.15
	8.1	113.0		100									649.22					
	6.6	119.6		100									649.14					
	8.5	128.1		100									648.95					650.13
	10.4	138.6		100									648.57					
DEBRIS	7.4	146.0		100									648.49					650.09
	5.5	151.4		100									648.31					
SCOUR	3.2	154.6		100									647.95					
DEBRIS	8.2	162.9		100									648.18					
	3.6	166.5		100									648.07					649.92
	6.6	173.1		100									648.27					
BEGIN POOL	5.6	178.7		100									647.15					649.87
	1.9	180.6		100									647.30					
	3.2	183.8		100									647.40					
	4.3	188.1		100									647.28					
POOL	5.2	193.2		100									646.40					649.86
SCOUR	11.9	205.1		100									646.82					
SCOUR	13.3	218.4		100									646.92					
SCOUR	9.7	228.0		100									647.42					
END-SCOUR	13.4	241.4		100									648.21					649.8
	6.2	247.6		100									648.67					
	4.2	251.7		100									648.83					649.86
	6.5	258.2		100									648.81					
BEGIN POOL	3.1	261.3		100									648.25					649.73
	5.4	266.7		100									648.22					
	4.6	271.3		100									648.41					
END POOL	8.2	279.5		100									648.30					649.71

River Basin:	Cape Fear
Watershed:	Little Troublesome Creek
XS ID	XS - 2 Riffle
Drainage Area (sq mi):	12.1
Date:	9/27/2006
Field Crew:	A. Helms, A. French

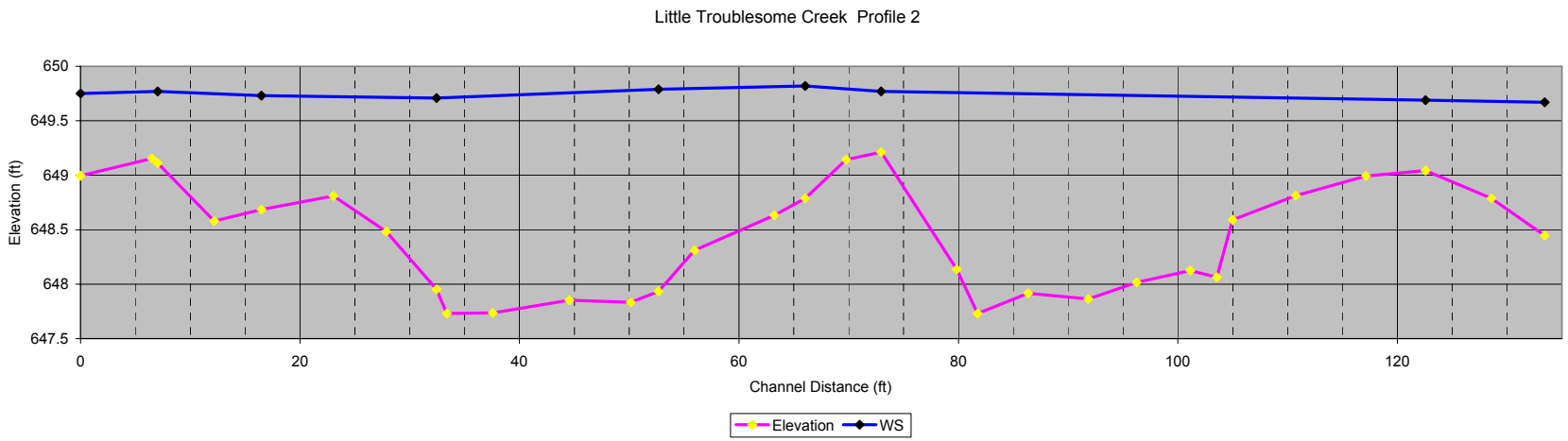
Station	Elevation
0.0	655.75
4.9	655.76
9.9	655.83
13.9	655.78
15.1	655.36
16.8	654.75
17.9	653.94
19.0	652.35
19.9	651.64
20.8	649.35
23.1	648.86
24.1	649.10
25.1	649.12
26.2	649.19
27.2	649.27
28.1	649.24
29.0	649.26
30.1	649.28
31.1	649.28
32.2	649.24
33.3	649.02
34.0	649.00
35.3	649.10
35.9	649.48
37.5	650.27
38.0	651.42
39.5	652.04
40.9	652.88
42.5	655.27
43.0	655.54
45.8	655.99
49.1	656.00
55.7	655.84
58.5	655.89

SUMMARY DATA	
Bankfull Elevation:	655.6
Bankfull Cross-Sectional Area:	135.8
Bankfull Width:	29.0
Flood Prone Area Elevation:	662.3
Flood Prone Width:	>60
Max Depth at Bankfull:	6.7
Mean Depth at Bankfull:	4.7
W / D Ratio:	6.2
Entrenchment Ratio:	2.0
Bank Height Ratio:	1.0
Water Surface Slope (ft/ft):	0.002





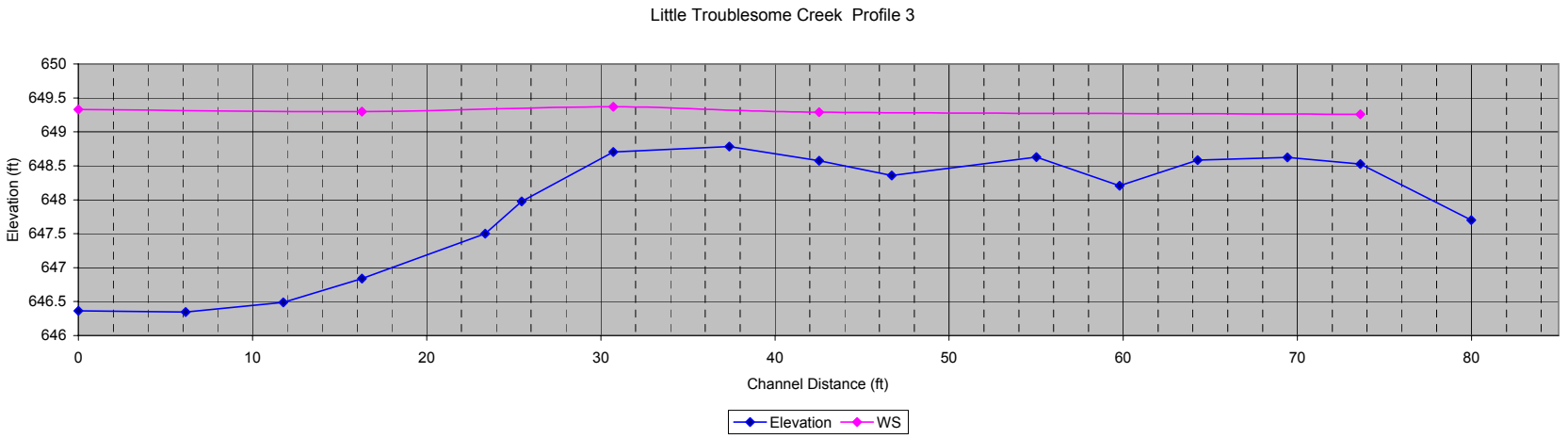
Slope Profile



Elevation BM: 100

notes	inc distance	station	BS 0	HI 100	FS TP	FS bed	depth water	FS LB	FS RB	FS BKF	FS WS	AZ azimuth	ELEV bed	ELEV water srf	ELEV LF	ELEV RB	ELEV BKF	ELEV WS
BEGIN RIFFLE		0		100									648.99					649.75
	6.5	6.5		100									649.15					
END RIFFLE	0.5	7.0		100									649.11					649.77
	5.2	12.2		100									648.58					
CLAY	4.3	16.5		100									648.69					649.73
	6.5	23.0		100									648.81					
	4.8	27.9		100									648.48					
BEGIN POOL	4.6	32.4		100									647.95					649.71
POOL	1.0	33.4		100									647.73					
POOL	4.2	37.6		100									647.74					
POOL	7.0	44.5		100									647.85					
POOL	5.6	50.1		100									647.83					
END POOL	2.5	52.7		100									647.93					649.79
	3.3	56.0		100									648.31					
	7.3	63.2		100									648.63					
BEGIN RIFFLE	2.8	66.0		100									648.79					649.82
RIFFLE	3.7	69.8		100									649.14					
END RIFFLE	3.2	73.0		100									649.21					649.77
	6.9	79.9		100									648.14					
	1.9	81.7		100									647.73					
	4.6	86.4		100									647.92					
	5.5	91.8		100									647.86					
	4.4	96.2		100									648.02					
	4.9	101.1		100									648.12					
	2.4	103.6		100									648.06					
CLAY	1.4	105.0		100									648.59					
	5.7	110.7		100									648.81					
	6.4	117.1		100									648.99					
END CLAY	5.4	122.6		100									649.04					649.69
	6.0	128.6		100									648.79					
BEGIN DEBRIS	4.8	133.4		100									648.45					649.67

Slope Profile



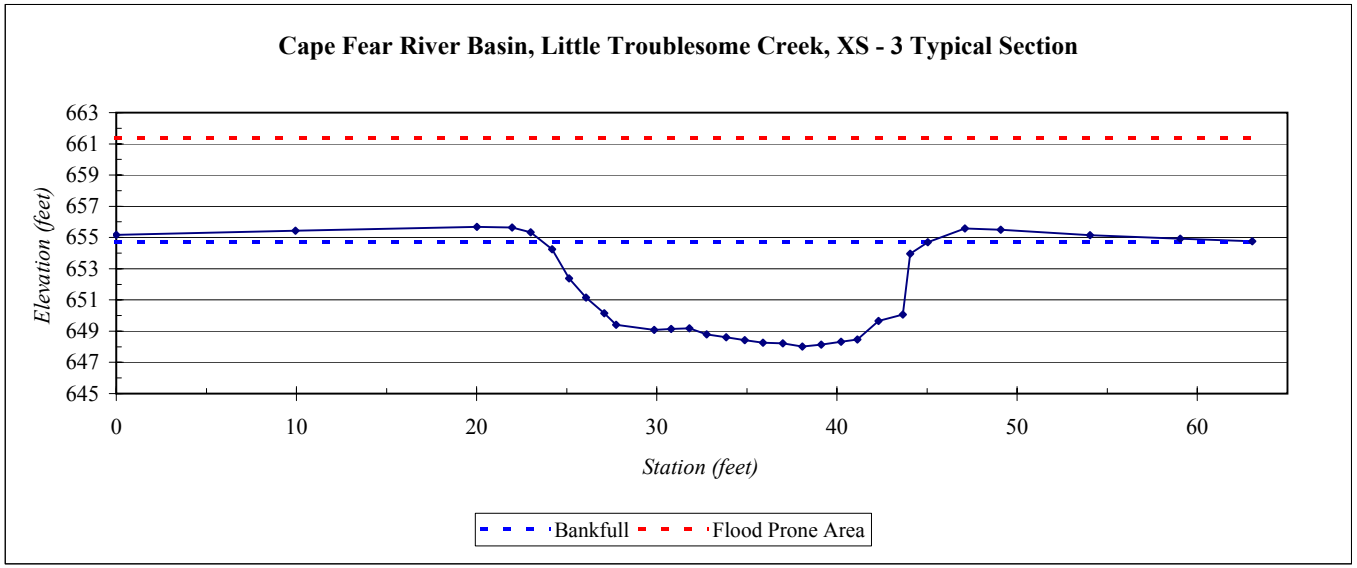
Elevation BM: 100

notes	inc distance	station	BS	HI	FS TP	FS bed	depth water	FS LB	FS RB	FS BKF	FS WS	AZ azimuth	ELEV bed	ELEV water srf	ELEV LF	ELEV RB	ELEV BKF	ELEV WS
			0	100														
END-DEBRIS		0		100									646.36					649.33
	6.2	6.2		100									646.35					
	5.6	11.8		100									646.49					
	4.5	16.3		100									646.84					649.3
	7.1	23.4		100									647.50					
	2.1	25.4		100									647.98					
BEGIN RIFFLE	5.3	30.7		100									648.70					649.37
	6.7	37.4		100									648.78					
	5.1	42.5		100									648.58					649.29
	4.2	46.7		100									648.36					
	8.3	55.0		100									648.63					
	4.8	59.8		100									648.21					
	4.5	64.3		100									648.58					
	5.2	69.4		100									648.62					
END RIFFLE	4.2	73.6		100									648.53					649.26
END-DEBRIS	6.4	80.0		100									647.70					

River Basin:	Cape Fear
Watershed:	Little Troublesome Creek
XS ID	XS - 3 Typical Section
Drainage Area (sq mi):	12.1
Date:	9/27/2006
Field Crew:	A. Helms, A. French

Station	Elevation
0.0	655.16
9.9	655.43
20.0	655.68
22.0	655.65
23.0	655.33
24.2	654.25
25.1	652.39
26.1	651.15
27.1	650.14
27.7	649.41
29.8	649.07
30.8	649.14
31.8	649.19
32.8	648.79
33.8	648.61
34.9	648.42
35.9	648.26
37.0	648.22
38.1	648.01
39.1	648.13
40.2	648.33
41.1	648.46
42.3	649.66
43.7	650.06
44.1	653.96
45.0	654.69
47.1	655.58
49.1	655.49
54.0	655.16
59.0	654.93
63.1	654.76

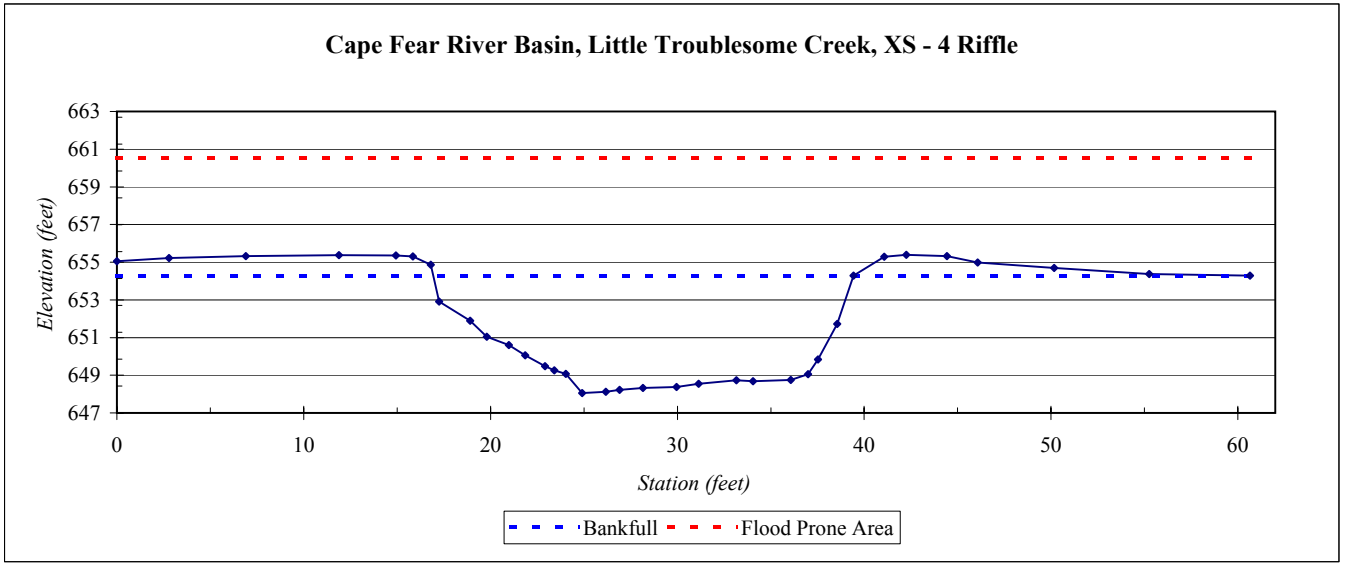
SUMMARY DATA	
Bankfull Elevation:	654.7
Bankfull Cross-Sectional Area:	107.3
Bankfull Width:	21.3
Flood Prone Area Elevation:	661.4
Flood Prone Width:	>65
Max Depth at Bankfull:	6.7
Mean Depth at Bankfull:	5.0
W / D Ratio:	4.2
Entrenchment Ratio:	3.0
Bank Height Ratio:	1.1
Water Surface Slope (ft/ft):	0.002



River Basin:	Cape Fear
Watershed:	Little Troublesome Creek
XS ID	XS - 4 Riffle
Drainage Area (sq mi):	12.1
Date:	9/27/2006
Field Crew:	A. Helms, A. French

Station	Elevation
0.0	655.05
2.8	655.22
6.9	655.32
11.9	655.37
14.9	655.37
15.8	655.30
16.8	654.86
17.3	652.91
18.9	651.90
19.8	651.04
21.0	650.59
21.8	650.06
22.9	649.48
23.4	649.26
24.0	649.08
24.9	648.06
26.2	648.12
26.9	648.22
28.2	648.32
30.0	648.37
31.1	648.54
33.2	648.73
34.1	648.68
36.1	648.76
37.0	649.06
37.5	649.84
38.6	651.72
39.4	654.29
41.1	655.28
42.3	655.39
44.4	655.32
46.1	654.98
50.2	654.69
55.3	654.37
60.6	654.29

SUMMARY DATA	
Bankfull Elevation:	654.3
Bankfull Cross-Sectional Area:	106.1
Bankfull Width:	22.3
Flood Prone Area Elevation:	660.5
Flood Prone Width:	>60
Max Depth at Bankfull:	6.2
Mean Depth at Bankfull:	4.8
W / D Ratio:	4.7
Entrenchment Ratio:	2.7
Bank Height Ratio:	1.2
Water Surface Slope (ft/ft):	0.002



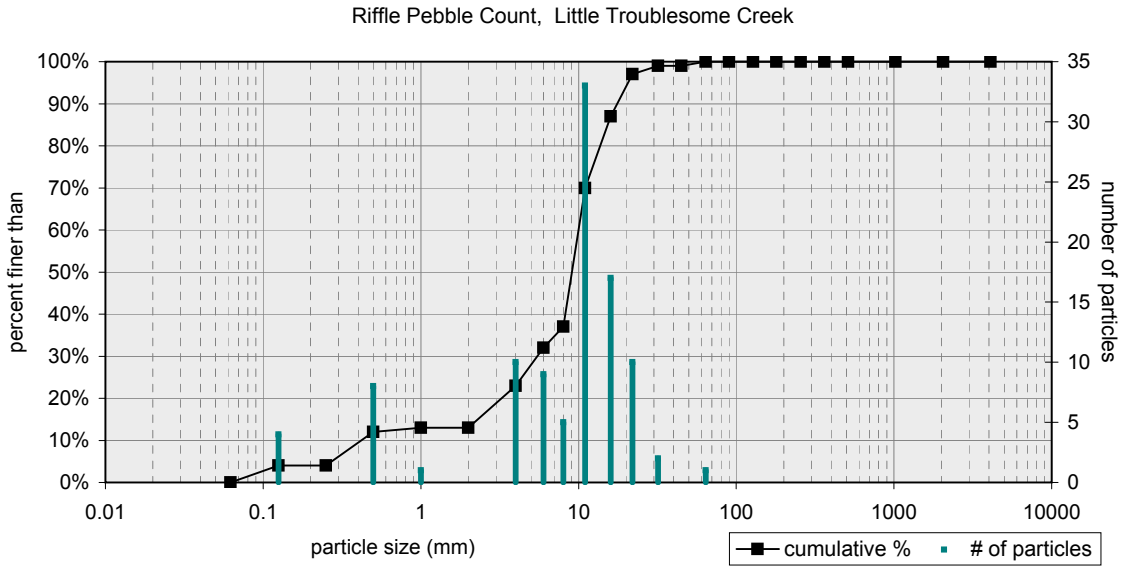
Riffle Pebble Count

Material	Size Range (mm)		Count
silt/clay	0	0.062	
very fine sand	0.062	0.13	**4**
fine sand	0.13	0.25	
medium sand	0.25	0.5	**8**
coarse sand	0.5	1	**1**
very coarse sand	1	2	
very fine gravel	2	4	**10**
fine gravel	4	6	**9**
fine gravel	6	8	**5**
medium gravel	8	11	**33**
medium gravel	11	16	**17**
coarse gravel	16	22	**10**
coarse gravel	22	32	**2**
very coarse gravel	32	45	
very coarse gravel	45	64	**1**
small cobble	64	90	
medium cobble	90	128	
large cobble	128	180	
very large cobble	180	256	
small boulder	256	362	
small boulder	362	512	
medium boulder	512	1024	
large boulder	1024	2048	
very large boulder	2048	4096	
	total particle count:		100

bedrock		
clay hardpan		
detritus/wood		
artificial		
	total count:	100

Riffle Pebble Count,

	Little Troublesome Creek
	Cape Fear
Note:	**Riffle XS-2**



based on sediment particles only	size percent less than (mm)						particle size distribution		
	D16	D35	D50	D65	D84	D95	gradation	geo mean	std dev
	2.462	7.13	9.1	10	15	21	2.7	6.1	2.5

based on total count	percent by substrate type								
	silt/clay	sand	gravel	cobble	boulder	bedrock	hardpan	wood/det	artificial
	0%	13%	87%	0%	0%	0%	0%	0%	0%

Riffle Pebble Count

Riffle Pebble Count,

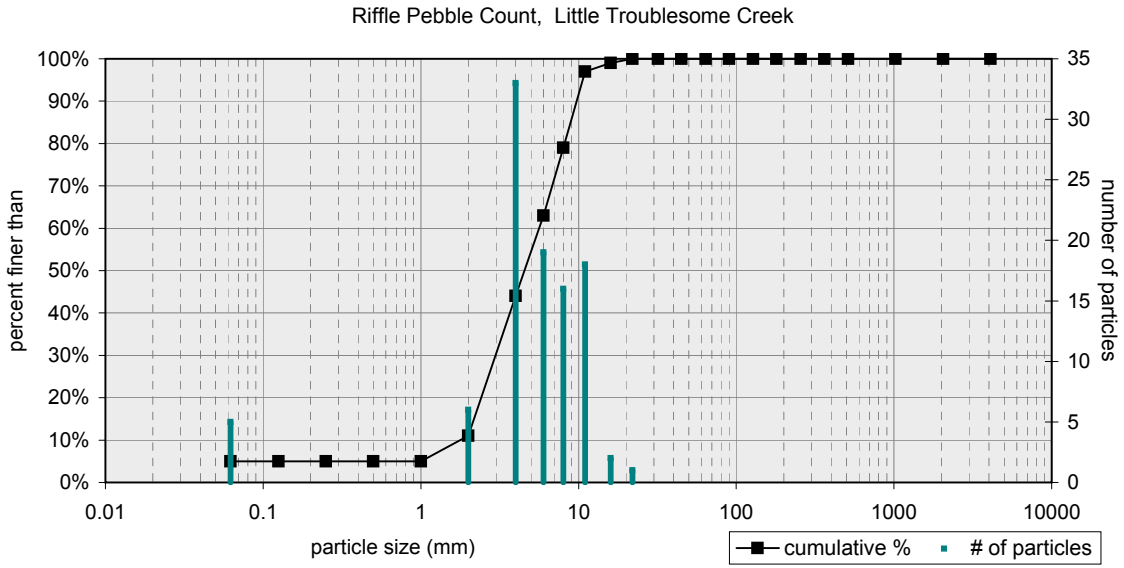
Little Troublesome Creek

Cape Fear

Note: **Riffle XS-4**

Material	Size Range (mm)		Count
silt/clay	0	0.062	**5**
very fine sand	0.062	0.13	
fine sand	0.13	0.25	
medium sand	0.25	0.5	
coarse sand	0.5	1	
very coarse sand	1	2	**6**
very fine gravel	2	4	**33**
fine gravel	4	6	**19**
fine gravel	6	8	**16**
medium gravel	8	11	**18**
medium gravel	11	16	**2**
coarse gravel	16	22	**1**
coarse gravel	22	32	
very coarse gravel	32	45	
very coarse gravel	45	64	
small cobble	64	90	
medium cobble	90	128	
large cobble	128	180	
very large cobble	180	256	
small boulder	256	362	
small boulder	362	512	
medium boulder	512	1024	
large boulder	1024	2048	
very large boulder	2048	4096	
	total particle count:		100

bedrock		
clay hardpan		
detritus/wood		
artificial		
total count:		100



based on sediment particles only	size percent less than (mm)						particle size distribution		
	D16	D35	D50	D65	D84	D95	gradation	geo mean	std dev
	2.221	3.31	4.5	6	9	11	2.0	4.4	2.0

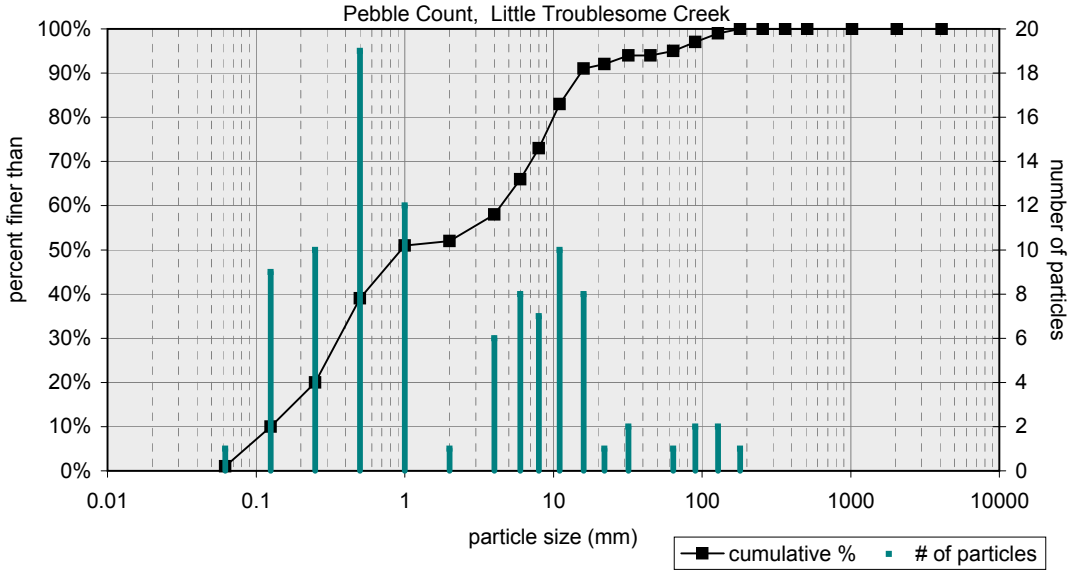
based on total count	percent by substrate type								
	silt/clay	sand	gravel	cobble	boulder	bedrock	hardpan	wood/det	artificial
	5%	6%	89%	0%	0%	0%	0%	0%	0%

Pebble Count of Channel Reach

Material	Size Range (mm)		Count	
silt/clay	0	0.062	**1**	##
very fine sand	0.062	0.13	**9**	##
fine sand	0.13	0.25	**10**	##
medium sand	0.25	0.5	**19**	##
coarse sand	0.5	1	**12**	##
very coarse sand	1	2	**1**	##
very fine gravel	2	4	**6**	##
fine gravel	4	6	**8**	##
fine gravel	6	8	**7**	##
medium gravel	8	11	**10**	##
medium gravel	11	16	**8**	##
coarse gravel	16	22	**1**	##
coarse gravel	22	32	**2**	##
very coarse gravel	32	45		##
very coarse gravel	45	64	**1**	##
small cobble	64	90	**2**	##
medium cobble	90	128	**2**	##
large cobble	128	180	**1**	##
very large cobble	180	256		##
small boulder	256	362		##
small boulder	362	512		##
medium boulder	512	1024		##
large boulder	1024	2048		##
very large boulder	2048	4096		##
	total particle count:		100	

bedrock		
clay hardpan		
detritus/wood		
artificial		
	total count:	100

Pebble Count,
Little Troublesome Creek
Cape Fear
Reach 1 US
Note:



based on sediment particles only	size percent less than (mm)						particle size distribution		
	D16	D35	D50	D65	D84	D95	gradation	geo mean	std dev
	0.189	0.43	0.9	6	12	64	8.6	1.5	7.8

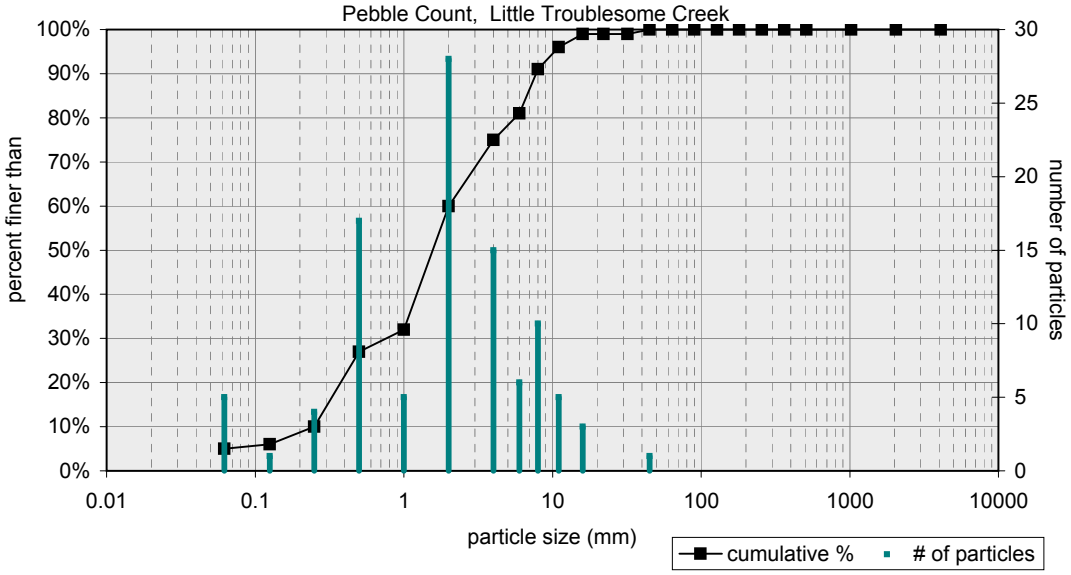
based on total count	percent by substrate type								
	silt/clay	sand	gravel	cobble	boulder	bedrock	hardpan	wood/det	artificial
	1%	51%	43%	5%	0%	0%	0%	0%	0%

Pebble Count of Channel Reach

Material	Size Range (mm)		Count	
silt/clay	0	0.062	**5**	##
very fine sand	0.062	0.13	**1**	##
fine sand	0.13	0.25	**4**	##
medium sand	0.25	0.5	**17**	##
coarse sand	0.5	1	**5**	##
very coarse sand	1	2	**28**	##
very fine gravel	2	4	**15**	##
fine gravel	4	6	**6**	##
fine gravel	6	8	**10**	##
medium gravel	8	11	**5**	##
medium gravel	11	16	**3**	##
coarse gravel	16	22		##
coarse gravel	22	32		##
very coarse gravel	32	45	**1**	##
very coarse gravel	45	64		##
small cobble	64	90		##
medium cobble	90	128		##
large cobble	128	180		##
very large cobble	180	256		##
small boulder	256	362		##
small boulder	362	512		##
medium boulder	512	1024		##
large boulder	1024	2048		##
very large boulder	2048	4096		##
	total particle count:		100	

bedrock			
clay hardpan			
detritus/wood			
artificial			
	total count:		100

Pebble Count,
Little Troublesome Creek
Cape Fear
Reach 2 including Profile 2 & 3
Note:



based on sediment particles only	size percent less than (mm)						particle size distribution		
	D16	D35	D50	D65	D84	D95	gradation	geo mean	std dev
	0.319	1.08	1.6	3	7	10	4.5	1.4	4.5

based on total count	percent by substrate type								
	silt/clay	sand	gravel	cobble	boulder	bedrock	hardpan	wood/det	artificial
	5%	55%	40%	0%	0%	0%	0%	0%	0%

Bank Erodibility Hazard Rating Guide

Stream: Little Troublesome **Reach:** Entire Reach (1,375lf) **Date:** 2/7/07 **Crew:** AH, AF

Bank Erosion Potential

Bank Height (ft): / Bankfull Height (ft):		Bank Height/ Bankfull Ht	Root Depth/ Bank Height	Root Density %	Bank Angle (Degrees)	Surface Protection%
VERY LOW	Value Range	1.0 – 1.1	0.9 – 1.0	80 – 100	0.0 – 20.0	80 – 100
	Index Range	1.0 – 1.9	1.0 – 1.9	1.0 – 1.9	1.0 – 1.9	1.0 – 1.9
	Choice	**V: 1.0 I: 1.0**	**V: I:**	**V: 80.0 I: 1.0**	**V: I:**	**V: 80.0 I: 1.0**
LOW	Value Range	1.11 – 1.19	0.5 – 0.89	55 – 79	21.0 – 60.0	55 – 79
	Index Range	2.0 – 3.9	2.0 – 3.9	2.0 – 3.9	2.0 – 3.9	2.0 – 3.9
	Choice	**V: I:**	**V: 0.80 I: 3.0**	**V: I:**	**V: I:**	**V: I:**
MODERATE	Value Range	1.2 – 1.5	0.3 – 0.49	30 – 54	61.0 – 80.0	30 – 54
	Index Range	4.0 – 5.9	4.0 – 5.9	4.0 – 5.9	4.0 – 5.9	4.0 – 5.9
	Choice	**V: I:**	**V: I:**	**V: I:**	**V: I:**	**V: I:**
HIGH	Value Range	1.6 – 2.0	0.15 – 0.29	15 – 29	81.0 – 90.0	15 – 29
	Index Range	6.0 – 7.9	6.0 – 7.9	6.0 – 7.9	6.0 – 7.9	6.0 – 7.9
	Choice	**V: I:**	**V: I:**	**V: I:**	**V: 90.0 I: 7.9**	**V: I:**
VERY HIGH	Value Range	2.1 – 2.8	0.05 – 0.14	5 – 14	91.0 – 119.0	10 – 14
	Index Range	8.0 – 9.0	8.0 – 9.0	8.0 – 9.0	8.0 – 9.0	8.0 – 9.0
	Choice	**V: I:**	**V: I:**	**V: I:**	**V: I:**	**V: I:**
EXTREME	Value Range	>2.8	<0.05	<5	>119	<10
	Index Range	10	10	10	10	10
	Choice	**V: I:**	**V: I:**	**V: I:**	**V: I:**	**V: I:**

V = value, I = index

SUB-TOTAL (Sum one index from each column) 13.9

Bank Material Description:

One layer consisting of clay/sand

Bank Materials

Bedrock (Bedrock banks have very low bank erosion potential)

Boulders (Banks composed of boulders have low bank erosion potential)

Cobble (Subtract 10 points. If sand/gravel matrix greater than 50% of bank material, then do not adjust)

Gravel (Add 5-10 points depending percentage of bank material that is composed of sand)

Sand (Add 10 points)

Silt Clay (+ 0: no adjustment)

Bank Sketch

BANK MATERIAL ADJUSTMENT 2

Stratification Comments:

Bankfull is nearly top of bank. The bank consists of sand/clay.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage

STRATIFICATION ADJUSTMENT 5

VERY LOW	LOW	MODERATE	HIGH	VERY HIGH	EXTREME
5-9.9	10-19.9	20-29.9	30-39.9	40-45.9	46-50

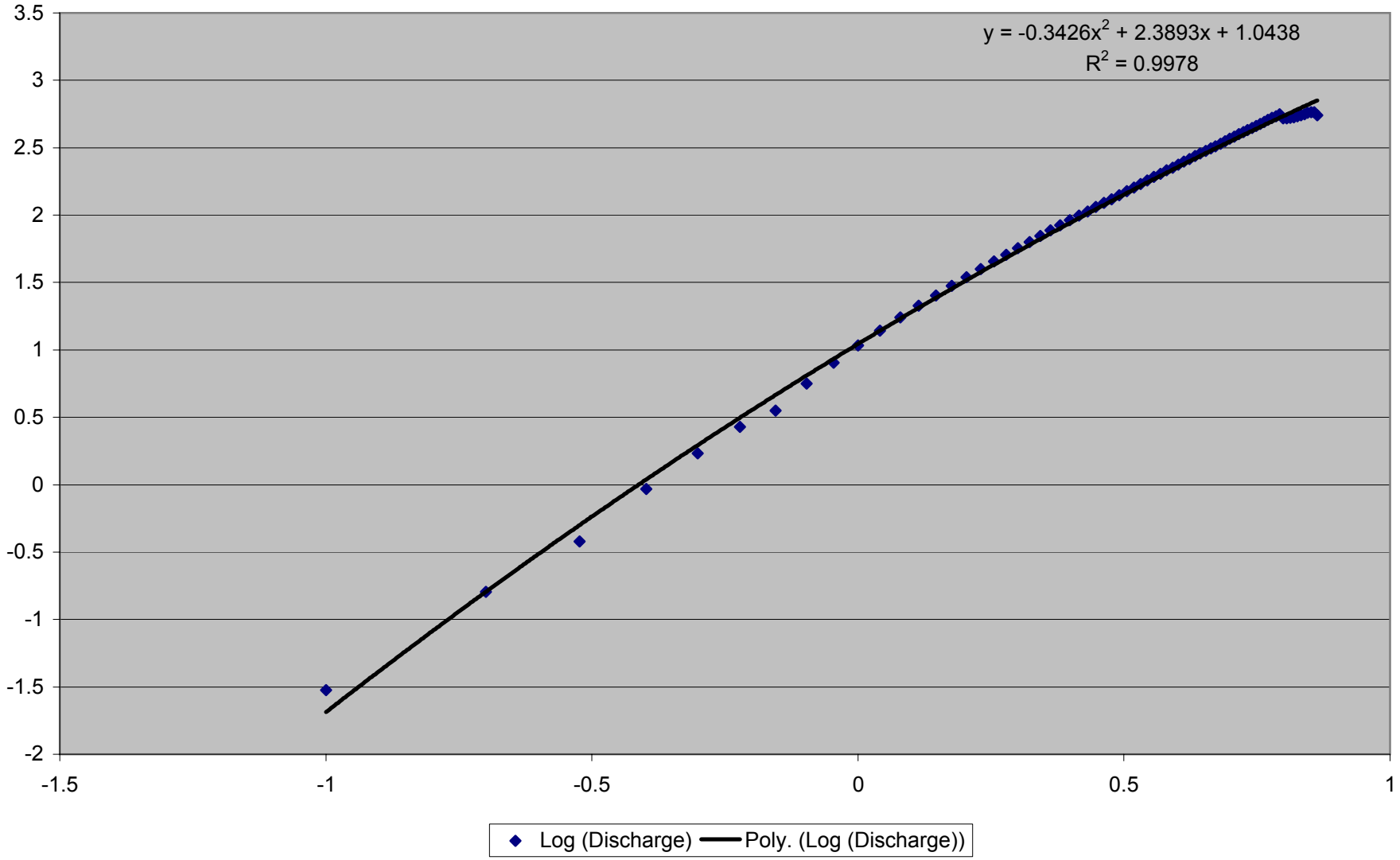
Bank location description (check one)

The BEHI was conducted on the entire LTC reach due to similar bank features throughout.

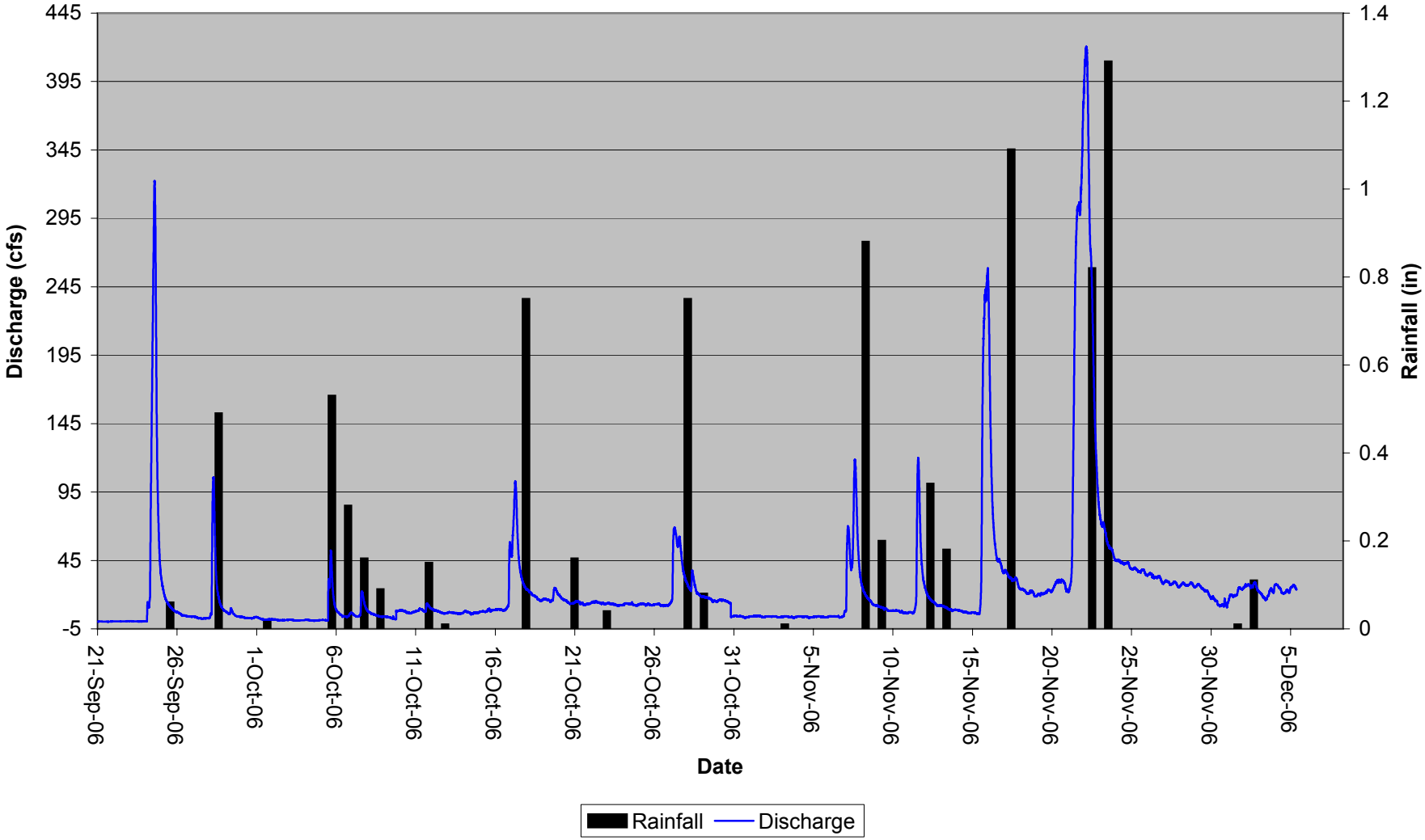
GRAND TOTAL 20.9

BEHI RATING Moderate

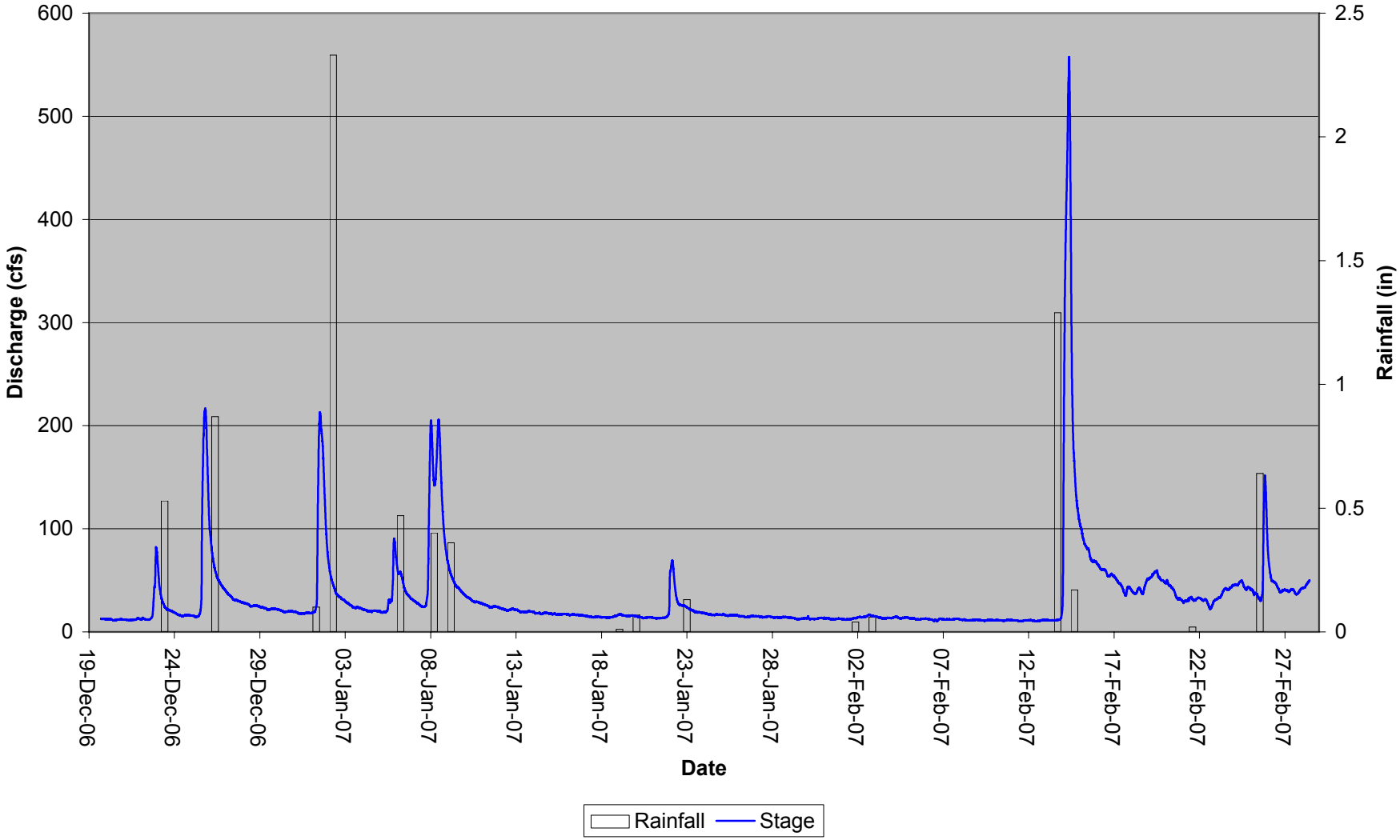
LTC Rating Curve



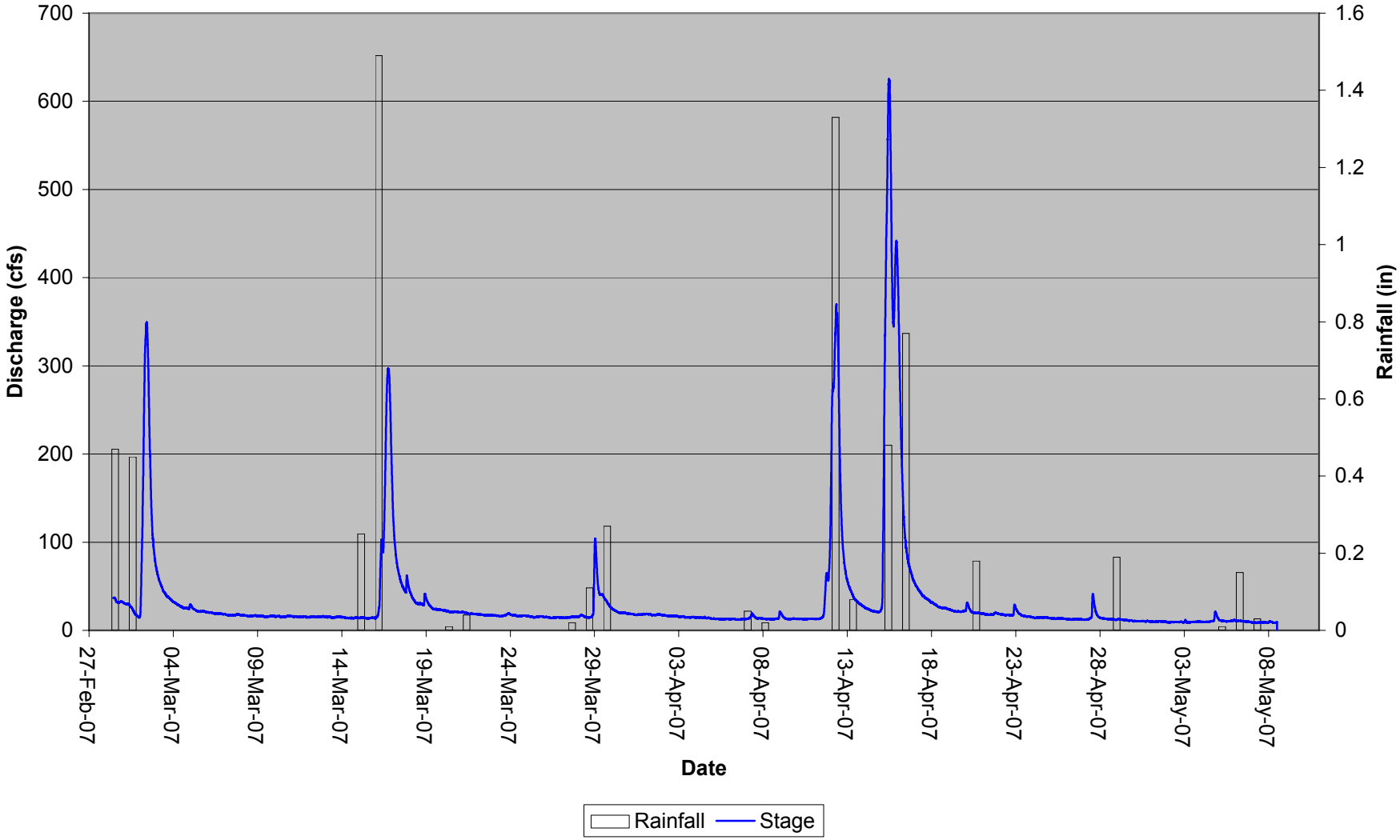
Little Troublesome Creek Hydrograph
(9/21/06) - (12/6/06)



Little Troublesome Stream Hydrograph
(12/19/06) - (2/28/07)

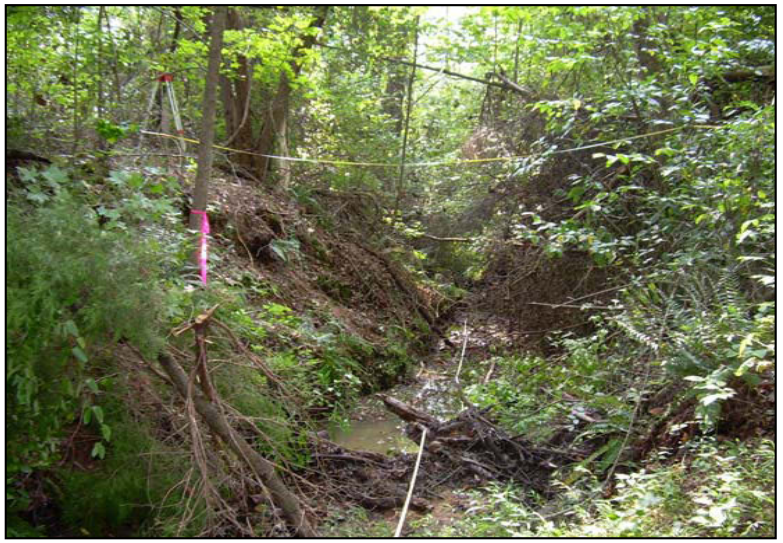


Little Troublesome Stream Hydrograph
(2/28/07) - (5/8/07)



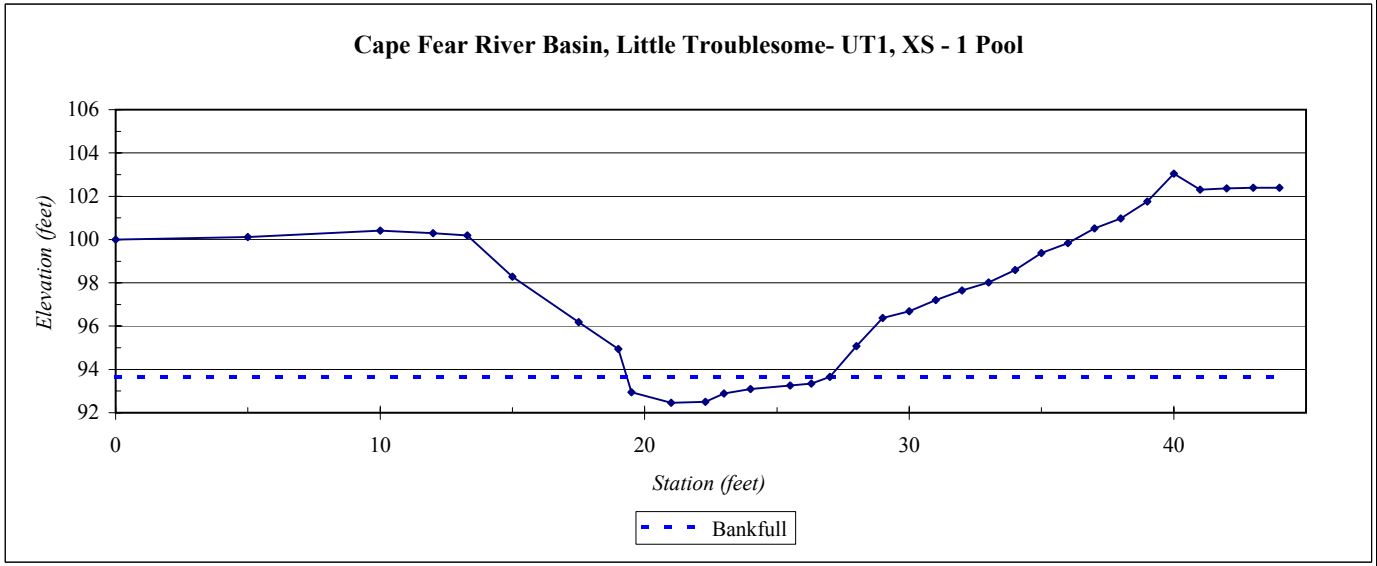
UT1 Existing Data

River Basin:	Cape Fear
Watershed:	Little Troublesome- UT1
XS ID	XS - 1 Pool
Drainage Area (sq mi):	0.1
Date:	9/18/2006
Field Crew:	A. Helms, B. Hayes

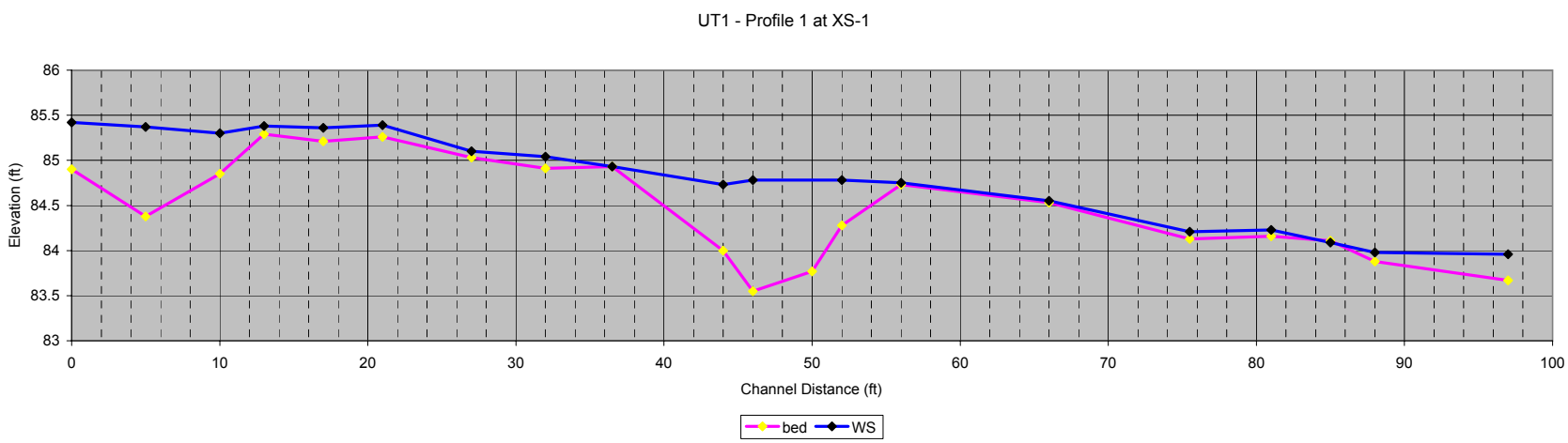


Station	Rod Ht.	Elevation
0	5.15	100.00
5	5.04	100.11
10	4.74	100.41
12	4.86	100.29
13.3	4.96	100.19
15	6.86	98.29
17.5	8.97	96.18
19	10.21	94.94
19.5	12.21	92.94
21	12.69	92.46
22.3	12.64	92.51
23	12.27	92.88
24	12.06	93.09
25.5	11.89	93.26
26.3	11.8	93.35
27	11.5	93.65
28	10.08	95.07
29	8.78	96.37
30	8.47	96.68
31	7.95	97.20
32	7.5	97.65
33	7.14	98.01
34	6.56	98.59
35	5.77	99.38
36	5.32	99.83
37	4.64	100.51
38	4.17	100.98
39	3.4	101.75
40	2.1	103.05
41	2.85	102.30
42	2.78	102.37
43	2.76	102.39
44	2.76	102.39

SUMMARY DATA	
Bankfull Elevation:	93.7
Bankfull Cross-Sectional Area:	5.5
Bankfull Width:	7.7
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	1.2
Mean Depth at Bankfull:	0.7
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	-
Water Surface Slope (ft/ft):	0.019



Slope Profile



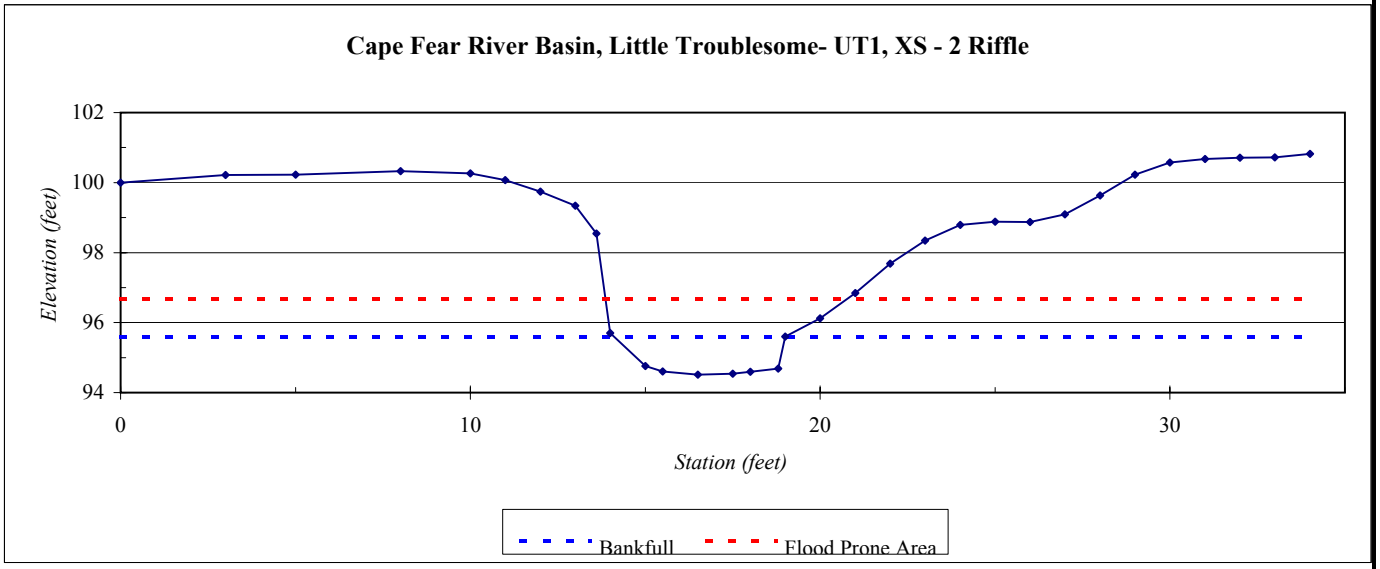
Elevation BM: 100

notes	inc distance	station	BS 0	HI 100	FS TP	FS bed	depth water	FS LB	FS RB	FS BKF	FS WS	AZ azimuth	ELEV bed	ELEV water srf	ELEV LF	ELEV RB	ELEV BKF	ELEV WS
		0		100		15.1					14.58		84.9					85.42
	5	5		100		15.62					14.63		84.38					85.37
	5	10		100		15.15					14.7		84.85					85.3
	3	13		100		14.71					14.62		85.29					85.38
	4	17		100		14.79					14.64		85.21					85.36
Head of Riffle	4	21		100		14.74					14.61		85.26					85.39
End of Riffle	6	27		100		14.97					14.9		85.03					85.1
	5	32		100		15.09					14.96		84.91					85.04
	4.5	36.5		100		15.07					15.07		84.93					84.93
Debris Jam	7.5	44		100		16					15.27		84					84.73
	2	46		100		16.45					15.22		83.55					84.78
TW, XS-1 Head of Pool	4	50		100		16.23							83.77					
End of Pool	2	52		100		15.72					15.22		84.28					84.78
Head of Riffle	4	56		100		15.27					15.25		84.73					84.75
	10	66		100		15.47					15.45		84.53					84.55
End of Riffle	9.5	75.5		100		15.87					15.79		84.13					84.21
	5.5	81		100		15.84					15.77		84.16					84.23
	4	85		100		15.89					15.91		84.11					84.09
Head of Pool	3	88		100		16.12					16.02		83.88					83.98
End of Pool	9	97		100		16.33					16.04		83.67					83.96

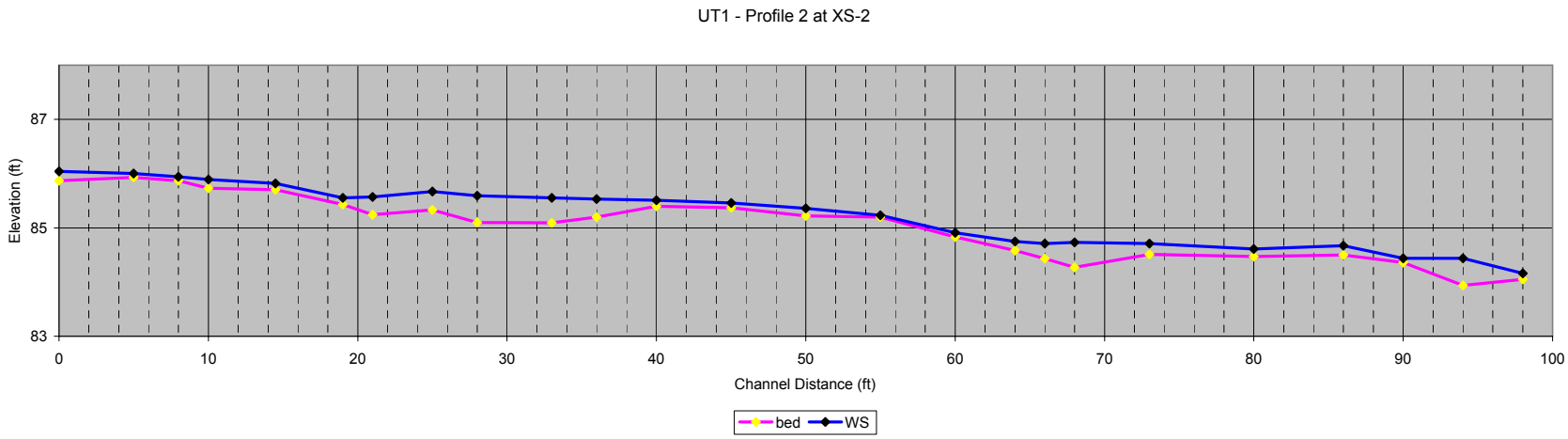
River Basin:	Cape Fear
Watershed:	Little Troublesome- UT1
XS ID	XS - 2 Riffle
Drainage Area (sq mi):	0.1
Date:	9/19/2006
Field Crew:	A. Helms, B. Hayes

Station	Rod Ht.	Elevation
0	5.68	100.00
3	5.46	100.22
5	5.45	100.23
8	5.35	100.33
10	5.42	100.26
11	5.61	100.07
12	5.94	99.74
13	6.34	99.34
13.6	7.14	98.54
14	9.98	95.70
15	10.92	94.76
15.5	11.08	94.60
16.5	11.17	94.51
17.5	11.14	94.54
18	11.09	94.59
18.8	10.99	94.69
19	10.08	95.60
20	9.56	96.12
21	8.84	96.84
22	8	97.68
23	7.34	98.34
24	6.89	98.79
25	6.8	98.88
26	6.81	98.87
27	6.59	99.09
28	6.05	99.63
29	5.45	100.23
30	5.11	100.57
31	5.01	100.67
32	4.97	100.71
33	4.96	100.72
34	4.86	100.82

SUMMARY DATA	
Bankfull Elevation:	95.6
Bankfull Cross-Sectional Area:	4.3
Bankfull Width:	4.9
Flood Prone Area Elevation:	96.7
Flood Prone Width:	7.0
Max Depth at Bankfull:	1.1
Mean Depth at Bankfull:	0.9
W / D Ratio:	5.6
Entrenchment Ratio:	1.4
Bank Height Ratio:	5.3
Water Surface Slope (ft/ft):	0.019



Slope Profile



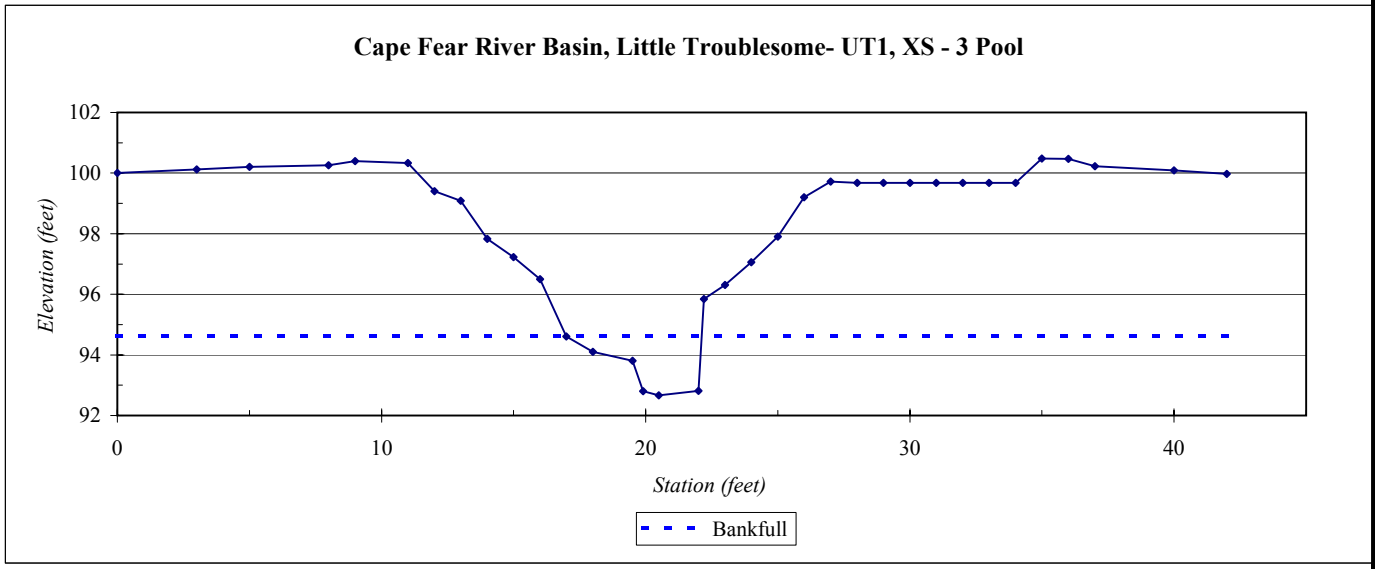
Elevation BM: 100

notes	inc distance	station	BS 0	HI 100	FS TP	FS bed	depth water	FS LB	FS RB	FS BKF	FS WS	AZ azimuth	ELEV bed	ELEV water srf	ELEV LF	ELEV RB	ELEV BKF	ELEV WS
		0		100		14.13					13.96		85.87					86.04
	5	5		100		14.07					14		85.93					86
	3	8		100		14.13					14.06		85.87					85.94
	2	10		100		14.27					14.11		85.73					85.89
Head of Riffle	4.5	14.5		100		14.3					14.18		85.7					85.82
End of Riffle	4.5	19		100		14.57					14.45		85.43					85.55
	2	21		100		14.76					14.43		85.24					85.57
Head of Pool	4	25		100		14.67					14.33		85.33					85.67
	3	28		100		14.9					14.41		85.1					85.59
	5	33		100		14.91					14.45		85.09					85.55
End of Pool	3	36		100		14.8					14.47		85.2					85.53
Head of Riffle	4	40		100		14.6					14.49		85.4					85.51
	5	45		100		14.63					14.54		85.37					85.46
	5	50		100		14.78					14.64		85.22					85.36
	5	55		100		14.8					14.77		85.2					85.23
	5	60		100		15.17					15.09		84.83					84.91
End of Riffle	4	64		100		15.42					15.25		84.58					84.75
	2	66		100		15.57					15.29		84.43					84.71
	2	68		100		15.73					15.27		84.27					84.73
	5	73		100		15.49					15.29		84.51					84.71
	7	80		100		15.53					15.39		84.47					84.61
	6	86		100		15.5					15.33		84.5					84.67
	4	90		100		15.64					15.56		84.36					84.44
	4	94		100		16.06					15.56		83.94					84.44
	4	98		100		15.95					15.84		84.05					84.16

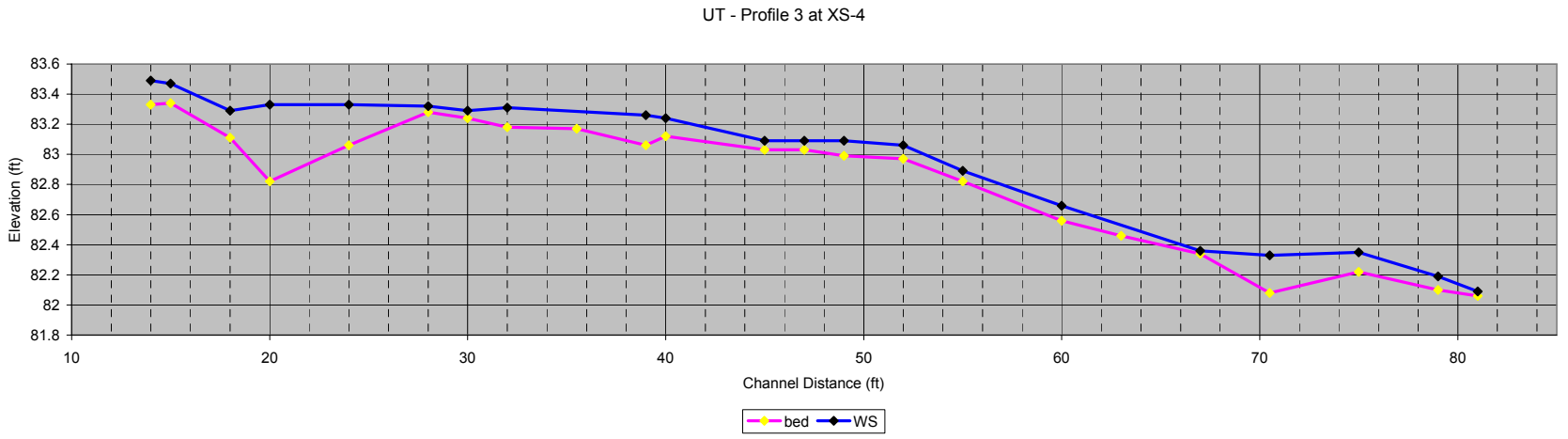
River Basin:	Cape Fear
Watershed:	Little Troublesome- UT1
XS ID	XS - 3 Pool
Drainage Area (sq mi):	0.1
Date:	9/19/2006
Field Crew:	A. Helms, B. Hayes

Station	Rod Ht.	Elevation
0	5.80	100.00
3	5.68	100.12
5	5.60	100.20
8	5.54	100.26
9	5.40	100.40
11	5.47	100.33
12	6.40	99.40
13	6.71	99.09
14	7.97	97.83
15	8.57	97.23
16	9.30	96.50
17	11.19	94.61
18	11.70	94.10
19.5	11.99	93.81
19.9	13.00	92.80
20.5	13.13	92.67
22	12.99	92.81
22.2	9.96	95.84
23	9.49	96.31
24	8.74	97.06
25	7.90	97.90
26	6.60	99.20
27	6.08	99.72
28	6.12	99.68
29	6.12	99.68
30	6.12	99.68
31	6.12	99.68
32	6.12	99.68
33	6.12	99.68
34	6.12	99.68
35	5.32	100.48
36	5.33	100.47
37	5.57	100.23
40	5.71	100.09
42	5.83	99.97

SUMMARY DATA	
Bankfull Elevation:	94.6
Bankfull Cross-Sectional Area:	5.8
Bankfull Width:	5.1
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	1.9
Mean Depth at Bankfull:	1.1
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	-
Water Surface Slope (ft/ft):	0.019



Slope Profile



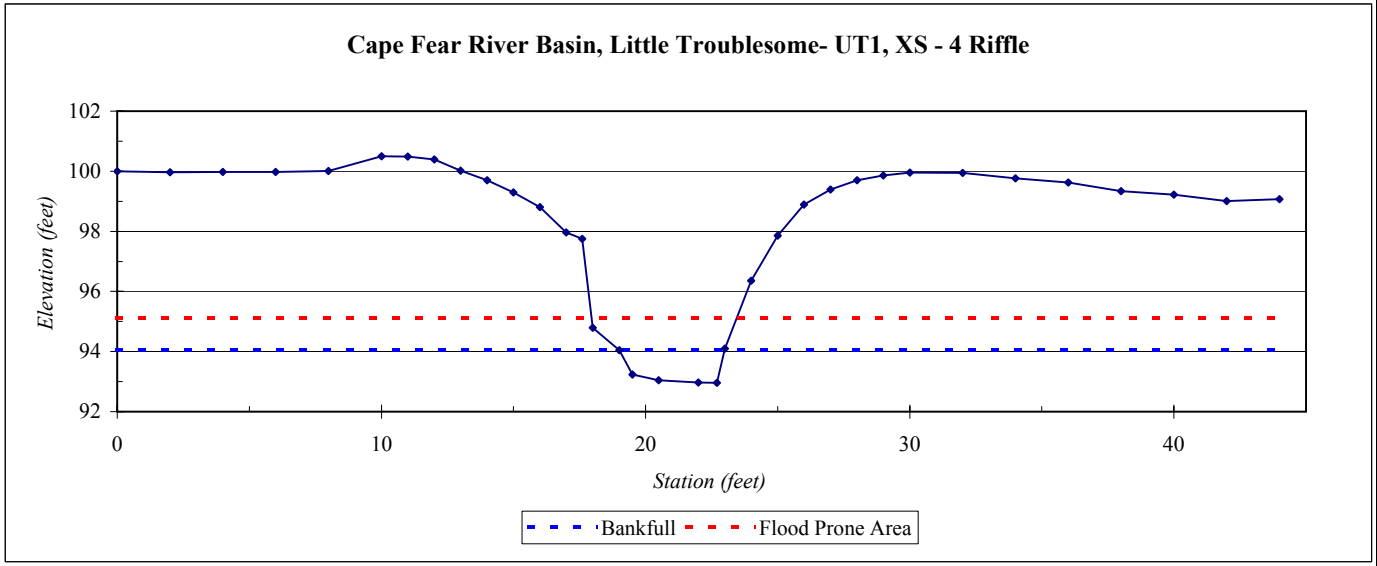
Elevation BM: 100

notes	inc distance	station	BS 0	HI 100	FS TP	FS bed	depth water	FS LB	FS RB	FS BKF	FS WS	AZ azimuth	ELEV bed	ELEV water srf	ELEV LF	ELEV RB	ELEV BKF	ELEV WS
		14		100		16.67					16.51		83.33					83.49
	1	15		100		16.66					16.53		83.34					83.47
Head of Pool	3	18		100		16.89					16.71		83.11					83.29
	2	20		100		17.18					16.67		82.82					83.33
End of Pool	4	24		100		16.94					16.67		83.06					83.33
	4	28		100		16.72					16.68		83.28					83.32
	2	30		100		16.76					16.71		83.24					83.29
	2	32		100		16.82					16.69		83.18					83.31
	3.5	35.5		100		16.83							83.17					
	3.5	39		100		16.94					16.74		83.06					83.26
	1	40		100		16.88					16.76		83.12					83.24
	5	45		100		16.97					16.91		83.03					83.09
	2	47		100		16.97					16.91		83.03					83.09
Head of Riffle	2	49		100		17.01					16.91		82.99					83.09
	3	52		100		17.03					16.94		82.97					83.06
End of Riffle	3	55		100		17.18					17.11		82.82					82.89
	5	60		100		17.44					17.34		82.56					82.66
	3	63		100		17.54							82.46					
	4	67		100		17.66					17.64		82.34					82.36
	3.5	70.5		100		17.92					17.67		82.08					82.33
Head of Riffle	4.5	75		100		17.78					17.65		82.22					82.35
	4	79		100		17.9					17.81		82.1					82.19
End of Riffle	2	81		100		17.94					17.91		82.06					82.09

River Basin:	Cape Fear
Watershed:	Little Troublesome- UT1
XS ID	XS - 4 Riffle
Drainage Area (sq mi):	0.1
Date:	9/19/2006
Field Crew:	A. Helms, B. Hayes

Station	Rod Ht.	Elevation
0	6.40	100.00
2	6.43	99.97
4	6.42	99.98
6	6.42	99.98
8	6.39	100.01
10	5.90	100.50
11	5.91	100.49
12	6.01	100.39
13	6.38	100.02
14	6.70	99.70
15	7.10	99.30
16	7.60	98.80
17	8.44	97.96
17.6	8.65	97.75
18	11.61	94.79
19	12.36	94.04
19.5	13.16	93.24
20.5	13.36	93.04
22	13.43	92.97
22.7	13.44	92.96
23	12.30	94.10
24	10.04	96.36
25	8.54	97.86
26	7.51	98.89
27	7.01	99.39
28	6.70	99.70
29	6.54	99.86
30	6.45	99.95
32	6.46	99.94
34	6.64	99.76
36	6.78	99.62
38	7.06	99.34
40	7.18	99.22
42	7.39	99.01
44	7.33	99.07

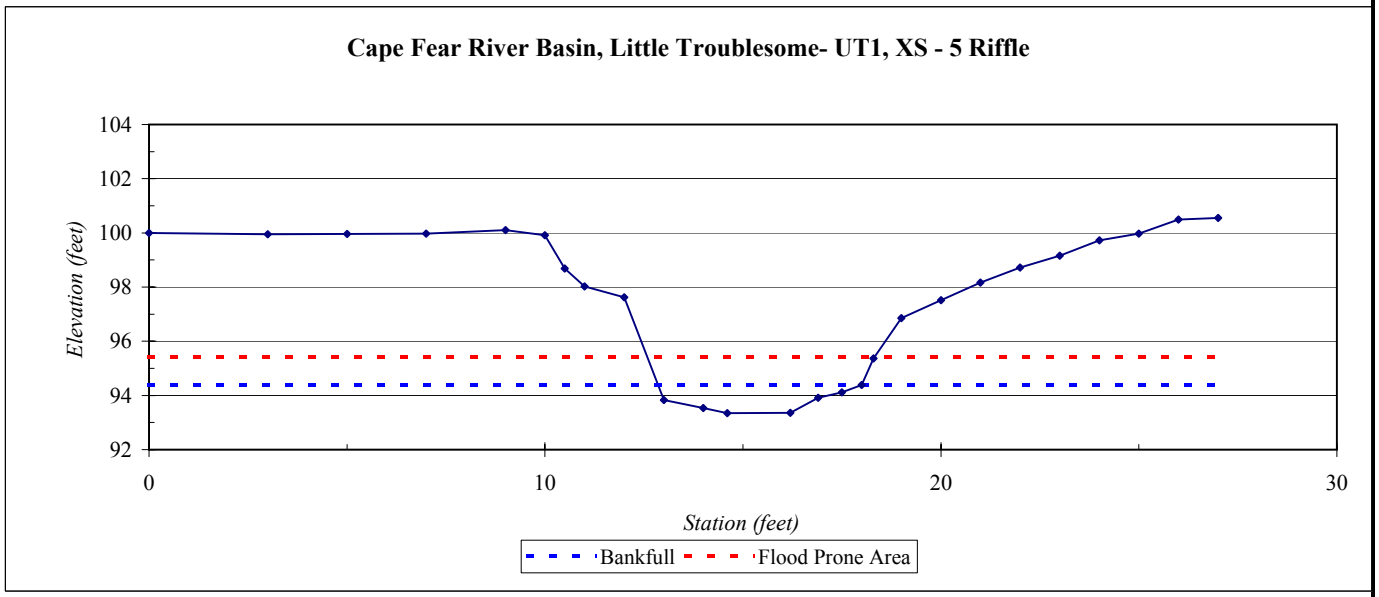
SUMMARY DATA	
Bankfull Elevation:	94.0
Bankfull Cross-Sectional Area:	3.6
Bankfull Width:	4.0
Flood Prone Area Elevation:	95.1
Flood Prone Width:	6.0
Max Depth at Bankfull:	1.1
Mean Depth at Bankfull:	0.9
W / D Ratio:	4.4
Entrenchment Ratio:	1.5
Bank Height Ratio:	6.5
Water Surface Slope (ft/ft):	0.019



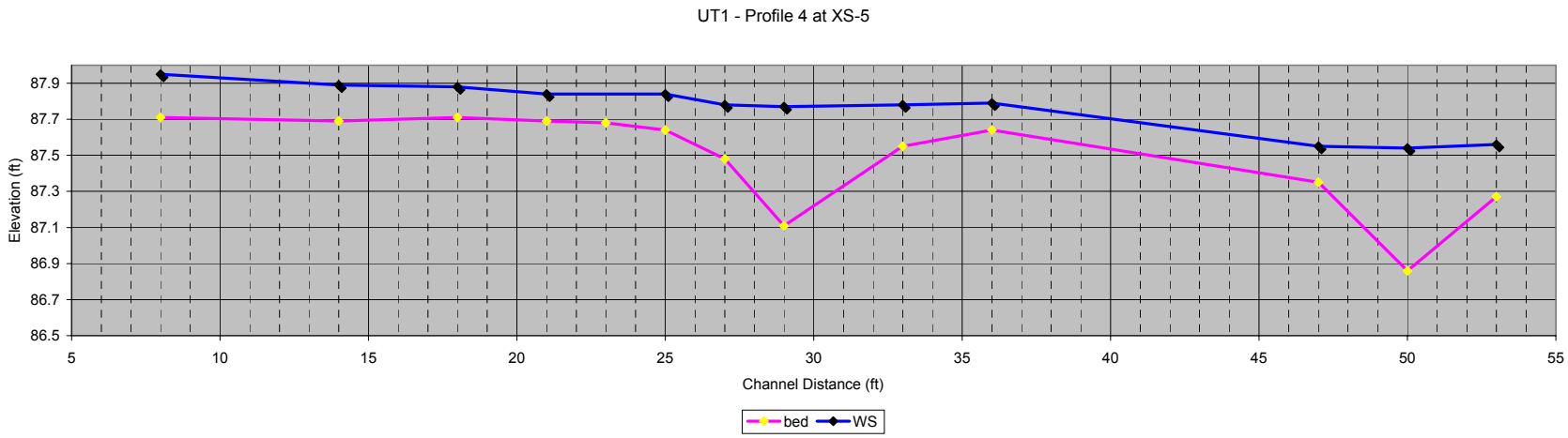
River Basin:	Cape Fear
Watershed:	Little Troublesome- UT1
XS ID	XS - 5 Riffle
Drainage Area (sq mi):	0.1
Date:	9/18/2006
Field Crew:	A. Helms, B. Hayes

Station	Rod Ht.	Elevation
0	5.62	100.00
3	5.67	99.95
5	5.66	99.96
7	5.65	99.97
9	5.52	100.10
10	5.71	99.91
10.5	6.94	98.68
11	7.60	98.02
12	8.00	97.62
13	11.79	93.83
14	12.08	93.54
14.6	12.27	93.35
16.2	12.26	93.36
16.9	11.71	93.91
17.5	11.50	94.12
18	11.24	94.38
18.3	10.25	95.37
19	8.77	96.85
20	8.10	97.52
21	7.45	98.17
22	6.90	98.72
23	6.46	99.16
24	5.89	99.73
25	5.65	99.97
26	5.13	100.49
27	5.07	100.55

SUMMARY DATA	
Bankfull Elevation:	94.4
Bankfull Cross-Sectional Area:	3.7
Bankfull Width:	5.1
Flood Prone Area Elevation:	95.4
Flood Prone Width:	5.3
Max Depth at Bankfull:	1.0
Mean Depth at Bankfull:	0.7
W / D Ratio:	7.0
Entrenchment Ratio:	1.0
Bank Height Ratio:	6.4
Water Surface Slope (ft/ft):	0.019



Slope Profile



Elevation BM: 100

notes	inc distance	station	BS 0	HI 100	FS TP	FS bed	depth water	FS LB	FS RB	FS BKF	FS WS	AZ azimuth	ELEV bed	ELEV water srf	ELEV LF	ELEV RB	ELEV BKF	ELEV WS
		8		100		12.29					12.05		87.71					87.95
	6	14		100		12.31					12.11		87.69					87.89
	4	18		100		12.29					12.12		87.71					87.88
Head of Riffle at XS-5	3	21		100		12.31					12.16		87.69					87.84
	2	23		100		12.32							87.68					
	2	25		100		12.36					12.16		87.64					87.84
	2	27		100		12.52					12.22		87.48					87.78
Head of Pool	2	29		100		12.89					12.23		87.11					87.77
	4	33		100		12.45					12.22		87.55					87.78
End of Pool	3	36		100		12.36					12.21		87.64					87.79
	11	47		100		12.65					12.45		87.35					87.55
Head of Pool	3	50		100		13.14					12.46		86.86					87.54
	3	53		100		12.73					12.44		87.27					87.56

Riffle Pebble Count

Riffle Pebble Count,

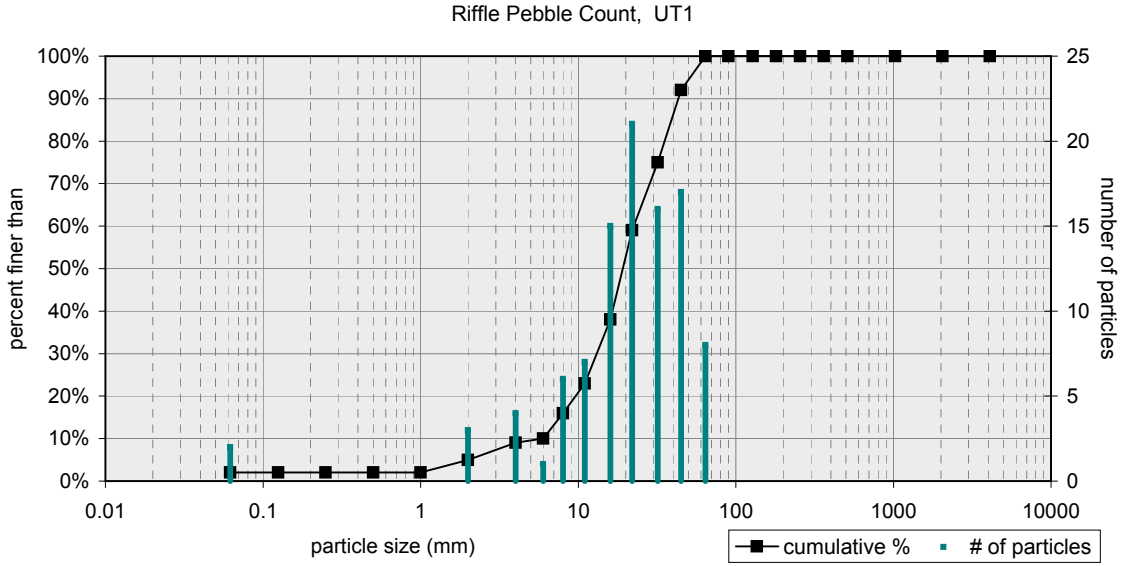
UT1

Cape Fear

Note: **Riffle XS-2**

Material	Size Range (mm)		Count
silt/clay	0	0.062	**2**
very fine sand	0.062	0.13	
fine sand	0.13	0.25	
medium sand	0.25	0.5	
coarse sand	0.5	1	
very coarse sand	1	2	**3**
very fine gravel	2	4	**4**
fine gravel	4	6	**1**
fine gravel	6	8	**6**
medium gravel	8	11	**7**
medium gravel	11	16	**15**
coarse gravel	16	22	**21**
coarse gravel	22	32	**16**
very coarse gravel	32	45	**17**
very coarse gravel	45	64	**8**
small cobble	64	90	
medium cobble	90	128	
large cobble	128	180	
very large cobble	180	256	
small boulder	256	362	
small boulder	362	512	
medium boulder	512	1024	
large boulder	1024	2048	
very large boulder	2048	4096	
	total particle count:		100

bedrock		
clay hardpan		
detritus/wood		
artificial		
	total count:	100



based on sediment particles only	size percent less than (mm)						particle size distribution		
	D16	D35	D50	D65	D84	D95	gradation	geo mean	std dev
	8.000	14.84	19.2	25	38	51	2.2	17.5	2.2

based on total count	percent by substrate type								
	silt/clay	sand	gravel	cobble	boulder	bedrock	hardpan	wood/det	artificial
	2%	3%	95%	0%	0%	0%	0%	0%	0%

Riffle Pebble Count

Riffle Pebble Count,

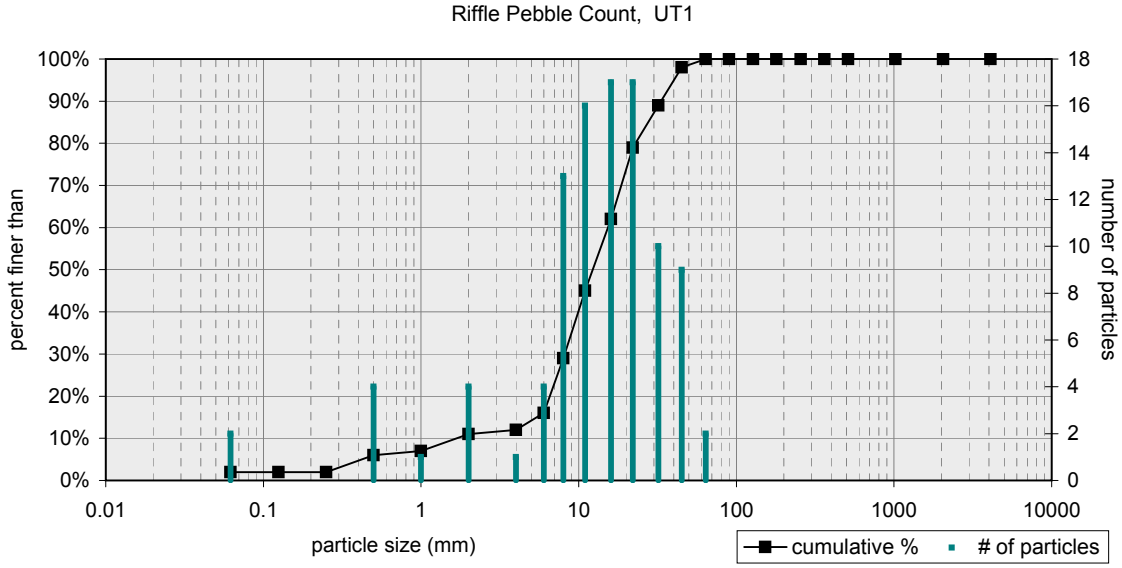
UT1

Cape Fear

Note: **Riffle XS-4**

Material	Size Range (mm)		Count
silt/clay	0	0.062	**2**
very fine sand	0.062	0.13	
fine sand	0.13	0.25	
medium sand	0.25	0.5	**4**
coarse sand	0.5	1	**1**
very coarse sand	1	2	**4**
very fine gravel	2	4	**1**
fine gravel	4	6	**4**
fine gravel	6	8	**13**
medium gravel	8	11	**16**
medium gravel	11	16	**17**
coarse gravel	16	22	**17**
coarse gravel	22	32	**10**
very coarse gravel	32	45	**9**
very coarse gravel	45	64	**2**
small cobble	64	90	
medium cobble	90	128	
large cobble	128	180	
very large cobble	180	256	
small boulder	256	362	
small boulder	362	512	
medium boulder	512	1024	
large boulder	1024	2048	
very large boulder	2048	4096	
	total particle count:		100

bedrock		
clay hardpan		
detritus/wood		
artificial		
	total count:	100



based on sediment particles only	size percent less than (mm)						particle size distribution		
	D16	D35	D50	D65	D84	D95	gradation	geo mean	std dev
	6.000	9.01	12.3	17	27	40	2.1	12.6	2.1

based on total count	percent by substrate type								
	silt/clay	sand	gravel	cobble	boulder	bedrock	hardpan	wood/det	artificial
	2%	9%	89%	0%	0%	0%	0%	0%	0%

Riffle Pebble Count

Riffle Pebble Count,

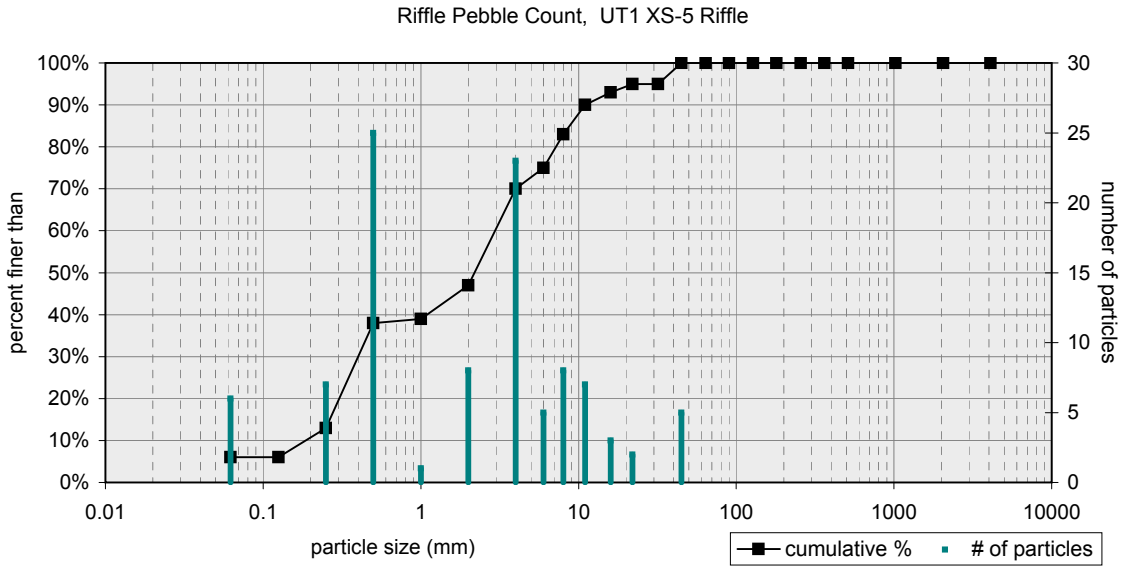
UT1 XS-5 Riffle

Cape Fear

Note: **Riffle XS-5**

Material	Size Range (mm)		Count
silt/clay	0	0.062	**6**
very fine sand	0.062	0.13	
fine sand	0.13	0.25	**7**
medium sand	0.25	0.5	**25**
coarse sand	0.5	1	**1**
very coarse sand	1	2	**8**
very fine gravel	2	4	**23**
fine gravel	4	6	**5**
fine gravel	6	8	**8**
medium gravel	8	11	**7**
medium gravel	11	16	**3**
coarse gravel	16	22	**2**
coarse gravel	22	32	
very coarse gravel	32	45	**5**
very coarse gravel	45	64	
small cobble	64	90	
medium cobble	90	128	
large cobble	128	180	
very large cobble	180	256	
small boulder	256	362	
small boulder	362	512	
medium boulder	512	1024	
large boulder	1024	2048	
very large boulder	2048	4096	
		total particle count:	100

bedrock		
clay hardpan		
detritus/wood		
artificial		
	total count:	100



based on sediment particles only	size percent less than (mm)						particle size distribution		
	D16	D35	D50	D65	D84	D95	gradation	geo mean	std dev
	0.272	0.46	2.2	3	8	22	5.9	1.5	5.6

based on total count	percent by substrate type								
	silt/clay	sand	gravel	cobble	boulder	bedrock	hardpan	wood/det	artificial
	6%	41%	53%	0%	0%	0%	0%	0%	0%

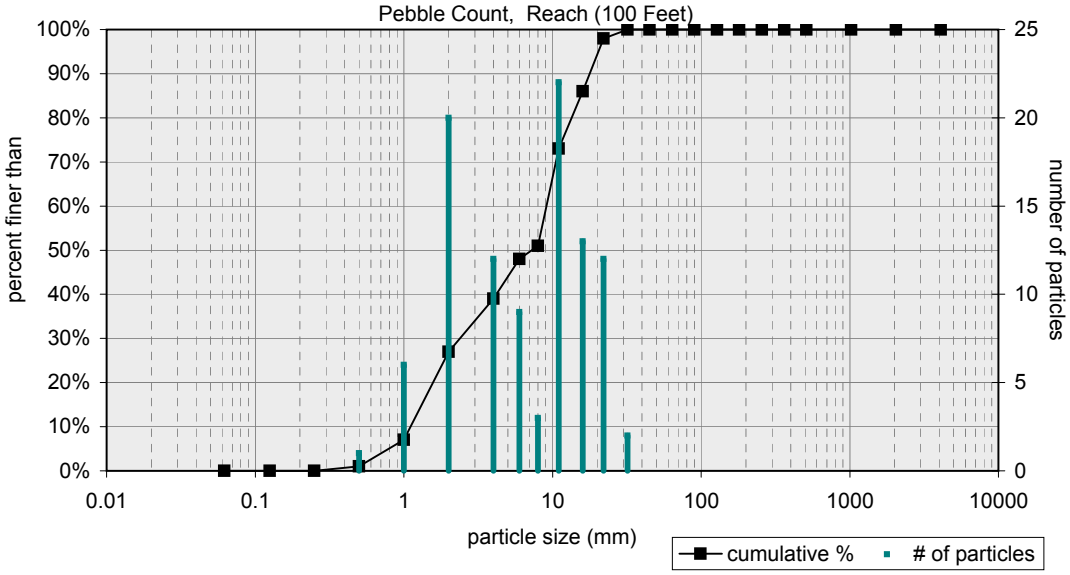
Pebble Count of Channel Reach

Material	Size Range (mm)		Count	
silt/clay	0	0.062		##
very fine sand	0.062	0.13		##
fine sand	0.13	0.25		##
medium sand	0.25	0.5	**1**	##
coarse sand	0.5	1	**6**	##
very coarse sand	1	2	**20**	##
very fine gravel	2	4	**12**	##
fine gravel	4	6	**9**	##
fine gravel	6	8	**3**	##
medium gravel	8	11	**22**	##
medium gravel	11	16	**13**	##
coarse gravel	16	22	**12**	##
coarse gravel	22	32	**2**	##
very coarse gravel	32	45		##
very coarse gravel	45	64		##
small cobble	64	90		##
medium cobble	90	128		##
large cobble	128	180		##
very large cobble	180	256		##
small boulder	256	362		##
small boulder	362	512		##
medium boulder	512	1024		##
large boulder	1024	2048		##
very large boulder	2048	4096		##
		total particle count:	100	

bedrock			
clay hardpan			
detritus/wood			
artificial			
		total count:	100

Pebble Count,
Reach (100 Feet)
Cape Fear

Note: **Reach (100 Feet)**



based on sediment particles only	size percent less than (mm)						particle size distribution		
	D16	D35	D50	D65	D84	D95	gradation	geo mean	std dev
	1.366	3.17	7.3	10	15	20	3.7	4.5	3.3

based on total count	percent by substrate type								
	silt/clay	sand	gravel	cobble	boulder	bedrock	hardpan	wood/det	artificial
	0%	27%	73%	0%	0%	0%	0%	0%	0%

Bank Erodibility Hazard Rating Guide

Stream: UT1 **Reach:** Entire Reach (1,200lf) **Date:** 2/7/07 **Crew:** AH, AF

Bank Erosion Potential

Bank Height (ft): / Bankfull Height (ft):		Bank Height/ Bankfull Ht		Root Depth/ Bank Height		Root Density %		Bank Angle (Degrees)		Surface Protection%	
VERY LOW	Value Range	1.0	1.1	0.9	1.0	80	100	0.0	20.0	80	100
	Index Range	1.0	1.9	1.0	1.9	1.0	1.9	1.0	1.9	1.0	1.9
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**
LOW	Value Range	1.11	1.19	0.5	0.89	55	79	21.0	60.0	55	79
	Index Range	2.0	3.9	2.0	3.9	2.0	3.9	2.0	3.9	2.0	3.9
	Choice	**V:**	**I:**	**V: 0.80**	**I: 3.0**	**V: 79.0**	**I: 3.9**	**V:**	**I:**	**V:**	**I:**
MODERATE	Value Range	1.2	1.5	0.3	0.49	30	54	61.0	80.0	30	54
	Index Range	4.0	5.9	4.0	5.9	4.0	5.9	4.0	5.9	4.0	5.9
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V: 50.0**	**I: 5.0**
HIGH	Value Range	1.6	2.0	0.15	0.29	15	29	81.0	90.0	15	29
	Index Range	6.0	7.9	6.0	7.9	6.0	7.9	6.0	7.9	6.0	7.9
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V: 90.0**	**I: 7.9**	**V:**	**I:**
VERY HIGH	Value Range	2.1	2.8	0.05	0.14	5	14	91.0	119.0	10	14
	Index Range	8.0	9.0	8.0	9.0	8.0	9.0	8.0	9.0	8.0	9.0
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**
EXTREME	Value Range	>2.8		<0.05		<5		>119		<10	
	Index Range	10		10		10		10		10	
	Choice	**V: 2.8**	**I: 10.0**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**

V = value, I = index

SUB-TOTAL (Sum one index from each column) 29.8

Bank Material Description:

Mostly smaller gravel mixed with sand

Bank Materials

Bedrock (Bedrock banks have very low bank erosion potential)

Boulders (Banks composed of boulders have low bank erosion potential)

Cobble (Subtract 10 points. If sand/gravel matrix greater than 50% of bank material, then do not adjust)

Gravel (Add 5-10 points depending percentage of bank material that is composed of sand)

Sand (Add 10 points)

Silt Clay (+ 0: no adjustment)

Bank Sketch

BANK MATERIAL ADJUSTMENT 10

Stratification Comments:

Many stratified layers were observed

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage

STRATIFICATION ADJUSTMENT 10

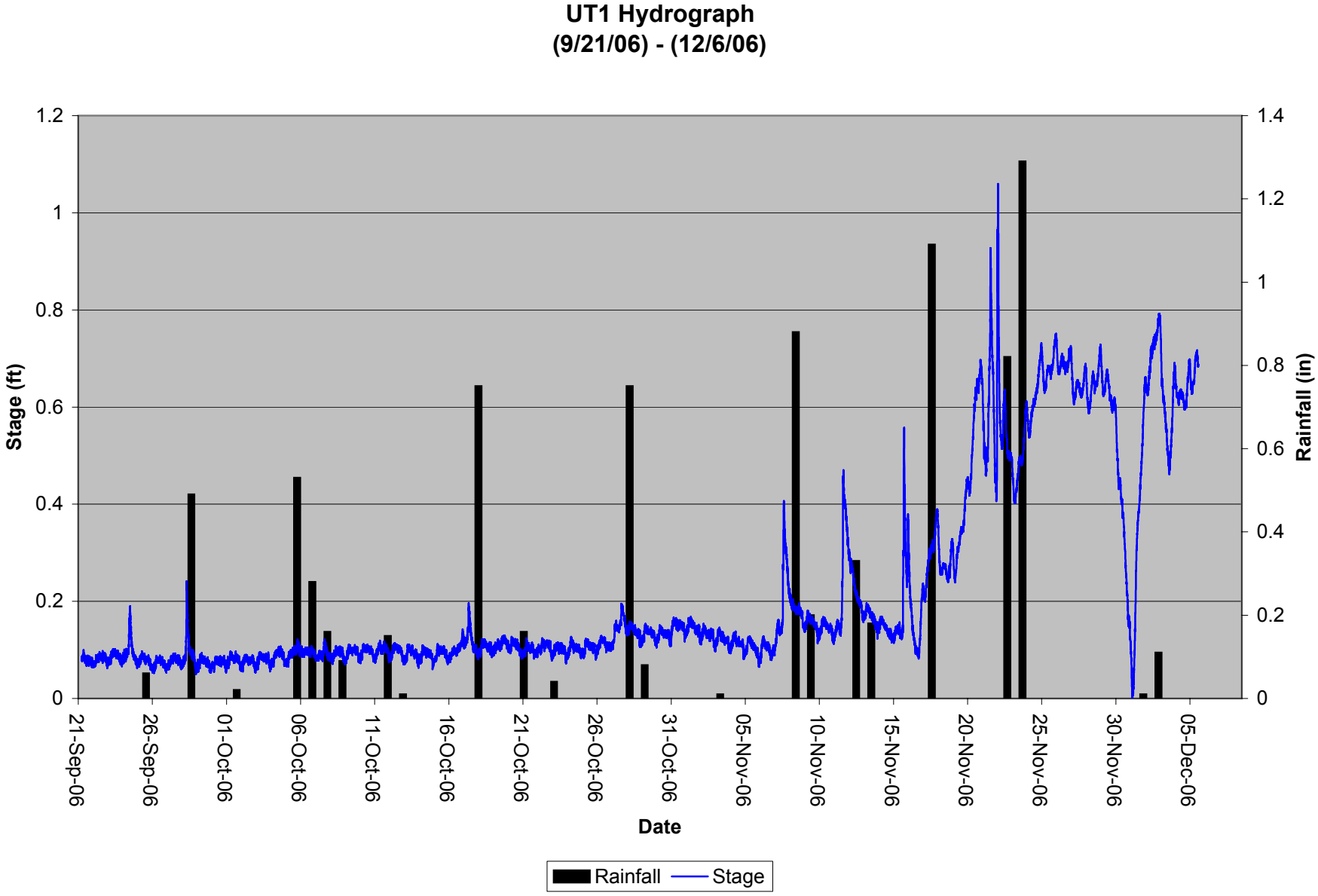
VERY LOW	LOW	MODERATE	HIGH	VERY HIGH	EXTREME
5-9.9	10-19.9	20-29.9	30-39.9	40-45.9	46-50

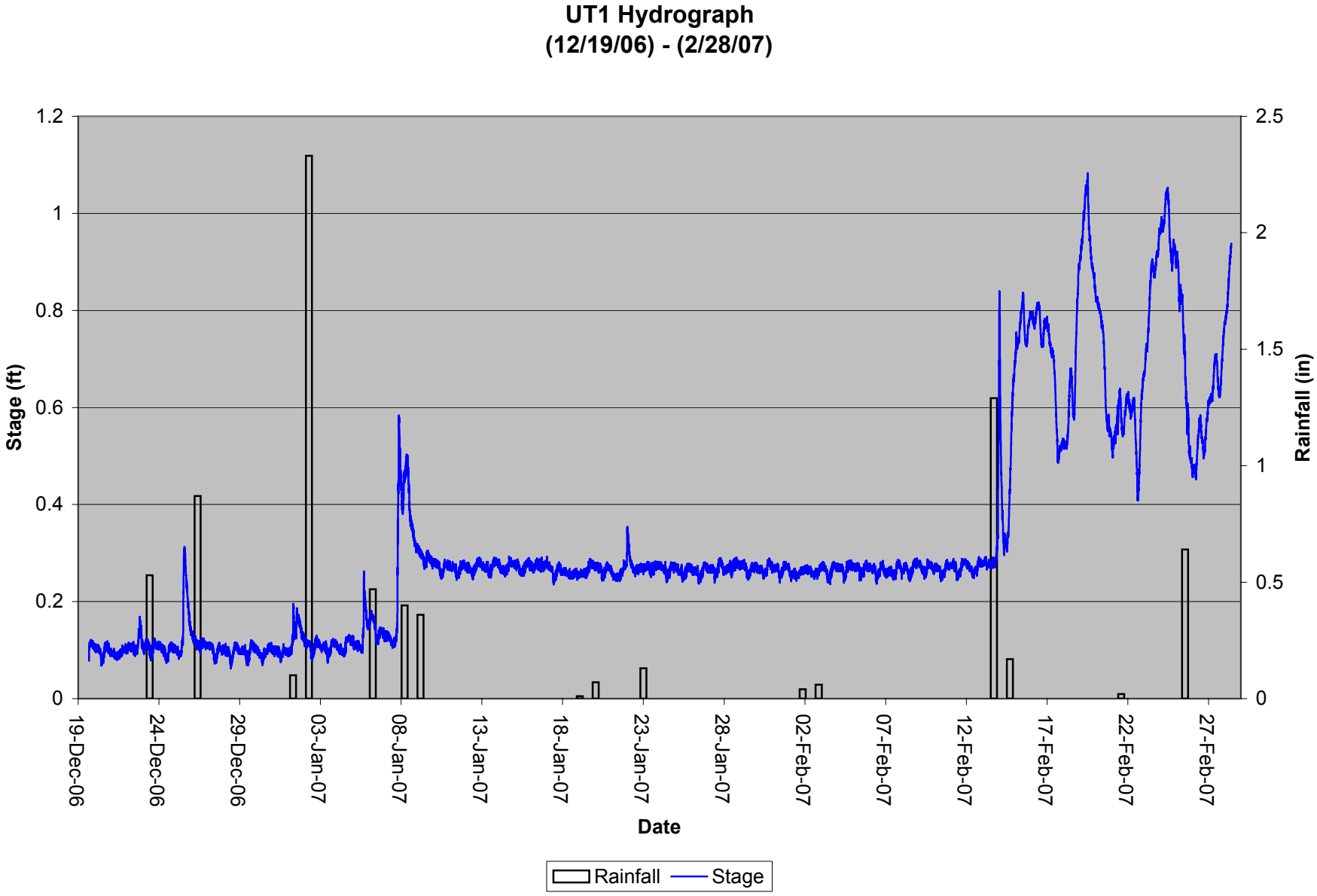
Bank location description (check one)

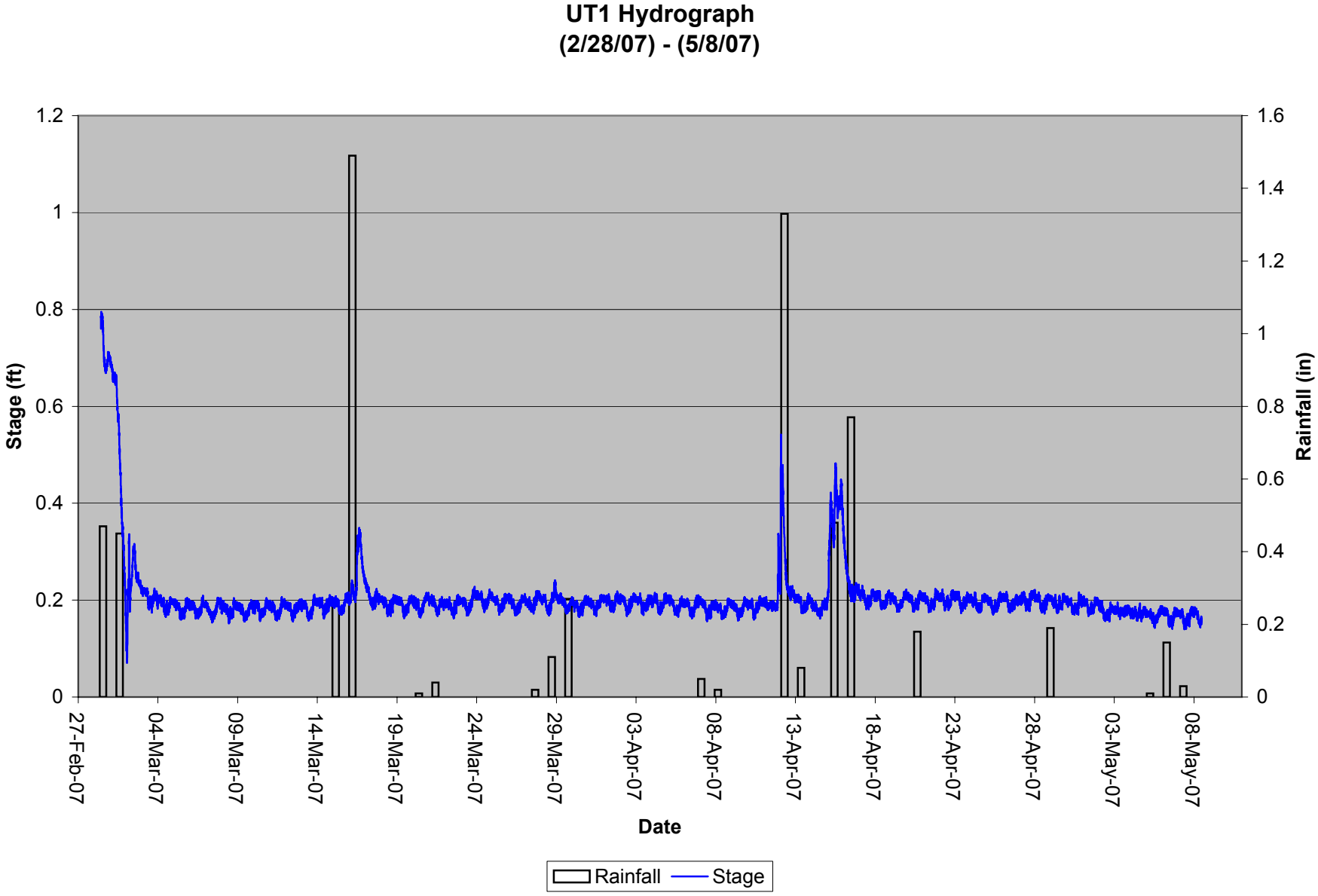
The BEHI was conducted on the entire LTC reach due to similar bank features throughout.

GRAND TOTAL 49.8

BEHI RATING Extreme


UT1 Hydrograph
(9/21/06) - (12/6/06)
Stage (ft)
Rainfall (in)
Date
1.2
1
0.8
0.6
0.4
0.2
0
1.4
1.2
1
0.8
0.6
0.4
0.2
0
21-Sep-06
26-Sep-06
01-Oct-06
06-Oct-06
11-Oct-06
16-Oct-06
21-Oct-06
26-Oct-06
31-Oct-06
05-Nov-06
10-Nov-06
15-Nov-06
20-Nov-06
25-Nov-06
30-Nov-06
05-Dec-06
Rainfall
Stage


UT1 Hydrograph
(12/19/06) - (2/28/07)
Stage (ft)
Rainfall (in)
Date
1.2
1
0.8
0.6
0.4
0.2
0
2.5
2
1.5
1
0.5
0
19-Dec-06
24-Dec-06
29-Dec-06
03-Jan-07
08-Jan-07
13-Jan-07
18-Jan-07
23-Jan-07
28-Jan-07
02-Feb-07
07-Feb-07
12-Feb-07
17-Feb-07
22-Feb-07
27-Feb-07
Rainfall
Stage


UT1 Hydrograph
(2/28/07) - (5/8/07)
Stage (ft)
Rainfall (in)
Date
1.2
1
0.8
0.6
0.4
0.2
0
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
27-Feb-07
04-Mar-07
09-Mar-07
14-Mar-07
19-Mar-07
24-Mar-07
29-Mar-07
03-Apr-07
08-Apr-07
13-Apr-07
18-Apr-07
23-Apr-07
28-Apr-07
03-May-07
08-May-07
Rainfall
Stage

Appendix D
Reference Reach Data

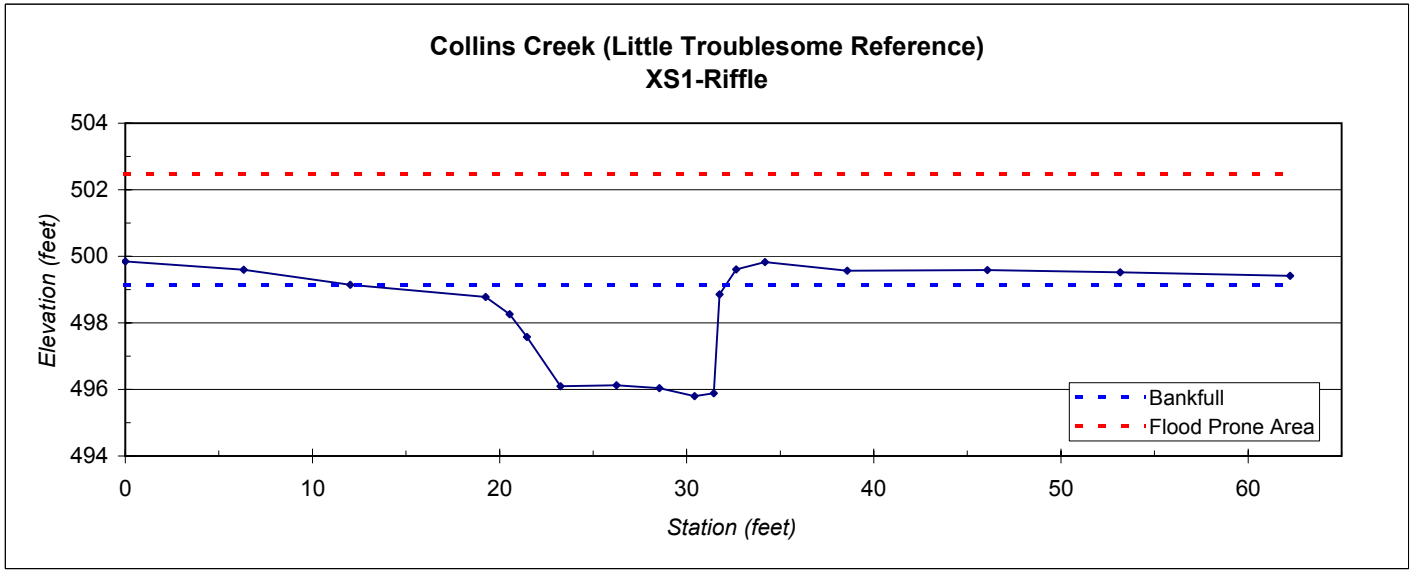
Collins Creek Reference Site

River Basin:	Cape Fear
Watershed:	Collins Creek (L:ittle Troublesome Ref
XS ID	XS1 Riffle
Drainage Area (sq mi):	
Date:	12/27/2006
Field Crew:	A. Helms, A. Spiller, B. Roberts

Station	Elevation
0.0	499.84
6.3	499.59
12.0	499.14
19.3	498.78
20.5	498.26
21.5	497.58
23.3	496.09
26.2	496.12
28.5	496.04
30.4	495.80
31.4	495.89
31.8	498.85
32.6	499.61
34.2	499.83
38.6	499.57
46.1	499.59
53.2	499.52
62.2	499.41

SUMMARY DATA	
Bankfull Elevation:	499.14
Bankfull Cross-Sectional Area:	33.4
Bankfull Width:	20.1
Flood Prone Area Elevation:	502.48
Flood Prone Width:	>60
Max Depth at Bankfull:	3.34
Mean Depth at Bankfull:	1.66
W / D Ratio:	12.1
Entrenchment Ratio:	3.0
Bank Height Ratio:	0.89
Slope (ft/ft):	0.003
Discharge (cfs)	114

Stream Type:	E4

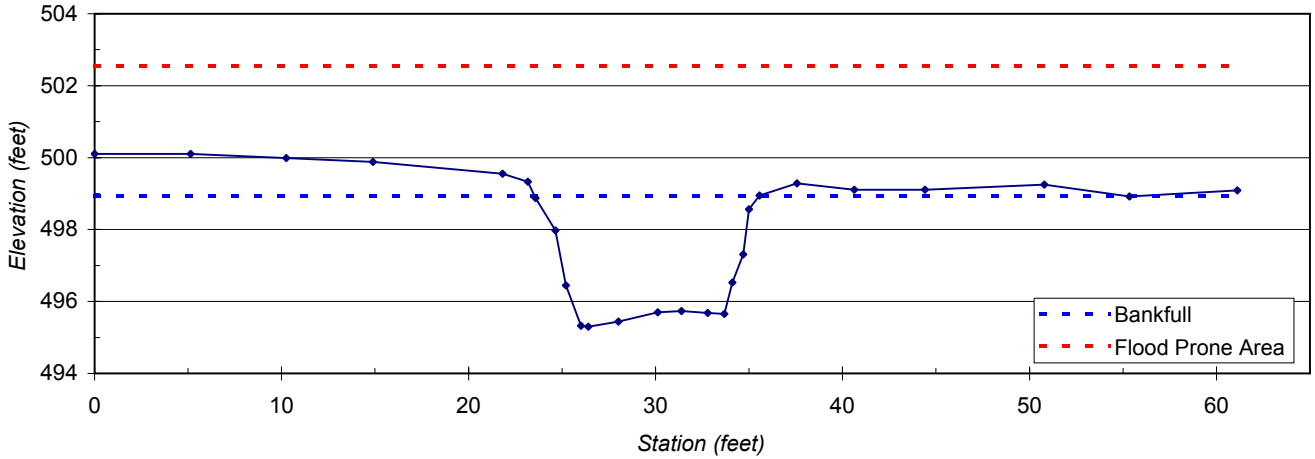


River Basin:	Cape Fear
Watershed:	Collins Creek (L:ittle Troublesome Ref
XS ID	XS2 Riffle
Drainage Area (sq mi):	
Date:	12/27/2006
Field Crew:	A. Helms, A. Spiller, B. Roberts

Station	Elevation
0.0	500.11
5.1	500.11
10.2	499.99
14.9	499.88
21.8	499.55
23.2	499.33
23.6	498.88
24.6	497.97
25.2	496.44
26.0	495.33
26.4	495.30
28.0	495.44
30.1	495.70
31.4	495.73
32.8	495.68
33.7	495.65
34.1	496.53
34.7	497.31
35.0	498.56
35.6	498.95
37.6	499.28
40.6	499.10
44.4	499.11
50.79	499.25
55.34	498.92
61.12	499.09

SUMMARY DATA	
Bankfull Elevation:	498.92
Bankfull Cross-Sectional Area:	32.4
Bankfull Width:	11.9
Flood Prone Area Elevation:	502.54
Flood Prone Width:	>60
Max Depth at Bankfull:	3.62
Mean Depth at Bankfull:	2.72
W / D Ratio:	4.4
Entrenchment Ratio:	5.0
Bank Height Ratio:	1.10
Slope (ft/ft):	0.003
Discharge (cfs)	141

Stream Type:	E4



Riffle Pebble Count

Riffle Pebble Count,

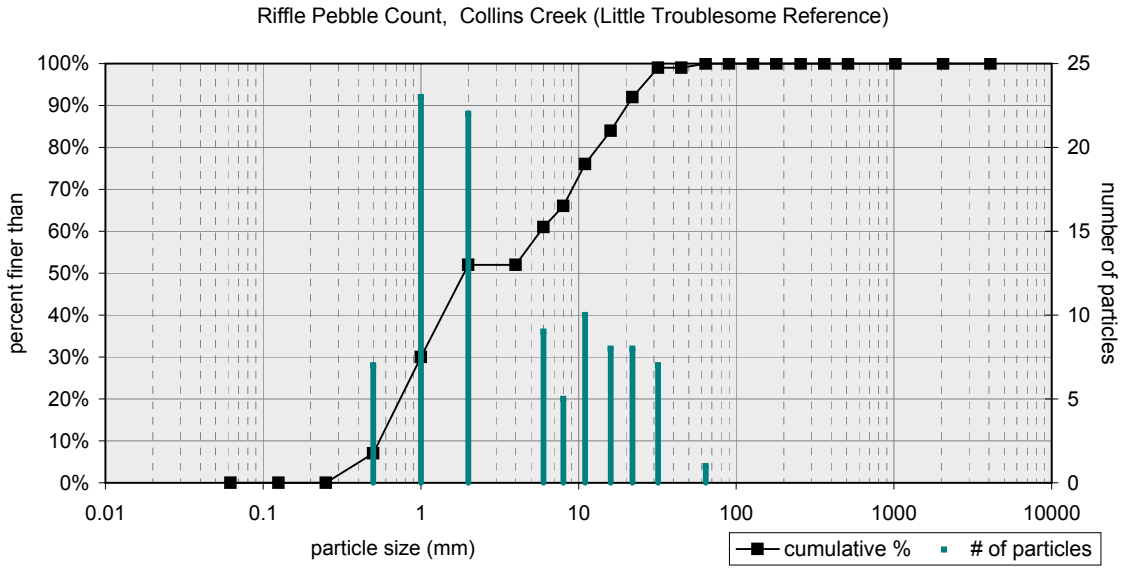
Collins Creek (Little Troublesome Reference)

Cape Fear

Note: **Riffle XS2**

Material	Size Range (mm)		Count
silt/clay	0	0.062	
very fine sand	0.062	0.13	
fine sand	0.13	0.25	
medium sand	0.25	0.5	**7**
coarse sand	0.5	1	**23**
very coarse sand	1	2	**22**
very fine gravel	2	4	
fine gravel	4	6	**9**
fine gravel	6	8	**5**
medium gravel	8	11	**10**
medium gravel	11	16	**8**
coarse gravel	16	22	**8**
coarse gravel	22	32	**7**
very coarse gravel	32	45	
very coarse gravel	45	64	**1**
small cobble	64	90	
medium cobble	90	128	
large cobble	128	180	
very large cobble	180	256	
small boulder	256	362	
small boulder	362	512	
medium boulder	512	1024	
large boulder	1024	2048	
very large boulder	2048	4096	
	total particle count:		100

bedrock		
clay hardpan		
detritus/wood		
artificial		
	total count:	100



based on sediment particles only	size percent less than (mm)						particle size distribution		
	D16	D35	D50	D65	D84	D95	gradation	geo mean	std dev
	0.656	1.17	1.9	8	16	26	5.7	3.2	4.9

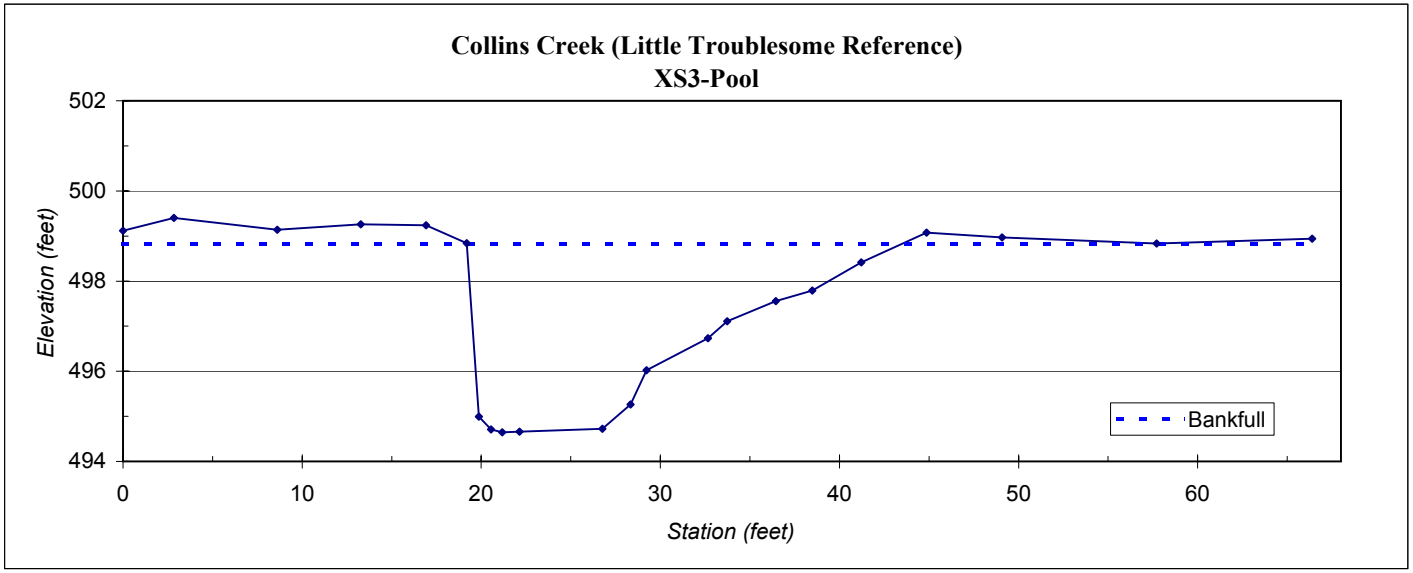
based on total count	percent by substrate type								
	silt/clay	sand	gravel	cobble	boulder	bedrock	hardpan	wood/det	artificial
	0%	52%	48%	0%	0%	0%	0%	0%	0%

River Basin:	Cape Fear
Watershed:	Collins Creek (L:ittle Troublesome Ref
XS ID	XS3 Pool
Drainage Area (sq mi):	
Date:	12/27/2006
Field Crew:	A. Helms, A. Spiller, B. Roberts

Station	Elevation
0.0	499.12
2.8	499.40
8.6	499.14
13.3	499.26
16.9	499.24
19.2	498.84
19.9	494.99
20.5	494.71
21.2	494.64
22.1	494.66
26.8	494.72
28.3	495.26
29.2	496.02
32.7	496.74
33.7	497.11
36.4	497.56
38.5	497.79
41.2	498.41
44.9	499.08
49.1	498.97
57.7	498.83
66.4	498.94

SUMMARY DATA	
Bankfull Elevation:	498.83
Bankfull Cross-Sectional Area:	57.9
Bankfull Width:	24.3
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	4.19
Mean Depth at Bankfull:	2.4
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	-
Slope (ft/ft):	0.003
Discharge (cfs)	

Stream Type:	E4



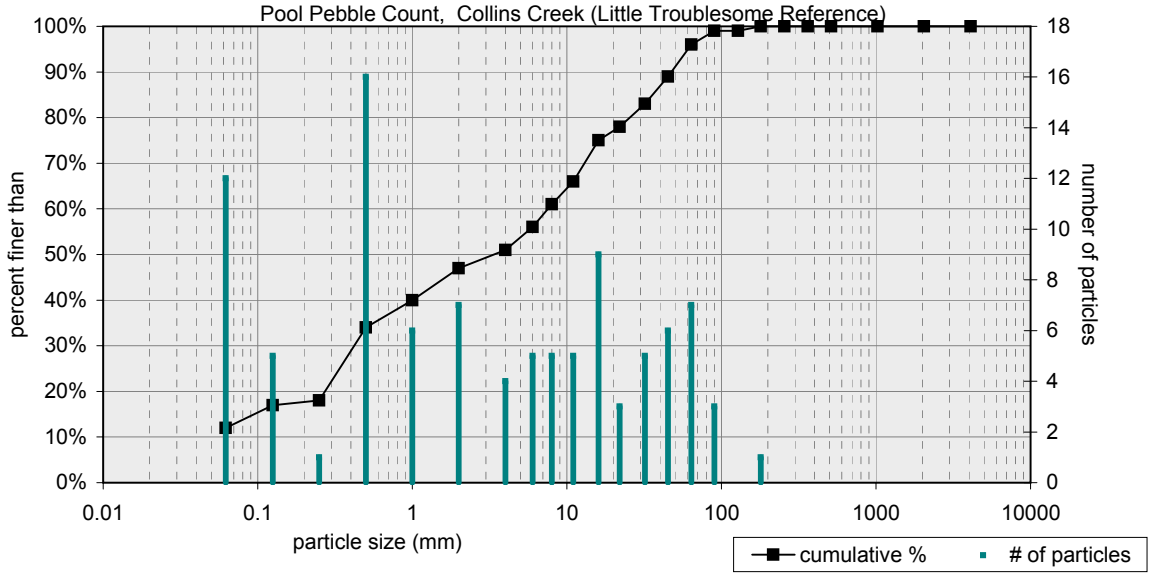
Pool Pebble Count

Material	Size Range (mm)		Count
silt/clay	0	0.062	**12**
very fine sand	0.062	0.13	**5**
fine sand	0.13	0.25	**1**
medium sand	0.25	0.5	**16**
coarse sand	0.5	1	**6**
very coarse sand	1	2	**7**
very fine gravel	2	4	**4**
fine gravel	4	6	**5**
fine gravel	6	8	**5**
medium gravel	8	11	**5**
medium gravel	11	16	**9**
coarse gravel	16	22	**3**
coarse gravel	22	32	**5**
very coarse gravel	32	45	**6**
very coarse gravel	45	64	**7**
small cobble	64	90	**3**
medium cobble	90	128	
large cobble	128	180	**1**
very large cobble	180	256	
small boulder	256	362	
small boulder	362	512	
medium boulder	512	1024	
large boulder	1024	2048	
very large boulder	2048	4096	
	total particle count:		100

bedrock		
clay hardpan		
detritus/wood		
artificial		
total count:		100

Pool Pebble Count,

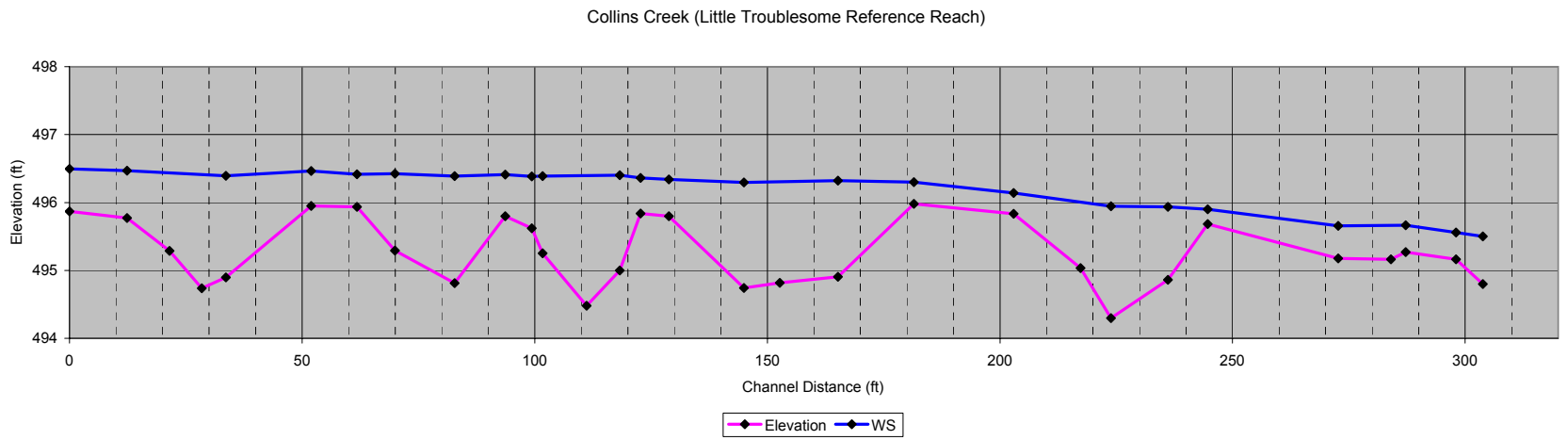
	Collins Creek (Little Troublesome Reference)
	Cape Fear
Note:	



based on sediment particles only	size percent less than (mm)						particle size distribution		
	D16	D35	D50	D65	D84	D95	gradation	geo mean	std dev
	0.109	0.56	3.4	10	34	61	20.5	1.9	17.7

based on total count	percent by substrate type								
	silt/clay	sand	gravel	cobble	boulder	bedrock	hardpan	wood/det	artificial
	12%	35%	49%	4%	0%	0%	0%	0%	0%

Slope Profile



Elevation BM: 100

notes	inc distance	station	BS 0	HI 100	FS TP	FS bed	depth water	FS LB	FS RB	FS BKF	FS WS	AZ azimuth	ELEV bed	ELEV water srf	ELEV LF	ELEV RB	ELEV BKF	ELEV WS
		0.0		100									495.8693					496.4937
Begin Pool	12.4	12.4		100									495.772					496.4671
	9.1	21.5		100									495.2886					
	6.9	28.4		100									494.7391					
End Pool	5.2	33.6		100									494.895					496.3907
Begin Riffle	18.3	52.0		100									495.9509					496.4619
End Riffle	9.8	61.8		100									495.9354					496.4138
Begin Pool	8.1	69.9		100									495.2926					496.426
End Pool	12.8	82.8		100									494.812					496.3869
Begin Riffle	10.9	93.6		100									495.7976					496.4113
End Riffle	5.7	99.3		100									495.6188					496.3838
Begin Pool	2.3	101.7		100									495.251					496.3891
	9.5	111.2		100									494.4782					
End Pool	7.1	118.3		100									495.0004					496.4004
Begin Riffle	4.5	122.8		100									495.8361					496.3606
End Riffle	6.1	128.9		100									495.7999					496.3401
Begin Pool	16.1	145.0		100									494.7427					496.2961
	7.7	152.7		100									494.8161					
End Pool	12.5	165.2		100									494.9066					496.3209
Begin Riffle	16.4	181.5		100									495.9798					496.2985
End Riffle	21.4	202.9		100									495.8352					496.1402
	14.4	217.3		100									495.0338					
Begin Pool	6.6	223.9		100									494.2961					495.9434
End Pool	12.2	236.1		100									494.8633					495.9376
Begin Riffle	8.6	244.7		100									495.6824					495.9015
End Riffle	28.0	272.7		100									495.1772					495.6558
	11.4	284.0		100									495.1644					
Begin Riffle	3.2	287.2		100									495.2709					495.6652
End Riffle	10.8	298.0		100									495.1633					495.5587
Begin Pool	5.8	303.8		100									494.7974					495.5013

Reference Reach Collins Creek

01.JPG

02.JPG

03.JPG

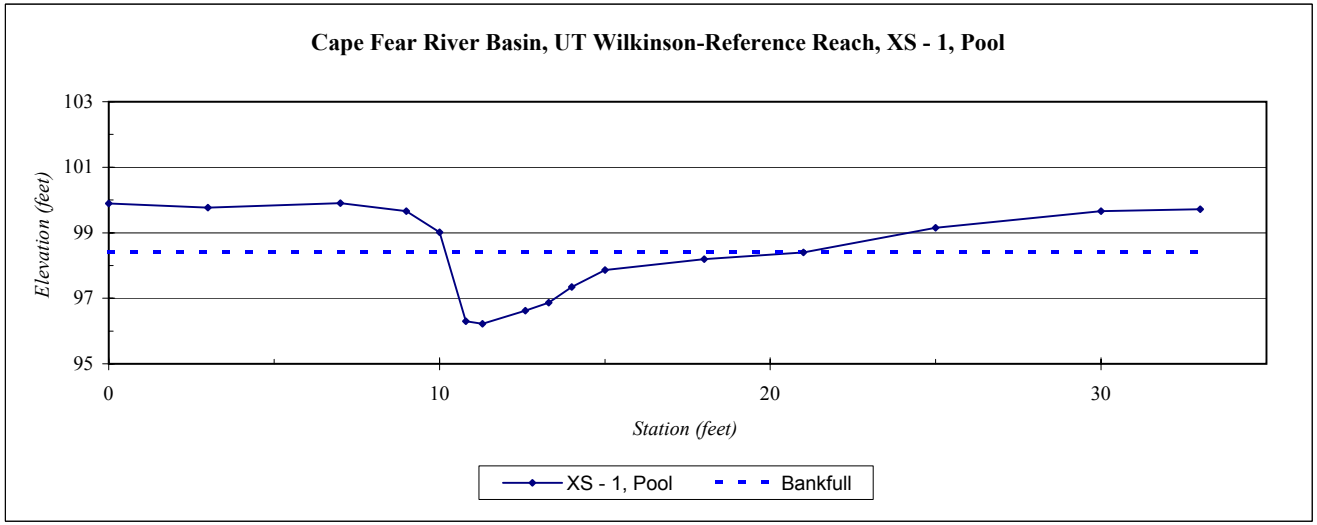
04.JPG

UT to Wilkinson Reference Site

River Basin:	Cape Fear
Watershed:	UT Wilkinson-Reference Reach
XS ID	XS - 1, Pool
Drainage Area (sq mi):	0.145
Date:	5/9/2006
Field Crew:	A. Helms, A. French

Station	Elevation
0	99.89
3	99.77
7	99.90
9	99.66
10	99.01
10.8	96.30
11.3	96.22
12.6	96.62
13.3	96.87
14	97.34
15	97.86
18	98.19
21	98.40
25	99.15
30	99.66
33	99.72

SUMMARY DATA	
Bankfull Elevation:	98.4
Bankfull Cross-Sectional Area:	8.6
Bankfull Width:	10.8
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	2.2
Mean Depth at Bankfull:	0.8
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	-
Water Surface Slope (ft/ft):	0.018



Riffle Pebble Count

Riffle Pebble Count,

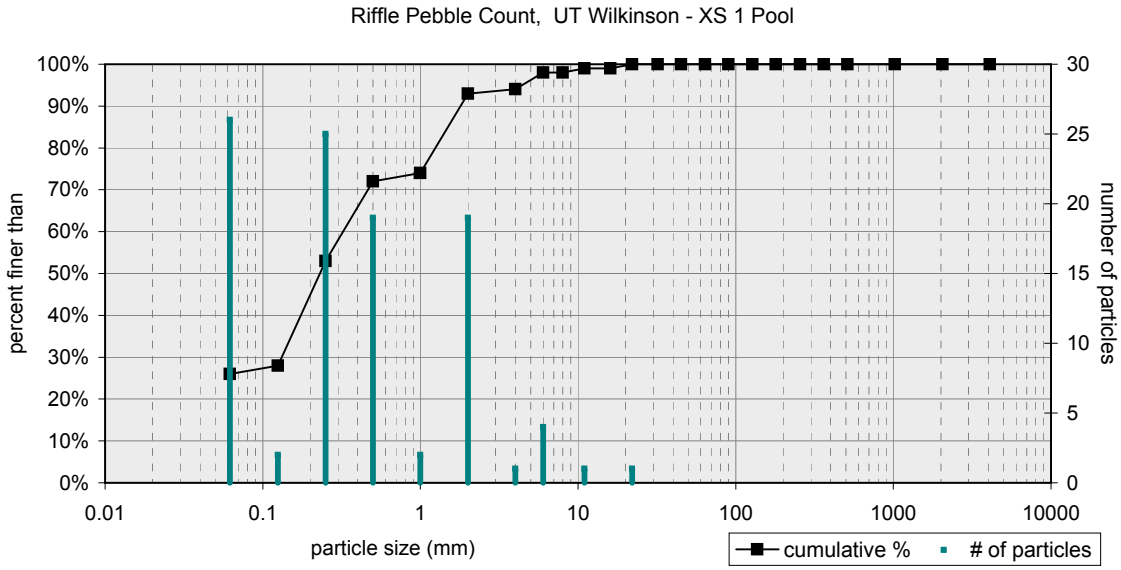
UT Wilkinson - XS 1 Pool

Cape Fear

Note: **XS 1**

Material	Size Range (mm)		Count
silt/clay	0	0.062	**26**
very fine sand	0.062	0.13	**2**
fine sand	0.13	0.25	**25**
medium sand	0.25	0.5	**19**
coarse sand	0.5	1	**2**
very coarse sand	1	2	**19**
very fine gravel	2	4	**1**
fine gravel	4	6	**4**
fine gravel	6	8	
medium gravel	8	11	**1**
medium gravel	11	16	
coarse gravel	16	22	**1**
coarse gravel	22	32	
very coarse gravel	32	45	
very coarse gravel	45	64	
small cobble	64	90	
medium cobble	90	128	
large cobble	128	180	
very large cobble	180	256	
small boulder	256	362	
small boulder	362	512	
medium boulder	512	1024	
large boulder	1024	2048	
very large boulder	2048	4096	
	total particle count:		100

bedrock		
clay hardpan		
detritus/wood		
artificial		
	total count:	100



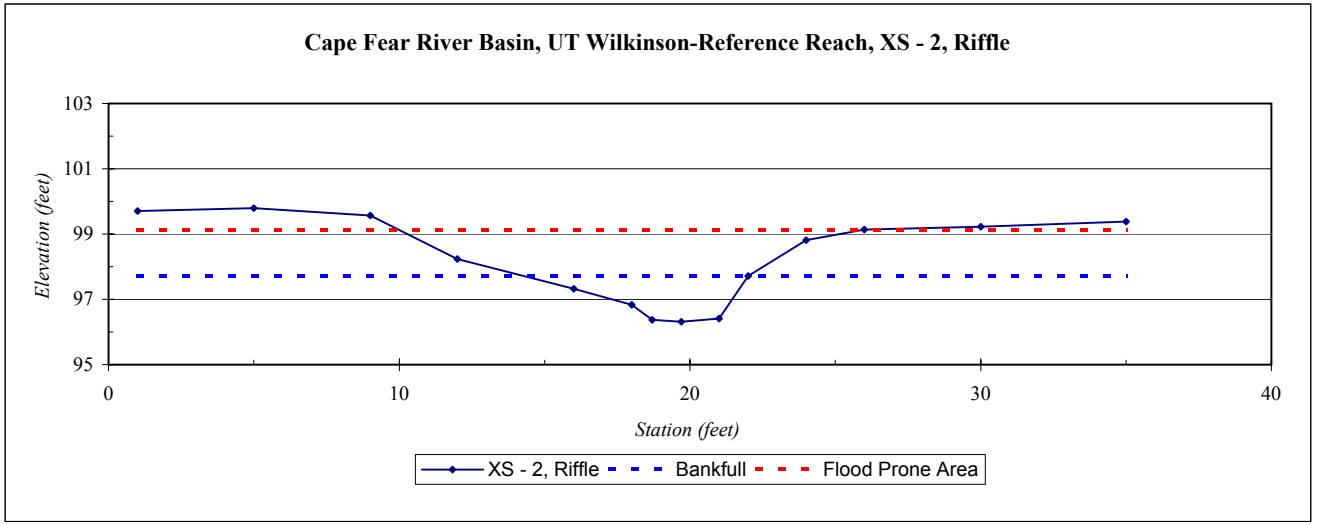
based on sediment particles only	size percent less than (mm)						particle size distribution		
	D16	D35	D50	D65	D84	D95	gradation	geo mean	std dev
	0.062	0.15	0.2	0	1	4	5.0	0.3	4.8

based on total count	percent by substrate type								
	silt/clay	sand	gravel	cobble	boulder	bedrock	hardpan	wood/det	artificial
	26%	67%	7%	0%	0%	0%	0%	0%	0%

River Basin:	Cape Fear
Watershed:	UT Wilkinson-Reference Reach
XS ID	XS - 2, Riffle
Drainage Area (sq mi):	0.145
Date:	5/9/2006
Field Crew:	A. Helms, A. French

Station	Elevation
1	99.70
5	99.80
9	99.57
12	98.23
16	97.33
18	96.84
18.7	96.37
19.7	96.32
21	96.41
22	97.72
24	98.81
26	99.13
30	99.22
35	99.38

SUMMARY DATA	
Bankfull Elevation:	97.7
Bankfull Cross-Sectional Area:	6.2
Bankfull Width:	7.7
Flood Prone Area Elevation:	99.1
Flood Prone Width:	16.0
Max Depth at Bankfull:	1.4
Mean Depth at Bankfull:	0.8
W / D Ratio:	9.6
Entrenchment Ratio:	2.1
Bank Height Ratio:	2.0
Water Surface Slope (ft/ft):	0.018



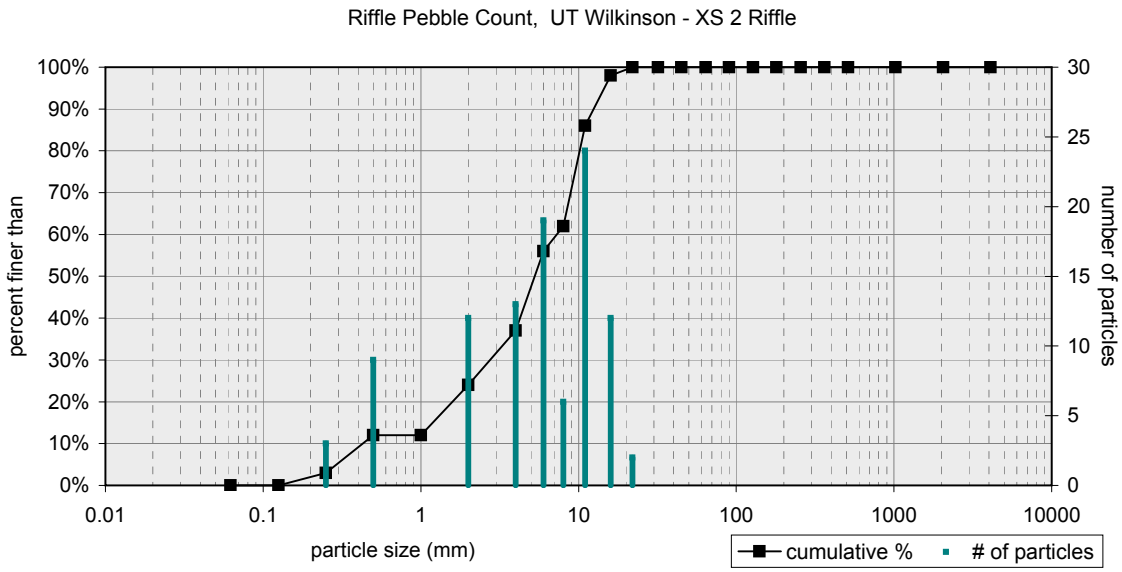
Riffle Pebble Count

Material	Size Range (mm)		Count
silt/clay	0	0.062	
very fine sand	0.062	0.13	
fine sand	0.13	0.25	**3**
medium sand	0.25	0.5	**9**
coarse sand	0.5	1	
very coarse sand	1	2	**12**
very fine gravel	2	4	**13**
fine gravel	4	6	**19**
fine gravel	6	8	**6**
medium gravel	8	11	**24**
medium gravel	11	16	**12**
coarse gravel	16	22	**2**
coarse gravel	22	32	
very coarse gravel	32	45	
very coarse gravel	45	64	
small cobble	64	90	
medium cobble	90	128	
large cobble	128	180	
very large cobble	180	256	
small boulder	256	362	
small boulder	362	512	
medium boulder	512	1024	
large boulder	1024	2048	
very large boulder	2048	4096	
	total particle count:		100

bedrock		
clay hardpan		
detritus/wood		
artificial		
total count:		100

Riffle Pebble Count,

	UT Wilkinson - XS 2 Riffle
	Cape Fear
Note:	**XS 2**



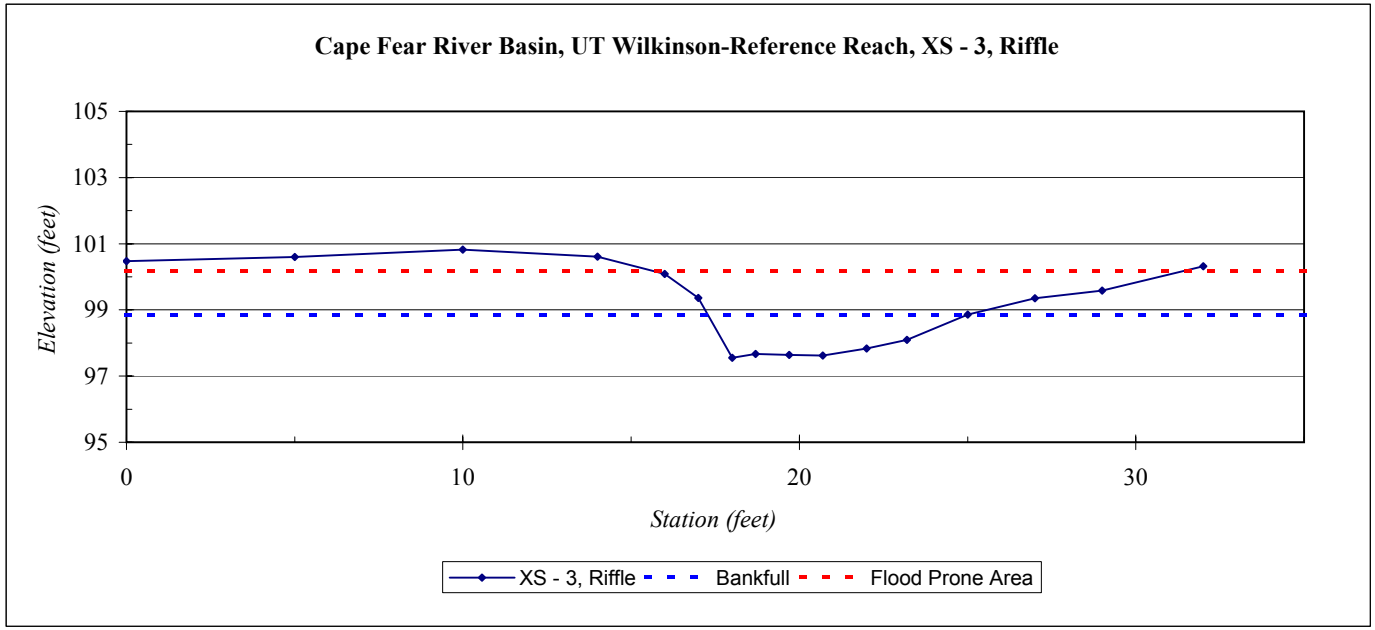
based on sediment particles only	size percent less than (mm)						particle size distribution		
	D16	D35	D50	D65	D84	D95	gradation	geo mean	std dev
	1.260	3.60	5.3	8	11	15	3.1	3.7	2.9

based on total count	percent by substrate type								
	silt/clay	sand	gravel	cobble	boulder	bedrock	hardpan	wood/det	artificial
	0%	24%	76%	0%	0%	0%	0%	0%	0%

River Basin:	Cape Fear
Watershed:	UT Wilkinson-Reference Reach
XS ID	XS - 3, Riffle
Drainage Area (sq mi):	0.145
Date:	5/9/2006
Field Crew:	A. Helms, A. French

Station	Elevation
0	100.47
5	100.60
10	100.82
14	100.61
16	100.09
17	99.36
18	97.56
18.7	97.67
19.7	97.64
20.7	97.63
22	97.83
23.2	98.10
25	98.86
27	99.35
29	99.59
32	100.32
35	100.97
39	101.20

SUMMARY DATA	
Bankfull Elevation:	98.9
Bankfull Cross-Sectional Area:	7.0
Bankfull Width:	7.7
Flood Prone Area Elevation:	100.2
Flood Prone Width:	16.0
Max Depth at Bankfull:	1.3
Mean Depth at Bankfull:	0.9
W / D Ratio:	8.5
Entrenchment Ratio:	2.1
Bank Height Ratio:	2.3
Water Surface Slope (ft/ft):	0.018



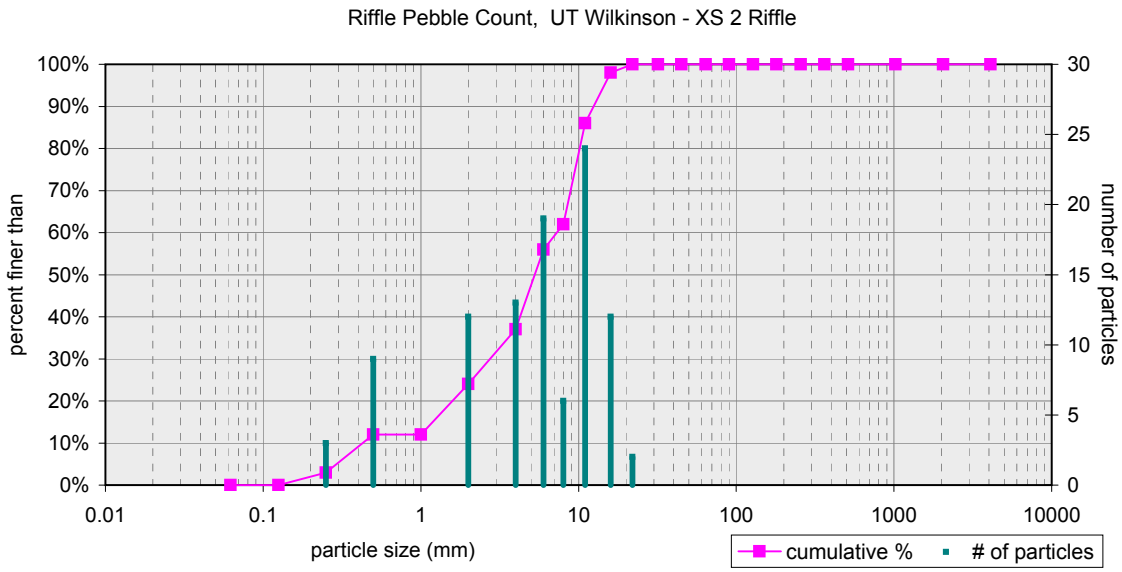
Riffle Pebble Count

Material	Size Range (mm)		Count
silt/clay	0	0.062	3
very fine sand	0.062	0.13	1
fine sand	0.13	0.25	4
medium sand	0.25	0.5	
coarse sand	0.5	1	1
very coarse sand	1	2	
very fine gravel	2	4	10
fine gravel	4	6	10
fine gravel	6	8	7
medium gravel	8	11	22
medium gravel	11	16	22
coarse gravel	16	22	16
coarse gravel	22	32	4
very coarse gravel	32	45	
very coarse gravel	45	64	
small cobble	64	90	
medium cobble	90	128	
large cobble	128	180	
very large cobble	180	256	
small boulder	256	362	
small boulder	362	512	
medium boulder	512	1024	
large boulder	1024	2048	
very large boulder	2048	4096	
		total particle count:	100

bedrock		
clay hardpan		
detritus/wood		
artificial		
	total count:	100

UT Wilkinson - XS 3 Riffle
Cape Fear

Note: XS 3



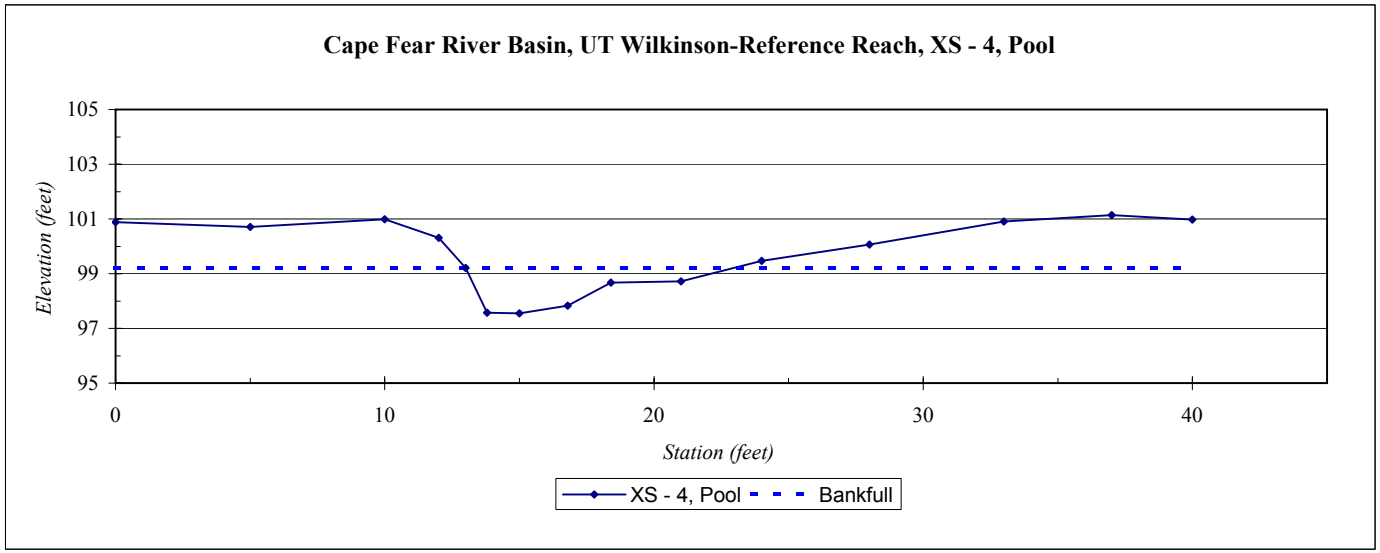
based on sediment particles only	size percent less than (mm)						particle size distribution		
	D16	D35	D50	D65	D84	D95	gradation	geo mean	std dev
	5.102	10.32	13.3	17	23	35	2.2	10.9	2.1

based on total count	percent by substrate type								
	silt/clay	sand	gravel	cobble	boulder	bedrock	hardpan	wood/det	artificial
	0%	12%	87%	1%	0%	0%	0%	0%	0%

River Basin:	Cape Fear
Watershed:	UT Wilkinson-Reference Reach
XS ID	XS - 4, Pool
Drainage Area (sq mi):	0.145
Date:	5/9/2006
Field Crew:	A. Helms, A. French

Station	Elevation
0	100.88
5	100.71
10	100.98
12	100.31
13	99.22
13.8	97.58
15	97.55
16.8	97.84
18.4	98.67
21	98.72
24	99.47
28	100.07
33	100.90
37	101.15
40	100.98

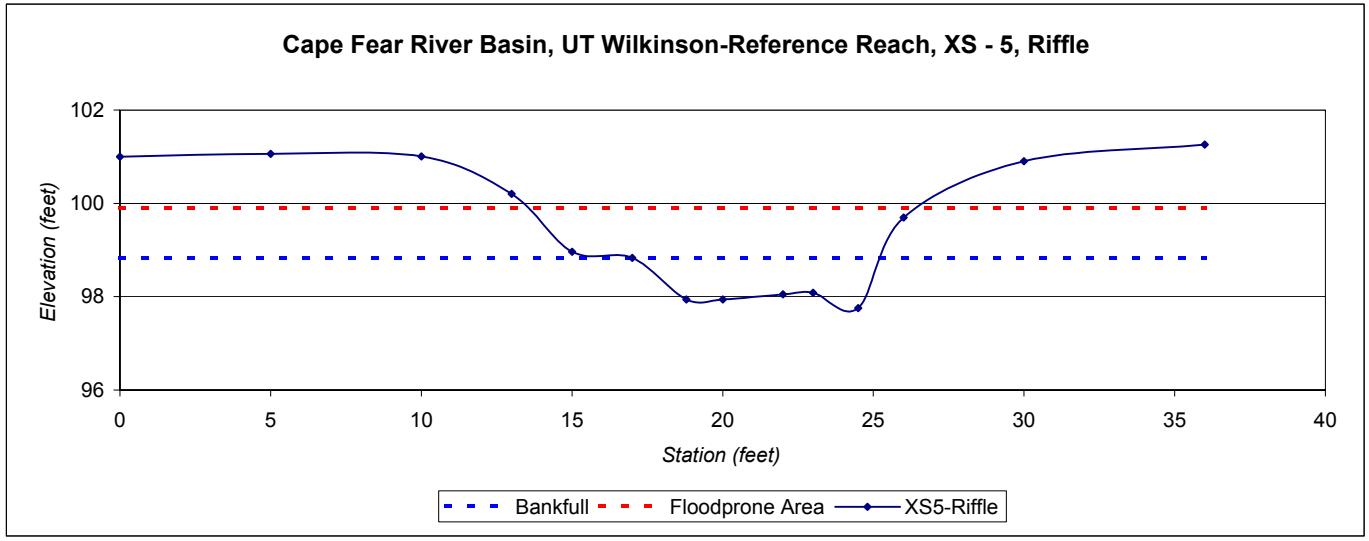
SUMMARY DATA	
Bankfull Elevation:	99.2
Bankfull Cross-Sectional Area:	8.8
Bankfull Width:	10.0
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	1.7
Mean Depth at Bankfull:	0.9
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	-
Water Surface Slope (ft/ft):	0.018



River Basin:	Cape Fear
Watershed:	UT Wilkinson-Reference Reach
XS ID	XS - 5, Riffle
Drainage Area (sq mi):	0.145
Date:	5/9/2006
Field Crew:	A. Helms, A. French

Station	Elevation
0.00	101.00
5.00	101.06
10.00	101.01
13.00	100.20
15.00	98.96
17.00	98.83
18.80	97.94
20.00	97.94
22.00	98.05
23.00	98.08
24.50	97.75
26.00	99.70
30.00	100.90
36.00	101.26

SUMMARY DATA	
Bankfull Elevation:	98.8
Bankfull Cross-Sectional Area:	6.1
Bankfull Width:	8.3
Flood Prone Area Elevation:	99.9
Flood Prone Width:	13.0
Max Depth at Bankfull:	1.1
Mean Depth at Bankfull:	0.7
W / D Ratio:	11.4
Entrenchment Ratio:	1.6
Bank Height Ratio:	2.7
Water Surface Slope (ft/ft):	0.018



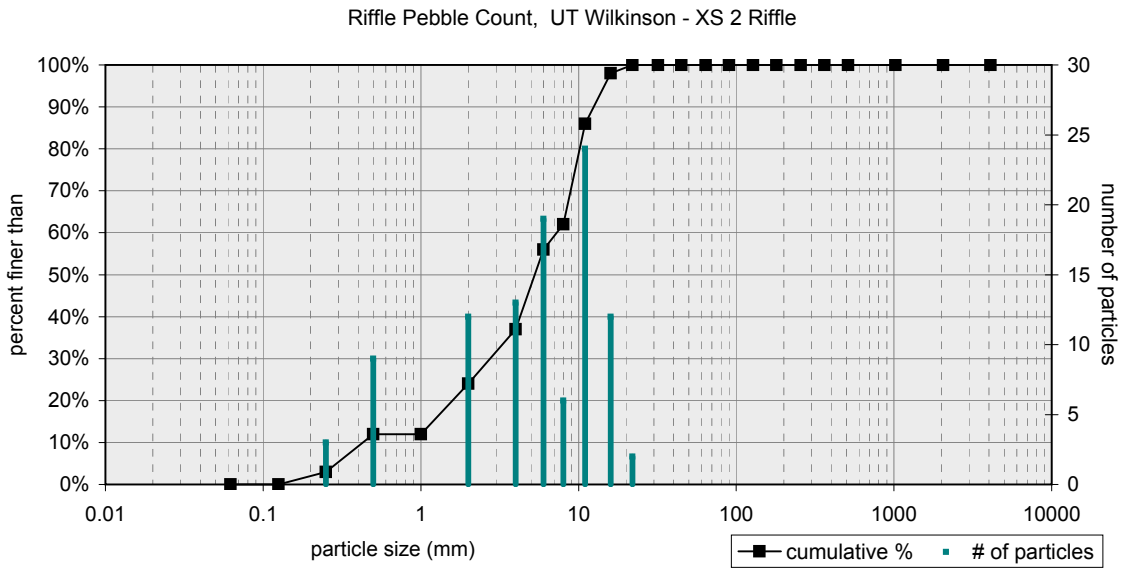
Riffle Pebble Count

Material	Size Range (mm)		Count
silt/clay	0	0.062	
very fine sand	0.062	0.13	**10**
fine sand	0.13	0.25	**17**
medium sand	0.25	0.5	**8**
coarse sand	0.5	1	**7**
very coarse sand	1	2	**9**
very fine gravel	2	4	**8**
fine gravel	4	6	**4**
fine gravel	6	8	**3**
medium gravel	8	11	**5**
medium gravel	11	16	**2**
coarse gravel	16	22	**4**
coarse gravel	22	32	
very coarse gravel	32	45	
very coarse gravel	45	64	
small cobble	64	90	**1**
medium cobble	90	128	**3**
large cobble	128	180	**10**
very large cobble	180	256	**5**
small boulder	256	362	**4**
small boulder	362	512	
medium boulder	512	1024	
large boulder	1024	2048	
very large boulder	2048	4096	
		total particle count:	100

bedrock		
clay hardpan		
detritus/wood		
artificial		
	total count:	100

Riffle Pebble Count,

	UT Wilkinson - XS 5 Riffle
	Cape Fear
Note:	**XS 5**



based on sediment particles only	size percent less than (mm)						particle size distribution		
	D16	D35	D50	D65	D84	D95	gradation	geo mean	std dev
	5.102	10.32	13.3	17	23	35	2.2	10.9	2.1

based on total count	percent by substrate type								
	silt/clay	sand	gravel	cobble	boulder	bedrock	hardpan	wood/det	artificial
	0%	12%	87%	1%	0%	0%	0%	0%	0%

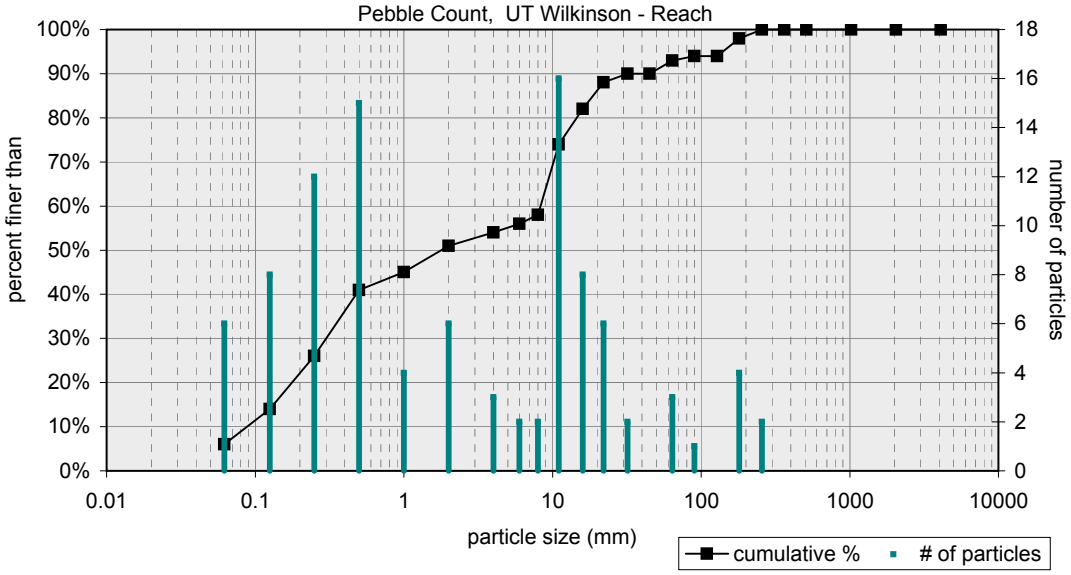
Pebble Count of Channel Reach

Material	Size Range (mm)		Count	
silt/clay	0	0.062	**6**	##
very fine sand	0.062	0.13	**8**	##
fine sand	0.13	0.25	**12**	##
medium sand	0.25	0.5	**15**	##
coarse sand	0.5	1	**4**	##
very coarse sand	1	2	**6**	##
very fine gravel	2	4	**3**	##
fine gravel	4	6	**2**	##
fine gravel	6	8	**2**	##
medium gravel	8	11	**16**	##
medium gravel	11	16	**8**	##
coarse gravel	16	22	**6**	##
coarse gravel	22	32	**2**	##
very coarse gravel	32	45		##
very coarse gravel	45	64	**3**	##
small cobble	64	90	**1**	##
medium cobble	90	128		##
large cobble	128	180	**4**	##
very large cobble	180	256	**2**	##
small boulder	256	362		##
small boulder	362	512		##
medium boulder	512	1024		##
large boulder	1024	2048		##
very large boulder	2048	4096		##
	total particle count:		100	

bedrock		
clay hardpan		
detritus/wood		
artificial		
total count:		100

Pebble Count,
UT Wilkinson - Reach
Cape Fear

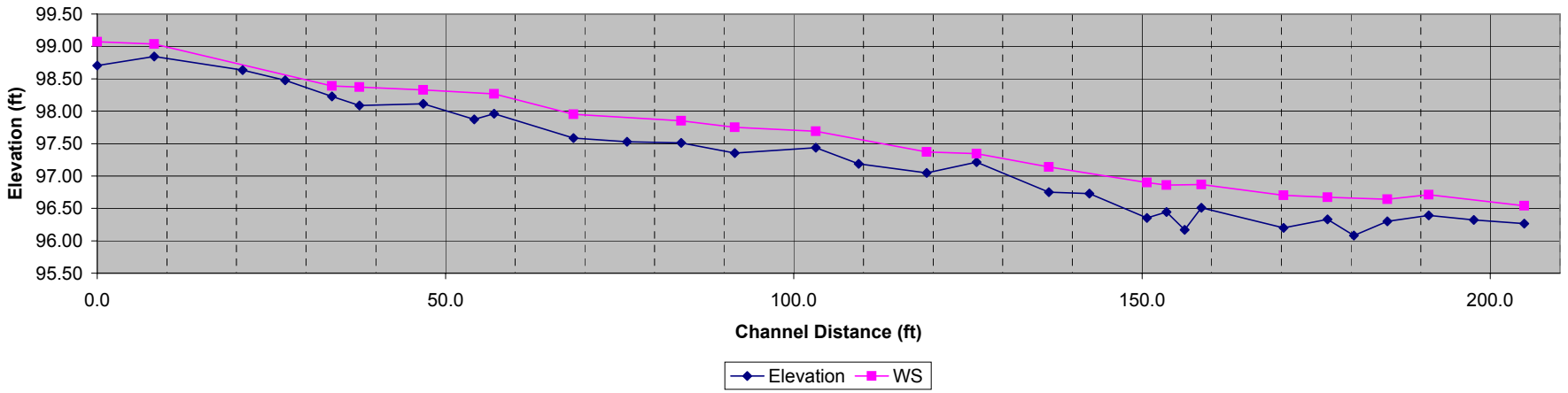
Note: **Reach**



based on sediment particles only	size percent less than (mm)						particle size distribution		
	D16	D35	D50	D65	D84	D95	gradation	geo mean	std dev
	0.140	0.38	1.8	9	18	139	11.3	1.6	11.3

based on total count	percent by substrate type								
	silt/clay	sand	gravel	cobble	boulder	bedrock	hardpan	wood/det	artificial
	6%	45%	42%	7%	0%	0%	0%	0%	0%

UT-Wilkinson Reference Profile



Elevation BM: 100

notes	inc distance	station	BS 0	HI 100	FS TP	FS bed	depth water	FS LB	FS RB	FS BKF	FS WS	AZ azimuth	ELEV bed	ELEV water srf	ELEV LF	ELEV RB	ELEV BKF	ELEV WS
				100														
TW	0	0.0		100									98.70					99.07
RIFF-start	8.18	8.2		100									98.85					99.04
RI	12.69	20.9		100									98.63					
RI	6.10	27.0		100									98.48					
RIFF-end	6.72	33.7		100									98.23					98.39
TW	3.93	37.6		100									98.09					98.37
TW	9.17	46.8		100									98.12					98.33
TW	7.32	54.1		100									97.87					
RIFF-start	2.85	57.0		100									97.96					98.27
RIFF-end	11.38	68.4		100									97.59					97.95
TW	7.69	76.0		100									97.53					
TW	7.78	83.8		100									97.51					97.85
TW	7.69	91.5		100									97.36					97.75
TW	11.66	103.2		100									97.44					97.69
TW	6.14	109.3		100									97.19					
TW	9.79	119.1		100									97.05					97.37
RIFF-start	7.15	126.2		100									97.21					97.34
RIFF-end	10.36	136.6		100									96.75					97.14
TW	5.82	142.4		100									96.73					
TW	8.26	150.7		100									96.35					96.90
POOL-start	2.81	153.5		100									96.45					96.86
POOL	2.63	156.1		100									96.17					
POOL-end	2.41	158.5		100									96.51					96.87
TW	11.78	170.3		100									96.20					96.70
POOL-start	6.31	176.6		100									96.33					96.67
POOL	3.81	180.4		100									96.08					
POOL-end	4.80	185.2		100									96.30					96.64
RIFF-start	5.96	191.2		100									96.39					96.71
RI	6.43	197.6		100									96.32					
RIFF-end	7.27	204.9		100									96.27					96.54

Reference Reach UT to Wilkinson

01.JPG

02.JPG

03.JPG

04.JPG

Appendix E
USACE Wetland Determination Forms and Wetland Map

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Determination Manual)

Project / Site: Little Troublesome Creek **Applicant / Owner:** **Investigator:** SFS	**Date:** 9-6-06 **County:** Rockingham **State:** NC
Do normal circumstances exist on the site? Yes X No **Is the site significantly disturbed (Atypical situation)?** Yes No X **Is the area a potential problem area?** Yes No X **(explain on reverse if needed)**	**Community ID:** **Transect ID:** **Plot ID:** W4-1A

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1. Boehmeria cylindrica	3	FACW+	9.		
2. Peltandra virginica	3	OBL	10.		
3. Impatiens capensis	3	FACW	11.		
4. Fraxinus pennsylvanica	1	FACW	12.		
5. Fraxinus pennsylvanica	2	FACW	13.		
6. Acer rubrum	1	FAC	14.		
7. Nyssa sylvatica	1	FAC	15.		
8.			16.		

Percent of Dominant Species that are OBL, FACW, or FAC excluding FAC-). 100%

Remarks:

HYDROLOGY

___ Recorded Data (Describe In Remarks):
- **___ Stream, Lake, or Tide Gauge**
- **___ Aerial Photographs**
- **___ Other**

X No Recorded Data Available

Field Observations:

Depth of Surface Water: _____(in.)

Depth to Free Water in Pit: _____(in.)

Depth to Saturated Soil: _____(in.)

Wetland Hydrology Indicators

Primary Indicators:
- **___ Inundated**
- **___ Saturated in Upper 12”**
- **___ Water Marks**
- **___ Drift Lines**
- **X Sediment Deposits**
- **X Drainage Patterns in Wetlands**

Secondary Indicators:
- **X Oxidized Roots Channels in Upper 12”**
- **___ Water-Stained Leaves**
- **___ Local Soil Survey Data**
- **X FAC-Neutral Test**
- **___ Other (Explain in Remarks)**

Remarks:

SOILS

Map Unit Name
(Series and Phase): Wehadkee Variant **Drainage Class:** Poorly

Taxonomy (Subgroup): Fluvaquentic Endoaquepts **Confirm Mapped Type? Yes** ___ **No** X

Profile Description:

Depth (inches)	Horizon	Matrix Colors (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-5	A	10YR 3/2			sil-l, 1fgr
5-12	Cg1	10YR 5/2	7.5YR 4/6 c2d		sicl, massive
12-18	Cg2	10YR 5/1	10YR 5/2 c2d		sil, massive

Hydric Soil Indicators:

___ Histosol	___ Concretions
___ Histic Epipedon	___ High Organic Content in Surface Layer in Sandy Soils
___ Sulfidic Odor	___ Organic Streaking in Sandy Soils
X Aquic Moisture Regime	X Listed On Local Hydric Soils List
___ Reducing Conditions	X Listed on National Hydric Soils List
X Gleyed or Low-Chroma Colors	___ Other (Explain in Remarks)

Remarks:
Sediment deposition high.
Accumulated partially decomposed plant materials in 5-18" zone. Two springs feed this wetland.

WETLAND DETERMINATION

Hydrophytic Vegetation Present? Yes X No ___
Wetland Hydrology Present? Yes X No ___
Hydric Soils Present? Yes X No ___

Is the Sampling Point Within a Wetland? Yes X No ___

Remarks:

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Determination Manual)

Project / Site: Little Troublesome Creek **Applicant / Owner:** **Investigator:** SFS	**Date:** 9-6-06 **County:** Rockingham **State:** NC
Do normal circumstances exist on the site? Yes X No **Is the site significantly disturbed (Atypical situation)?** Yes No X **Is the area a potential problem area?** Yes No X **(explain on reverse if needed)**	**Community ID:** **Transect ID:** **Plot ID:** W1-1A

VEGETATION

Dominant Plant Species	Stratum	Indicator
1. Murdannia keisak	3	OBL
2. Boehmeria cylindrica	3	FACW+
3. Peltandra virginica	3	OBL
4. Acer rubrum	2	FAC
5. Acer rubrum	1	FAC
6. Fraxinus pennsylvanica	1	FACW
7. Ulmus americana	2	FACW-
8.		

Dominant Plant Species	Stratum	Indicator
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		

Percent of Dominant Species that are OBL, FACW, or FAC excluding FAC-). 100%

Remarks:

HYDROLOGY

___ **Recorded Data (Describe In Remarks):**
- ___ **Stream, Lake, or Tide Gauge**
- ___ **Aerial Photographs**
- ___ **Other**

X **No Recorded Data Available**

Field Observations:

Depth of Surface Water: _____ **(in.)**

Depth to Free Water in Pit: _____ **(in.)**

Depth to Saturated Soil: _____ **(in.)**

Wetland Hydrology Indicators

Primary Indicators:
- ___ **Inundated**
- ___ **Saturated in Upper 12”**
- ___ **Water Marks**
- ___ **Drift Lines**
- ___ **Sediment Deposits**
- X **Drainage Patterns in Wetlands**

Secondary Indicators:
- X **Oxidized Roots Channels in Upper 12”**
- ___ **Water-Stained Leaves**
- X **Local Soil Survey Data**
- ___ **FAC-Neutral Test**
- ___ **Other (Explain in Remarks)**

Remarks:

SOILS

Map Unit Name
(Series and Phase): Wehadkee **Drainage Class:** Poorly

Taxonomy (Subgroup): Fluvaaquentic Endoaquepts **Confirm Mapped Type? Yes** ___ **No** X

Profile Description:

Depth (inches)	Horizon	Matrix Colors (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-1	A	10YR 5/2			l, 1fgr
1-12	Bg1	10YR 5/2	7.5YR 4/4 c2d		cl, 1msbk
12-15	Bg2	10YR 5/2	7.5YR 4/4 m2d		cl-l, 1fsbk

Hydric Soil Indicators:

___ Histosol	___ Concretions
___ Histic Epipedon	___ High Organic Content in Surface Layer in Sandy Soils
___ Sulfidic Odor	___ Organic Streaking in Sandy Soils
X Aquic Moisture Regime	X Listed On Local Hydric Soils List
___ Reducing Conditions	X Listed on National Hydric Soils List
X Gleyed or Low-Chroma Colors	___ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present? **Yes** X **No** ___
Wetland Hydrology Present? **Yes** X **No** ___
Hydric Soils Present? **Yes** X **No** ___

Is the Sampling Point Within a Wetland? **Yes** X **No** ___

Remarks:

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Determination Manual)

Project / Site: Little Troublesome Creek
Applicant / Owner:
Investigator: SFS

Date: 9-6-06
County: Rockingham
State: NC

Do normal circumstances exist on the site? Yes X No
Is the site significantly disturbed (Atypical situation)? Yes No X
Is the area a potential problem area? Yes No X
(explain on reverse if needed)

Community ID:
Transect ID:
Plot ID: W1-1B

VEGETATION

Dominant Plant Species	Stratum	Indicator
1. Fraxinus pennsylvanica	2	FACW
2. Betula nigra	2	FACW
3. Rosa multiflora	2	FACU
4. Lonicera japonica	4	FAC-
5. Boehmeria cylindrica	3	FACW+
6. Solanum carolinense	3	UPL
7.		
8.		
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		

Percent of Dominant Species that are OBL, FACW, or FAC excluding FAC-). 50%

Remarks:

HYDROLOGY

___ **Recorded Data (Describe In Remarks):**
- ___ **Stream, Lake, or Tide Gauge**
- ___ **Aerial Photographs**
- ___ **Other**

_X_ **No Recorded Data Available**

Field Observations:

Depth of Surface Water: _____ **(in.)**

Depth to Free Water in Pit: _____ **(in.)**

Depth to Saturated Soil: >15 **(in.)**

Wetland Hydrology Indicators

Primary Indicators:
- ___ **Inundated**
- ___ **Saturated in Upper 12”**
- ___ **Water Marks**
- ___ **Drift Lines**
- ___ **Sediment Deposits**
- ___ **Drainage Patterns in Wetlands**

Secondary Indicators:
- ___ **Oxidized Roots Channels in Upper 12”**
- ___ **Water-Stained Leaves**
- ___ **Local Soil Survey Data**
- ___ **FAC-Neutral Test**
- ___ **Other (Explain in Remarks)**

Remarks:

SOILS

Map Unit Name
(Series and Phase): Chewacla Variant **Drainage Class:** Somewhat Poorly

Taxonomy (Subgroup): Fluvaquentic Dystrudepts **Confirm Mapped Type? Yes** ___ **No** X

Profile Description:

Depth (inches)	Horizon	Matrix Colors (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-4	Ap	10YR 4/3			sl, 1fgr
4-10	Bw1	10YR 5/4			l, 1fsbk
10-15	Bw2	10YR 6/6	10YR 7/1 f1f		c, 1fsbk

Hydric Soil Indicators:

- ___ Histosol
- ___ Histic Epipedon
- ___ Sulfidic Odor
- ___ Aquic Moisture Regime
- ___ Reducing Conditions
- ___ Gleyed or Low-Chroma Colors
- ___ Concretions
- ___ High Organic Content in Surface Layer in Sandy Soils
- ___ Organic Streaking in Sandy Soils
- ___ Listed On Local Hydric Soils List
- ___ Listed on National Hydric Soils List
- ___ Other (Explain in Remarks)

Remarks:
Disturbed and possibly filled.

WETLAND DETERMINATION

Hydrophytic Vegetation Present? Yes ___ No X
Wetland Hydrology Present? Yes ___ No X
Hydric Soils Present? Yes ___ No X

Is the Sampling Point Within a Wetland? Yes ___ No X

Remarks:

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Determination Manual)

Project / Site: Little Troublesome Creek **Applicant / Owner:** **Investigator:** SFS	**Date:** 9-6-06 **County:** Rockingham **State:** NC
Do normal circumstances exist on the site? Yes X No **Is the site significantly disturbed (Atypical situation)?** Yes No X **Is the area a potential problem area?** Yes No X **(explain on reverse if needed)**	**Community ID:** **Transect ID:** **Plot ID:** W3-1A

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1. Peltandra virginica	3	OBL	9.		
2. Boehmeria cylindrica	3	FACW+	10.		
3. Impatiens capensis	3	FACW	11.		
4. Polygonum punctatum	3	FACW+	12.		
5.			13.		
6.			14.		
7.			15.		
8.			16.		

Percent of Dominant Species that are OBL, FACW, or FAC excluding FAC-). 100%

Remarks:

HYDROLOGY

___ Recorded Data (Describe In Remarks):
- **___ Stream, Lake, or Tide Gauge**
- **___ Aerial Photographs**
- **___ Other**

X No Recorded Data Available

Field Observations:

Depth of Surface Water: _____(in.)

Depth to Free Water in Pit: _____(in.)

Depth to Saturated Soil: _____(in.)

Wetland Hydrology Indicators

Primary Indicators:
- **___ Inundated**
- **X Saturated in Upper 12”**
- **___ Water Marks**
- **___ Drift Lines**
- **___ Sediment Deposits**
- **___ Drainage Patterns in Wetlands**

Secondary Indicators:
- **X Oxidized Roots Channels in Upper 12”**
- **___ Water-Stained Leaves**
- **___ Local Soil Survey Data**
- **X FAC-Neutral Test**
- **___ Other (Explain in Remarks)**

Remarks:

SOILS

Map Unit Name (Series and Phase): Wehadkee **Drainage Class:** Poorly

Taxonomy (Subgroup): Fluvaquentic Endoaguepts **Confirm Mapped Type? Yes** ___ **No** X

Profile Description:

Depth (inches)	Horizon	Matrix Colors (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-1	A1	10YR 5/2	7.5YR 4/6 c2d		l, 1fgr
1-5	Bg1	10YR 5/2	7.5YR 4/6 c2d		sicl-sic, 1msbk
5-11	Bg2	10YR 5/2	7.5YR 4/6 m2d		sicl, 1msbk
11-13	Bg3	2.5Y 5/3	2.5Y 5/2 c2f		sicl, 1msbk
			10YR 5/4 c2d		
			10YR 3/6 f1d		
13-20	Bg4	2.5Y 5/2	7.5YR 4/4 c2p		sicl, 1msbk

Hydric Soil Indicators:

___ Histosol	___ Concretions
___ Histic Epipedon	___ High Organic Content in Surface Layer in Sandy Soils
___ Sulfidic Odor	___ Organic Streaking in Sandy Soils
X Aquic Moisture Regime	X Listed On Local Hydric Soils List
___ Reducing Conditions	X Listed on National Hydric Soils List
X Gleyed or Low-Chroma Colors	___ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present? Yes X No ___
Wetland Hydrology Present? Yes X No ___
Hydric Soils Present? Yes X No ___

Is the Sampling Point Within a Wetland? Yes X No ___

Remarks:

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Determination Manual)

Project / Site: Little Troublesome Creek
Applicant / Owner:
Investigator: SFS

Date: 9-6-06
County: Rockingham
State: NC

Do normal circumstances exist on the site? Yes X No
Is the site significantly disturbed (Atypical situation)? Yes No X
Is the area a potential problem area? Yes No X
(explain on reverse if needed)

Community ID:
Transect ID:
Plot ID: W3-1B

VEGETATION

Dominant Plant Species	Stratum	Indicator
1. Vernonia noveboracensis	3	FAC+
2. Festuca arundinacea	3	FAC-
3. Microstegium vimineum	3	UPL
4. Platanus occidentalis	1	FACW-
5.		
6.		
7.		
8.		
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		

Percent of Dominant Species that are OBL, FACW, or FAC excluding FAC-): 50%

Remarks:
Old Pasture.

HYDROLOGY

___ **Recorded Data (Describe In Remarks):**
- ___ **Stream, Lake, or Tide Gauge**
- ___ **Aerial Photographs**
- ___ **Other**

X **No Recorded Data Available**

Field Observations:

Depth of Surface Water: _____ **(in.)**

Depth to Free Water in Pit: _____ **(in.)**

Depth to Saturated Soil: >20 **(in.)**

Wetland Hydrology Indicators

Primary Indicators:
- ___ **Inundated**
- ___ **Saturated in Upper 12”**
- ___ **Water Marks**
- ___ **Drift Lines**
- ___ **Sediment Deposits**
- ___ **Drainage Patterns in Wetlands**

Secondary Indicators:
- ___ **Oxidized Roots Channels in Upper 12”**
- ___ **Water-Stained Leaves**
- ___ **Local Soil Survey Data**
- ___ **FAC-Neutral Test**
- ___ **Other (Explain in Remarks)**

Remarks:

SOILS

Map Unit Name (Series and Phase): Pacolet Variant **Drainage Class:** Well

Taxonomy (Subgroup): Typic Kanhapludults **Confirm Mapped Type? Yes** ___ **No** X

Profile Description:

Depth (inches)	Horizon	Matrix Colors (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-6	A	10YR 4/3			sl, 1fgr
6-15	Bt1	7.5YR 5/6	7.5YR 2.5/3 c2d		scl, 1fsbk
15-18	Bt2	10YR 5/4	10YR 4/4 c2d		sl w/ mica, 1fsbk
					< 2% concretions
18-20	Bt3	7.5YR 5/4	7.5YR 4/4 c2d		scl, 1fsbk

Hydric Soil Indicators:

- ___ Histosol
- ___ Histic Epipedon
- ___ Sulfidic Odor
- ___ Aquic Moisture Regime
- ___ Reducing Conditions
- ___ Gleyed or Low-Chroma Colors
- ___ Concretions
- ___ High Organic Content in Surface Layer in Sandy Soils
- ___ Organic Streaking in Sandy Soils
- ___ Listed On Local Hydric Soils List
- ___ Listed on National Hydric Soils List
- ___ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present? Yes ___ No X
Wetland Hydrology Present? Yes ___ No X
Hydric Soils Present? Yes ___ No X

Is the Sampling Point Within a Wetland? Yes ___ No X

Remarks:

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Determination Manual)

Project / Site: Little Troublesome Creek **Applicant / Owner:** **Investigator:** SFS	**Date:** 9-6-06 **County:** Rockingham **State:** NC
Do normal circumstances exist on the site? Yes X No **Is the site significantly disturbed (Atypical situation)?** Yes No X **Is the area a potential problem area?** Yes No X **(explain on reverse if needed)**	**Community ID:** **Transect ID:** **Plot ID:** W4-1B

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1. Microstegium vimineum	3	UPL	9. Asimina triloba	2	FAC
2. Parthenocissus quinquefolia	4	FAC	10.		
3. Lonicera japonica	4	FAC-	11.		
4. Toxicodendron radicans	4	FAC	12.		
5. Acer rubrum	1	FAC	13.		
6. Cornus florida	1	FACU	14.		
7. Liquidambar styraciflua	1	FAC+	15.		
8. Nyssa sylvatica	2	FAC	16.		

Percent of Dominant Species that are OBL, FACW, or FAC excluding FAC-). 66%

Remarks:

HYDROLOGY

___ **Recorded Data (Describe In Remarks):**
- ___ **Stream, Lake, or Tide Gauge**
- ___ **Aerial Photographs**
- ___ **Other**

X **No Recorded Data Available**

Field Observations:

Depth of Surface Water: _____ **(in.)**

Depth to Free Water in Pit: _____ **(in.)**

Depth to Saturated Soil: >24 **(in.)**

Wetland Hydrology Indicators

Primary Indicators:
- ___ **Inundated**
- ___ **Saturated in Upper 12”**
- ___ **Water Marks**
- ___ **Drift Lines**
- ___ **Sediment Deposits**
- ___ **Drainage Patterns in Wetlands**

Secondary Indicators:
- ___ **Oxidized Roots Channels in Upper 12”**
- ___ **Water-Stained Leaves**
- ___ **Local Soil Survey Data**
- ___ **FAC-Neutral Test**
- ___ **Other (Explain in Remarks)**

Remarks:

SOILS

Map Unit Name
(Series and Phase): Pacolet Variant **Drainage Class:** Moderately Well

Taxonomy (Subgroup): Typic Kanhapludults **Confirm Mapped Type? Yes** ___ **No** X

Profile Description:

Depth (inches)	Horizon	Matrix Colors (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-2	A1	10YR 4/3			sl, 1fgr
2-7	A2	10YR 4/3	7.5YR 4/6 f1d		sl, 1fgr
7-12	Bt1	5YR 4/6	7.5YR 5/6 c2d		scl, 1msbk
12-20	C1	10YR 5/4	10YR 5/6 c2d		ls, 1fsbk
20-24	C2	10YR 5/3			s, sg
24-28	Cg1	10YR 4/1			sl, 1fgr

Hydric Soil Indicators:

- ___ Histosol
- ___ Histic Epipedon
- ___ Sulfidic Odor
- ___ Aquic Moisture Regime
- ___ Reducing Conditions
- ___ Gleyed or Low-Chroma Colors
- ___ Concretions
- ___ High Organic Content in Surface Layer in Sandy Soils
- ___ Organic Streaking in Sandy Soils
- ___ Listed On Local Hydric Soils List
- ___ Listed on National Hydric Soils List
- ___ Other (Explain in Remarks)

Remarks:
Buried surface at 24". Colluvial deposition.

WETLAND DETERMINATION

Hydrophytic Vegetation Present? Yes X No ___
Wetland Hydrology Present? Yes ___ No X
Hydric Soils Present? Yes ___ No X

Is the Sampling Point Within a Wetland? Yes ___ No X

Remarks:

NOTES:

1. SUBJECT PROPERTY BOUNDARY INFORMATION SHOWN IS BASED ON A PLAN ENTITLED "CONSERVATION EASEMENT FOR ECOSYSTEM ENHANCEMENT PROGRAM ON THE PROPERTY OF NEAL HALL (SPO#079-AAG) AND MR. JAMES G. MITCHELL (SPO#079-AAI)", PREPARED BY C.E. ROBERTSON & ASSOCIATES, DATED APRIL 11, 2006.
2. ALL WETLAND AND NON WETLAND AREAS SHOWN HEREON ARE WITHIN THE SUBJECT PROPERTY.
3. AREA OUTSIDE OF THE SUBJECT PROPERTY NOT EVALUATED FOR JURISDICTIONAL WETLANDS.
4. THE BASIS OF THE COORDINATES SHOWN HEREON IS THE NORTH CAROLINA STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM 1983.
5. ALL WETLAND FLAGS AND DATA POINTS WERE LOCATED IN THE FIELD BY CONVENTIONAL SURVEY METHODS BETWEEN SEPTEMBER 2006 AND JANUARY 2007.

"THIS CERTIFIES THAT THIS COPY OF THIS PLAT ACCURATELY DEPICTS THE BOUNDARY OF THE JURISDICTION OF SECTION 404 OF THE CLEAN WATER ACT AS DETERMINED BY THE UNDERSIGNED ON THIS DATE. UNLESS THERE IS A CHANGE IN THE LAW OR OR OUR PUBLISHED REGULATIONS, THIS DETERMINATION OF SECTION 404 JURISDICTION MAY BE RELIED UPON FOR A PERIOD NOT TO EXCEED FIVE YEARS FROM THIS DATE. THIS DETERMINATION WAS MADE UTILIZING THE 1987 CORPS OF ENGINEERS WETLANDS DELINEATION MANUAL."

NAME: _____

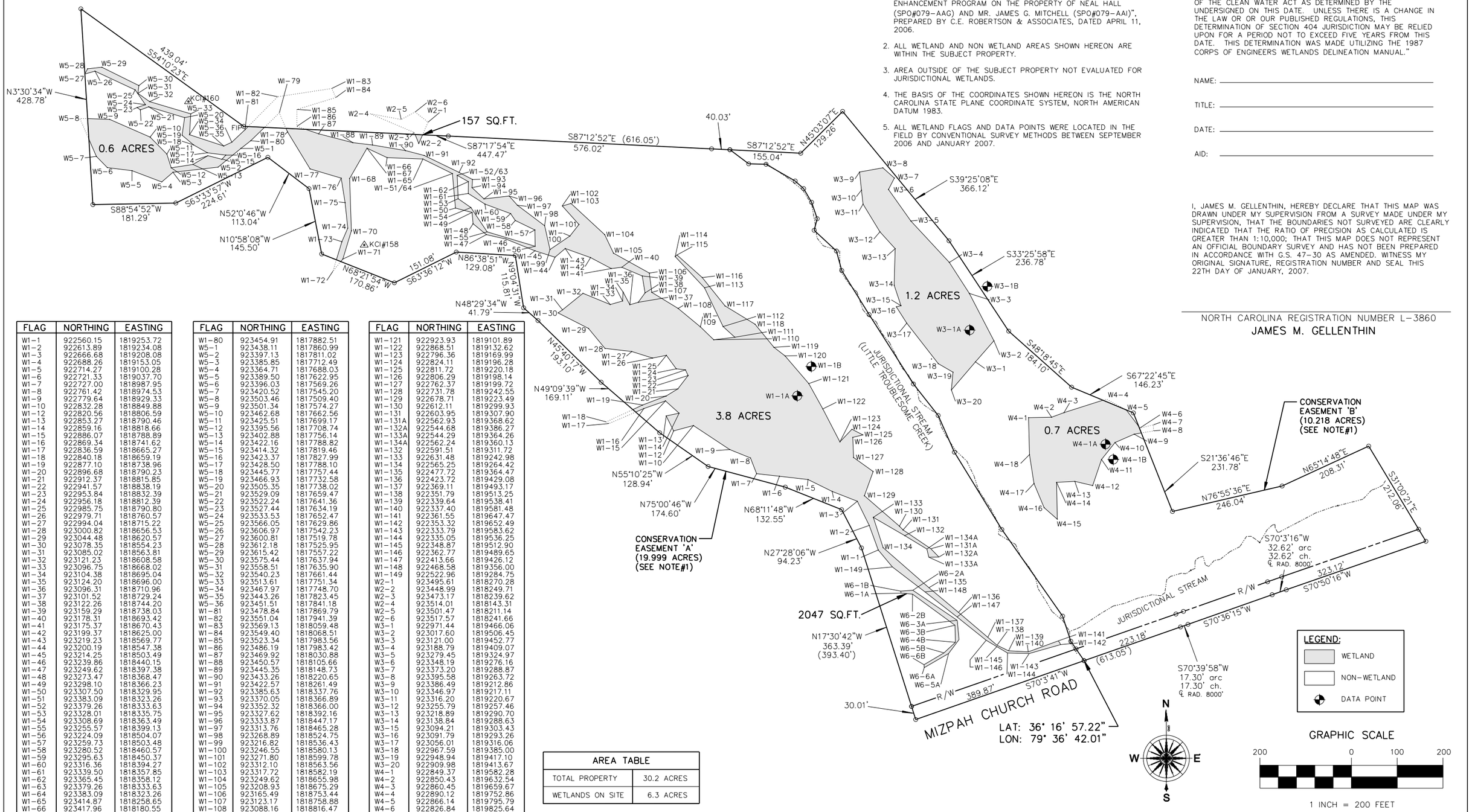
TITLE: _____

DATE: _____

AID: _____

I, JAMES M. GELLENTHIN, HEREBY DECLARE THAT THIS MAP WAS DRAWN UNDER MY SUPERVISION FROM A SURVEY MADE UNDER MY SUPERVISION, THAT THE BOUNDARIES NOT SURVEYED ARE CLEARLY INDICATED THAT THE RATIO OF PRECISION AS CALCULATED IS GREATER THAN 1:10,000; THAT THIS MAP DOES NOT REPRESENT AN OFFICIAL BOUNDARY SURVEY AND HAS NOT BEEN PREPARED IN ACCORDANCE WITH G.S. 47-30 AS AMENDED. WITNESS MY ORIGINAL SIGNATURE, REGISTRATION NUMBER AND SEAL THIS 22TH DAY OF JANUARY, 2007.

NORTH CAROLINA REGISTRATION NUMBER L-3860
JAMES M. GELLENTHIN



FLAG	NORTHING	EASTING
W1-1	922560.15	1819253.72
W1-2	922613.89	1819234.08
W1-3	922666.68	1819208.08
W1-4	922688.26	1819153.05
W1-5	922714.27	1819100.28
W1-6	922721.33	1819037.70
W1-7	922727.00	1818987.95
W1-8	922761.42	1818974.53
W1-9	922779.64	1818929.33
W1-10	922832.28	1818849.88
W1-12	922820.56	1818806.59
W1-13	922853.27	1818790.46
W1-14	922859.16	1818818.66
W1-15	922886.07	1818788.89
W1-16	922869.34	1818741.62
W1-17	922836.59	1818665.27
W1-18	922840.18	1818659.19
W1-19	922877.10	1818738.96
W1-20	922896.68	1818790.23
W1-21	922912.37	1818815.85
W1-22	922941.57	1818838.19
W1-23	922953.84	1818832.39
W1-24	922956.18	1818812.39
W1-25	922985.75	1818790.80
W1-26	922979.71	1818760.57
W1-27	922994.04	1818715.22
W1-28	923000.82	1818656.53
W1-29	923044.48	1818620.57
W1-30	923078.35	1818554.23
W1-31	923085.02	1818563.81
W1-32	923123.23	1818608.58
W1-33	923096.75	1818668.02
W1-34	923104.38	1818695.04
W1-35	923124.20	1818696.00
W1-36	923096.31	1818710.96
W1-37	923101.52	1818729.24
W1-38	923122.26	1818744.20
W1-39	923159.29	1818738.03
W1-40	923178.31	1818693.42
W1-41	923175.37	1818670.43
W1-42	923199.37	1818625.00
W1-43	923219.23	1818569.77
W1-44	923200.19	1818547.38
W1-45	923214.25	1818503.49
W1-46	923239.86	1818440.15
W1-47	923249.62	1818397.38
W1-48	923273.47	1818368.47
W1-49	923298.10	1818366.23
W1-50	923307.50	1818329.95
W1-51	923383.09	1818323.26
W1-52	923379.26	1818333.63
W1-53	923328.01	1818335.75
W1-54	923308.69	1818363.49
W1-55	923255.57	1818399.13
W1-56	923224.09	1818504.07
W1-57	923259.73	1818503.48
W1-58	923280.52	1818460.57
W1-59	923295.63	1818450.37
W1-60	923316.36	1818394.27
W1-61	923339.50	1818357.85
W1-62	923365.45	1818358.12
W1-63	923379.26	1818333.63
W1-64	923383.09	1818323.26
W1-65	923414.87	1818258.65
W1-66	923417.96	1818180.55
W1-67	923438.51	1818136.58
W1-68	923372.24	1818098.50
W1-70	923257.83	1818102.42
W1-71	923196.13	1818083.63
W1-72	923169.74	1818062.15
W1-73	923234.11	1818081.69
W1-74	923263.76	1818094.49
W1-75	923319.36	1818088.71
W1-76	923373.04	1818080.25
W1-77	923393.23	1818012.13
W1-78	923474.04	1817962.96
W1-79	923515.70	1817944.96

FLAG	NORTHING	EASTING
W1-80	923454.91	1817882.51
W5-1	923438.11	1817860.99
W5-2	923397.13	1817811.02
W5-3	923385.85	1817712.49
W5-4	923364.71	1817688.03
W5-5	923389.50	1817622.95
W5-6	923396.03	1817569.26
W5-7	923420.52	1817545.20
W5-8	923503.46	1817509.40
W5-9	923501.34	1817574.27
W5-10	923462.68	1817662.56
W5-11	923425.51	1817699.17
W5-12	923395.56	1817708.74
W5-13	923402.88	1817756.14
W5-14	923422.16	1817788.82
W5-15	923414.32	1817819.46
W5-16	923423.37	1817827.99
W5-17	923428.50	1817788.10
W5-18	923445.77	1817757.44
W5-19	923466.93	1817732.58
W5-20	923505.35	1817738.02
W5-21	923529.09	1817659.47
W5-22	923522.24	1817641.36
W5-23	923527.44	1817634.19
W5-24	923533.53	1817652.47
W5-25	923566.05	1817629.86
W5-26	923606.97	1817542.23
W5-27	923600.81	1817519.78
W5-28	923612.18	1817525.95
W5-29	923615.42	1817557.22
W5-30	923575.44	1817637.94
W5-31	923558.51	1817635.90
W5-32	923540.23	1817661.44
W5-33	923513.61	1817751.34
W5-34	923467.97	1817748.70
W5-35	923443.26	1817823.45
W5-36	923451.51	1817841.18
W1-81	923478.84	1817869.79
W1-82	923551.04	1817941.39
W1-83	923569.13	1818059.48
W1-84	923549.40	1818068.51
W1-85	923523.34	1817983.56
W1-86	923486.19	1817983.42
W1-87	923469.92	1818030.88
W1-88	923450.57	1818105.66
W1-89	923445.35	1818148.73
W1-90	923433.26	1818220.65
W1-91	923422.57	1818261.49
W1-92	923385.63	1818337.76
W1-93	923370.05	1818366.89
W1-94	923352.32	1818366.00
W1-95	923327.62	1818392.16
W1-96	923333.87	1818447.17
W1-97	923313.76	1818465.28
W1-98	923268.89	1818524.75
W1-99	923216.82	1818536.43
W1-100	923246.55	1818580.13
W1-101	923271.80	1818599.78
W1-102	923312.10	1818563.56
W1-103	923317.72	1818582.19
W1-104	923249.62	1818655.98
W1-105	923208.93	1818675.29
W1-106	923165.49	1818753.44
W1-107	923123.17	1818758.88
W1-108	923088.16	1818816.47
W1-109	923047.89	1818865.13
W1-110	923019.76	1818894.20
W1-111	923025.16	1818940.48
W1-112	923048.48	1818914.77
W1-113	923133.45	1818874.10
W1-114	923201.50	1818810.01
W1-115	923205.06	1818813.98
W1-116	923155.71	1818869.08
W1-117	923093.66	1818918.87
W1-118	923053.78	1818984.34
W1-119	923003.27	1819025.80
W1-120	922984.34	1819050.06

FLAG	NORTHING	EASTING
W1-121	922923.93	1819101.89
W1-122	922868.51	1819132.62
W1-123	922796.36	1819169.99
W1-124	922824.11	1819196.28
W1-125	922811.72	1819220.18
W1-126	922806.29	1819198.14
W1-127	922762.37	1819199.72
W1-128	922731.78	1819242.55
W1-129	922678.71	1819223.49
W1-130	922612.11	1819299.93
W1-131	922603.95	1819307.90
W1-131A	922562.93	1819368.62
W1-132A	922544.68	1819386.27
W1-133A	922544.29	1819364.26
W1-134A	922562.24	1819360.13
W1-132	922591.51	1819311.72
W1-133	922631.48	1819242.98
W1-134	922565.25	1819264.42
W1-135	922477.72	1819364.47
W1-136	922423.72	1819429.08
W1-137	922369.11	1819493.17
W1-138	922351.79	1819513.25
W1-139	922339.64	1819538.41
W1-140	922337.40	1819569.12
W1-141	922361.55	1819647.47
W1-142	922353.32	1819652.49
W1-143	922333.79	1819583.62
W1-144	922335.05	1819536.25
W1-145	922348.87	1819512.90
W1-146	922362.77	1819489.65
W1-147	922413.66	1819426.12
W1-148	922468.58	1819356.00
W1-149	922522.96	1819284.75
W2-1	923495.61	1818270.28
W2-2	923448.99	1818249.71
W2-3	923473.17	1818239.62
W2-4	923514.01	1818143.31
W2-5	923501.47	1818211.14
W2-6	923517.57	1818241.66
W3-1	922971.44	1819466.06
W3-2	923017.60	1819506.45
W3-3	923121.00	1819452.77
W3-4	923188.79	1819409.07
W3-5	923279.45	1819324.97
W3-6	923348.19	1819276.16
W3-7	923373.20	1819288.87
W3-8	923395.58	1819263.72
W3-9	923386.49	1819212.86
W3-10	923346.97	1819217.11
W3-11	923316.20	1819220.67
W3-12	923255.79	1819257.46
W3-13	923218.89	1819290.70
W3-14	923138.84	1819288.63
W3-15	923094.21	1819334.43
W3-16	923091.79	1819293.26
W3-17	923056.01	1819316.06
W3-18	922967.59	1819385.00
W3-19	922948.94	1819417.10
W3-20	922909.98	1819413.67
W4-1	922849.37	1819582.28
W4-2	922850.43	1819632.54
W4-3	922860.45	1819659.67
W4-4	922890.12	1819752.86
W4-5	922866.14	1819795.79
W4-6	922826.84	1819825.64
W4-7	922833.76	1819854.98
W4-8	922820.58	1819855.48
W4-9	922813.41	1819812.98
W4-10	922795.08	1819771.09
W4-11	922758.03	1819741.55
W4-12	922701.02	1819722.33
W4-13	922710.18	1819683.22
W4-14	922708.03	1819643.47
W4-15	922627.53	1819644.99
W4-16	922652.66	1819616.24
W4-17	922705.50	1819594.05
W4-18	922768.72	1819584.36

AREA TABLE	
TOTAL PROPERTY	30.2 ACRES
WETLANDS ON SITE	6.3 ACRES

DATA POINTS		
FLAG	NORTHING	EASTING
W1-1A	922897.11	1819076.81
W1-1B	922961.25	1819107.57
W3-1A	923040.83	1819453.48
W3-1B	923136.36	1819492.19
W4-1A	922791.39	1819750.40
W4-1B	922758.07	1819767.40

12053743

KCI ASSOCIATES OF NORTH CAROLINA

KCI ASSOCIATES OF N.C.
ENGINEERS, SURVEYORS AND PLANNERS

4601 SIX FORKS ROAD, SUITE 220
RALEIGH, NC 27609
PHONE (919) 783-9214 * FAX (919) 783-9266

WETLAND BOUNDARY PLAT
FOR
LITTLE TROUBLESOME
MIZPAH CHURCH ROAD
WILLIAMSBURG TWSP., ROCKINGHAM CO., NC

DATE:	SCALE:	SHEET:
JAN. 22, 2007	1" = 200'	1 OF 1