Harrell Site
Edgecombe County, North Carolina

Stream and Wetland Restoration Plan

Contract No. D05025-1

North Carolina Ecosystem Enhancement Program

April 2007

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SCO Contract No. D05025-1
KCI Project No. 12054239

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April 2007

EXECUTIVE SUMMARY

The Harrell Stream and Wetland Restoration Site is located in the Coastal Plain in Edgecombe County, North Carolina. The project will mitigate stream and wetland impacts within the 8-digit hydrologic cataloging unit 03020101 in the Tar-Pamlico River Basin by restoring 6,987 linear feet on an Unnamed Tributary to Swift Creek (UTSC) and 15.0 acres of Coastal Plain Small Stream Swamp wetland community.

The project watershed drains toward the southeast with a contributing area of approximately 0.69 square mile (441 acres) at the downstream limits of the site. Approximately 387.2 acres drain to the UTSC while 56.9 acres drain to the project wetland site. The surrounding area is predominately rural and has low development pressure at this time. Overall, the project watershed is about 94.6% agriculture, 4.2% forest and 1.2% rangeland.

The stream has been channelized and straightened since at least 1948. Currently, the entire site is under agricultural production and the fields are cultivated right up to the top of the stream banks. The existing project stream is 6,338 linear feet. There are no remaining vegetated buffers or in-stream features in the channel and the banks are nearly vertical. The channel can be characterized as having poor streambed variability and habitat diversity.

Two reference reaches were used for this project to develop dimensionless ratios: a headwater reach of the Mitchell River in Surry County, North Carolina and North Prong Creek in Durham County, North Carolina. The Mitchell River reference site is classified as a "B4c" channel and morphological data from this reference stream were used for the design of Reach 1 of the UTSC. The North Prong Creek reference reach was classified as a narrow width/depth ratio C5 stream type and was used to design Reaches 2, 3, and 4 on the UTSC.

The proposed wetland restoration site is located northeast of the UTSC and consists of 15.0 acres of drained hydric soils currently used for agriculture. The area has been ditched and drained since at least 1948 and jurisdictional hydrology no longer exists on the site. The wetland site is adjacent to a forested wetland buffer along Swift Creek and restoration of the site has the potential to increase the amount of connected wetland habitat. A suitable reference wetland was not found for this wetland site. KCI will use the description of a Coastal Plain Small Stream Swamp by Schafale and Weakley as a surrogate vegetative community as needed.

The primary goals for this project are:

- Protect aquatic resources from excess nutrients, sediment, and other pollutants coming from the agricultural watershed.
- Reestablish a functional Coastal Plain Small Swamp Stream wetland complex that creates terrestrial and aquatic habitat and connects to the existing floodplain corridor along Swift Creek.

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

- Restore 6,987 linear feet of stable stream channel with the appropriate pattern, profile, and dimension that can support a sand transport system.
- Connect the stream to a functioning floodplain.
- Fill and plug ditches in the drained hydric soils to restore saturated hydrologic conditions for 5% of the growing season.
- Plant tree species typical of a Coastal Plain Small Swamp Stream along the UTSC riparian corridor and floodplain as well as in the restored wetland.

Stream Restoration						
Reach	**Station Range**	**Mitigation Type**	**Priority Approach**	**Stream Classification**	**Existing Linear Footage**	**Designed Linear Footage**
Reach 1	10+00 - 22+65	Restoration	P3	B5c	1,224	1,265
Reach 2	22+65 - 37+30	Restoration	P2	C5	1,389	1,465
Reach 3	37+30 - 52+90	Restoration	P2	C5	1,231	1,560
Reach 4	52+90 - 79+87	Restoration	P2	C5	2,494	2,697
Wetland Restoration						
Acreage	**Soil Type**	**Mitigation Type**	**Designed Community Type**			
15.0	Roanoke	Restoration	Coastal Plain Small Stream Swamp			

Reach 1 will be restored using a Priority 3 approach. At this site, the width/depth ratio will be increased and the bank slopes cut back within the existing channel. A B5c channel will be created with a sinuosity of 1.03 for 1,265 linear feet of stream.

Reaches 2, 3, and 4 cover the remainder of the stream and will be restored using a Priority 2 approach. The restoration will establish a bankfull channel with a new floodplain and the design bankfull stage will equal the new floodplain elevation (bank height ratio = 1.0). A C5 channel morphology with a sinuosity ranging from 1.05-1.27 will restore 5,114 linear feet of existing stream to 5,722 linear feet of restored channel.

In order to further protect the UTSC from agricultural run-off, water quality treatment areas will be installed at the base of the ditches that drain to UTSC. These areas will store and treat a portion of the run-off before it reaches UTSC.

The sediment regime in the UTSC is dominated by sand and dune/anti-dune processes need to be allowed to function in order to maintain stability in the channel. If there are impediments to these shifting sand processes, the sand can become more turbulent and form powerful waves throughout the channel. For this reason, a limited number of stream structures will be installed in the restored reaches. Only two riffle grade control structures and three log drop structures will be used throughout the stream.

In order to restore the wetland, the existing ditch network will be plugged and filled to block water from leaving the site. Ditch plugs will be placed in the four ditch outlets. In addition to blocking the major outlets from the site, KCI will also recreate wetland microtopography to form small depressions and rises throughout the site that resemble the minor variations found in a natural wetland system.

To complete the project, both the stream and wetland sites will be planted with species consistent with a Coastal Plain Small Stream Swamp community. Trees will be planted at a density of 436 trees per acre (10 feet by 10 feet spacing) to achieve a mature survivability of 320 trees per acre.

Both the stream and wetland restoration sites will be monitored to evaluate project success. For the stream, monitoring shall consist of the collection and analysis of stream stability and riparian/stream bank vegetation survivability data to support the evaluation of the project in meeting established restoration objectives. The wetland site will be deemed successful once hydrology is established and vegetation success criteria are met.

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1.0 INTRODUCTION

The Harrell Stream and Wetland Restoration Site is a full-delivery project developed for the North Carolina Ecosystem Enhancement Program (EEP) to mitigate stream and non-riparian wetland impacts within the 8-digit hydrologic cataloging unit 03020101. The project will restore 6,987 linear feet on an Unnamed Tributary to Swift Creek (UTSC) and 15.0 acres of Coastal Plain Small Stream Swamp wetland community. This restoration plan presents the existing site and watershed conditions, the restoration design criteria, the design summary, and the proposed monitoring protocol.

2.0 PROJECT SITE IDENTIFICATION AND LOCATION

2.1 Directions to Project Site

The HPRS is part of a 319-acre parcel owned by Mr. Floyd and Mrs. Ernestine Harrell. The site is located approximately six miles northeast of Rocky Mount, North Carolina in Edgecombe County (Figure 1). The latitude and longitude of the project site are 36.0201 North and 77.6807 West (WGS1984).

To reach the site from Raleigh:
Proceed east on U.S. Route 264-East/64-East (US 264E/64E) for approximately 17 miles. Continue on US 64E for another 30 miles. Take the U.S. Route 301 Bypass and then U.S. Route 301 (US 301) north into Battleboro. Turn right on E. Battleboro Avenue, which becomes Battleboro-Leggett Road. Continue past the first turn onto Morning Star Church Road on the left just outside of town. Go about 5 miles and turn left onto the second Morning Star Church Rd (the road loops around). Go one mile and turn right onto a dirt road opposite Benson Farm Rd. The stream restoration site will begin as the stream exits the culvert under Morning Star Church Rd.

2.2 USGS Hydrologic Unit Code and NCDWQ River Basin Designations

The Unnamed Tributary to Swift Creek (UTSC) is a second-order perennial stream that flows west to east for approximately 6,338 linear feet once on the Harrell property. The stream drains into Swift Creek approximately 500 linear feet after leaving the project site.

The project site is situated within the 03020101 (Tar-Pamlico 01) Watershed Cataloging Unit (8-digit HUC) and the 03020101130090 Local Watershed Unit (14-digit HUC). It is within the North Carolina Division of Water Quality (NCDWQ) Subbasin 03-03-02. In the North Carolina Ecosystem Enhancement Program's (EEP) Tar-Pamlico River Basin Watershed Restoration Plan, the Swift Creek watershed has not been identified as a high priority, Targeted Hydrologic Unit.

3.0 WATERSHED CHARACTERIZATION

The project watershed is a small agricultural drainage in the inner Coastal Plain as seen in Figure 2. The surrounding topography is characterized by flat bottomlands and gently rolling hills. The elevation in the project watershed ranges from 65 to 119 feet above mean sea level.

3.1 Drainage Area

The project watershed drains toward the southeast with a contributing area of approximately 0.69 square mile (441 acres) at the downstream limits of the site. The project stream has a total drainage area of 387.2 acres while 56.9 acres drain to the project wetland. The UTSC enters Swift Creek at a point approximately 7.8 miles upstream of the confluence with the Tar River as seen in Figure 3. The project area is located in the United States Geological Survey (USGS) Whitakers Quadrangle.

3.2 Surface Water Classification/Water Quality

The NCDWQ assigns surface water classifications in order to help protect, maintain, and preserve water quality. For the water resources classification, Swift Creek, as the receiving waters, was used to characterize the UTSC. The section of Swift Creek just downstream of the project area (28-78-(2.5)) is listed as a Class C and Nutrient Sensitive Water (NSW). The NCDWQ reduced the bioclassification of Swift Creek in 2002 from excellent to good, listing constricted flow as the reason for the downgrade. This reduced flow has led to lower dissolved oxygen levels in the stream.

- **Class C waters** 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

- **Nutrient Sensitive Water (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 nonpoint 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, DWQ 2006).

3.3 Geology and Soils

The site lies within the Southeastern Floodplains and Low Terraces ecoregion of the Coastal Plain physiographic province. The area is referred to as the inner Coastal Plain and is characterized by more relief than the outer Coastal Plain. The underlying sediments of the site are from the Yorktown Formation and Duplin Formation Undivided. The Yorktown Formation is described as fossilferous clay with varying amounts of fine-grained sand, bluish gray, shell material commonly concentrated in lenses and is found mainly in areas north of Neuse River. The Duplin Formation is described as shelly, medium to coarse-grained sand, sandy marl, and limestone, bluish gray, mainly in area south of Neuse River (NCGS 1985).

The project watershed primarily intersects the soils in the Roanoke-Conetoe-Portsmouth association, which is described as nearly level and gently sloping, very poorly drained, poorly drained, and well-drained soils that have a clayey to sandy subsoil. These associated soils are typically found on broad flats, smooth to slightly rounded ridges, or depressions. The predominant soil series in the project watershed are Altavista fine sandy loam, Cape Fear loam, Dogue fine sandy loam, Norfolk loamy sand, Rains fine sandy loam, and Roanoke loam (Figure 4). Altavista fine sandy loam consists of a brown fine sandy loam surface layer and a sandy clay loam to sandy loam subsurface. The Cape Fear loam has a black loam surface layer and clay loam to sandy clay loam subsurface. Dogue fine sandy loam has a brown fine sandy loam surface and clay to sandy clam loam subsoil. The Norfolk loamy sand series has a brown loamy sand surface and sandy clay loam subsoil. The Portsmouth fine loamy sand has very dark gray fine sandy loam surface layer and sandy loam to sandy clay loam subsoil. The Rains fine sandy loam has a surface layer of very dark gray fine sandy loam and gray sandy clay loam subsoil. The Roanoke loam has a surface of dark grayish brown loam and gray clay to sandy clay loam subsoil (USDA, SCS 1979).

3.4 Historical Land Use and Development Trends

3.4.1 Historical Resources

Historical aerial photographs were obtained from the Edgecombe County Natural Resources Conservation Service (NRCS) office in order to more effectively assess the existing site conditions. All available aerial photographs were reviewed in order to create a chronology of land disturbance. Aerial photographs of the site were obtained from 1948, 1954, 1964, 1971, 1979, 1998, 2002, and 2005 (Appendix A).

In 1948, the northern portion of the stream site contains agricultural land while the southern portion along the stream is forested. The stream had already been straightened at this point. The wetland area had also been converted to agriculture by this time, which included a series of drainage ditches in place across the site. In 1954, the subject property shows little change from the 1948 conditions.

In 1964, the subject property closely resembles the 1954 conditions, but the southwest and southeast portions of the wetland area are forested. In 1971 and 1979, the subject property closely resembles the 1964 conditions.

The entire property has been cleared by 1998 and is under agricultural production. The drainage features are largely unchanged from the conditions in 1948. In 2002 and 2005, the subject property closely resembles the 1998 conditions; no significant differences are discernable.

The stream channel shows the same observable pattern from 1948 up until its current condition. No changes in either the stream valley or stream channel within the project area were observed in the historical aerial photographs. Therefore, any alterations to the stream channel occurred prior to 1948. No significant changes have occurred in the project area since 1948.

3.4.2 Land Use and Development Potential

The project watershed is 441 acres in size as seen in Figure 3. The surrounding area is predominately rural and has low development pressure at this time. Overall, the project watershed is approximately 94.6% agriculture, 4.2% forest and 1.2% rangeland based on the North Carolina GAP land use classification using 1992 and 1993 aerial photography (McKerrow 2003).

3.5 Endangered/Threatened Species

KCI requested a formal review by the North Carolina Natural Heritage Program (NCNHP) in July 2005 to evaluate the presence of any rare species, critical habitat, and priority natural areas on the project site and to determine the potential impact of the proposed project on these resources. In their findings letter dated July 11, 2005 (Appendix B), the NCNHP indicated “no record of rare species, significant natural communities, or priority natural areas at the site or within a mile of the project area”. In addition, no threatened or endangered species were identified in the project area during the existing conditions site assessment. Also, a formal review by the United States Fish and Wildlife Service (USFWS) was requested in July 2005, but no correspondence was returned.

3.6 Cultural Resources

To evaluate the presence of significant cultural resources on the subject property, KCI requested a formal review at the North Carolina Department of Cultural Resources, State Historic Preservation Office (SHPO). The formal SHPO review dated July 18, 2005 found no historic properties within the project

area (see Appendix B). The formal review by the State Archaeology Office identified no potential archaeology sites on or around the subject property.

3.7 Potential Constraints

KCI investigated any potential site conditions that could hinder restoration activities. They were documented during the field investigation and are summarized below.

3.7.1 Property Ownership and Boundary

The project site is located on a single private property owned by Mr. Floyd and Mrs. Ernestine Harrell of 6444 NC Highway 42, Tarboro, North Carolina, 27886. KCI facilitated the acquisition of a conservation easement to be held by the State of North Carolina on the area identified for stream and wetland restoration. The conservation easement boundary (plat with legal description) has been included in Appendix C.

3.7.2 Site Access

There will be one access point to the project site off of Morning Star Church Road at the northwestern corner of the project site. This is a legal access point guaranteed with an ingress/egress easement. During the restoration of the stream and wetland components, construction equipment will be able to maneuver up and down the site as necessary.

3.7.3 Utilities

There are no utilities located on the project site.

3.7.4 FEMA/Hydrologic Trespass

The UTSC and the wetland restoration site are both located within the 100-year floodplain (Zone AE) of Swift Creek and a downstream portion of UTSC is within the floodway of Swift Creek (Figure 6). As such, any modifications that would result in the increase of the 100-year flood elevation would require a Conditional Letter of Map Revision (CLOMR). It is the intent of the restoration design to maintain the existing 100-year flood elevations. A proposed hydrology and hydraulics (H&H) summary will be submitted with a letter indicating that an increase in the 100-year flood elevation is not anticipated (No-Rise Certification).

A conditional floodplain model is being developed by using detailed topographic survey from the construction drawings completed for the restoration project. This conditional model will be revised to reflect changes to the channel and floodplain as the result of restoration (proposed model).

The proposed project reach is entirely contained within the Harrell property. The restoration of the project reach is not anticipated to produce hydrologic trespass conditions on any adjacent properties.

4.0 PROJECT SITE STREAMS (EXISTING CONDITIONS)

A field assessment was conducted in April 2006 to document existing conditions and to aid the development of an appropriate design for the stream restoration. The existing stream channel, ditches, ponds, wetland, and drained hydric soils at the project site are illustrated in Figure 7 and documented in the site photographs (Appendix D). Observations and collected data are summarized below and presented in Appendix E. The site was revisited several times from April 2006 to January 2007 to take further

measurements. Portions of the ditch network are displayed on the USGS quadrangle as a blue line stream, but a consultation with the North Carolina Division of Water Quality indicated that only the main channel of the UTSC was a jurisdictional waterway (see Appendix B).

4.1 General Site Description

The UTSC flows from west to east and drains approximately 387 acres of agricultural land into Swift Creek. The stream begins from a ridge at the top of the small watershed and flows for approximately 1,700 feet through farmland until the project reach begins. The project begins at Station 10+00 as the stream exits a culvert that goes under Morning Star Church Road. It then travels through agricultural fields on the Harrell property. Once the UTSC leaves the project boundary, it travels approximately 500 linear feet through a forested bottomland before reaching Swift Creek.

The existing project stream is 6,338 linear feet and has been ditched extensively since at least 1948 as seen in historic aerial photographs. There are no remaining vegetated buffers or in-stream features in the channel. The banks are nearly vertical and are cut up to the top of the bank for agricultural production. Several culverts convey water under agricultural crossings. At this time, sediment, nutrients and agricultural chemicals have direct access to the watercourse and can be deposited directly into Swift Creek. Fine sediments from the eroding stream banks and inputs from adjacent agricultural fields are also affecting water quality. The channel can be characterized as having poor streambed variability and habitat diversity.

4.2 Channel Morphology (Pattern, Dimension, and Profile)

A Rosgen Level III assessment was conducted to collect existing stream dimension, pattern, and profile data and determine the degree of channel instability. Channel cross-sections and profiles were surveyed at ten representative locations along the UTSC. Bed materials were sampled with pebble counts at seven of these ten locations. Data developed from these surveys are presented in Appendix E and a summary of existing channel morphology is shown in Table 4.

4.3 Channel Stability Assessment

A qualitative stability assessment was performed to estimate the level of departure from a stable stream system and to determine the likely causes of channel disturbance.

The UTSC is deeply incised as it enters the Harrell Property from the culvert under Morning Star Church Road. Cross-section #1, which is approximately 830 feet downstream of the beginning of the project, had a bank height ratio of 1.8 at the time of assessment. Further downstream, cross-sections #2 through #7 had bank height ratios ranging from 1.4-1.8. The stream has eroded down to a clay bottom and does not have regular access to the floodplain. Starting at Cross-section #8, the channel is not as incised and has bank height ratios from 1.0 to 1.2. The existing channel slope also decreases in this reach as the stream nears the end of the project. At the end of the project, the UTSC is affected by backwater from Swift Creek and has received large sediment deposits during storm events.

4.4 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. The identification of bankfull stage, especially in a degraded system, can be difficult. Therefore, verification measures were undertaken to facilitate the correct identification of the bankfull stage on the UTSC.

To verify bankfull stage at UTSC, regional hydraulic geometry relationships (regional curves) were used. 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 physiographic province. Regional curves and corresponding equations from Harman et *al.* were used to approximate bankfull in the project reach (1999). Based on the regional curves, a bankfull discharge and cross-sectional area of 62 ft^3/s and 15 ft^2 would be anticipated at the bottom of the project reach.

4.5 Stream Vegetation

Currently, there is no riparian vegetation at the project site. Agricultural fields are farmed right up to the top of bank along the entire length of the stream.

5.0 REFERENCE STREAMS

A reference reach is a channel with a stable dimension, pattern, and profile within a particular valley morphology. Reference reaches are 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). Two reference reaches were used for this project: a headwater reach of the Mitchell River in Surry County, North Carolina and North Prong Creek in Durham County, North Carolina.

5.1 Mitchell River Reference Site

A headwater reach of the Mitchell River was surveyed by the North Carolina State University Water Quality Group in February 2003. The reference site is located in the northwestern portion of Surry County as seen in Figure 8. The reach was classified as a B4c channel at this location and morphological data from this reference stream were used for the design of the upper portion of the UTSC.
The water surface slope and dimensions at this reference reach made it suitable for developing dimensionless ratios for the upper portion of UTSC. Morphological data are presented in Table 4, but no representative cross-sections, profile, or pebble counts were available.

5.2 Mitchell River Watershed Characterization

The watershed for the Mitchell River headwater reach is located in Alleghany and Surry counties in northwestern North Carolina (Figure 9). It is part of the 14-digit hydrologic unit code 03040101080010 in the Yadkin River Basin and the NCDWQ subbasin 03-07-02. The 6.0-square mile watershed is approximately 92% forest and 5% rangeland (McKerrow 2003). The UTMR is located in the Southern Crystalline Ridges and Mountains ecoregion in the Blue Ridge physiographic province. Elevations in the watershed range from 1,470 to 3,148 feet above mean sea level.

5.3 North Prong Reference Site

A stable section of North Prong Creek, a second order stream located in Durham County, was selected as the reference reach for the downstream portion of the restoration project (Figure 10). Approximately 400 linear feet (20 bankfull widths) of North Prong Creek were surveyed by KCI in October 2002. This reach has a sediment regime similar to the UTSC. Likewise, the valley slope (0.23% compared to 0.24% at the project site) and sediment distribution (d_{50} of 0.2 mm compared to 0.4 mm) of the reference site are very similar to that of the project site. North Prong Creek is located in the Piedmont instead of the Coastal Plain physiographic region, but no other appropriate C5 reference was found in the Coastal Plain.

The North Prong Creek reference reach was classified as a narrow width/depth ratio C5 stream type. Collected morphological data as well as representative photographs of the reference site are provided in Appendix F. The measured morphological variables and dimensionless hydraulic geometry relationships developed to facilitate the restoration design are provided in Table 4.

5.4 North Prong Watershed Characterization

North Prong Creek is located in southern portion of Durham County, North Carolina and is in the 14-digit hydrologic unit 03030002060140 within the Cape Fear Basin. The stream was surveyed just upstream of the point where it drains into Northeast Creek. The watershed for North Prong Creek contains approximately 3.15 square miles (Figure 11). It is found in the NCDWQ 03-06-05 subbasin. The reference reach is located in the Triassic Basins ecoregion in the Piedmont physiographic province.

The portion of the stream used as a reference is found approximately 1,500 feet northwest of the intersection of Interstate 40 and State Highway 55. The elevation in the reference reach watershed ranges from approximately 258 to 408 feet above mean sea level.

6.0 PROJECT SITE WETLANDS (EXISTING CONDITIONS)

The proposed wetland restoration site is located northeast of the UTSC and consists of 15.0 acres of drained hydric soils currently used for agriculture (Figure 7). A series of drainage ditches runs through the proposed wetland site and it drains everything to the east, which inhibits the formation of saturated conditions on the site. The area has been ditched and drained since at least 1948 and jurisdictional hydrology no longer exists on the site. The wetland site is adjacent to a forested wetland buffer along Swift Creek and has the potential to increase the amount of Coastal Plain connected wetland habitat.

6.1 Jurisdictional Wetlands

A wetland delineation was performed at the site in June 2006 using the methods set out by the US Army Corps of Engineers (USACE 1987). There were no existing wetlands except for those that had formed in the bottoms of the drainage ditches (Appendix G). The US Army Corps of Engineers (USACE) issued a permit allowing these wetlands to be filled, because the site will be returned to a functioning wetland.

6.2 Hydrologic Characterization

There is a system of drainage ditches throughout the wetland project site as seen in Figure 7. These waterways drain both surface and groundwater from the site and have allowed agriculture to take place despite the poorly drained soils and flat site topography.

6.2.1 Groundwater Modeling

The numerous modifications to the hydrology of this area have effectively drained the wetland. The development of a network of ditches up to three feet deep has halted the influence of flooding on the area. The effect of ditching on wetland hydrology was evaluated in DRAINMOD using: the NRCS model Map Unit Users File (MUUF) for Roanoke soil; the daily rainfall and daily maximum and minimum temperatures for Rocky Mount and Tarboro for the period from 1950 to 2004 (National Climatic Data Center); and the Edgecombe County growing season (21 March to 11 November). This analysis concluded that the existing ditch network has removed jurisdictional hydrology from the evaluated areas.

6.2.2 Surface Water Modeling

KCI performed an analysis of surface water inputs in order to differentiate between riparian and nonriparian wetlands. The floodplain boundaries from DFIRM maps developed by the North Carolina Floodplain Mapping Program were used to interpolate the extent of the Swift Creek 5-year floodplain. This analysis showed that the 5-year floodplain from Swift Creek extends to 74 feet above mean sea level in this location. This elevation defined the boundary of the nonriparian wetland restoration site for this project.

6.2.3 Hydrologic Budget for Restoration Site

Existing Conditions

Existing site hydrology was modeled by developing an annual water budget that calculates hydrologic inputs and outputs in order to estimate the change in storage on a monthly time step (Appendix H).

In order to set up the water budget, historic climatic data were obtained from the North Carolina State Climatic Office. The weather station Tarboro 1 S (318500) in Tarboro, North Carolina was used, because it is the nearest station with daily precipitation and temperature records. The station is located approximately 12 miles to the southeast of the Harrell Site. Monthly precipitation totals from the entire period of record (1948-2005) were reviewed and three years were selected to represent a range of precipitation conditions: dry year (1988), average year (1977), and wet year (1989).

Potential inputs to the water budget include precipitation, groundwater, and surface inputs. For precipitation, the data from the three selected years were used in the budget. Groundwater input likely exists, but was considered negligible in comparison to the magnitude of surface and precipitation inputs. Surface water input was calculated using the USDA Soil Conservation Service (SCS) runoff curve number equation (USDA, SCS 1986).

Outputs from the site include potential evapotranspiration (PET), groundwater, and surface water outlets. PET was calculated by the Thornthwaite method using mean monthly temperatures determined from the chosen years of record: 1988, 1977, and 1989. Groundwater represents losses from the site due to downward seepage through the soil profile and was assumed to be $2x10^{-6}$ ft/min (1.04 inches per month), which is typical of low permeability soils associated with wetlands. A substantial amount of water is also lost through the existing ditches on-site. A DRAINMOD model was set up to simulate the effect of the existing drainage network on wetland hydrology. The program evaluated 40 years of available precipitation data and produced the annual loss due to the ditches for the three selected years.

Once the inputs and outputs were determined, a net monthly total was calculated in inches and used to estimate a yearly water budget. The model assumes unsaturated conditions at the beginning of the year. A maximum wetland water volume of 4.68 inches was calculated based on the specific yield of 0.13 for 36 inches of Roanoke soil in order to analyze conditions in the upper three feet of the soil profile. The

resulting hydrographs for the average, dry, and wet years show a seasonal pattern. The model shows that the majority of hydrologic inputs to the site come during the rainy spring months. The site begins to lose saturation in the upper twelve inches in the summer months. The late fall sees an increase in hydrologic inputs again. The dry year shows very little wetland hydrology overall.

Proposed Conditions

A modified water budget was developed to analyze the effect of restoration actions on the site hydrology. The loss of water from the existing ditches was removed from the calculations, because these ditches will be filled and no longer carry water off the site. To estimate the impact from recreating wetland microtopography, an additional two inches of hydrologic capacity was added to the calculations. Based on these changes, the budget shows a noticeable increase in the spring. In particular, the wet year has wetland hydrology throughout almost the entire year. The dry year does not show much change from the existing to proposed budget, which indicates that during a drought year the wetland may not experience consecutive saturated conditions expect during the first months of the growing season. The normal year is predicted to have saturation during the earlier part of the growing season with occasional dry periods during the late summer months.

6.3 Soil Characterization

A soils investigation at the proposed wetland restoration site was conducted by a certified soil scientist from KCI to determine the extent and distribution of the hydric soils 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.

To develop a detailed soils map, several soil borings were advanced on the site in the general hydric soil areas identified by landscape position, vegetation and slope. Once the hydric soil borings were identified, the soil scientist marked the point and established a visual line to the next auger boring where again hydric soil conditions were confirmed by additional borings. The soil scientist moved along the edges of the mapping unit and marked each point along the line. To confirm the hydric soil mapping unit, soil borings were advanced to a depth of 50 inches. The soil profile descriptions identified the individual horizons in the topsoil and upper subsoil as well as the depth, color, texture, structure, boundary, and evidence of restrictive horizons and redoximorphic features. The extent of the mapped hydric soils is shown in Figure 7.

6.3.1 Taxonomic Classification

The soil type at the wetland restoration site is Roanoke loam series, which is classified as a fine, mixed, semiactive thermic Typic Endoaquult.

6.3.2 Profile Description

The Roanoke loam series is described as a poorly drained silt loam that forms in fluvial sediments on stream terraces. The series consists of very deep, slowly permeable or very slowly permeable soils that have a moderate shrink-swell potential. Slopes are typically 0 to 2 percent. Mapped areas of the Roanoke series in Edgecombe County range from 4 acres to more than 100 acres. Typically, the surface layer is

dark grayish brown loam and 8 inches thick. Organic matter content is medium and there is also a high available water capacity in the surface layer. The seasonal high water table is at or near the surface. The subsoil is typically 44 inches thick with gray clay loam in the upper portion, gray clay in the middle part, and gray sandy clay loam in the lower area. The underlying material up to 90 inches is gray coarse sand (USDA, SCS 1979). The series is listed by the Natural Resource Conservation Service (NRCS) as a hydric soil.

6.3.3 Soil Properties

The Roanoke series has a saturated hydraulic conductivity from 0.06 to 2.0 inches/hour. The percent organic matter is approximately 0 to 2.0% and the bulk density is in the range of 1.20 to 1.65 g/cc (USDA, SCS 1979).

6.4 Wetland Plant Community Characterization

The wetland restoration site is currently under seasonal agricultural production. There is no wetland vegetation in the farmed area. The bottoms of the ditches do contain hydrophytic species such as cattail (*Typha latifolia)*, water primrose *(Ludwigia spp.)* and knotweed *(Polygonum spp.)*, but there are no woody species within the restoration site.

7.0 REFERENCE WETLAND

A suitable reference wetland was not found for this project. KCI contacted several landowners with potential reference wetland sites, but none were willing to allow their land to be used for an initial survey and groundwater monitoring. KCI will use the description by Schafale and Weakley as a surrogate vegetative community as needed (1990).

8.0 PROJECT SITE RESTORATION PLAN

Approximately 6,987 linear feet of stream and 15.0 acres of Coastal Plain Small Stream Swamp wetland will be restored at the Harrell Site. The restored stream and wetland will provide a buffer between the existing functioning wetlands along Swift Creek and the agricultural activities in the local watershed.

8.1 Restoration Project Goals and Objectives

The ecological diversity and water quality at the Harrell Site are significantly limited under the existing conditions. This project aims to restore terrestrial and aquatic habitat and to improve water quality by reestablishing stable fluvial geomorphic features, wetland hydrology, and native Coastal Plain vegetation.

The primary goals for this project are:

- Protect aquatic resources from excess nutrients, sediment, and other pollutants coming from the agricultural watershed.
- Reestablish a functional Coastal Plain Small Swamp Stream wetland complex that creates terrestrial and aquatic habitat and connects to the existing floodplain corridor along Swift Creek.

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

- Restore 6,987 linear feet of stable stream channel with the appropriate pattern, profile, and dimension that can support a sand transport system.
- Connect the stream to a functioning floodplain.

- Fill and plug ditches in the drained hydric soils to restore saturated hydrologic conditions for 5% of the growing season.
- Plant tree species typical of a Coastal Plain Small Swamp Stream along the UTSC riparian corridor and floodplain as well as in the restored wetland.

8.1.1 Designed Channel Classification

The UTSC has been channelized and extensively disturbed as a result of agricultural use. Both Priority 2 and Priority 3 approaches will be used to restore this stream. The division of reaches and priority types can be seen in Table 1.

Reach 1 extends from Stations 10+00 to 22+65, which is the first 1,224 linear feet of existing channel. A Priority 3 approach was used within the existing stream corridor and belt width with adjustments made to the stream pattern and dimension (Rosgen 1997). The width/depth ratio will be increased and the banks sloped back to establish the appropriate entrenchment ratio for the design channel. A B5c channel will be created with a sinuosity of 1.03 for 1,265 linear feet of stream. The Mitchell River Headwaters provided the reference morphological criteria and hydraulic geometry relationships from which the proposed design was based (Table 4).

Reaches 2 (22+65-37+30), 3 (37+30-52+90), and 4 (52+90-79+87), which cover the remainder of the stream, will be restored using a Priority 2 approach (Rosgen 1997). This method involves reestablishing a natural profile, planform, and cross-section on the existing channel elevation. The restoration will create a bankfull channel with a new floodplain and the design bankfull stage will equal the new floodplain elevation (bank height ratio = 1.0). The new channel will meander within an approximate belt width of 45 to 100 feet as determined by criteria from the reference reach. Grading will be conducted to establish a floodplain and the appropriate cross-sectional area. A total of three stream crossings will be maintained for the landowner to allow access across the easement to agricultural lands. A C5 channel morphology with a sinuosity ranging from 1.05-1.27 will restore 5,114 linear feet of existing stream to 5,722 linear feet of restored channel. North Prong Creek was the reference site used to develop the morphological criteria and hydraulic geometry relationships that were the basis for the proposed stream dimension, pattern, and profile.

The sediment regime in the UTSC is dominated by sand (Appendix E). In a predominantly sand system, the bed is mobilized during storm events, because small sand particles move during turbulent flow. Typical pool and riffle features do not exist in a sand system. Instead, these features shift as sand dunes build up and break down throughout the channel. The dune/anti-dune processes maintain stability in the channel. If there are impediments to these shifting sand processes, the sand can become more turbulent and form powerful waves throughout the channel. For this reason, a limited amount of stream structures will be installed in the restored reaches. Both Reach 2 and Reach 3 will receive one riffle grade control structure, which will stabilize sections of the profile where the channel will need to be built up to a certain elevation. Three log drop structures will be placed in Reach 3; these structures are designed to provide grade control and stability (refer to the details on Stream Plan Sheet 2). The log drop structures will also be more typical of in-stream habitat found in a small Coastal Plain Small Stream Swamp complex.

In order to promote dune/anti-dune processes in the channel, a gravel/sand starter bed will be installed over the existing clay bed in reaches 2, 3, and 4. Approximately 0.2 foot of pea gravel overlaid with 0.3-0.5 foot of sand will be placed in the channel. The profile will be constructed 0.5-0.7 foot lower to accommodate this increase in elevation once the starter bed is in place.

Seven agricultural ditches will still flow into the UTSC. In order to improve the quality of the ditch drainage entering the stream, water quality treatment areas will be constructed within the new floodplain.

These areas will consist of shallow depressions that will slow and treat water before it enters the stream. These features are shown in Stream Detail Sheet 2. The inlet and outlets to the water quality treatment areas will be strengthened with rock stabilization. A depression of six inches or less will be graded to provide storage and treatment of the ditch run-off before it reaches the UTSC. A total of six water quality areas will be installed along the UTSC where ditches join the stream. A larger channel that enters the stream from the southwest corner of the project will not receive a water quality treatment area. This straightened channel receives drainage from an approximately 100-acre watershed and has an intermittent flow regime. An in-line detention structure would influence the flow characteristics of the channel and therefore the channel will remain free-flowing. A vegetated riparian buffer will be established adjacent to this feature within the easement boundary. All of the water treatment areas will be planted with native species as described in Section 8.4.1.

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.

8.1.2 Target Plant Communities

The design vegetative community for both the restored wetland and the UTSC is a Coastal Plain Small Stream Swamp (Brownwater subtype) as described by Schafale and Weakley (1990). This community type fits into the natural topography of the project watershed. The Coastal Plain Small Stream Swamp is characterized by a variable canopy, which can be dominated by combinations of bald cypress (*Taxodium distichum*), water tupelo (*Nyssa aquatica*), and various bottomland hardwoods such as swamp chestnut oak (*Quercus michauxii*), Shumard oak (*Q. shumardii*), cherrybark oak (*Q. pagoda (falcata var. pagodaefolia)*), laurel oak (*Q. laurifolia*), black oak (*Q. nigra*), willow oak (*Q. phellos*), sweetgum (*Liquidambar styraciflua*), sugarberry (*Celtis laevigata*), sycamore (*Platanus occidentalus*), river birch (*Betula nigra*), green ash (*Fraxinus pennsylvanica*), black willow (*Salix nigra*), and swamp cottonwood (*Populus heterophylla*). Understory species include American hornbeam (*Carpinus caroliniana*), Carolina ash (*Fraxinus caroliniana*), American holly (*Ilex opaca*), and red maple (*Acer rubrum*).

8.2 Sediment Transport Analysis

The UTSC is a sand-dominated system and sand channels have a unique transport process where particles are suspended in the water column during turbulent flows. During fully turbulent flow, all of the sand can move, but this is rarely the case. In partial transport scenarios, there is a complex relationship between the sand being suspended and the sand slowly depositing back on the bed.

Sand streams have thick plane beds during low flow conditions. Bed variations (pools) only result from scenarios (i.e., objects in the stream) that would induce local scour. At high flows, dunes form and they move downstream by eroding their faces and re-depositing downstream. At bankfull flows, these dunes can wash out causing the plane bed to reform at a lower elevation with the volumetric difference in sediment moving downstream in suspension. During extreme conditions, standing waves can form, and the undulations can extend to the clay streambed forming anti-dunes. The migration of anti-dunes upstream consequently forces the waves with them. In the proposed restoration, this process provides the mechanism by which sediment transport will occur and provide bed heterogeneity.

Sand channels must have adequate capacity to allow dunes to form and move. This design capacity is related to the available sediment supply. The agricultural nature of the watershed and the existing sediment sampled in the channel suggest the availability of sufficient sediment to support this design system. These “reference transport conditions” were limited in the project stream but are quite common and visible in many stable and quasi-stable channels in the Coastal Plain. The shape of the rigid streambed and the thickness of sand in the reference sections serve as the criteria for the design of the

restoration reaches. The hydraulics of similar sections associated with the sand beds allows for scaling of the parameters for the restored reaches.

The design channels in Reaches 2 – 4 will be a C5 type with silt/clay banks. The channel will be excavated approximately 0.5-0.7 foot below the finished grade elevation and backfilled with a small gravel/sand bed (0.2 foot gravel/0.3-0.5 foot sand) providing the mechanism for the dune formation. The dunes will serve as the primary resistance in the channel until vegetation establishes. The starter bed will allow for normal dune function immediately following construction and will help to prevent bed degradation and erosion. The design slope associated with the pattern layout has been sized to accommodate the sand transport processes. As has been previously discussed in Section 8.1.1, several rigid structures have also been designed to serve as grade control and compliment the sand channel design.

8.3 Wetland Hydrologic Modifications

The restoration of wetland hydrology will focus on removing the ditch network that drains off all excess surface water and groundwater within the upper horizons. The restoration actions are shown on the Wetland Plan Sheets.

8.3.1 Narrative of Modifications

To restore the wetland, the existing ditch network will be plugged and filled to block water from leaving the site. Ditch plugs will be placed in the four existing ditch outlets. At the downstream end of the wetland site, a rock-stabilized outlet will be installed to prevent the channel from reforming. In addition to blocking the major outlets from the site, KCI will also recreate wetland microtopography. The site will be graded to form small depressions and rises throughout the site that resemble the minor variations in elevation found in a natural wetland system. These modifications will allow precipitation and overland flow to remain on the wetland site. The removal of the ditches will also raise the groundwater level.

8.4 Natural Plant Community Restoration

8.4.1 Stream Riparian Planting

On the restored stream banks, live stakes will be used in conjunction with the native herbaceous seed mix to provide natural stabilization. Appropriate species identified for live staking include:

Silky dogwood	*Cornus amomum*
Black willow	*Salix nigra*
Elderberry	*Sambucus canadensis*

A herbaceous seed mix composed of the appropriate native species will also be developed and used to further stabilize and restore the riparian and bank zones.

Riparian plantings shall consist of native woody species. KCI will plant 436 stems per acre (10 feet by 10 feet spacing) to achieve a mature survivability of 320 stems per acre. Plant placement and groupings will be randomized during installation in order to develop a more naturalized appearance. Woody vegetation planting will be conducted during dormancy. Species to be planted in the floodplain area will consist of at least five of the following:

River birch	*Betula nigra*
Beautyberry	*Callicarpa americana*

Sugarberry	*Celtis laevigata*
Persimmon	*Diospyros virginiana*
Green ash	*Fraxinus pennsylvanica*
Sycamore	*Platanus occidentalis*
Swamp chestnut oak	*Quercus michaux*ii
Willow oak	*Quercus phellos*
Possumhaw viburnum	*Viburnum nudum*

Species to be planted in the riparian area leading up from the floodplain may consist of the following:

Shagbark hickory	*Carya ovata*
Black walnut	*Juglans nigra*
Southern red oak	*Quercus falcata*

8.4.2 Wetland Planting

Plantings shall consist of native species commonly found in Coastal Plain Small Stream Swamp communities and will be planted at a density of 436 trees per acre (10 feet by 10 feet spacing) to achieve a mature survivability of 320 trees per acre. Plant placement and groupings will be randomized during installation in order to develop a more naturalized appearance. Woody vegetation planting will be conducted during dormancy. Tree species to be planted at the wetland site may consist of the following species. Trees from Zone A will be planted in the lowest, wettest areas of the wetland near the former outlet. Species from Zone B will likely cover the largest area and consist of a mixture of obligate and facultative species that will do well in fluctuating water levels. Zone C trees will be planted upper edges of the wetland.

Zone A

Water hickory	*Carya aquatica*	OBL
Green ash	*Fraxinus pennsylvanica*	FACW
Water tupelo	*Nyssa aquatica*	OBL
Bald cypress	*Taxodium distichum*	OBL
Possumhaw viburnum	*Viburnum nudum*	FACW+

Zone B

Green ash	*Fraxinus pennsylvanica*	FACW
Water tupelo	*Nyssa aquatica*	OBL
Laurel oak	*Quercus laurifolia*	FACW
Swamp chestnut oak	*Quercus michauxii*	FACW-
Willow oak	*Quercus phellos*	FACW-
Possumhaw viburnum	*Viburnum nudum*	FACW+

Zone C

Beautyberry	*Callicarpa americana*	FACU-
Laurel oak	*Quercus laurifolia*	FACW
Swamp chestnut oak	*Quercus michauxii*	FACW-
Cherrybark oak	*Quercus pagoda*	FAC+
Willow oak	*Quercus phellos*	FACW-

8.4.3 On-Site Invasive Species Management

Currently, there are no invasive species present at either the stream or wetland restoration sites, because both are under agricultural production. No management actions are anticipated at this time.

9.0 PERFORMANCE CRITERIA

Both the stream and wetland restoration sites will be monitored to evaluate project success. For the stream, monitoring shall consist of the collection and analysis of stream stability and riparian/stream bank vegetation survivability data to support the evaluation of the project in meeting established restoration objectives. Specifically, stream success will be assessed utilizing measurements of stream dimension, pattern, and profile, site photographs, and vegetation sampling. The wetland site will be deemed successful once hydrology is established and vegetation success criteria are met.

9.1 Stream Stability

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

Fourteen permanent cross-sections will be established and used to evaluate stream dimension. One pool and one riffle cross-section each will be installed on Reach 1. Reaches 2, 3, and 4 will have three, four, and five cross-sections, respectively. Permanent monuments will be established by either conventional survey or GPS. 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. Based on these values, sinuosity, meander width ratio, radius of curvature, and meander length/bankfull width ratios will be calculated.

Profile

A total of 3,000 linear feet of profile will be surveyed along the restored stream. Longitudinal profiles will be conducted on 500 linear feet of Reach 1. An additional 2,500 linear feet of profile measurements will be completed along reaches 2, 3, and 4. Measurements will include average water surface slopes for all of the reaches as well as pool and riffle slopes and pool-to-pool spacing for Reach 1. Annual measurements should indicate stable bedform features with little change from the as-built survey.

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
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 log drop structures.

9.2 Stream Riparian Vegetation

KCI will monitor vegetation for five years following the first growing season. The success of the riparian buffer plantings will be evaluated using eighteen (2% of the total buffer area) ten by ten meter vegetative sampling plots. The corners of each monitoring plot will be permanently marked in the field. Data will be collected at each plot for: total number of stems, species, percent survival, height, estimated percent cover of all species, and evidence of insects, disease or browsing. Additionally, a photograph will be taken of each plot and 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 such as controlling invasive species, removing dead/dying plants and replanting will be undertaken. Non-target species must not constitute more than 20% of the woody vegetation based on permanent monitoring plots.

9.3 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 project wetland. Within the restoration area, four automatic recording gauges will be established to cover a density of one automatic well per four acres. Daily data will be collected from the automatic gauges over the 5-year monitoring period following wetland construction.

Wetland hydrology will be considered established if well data from the site indicate that groundwater is within 12 inches of the soil surface for 5% of the growing season during normal weather conditions. The growing season was taken from COOP Station 318500, which is located in Tarboro in Edgecombe County. 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 Edgecombe County extends from March 21 to November 11 for a total of 235 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 of the soil surface for 12 consecutive days or more during the growing season.

9.4 Wetland Vegetation

The success criteria for the planted species in the wetland restoration area will be based on survival and growth. Beginning at the end of the first growing season, KCI will monitor vegetation for five years following the planting.

Twelve permanent monitoring plots measuring ten by ten meters will be established in the wetland restoration area ensuring a 2% monitoring coverage of the total restoration acreage. Plots will be systematically located to ensure even placement. Data will be collected at each plot for: total number of stems, species, percent survival, height, estimated percent cover of all species, and evidence of insects, disease or browsing. Survival of planted species must be 320 stems/acre at the end of five years of monitoring. Non-target species must not constitute more than 20% of the woody vegetation based on permanent monitoring plots. Management actions such as controlling invasive species, removing dead/dying plants and replanting will be undertaken as necessary.

9.5 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 years.

Annual monitoring reports will be prepared and submitted after all monitoring tasks for each year are completed. The report will document the monitored components of the restoration plan (hydrology and vegetation) and include all collected data, analyses, and photographs. Each report will provide the new monitoring data and compare the most recent results against previous findings. The monitoring report format will be similar to that set out in the most recent EEP monitoring protocol.

Variations from the designed stream and wetland can be anticipated due to unknown site conditions, inputs from outside the restoration site, regional climatic variations, or acts of God, etc. Regular management activities will be implemented as necessary to ensure that the goals and objectives of the project are met. These activities will be conducted throughout the year and may include invasive species control or other management activities. If the monitoring identifies failures in the project site, a remedial action plan will be developed to investigate the causes of the failure and propose actions to rectify the problem.

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Tables

Table 1. Project Restoration Structure and Objectives
Harrell Stream Restoration

Reach	Station Range	Restoration Type	Priority Approach	Existing Linear Footage	Designed Linear Footage	Comments
Reach 1	10+00 - 22+65	Restoration	P3	1,224	1,265	Connects to downstream crossing and culvert
Reach 2	22+65 - 37+30	Restoration	P2	1,389	1,465	Connects to upstream crossing and culvert
Reach 3	37+30 - 52+90	Restoration	P2	1,231	1,560	Begins where large ditch enters the stream and ends at downstream crossing and culvert
Reach 4	52+90 - 79+87	Restoration	P2	2,494	2,697	Connects to upstream crossing and culvert

Table 2. Drainage Areas
Harrell Stream Restoration

Reach	Drainage Area (acres)
Reach 1 (Beginning to first road crossing)	125.9
Reach 2 (First road crossing to confluence with major ditch)	147.1
Reach 3 (From confluence with major ditch to second road crossing)	271.3
Reach 4 (From second road crossing to end of project)	387.2

Table 3. Land Use of Watershed
Harrell Stream and Wetland Restoration

Land Use	Acreage	Percentage of Watershed
Agriculture	419.9	94.6%
Forest	18.7	4.2%
Rangeland	5.3	1.2%
Wetland	0.2	0.0%

Table 4. Morphological Design Criteria

Variables		EXISTING				Ref. Reach Mitchell River HW	Ref. Reach North Prong Creek	PROPOSED			
		UTSC1	UTSC2	UTSC3	UTSC4			UTSC 1	UTSC 2	UTSC 3	UTSC 4
Rosgen Stream Type		E5	E5	E5	E5	B4c	C5	B5c	C5	C5	C5
Drainage Area (mi^2)		0.197	0.230	0.424	0.605	6.0	3.04	0.197	0.229	0.424	0.605
Bankfull Width (W_{bkf}) (ft)		5.4	6.1	7.6	9.5	29.2-35.0	17.8	10	10	12	13.4
Bankfull Mean Depth (d_{bkf}) (ft)		1.3	1.3	1.6	1.5	2.0-2.1	1.5	0.9	1.1	1.4	1.6
Bankfull Cross Sectional Area (A_{bkf}) (ft^2)		7.3	7.8	11.6	13.8	62.5-68.8	26.2	9.1	11.2	16.8	21.6
Width/depth Ratio (W_{bkf}/d_{bkf})		4.1	4.8	5.0	7.0	13.9-17.5	12.1	11.1	9.1*	8.6*	8.4*
Maximum Depth (d_{mbkf}) (ft)		2.0	1.9	2.7	2.5	2.7-2.8	3.0	1.4	1.6	2.0	2.3
Width of Flood Prone Area (W_{fpa}) (ft)		>70	>70	>70	>60	44-64	600+	18+	30+	30+	30+
Entrenchment Ratio (ER)		13.0	11.1	9.5	7.2	1.3-2.2	33.7	1.8+	3.0+	2.5+	2.2+
Water Surface Slope (S) (ft/ft)		0.004	0.007	0.006	0.0023	0.0084	0.0024	0.0067	0.0023	0.0023	0.0023
Sinuosity (stream length/valley length) (K)		1**	1**	1**	1**	1.1	1.28	1.03	1.05	1.27	1.08
Dimension	Pool Depth (ft)	**	**	**	**	2.7	***	1.5	***	***	***
	Riffle Depth (ft)	**	**	**	**	0.9-1.2	***	0.9	***	***	***
	Pool Width (ft)	**	**	**	**	27	***	11	***	***	***
	Riffle Width (ft)	**	**	**	**	8.7-12.3	***	10	***	***	***
	Pool XS Area (sf)	**	**	**	**	72.5	***	16	***	***	***
	Riffle XS Area (sf)	**	**	**	**	62.5-68.8	***	9.1	***	***	***
	Pool Depth/Mean Riffle Depth	**	**	**	**	1.3-1.4	***	1.7	***	***	***
	Pool Width/Riffle Width	**	**	**	**	0.9	***	1.1	***	***	***
	Pool Area/Riffle Area	**	**	**	**	1.1	***	1.8	***	***	***
	Max pool depth/d_{bkf}	**	**	**	**	2.0-3.5	***	2.7	***	***	***
	Low Bank Height/ d_{mbkf}	2.74	2.30	2.64	1.69	-	3.0	1	1	1	1
	Mean Bankfull Velocity (V) (fps)	3.27	3.97	3.96	2.20	3.2-5.3	3.1	3.3	2.7	2.7	3.2
	Bankfull Discharge (Q) (cfs)	24	31	44-51	20-31	280	83	25-30	25-30	40-45	65-70
Pattern	Meander length (L_m) (ft)	**	**	**	**	140-500	94-143	50-200	100-200	120-240	130-260
	Radius of Curvature (R_c) (ft)	**	**	**	**	70-220	37-40	30-80	30-50	40-60	40-70
	Belt Width (W_{blt}) (ft)	**	**	**	**	100-400	158	45-65	45-60	60-100	50-90
	Meander Width Ratio	**	**	**	**	3.0-14.0	8.9	4-10	4-10	4-10	4-10
	R_c/ W_{bkf} Ratio	**	**	**	**	2.0-7.5	2.1-2.3	3-8	3-5	3-5	3-5
	L_m / W_{bkf} Ratio	**	**	**	**	4.0-17.1	5.3-8.0	5-20	10-20	10-20	10-20
Profile	Valley Slope	0.004	0.003	0.002	0.0014	0.009	0.0023	0.0069	0.0024	0.0029	0.0025
	Average Water Surface Slope	0.004	0.007+	0.006+	0.0023+	0.0084	0.0024	0.0067	0.0023	0.0023	0.0023
	Riffle Slope	**	**	**	**	0.007-0.027	***	0.0085	***	***	***
	Pool Slope	**	**	**	**	0.0-0.003	***	0.003	***	***	***
	Pool to Pool Spacing	**	**	**	**	115-400	***	74-228	***	***	***
	Pool Length	**	**	**	**	-	***	26-60	***	***	***
	Riffle Slope/Avg WS Slope	**	**	**	**	0.8-3.2	***	1.27	***	***	***
	Pool Slope/ Avg WS Slope	**	**	**	**	0.01-0.3	***	0.45	***	***	***
	Pool Length/ W_{bkf}	**	**	**	**	-	***	2.6-6.0	***	***	***
	Pool to Pool Spacing/W_{bkf}	**	**	**	**	1.5-3.8	***	7.4-22.8	***	***	***

* The width/depth ratio is lower than that typical of a C type stream, but the channel has been designed with greater depth to accommodate the formation of a dune/anti-dune sand system.
** The existing stream has been channelized and does not have a natural meander pattern with distinct pool and riffle features.
*** Sand streams are not characterized by riffle and pool features, but rather by a dune/anti-dune system.
\+ Stream slope exceeds valley slope in reaches that are experiencing base lowering more rapidly than the existing valley gradient.

Figures

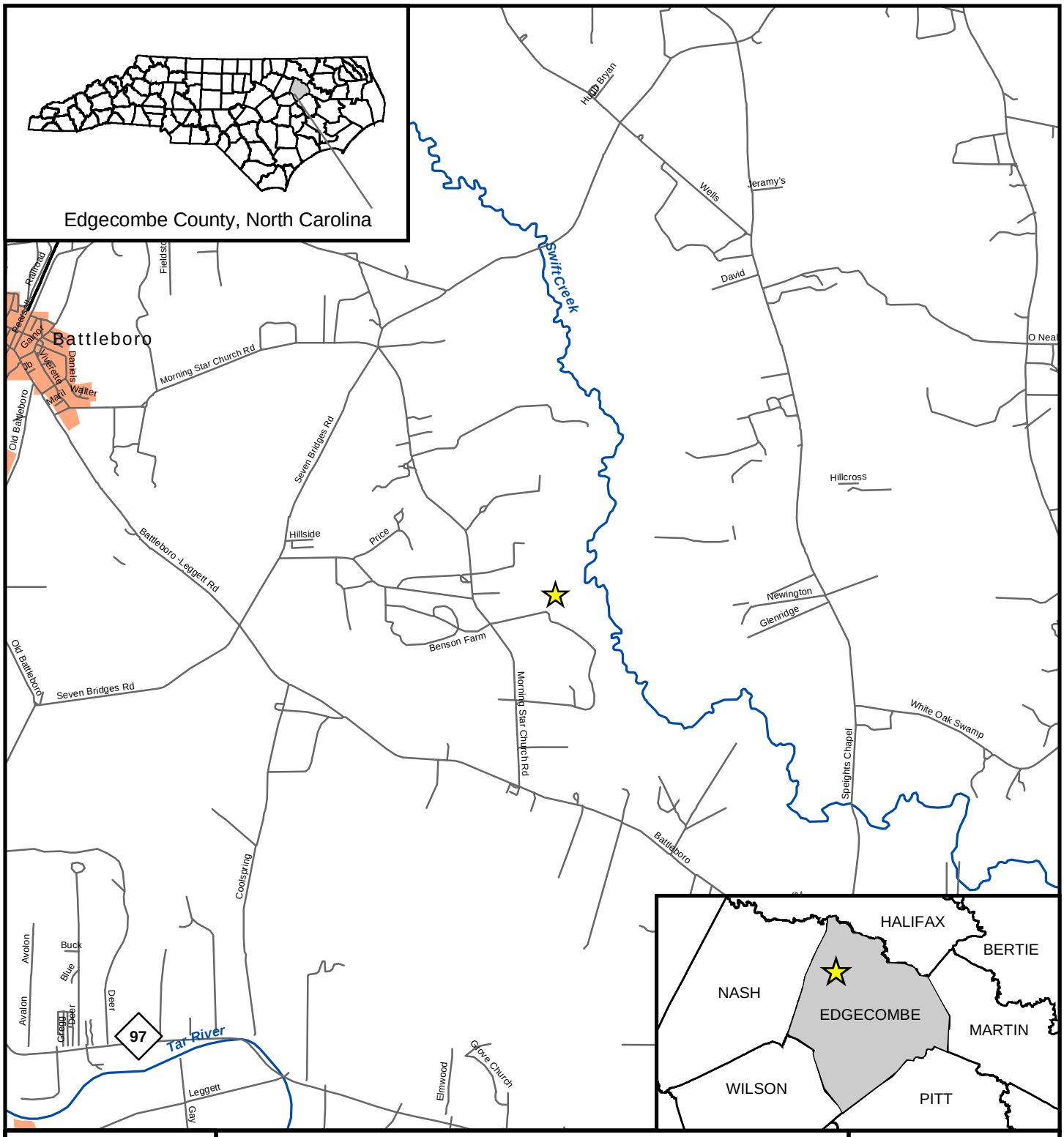

Figure 1. Vicinity Map

KCI TECHNOLOGIES

KCI ASSOCIATES OF NC

ENVIRONMENTAL TECHNOLOGIES AND CONSTRUCTION, INC.

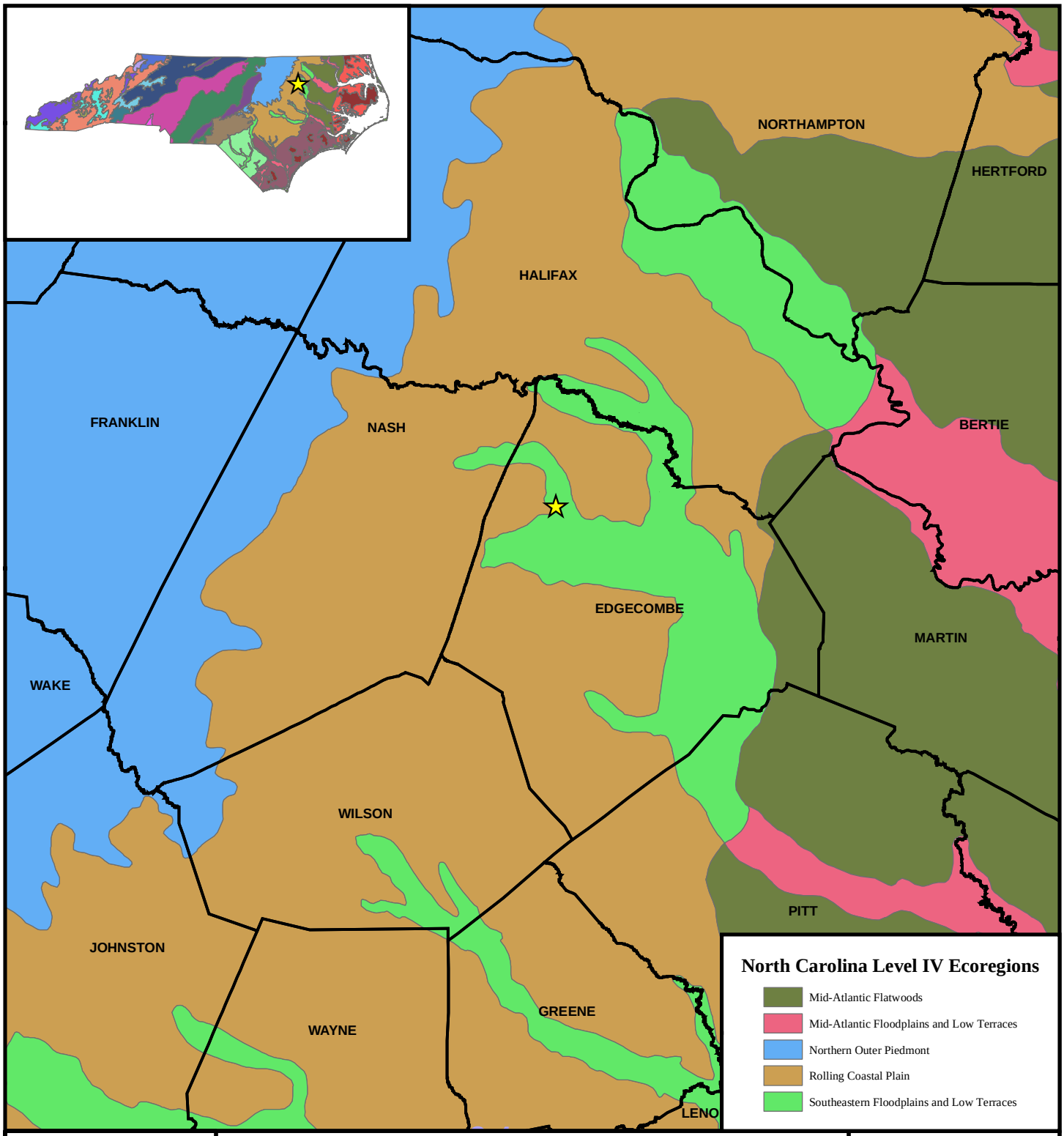

Figure 2. North Carolina Ecoregions

Site Location

County Boundaries

N
W E
S

1:633,600

1 inch equals 10 miles

10 5 0 10 Miles

KCI TECHNOLOGIES

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ENVIRONMENTAL TECHNOLOGIES AND CONSTRUCTION, INC.

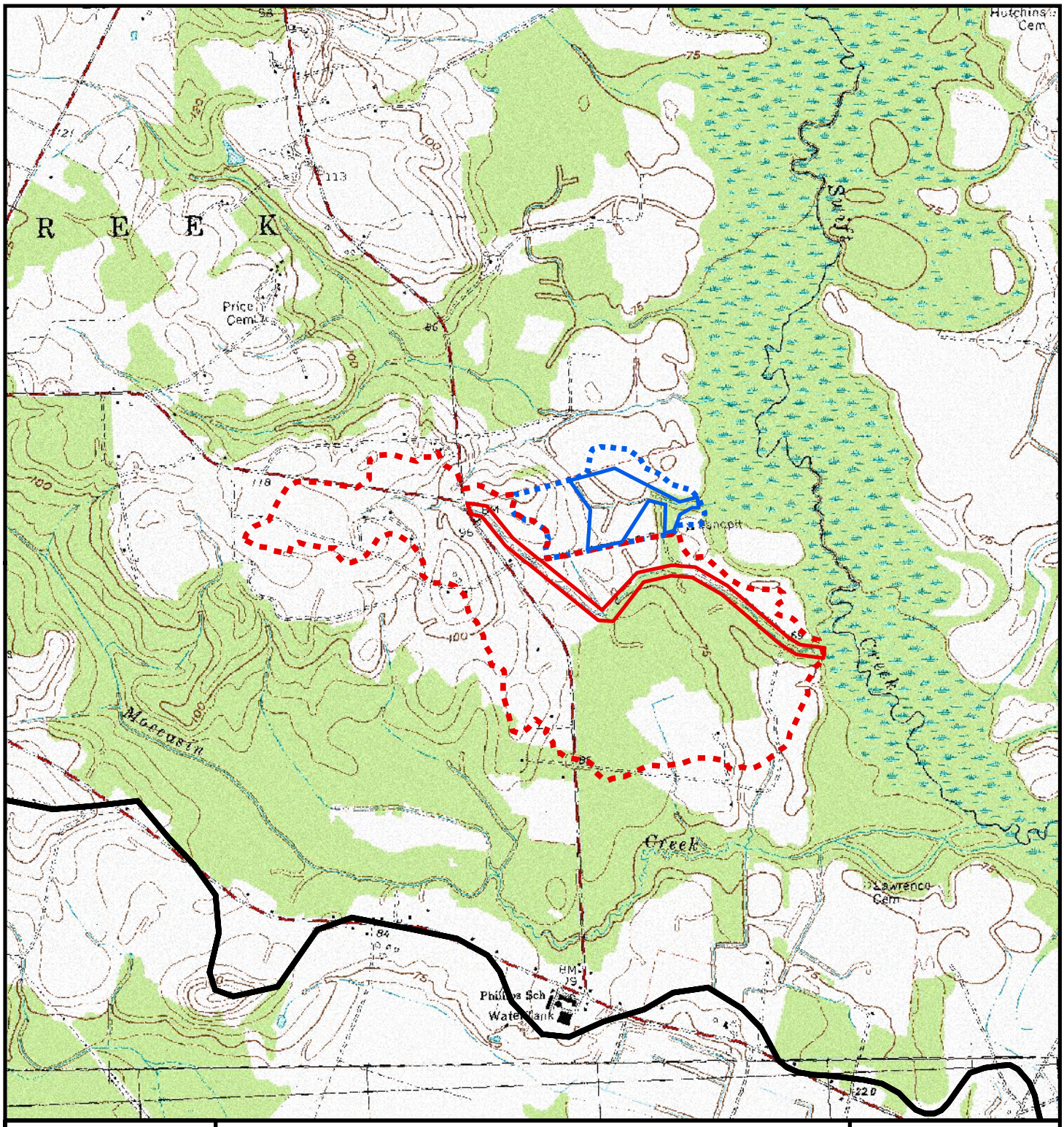
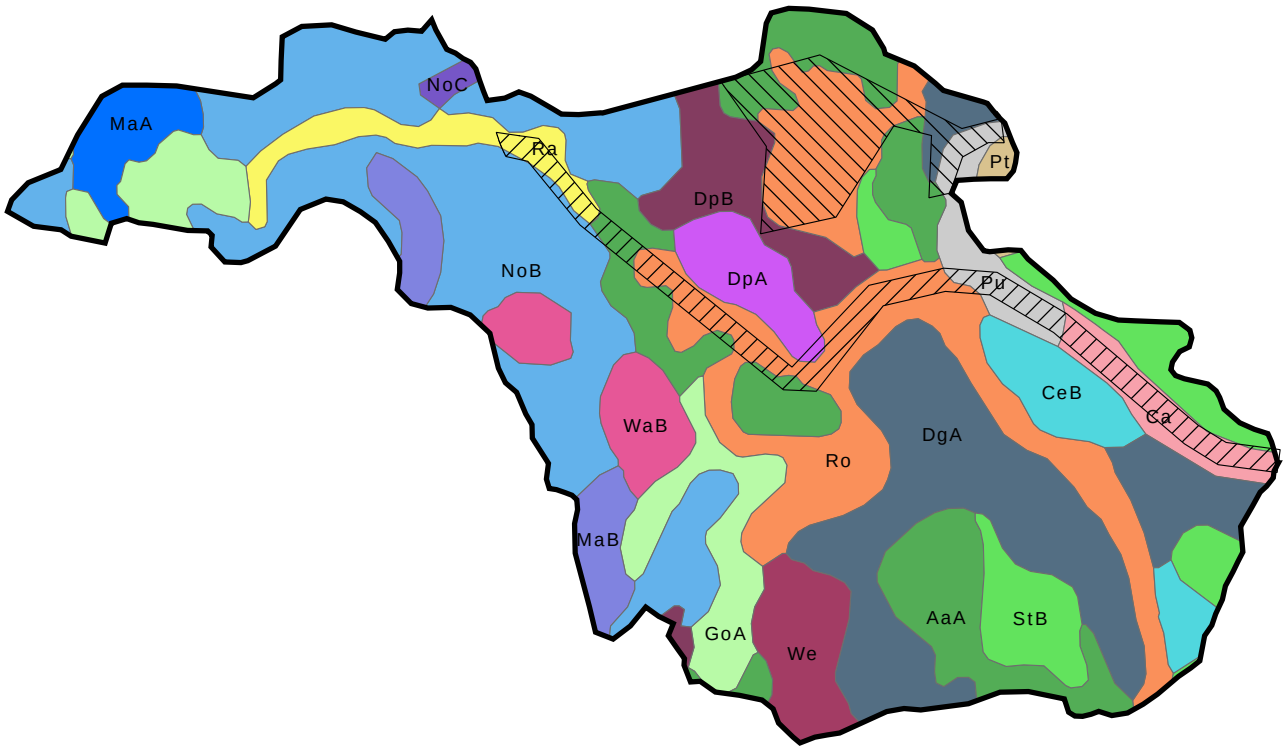


Figure 3. Project Site Watershed



Soil Series

- AaA - Altavista Fine Sandy Loam, 0 To 3 Percent Slopes
- Ca - Cape Fear Loam
- CeB - Conetoe Loamy Sand, 0 To 4 Percent Slopes
- DgA - Dogue Fine Sandy Loam, 0 To 3 Percent Slopes
- DpA - Duplin Sandy Loam, 0 To 2 Percent Slopes
- DpB - Duplin Sandy Loam, 2 To 5 Percent Slopes
- GoA - Goldsboro Fine Sandy Loam, 0 To 2 Percent Slopes
- MaA - Marlboro Sandy Loam, 0 To 2 Percent Slopes
- MaB - Marlboro Sandy Loam, 2 To 6 Percent Slopes
- NoB - Norfolk Loamy Sand, 2 To 6 Percent Slopes
- NoC - Norfolk Loamy Sand, 6 To 10 Percent Slopes
- Pt - Pits
- Pu - Portsmouth Fine Sandy Loam
- Ra - Rains Fine Sandy Loam
- Ro - Roanoke Loam
- StB - State Loamy Sand, 0 To 4 Percent Slopes
- WaB - Wagram Loamy Sand, 0 To 6 Percent Slopes
- We - Wahee Fine Sandy Loam

KCI TECHNOLOGIES

Figure 4. Project Site NRCS Soil Survey

- Stream Project Boundary
- Wetland Project Boundary
- Project Watershed

N
W E
S

1:15,000

1 inch equals 1,250 feet

1,250 625 0 1,250 Feet

Source: Soil Survey of Edgecombe County, USDA SCS 1979

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ENVIRONMENTAL TECHNOLOGIES AND CONSTRUCTION, INC.

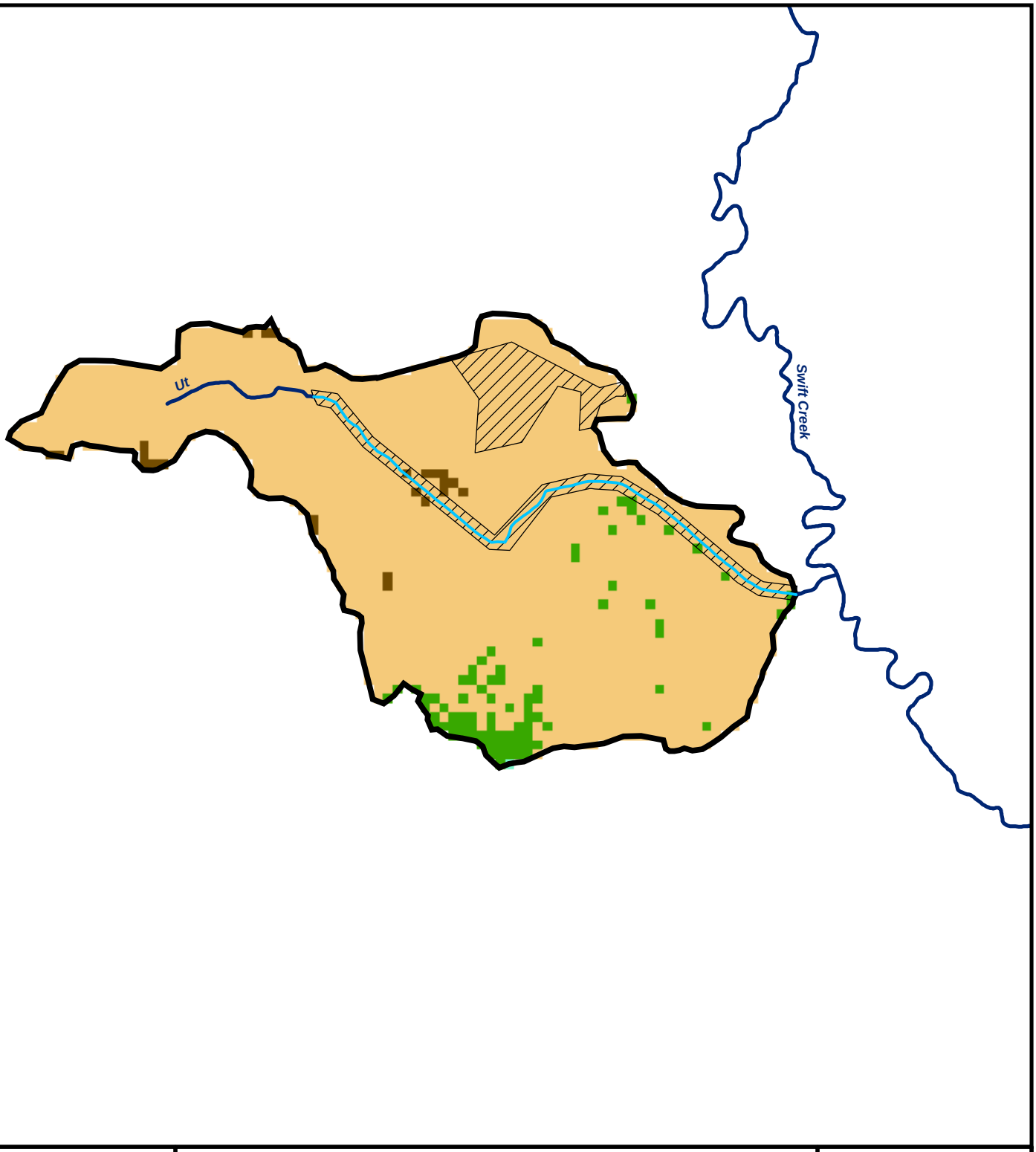

Figure 5. Project Watershed Land Use

Agriculture
Rangeland
Forest
Wetland
Project Watershed
Project Site Boundary
Project Stream
Other Streams

N
W
E
S

1:18,000
1 inch equals 1,500 feet
1,500 750 0 1,500 Feet

Source: NC GAP Land Cover Dataset Using Anderson I Classification

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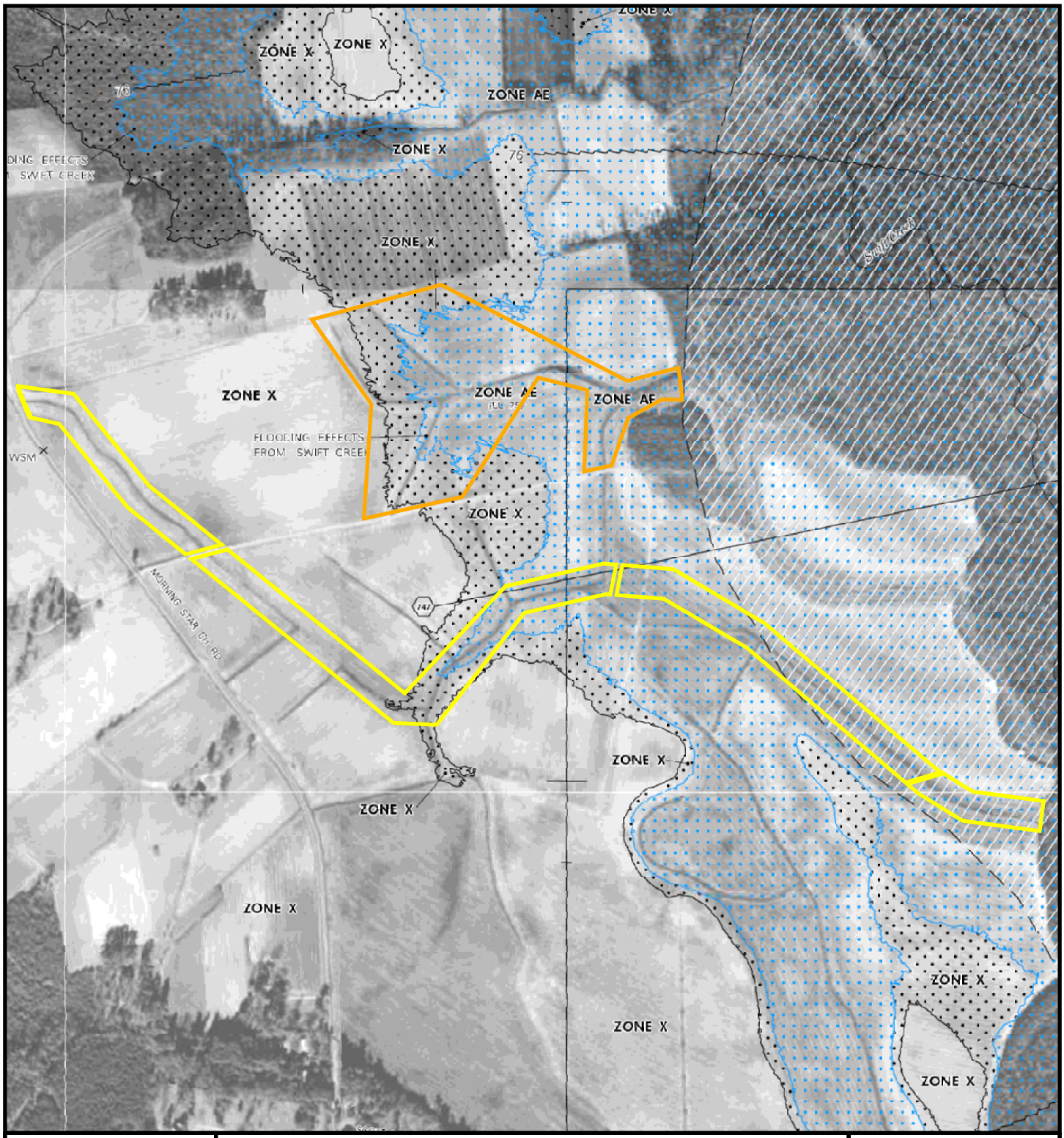

Figure 6. Project Site Floodplain Map

Special Flood Hazard Area
(Subject to inundation by the 1% annual chance flood)

Floodway Areas in Zone AE

Stream Project Boundary

Wetland Project Boundary

Zone X
(Area of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood)

N
W E
S

1:8,400
1 inch equals 700 feet

700 350 0 700 Feet

Source: FEMA Panels 3882, 3883, 3892, and 3893

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Figure 7. Existing Hydrologic Conditions

- Project Stream
- Ditch
- Other Streams
- Crossing
- I-beam Crossing
- Irrigation Line
- Stream Gauge
- Cross-Section (XS)
- Stream Profile (P)
- Drained Hydric Soils (15.0 acres)
- Project Site Boundary

N W E S

1:8,400
1 inch equals 700 feet

700 350 0 700 Feet

Image Source: Edgecombe County GIS, 2002

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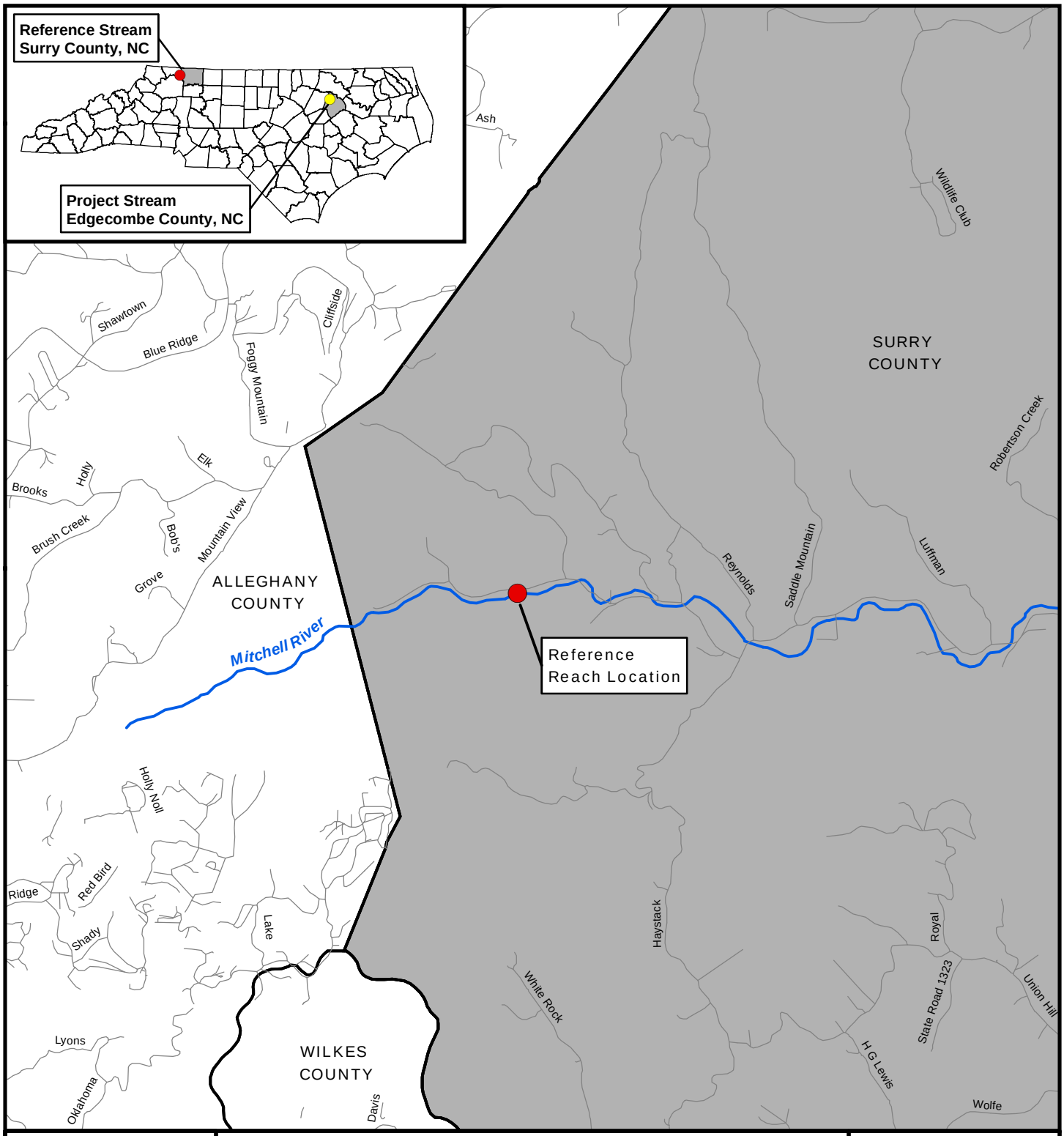

Figure 8. Reference Reach Vicinity Map (Mitchell River)

- Reference Reach
- Project Location
- Roads
- Major Streams and Rivers
- County Boundaries
- Surry County

1:63,360

1 inch equals 1 miles

1 0.5 0 1 Miles

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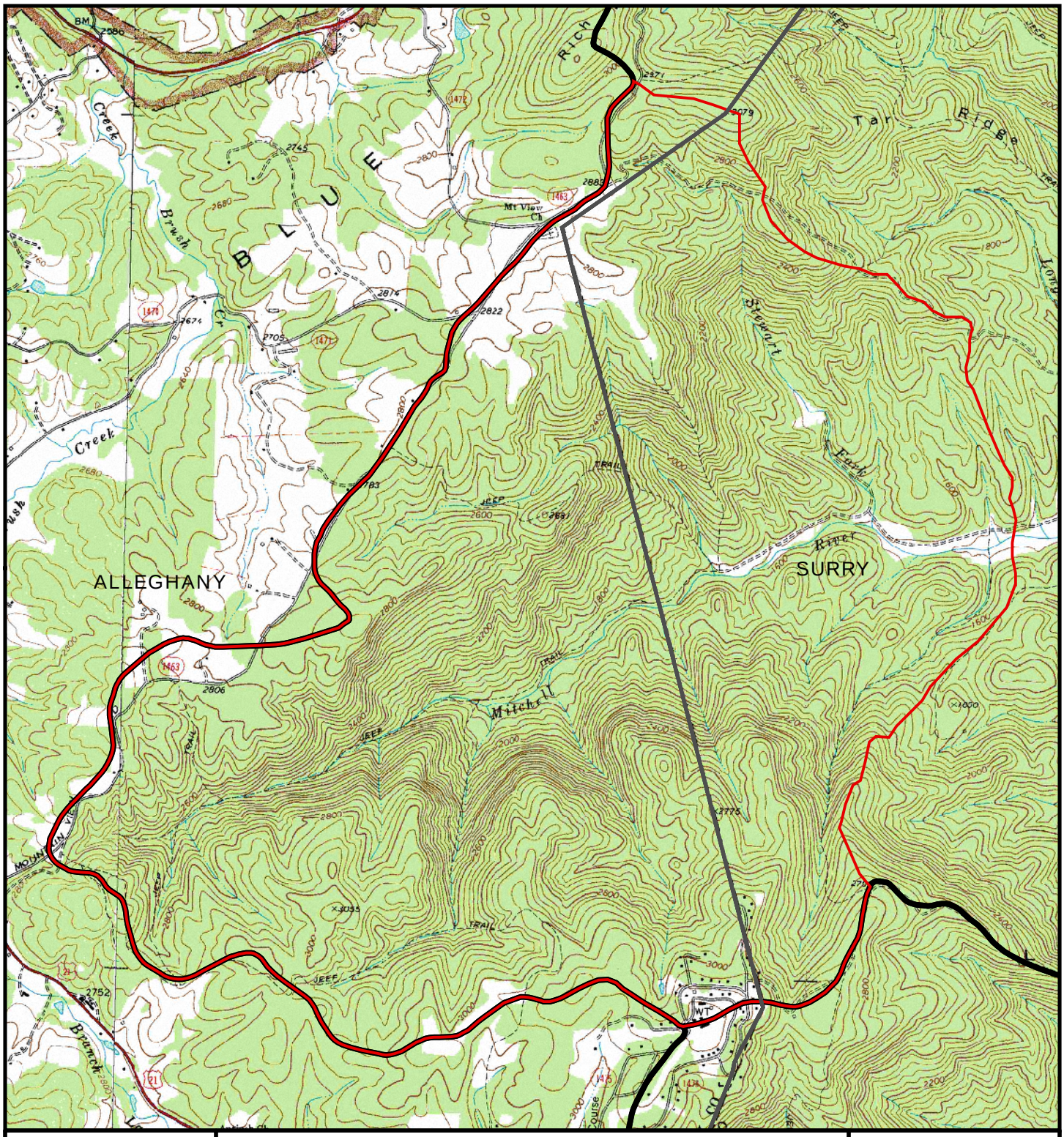

Figure 9. Reference Reach Watershed (Mitchell River)

Project Watershed

14-digit HUC boundaries

N
W E
S

1:30,000

1 inch equals 2,500 feet

2,500 1,250 0 2,500 Feet

Source: USGS Topographic Quadrangles, Glade Valley (1968) and Roaring Gap (1971)

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ENVIRONMENTAL TECHNOLOGIES AND CONSTRUCTION, INC.

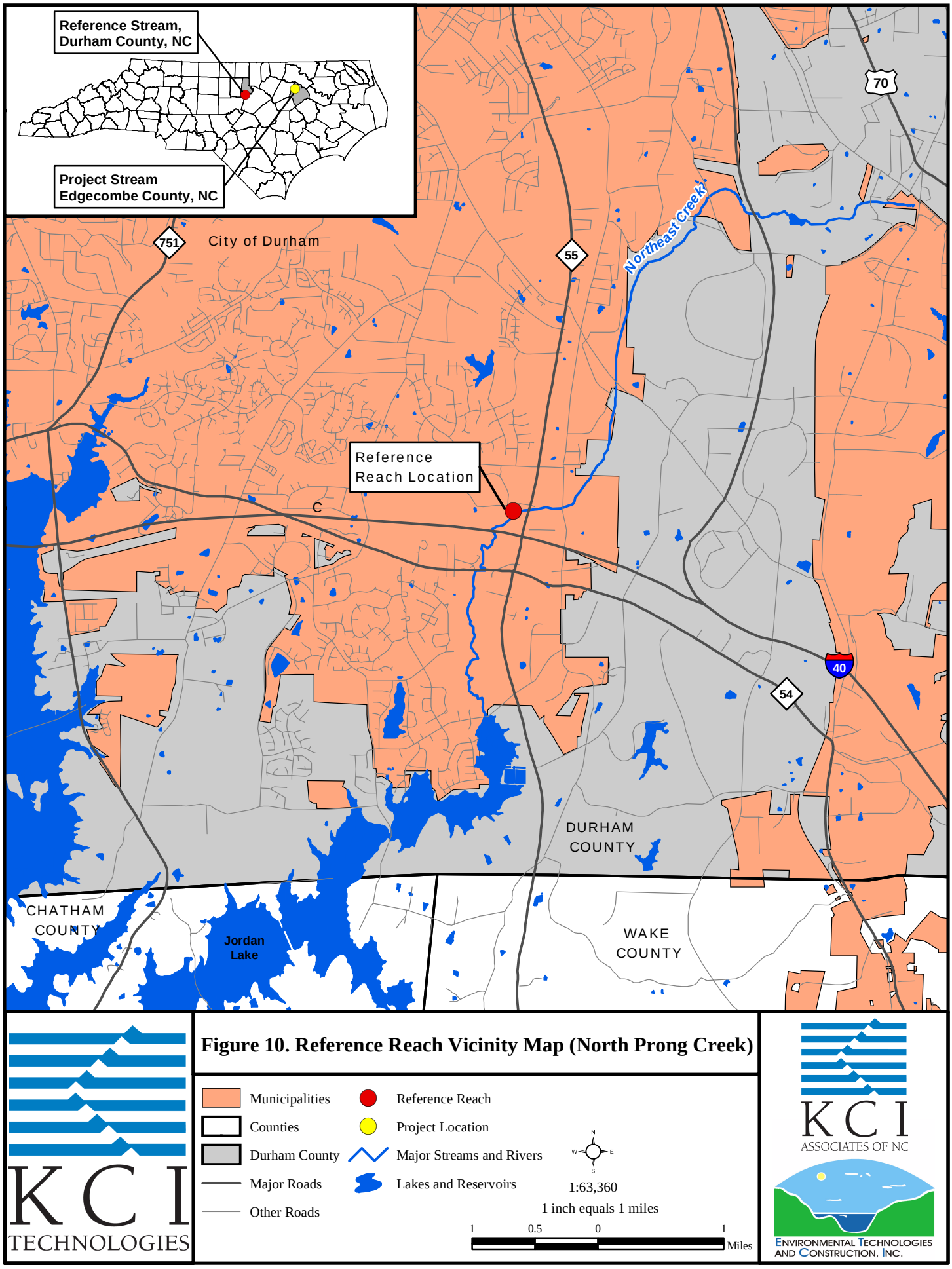

Figure 10. Reference Reach Vicinity Map (North Prong Creek)

Municipalities
Counties
Durham County
Major Roads
Other Roads
Reference Reach
Project Location
Major Streams and Rivers
Lakes and Reservoirs

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

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ENVIRONMENTAL TECHNOLOGIES AND CONSTRUCTION, INC.

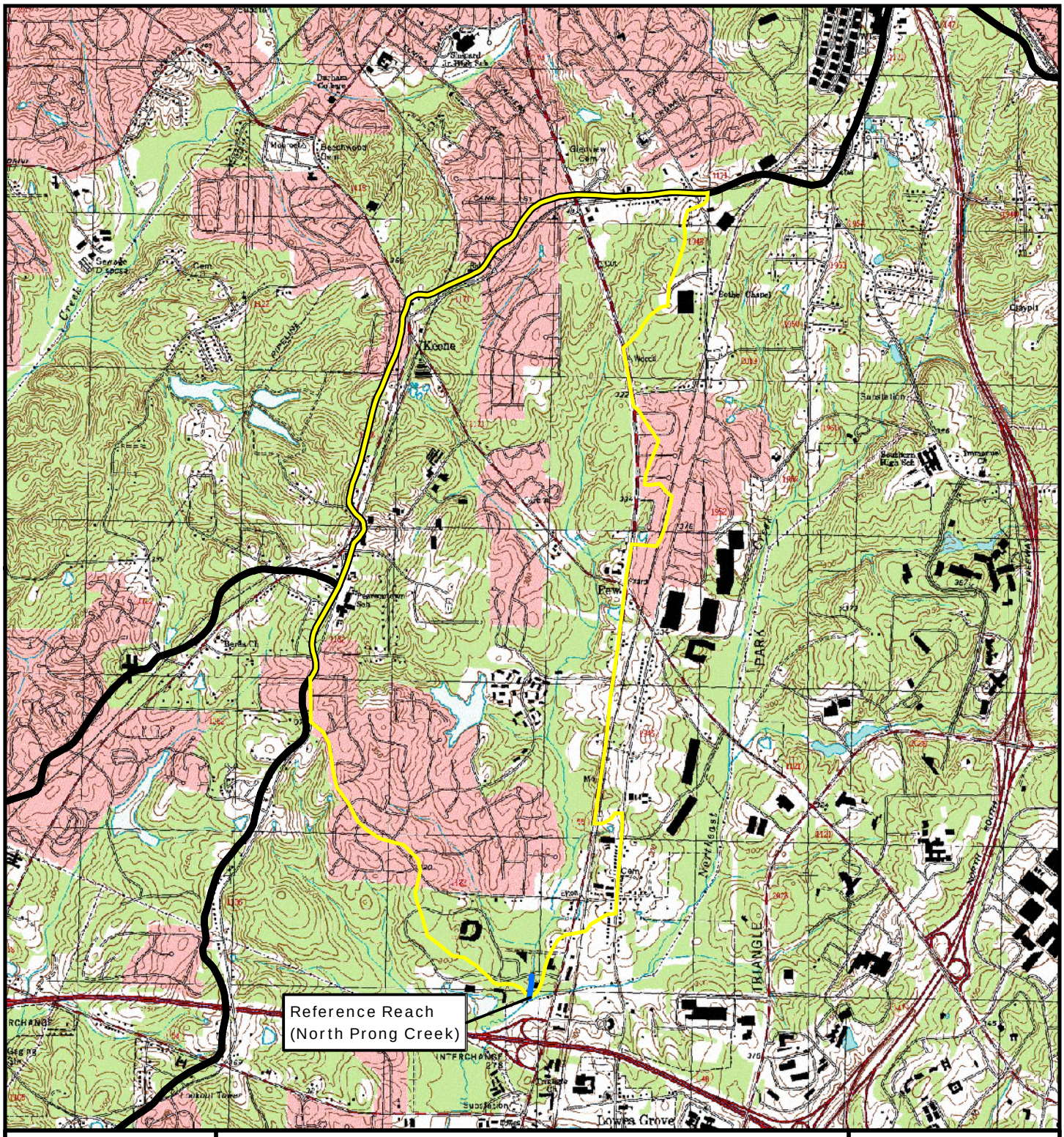


Figure 11. Reference Reach Watershed (North Prong Creek)

Reference Reach Watershed Boundary

14-digit HUC Boundaries

1:36,000
1 inch equals 3,000 feet

3,000 1,500 0 3,000 Feet

Source: USGS Topographic Quadrangle, Southwest Durham 1981

KCI TECHNOLOGIES

KCI ASSOCIATES OF NC

ENVIRONMENTAL TECHNOLOGIES AND CONSTRUCTION, INC.

Stream Plan Sheets

CONTRACT #: D05025-1

KCI JOB# : 12054239

STATE OF NORTH CAROLINA
ECOSYSTEM ENHANCEMENT PROGRAM

STATE	CONTRACT NUMBER	SHEET NO.	TOTAL SHEETS
N.C.	D05025-1	1	28

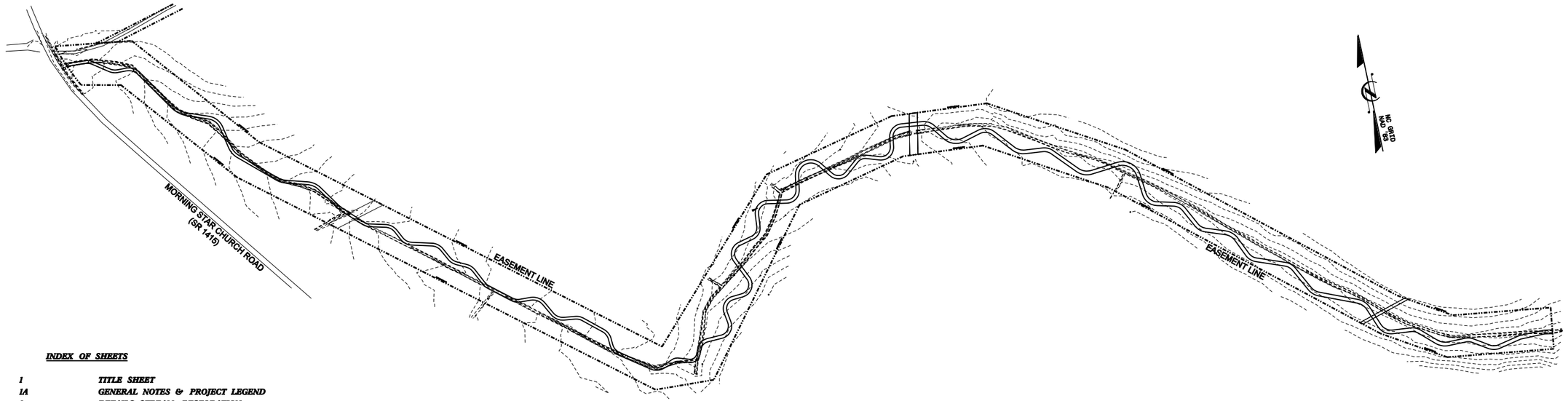
SYM.	DESCRIPTION	DATE	APPROVED
A	SUBMITTED WITH RESTORATION PLAN	MAR 2007	
B	REVISED PER LAND QUALITY COMMENTS	APRIL 2007	
C	REVISED PER DWQ COMMENTS	APRIL 2007	
	REVISIONS		

EDGECOMBE COUNTY

LOCATION: HARRELL SITE
MORNING STAR CHURCH ROAD
EDGECOMBE CO., NORTH CAROLINA

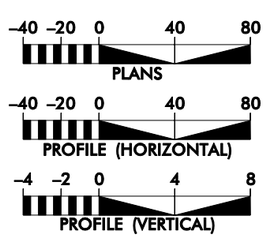
TYPE OF WORK: STREAM RESTORATION SITE

VICINITY MAP
NOT TO SCALE



INDEX OF SHEETS

GRAPHIC SCALES



PROJECT LENGTH

STREAM RESTORATION LENGTH = 6,987 FEET

PROJECT TOTAL AREA OF DISTURBANCE = 28 ACRES

Prepared In the Office of:

KCI ASSOCIATES OF NC
ENGINEERS•PLANNERS•ECOLOGISTS
SUITE 220 LANDMARK CENTER II
4601 SIX FORKS RD., RALEIGH, NC

GARY M. MRYNCZA, P.E., P.H.
PROJECT ENGINEER

ADAM SPILLER / ALEX FRENCH
NATURAL CHANNEL DESIGN

PROJECT ENGINEER

SIGNATURE: ***P.E.***

Prepared for:

Ecosystem Enhancement PROGRAM

GUY PEARCE
CONTRACT ADMINISTRATOR

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 GPS CONTROL POINTS.

GPS#4	N = 828,606.509	E = 2,390,243.341	ELEV.= 70.590′
GPS#21	N = 827,964.785	E = 2,385,803.660	ELEV.= 105.530′

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

Proposed Channel Block

Proposed Riffle Grade Control

Proposed Log Drop

Stabilized Rock Outlet

GENERAL

Existing Woods Line

Minor Contour Line

Major Contour Line (720)

SEDIMENT & EROSION CONTROL

Stabilized Construction Entrance (SCE)

Silt Fence (SF)

Limits of Disturbance (LOD)

Rock Silt Screen (Std. Drawing 1636.01)

Temporary Stream Crossing

Silt Fence Rock Outlet

A	SUBMITTED WITH RESTORATION PLAN	MAR 2007	
C	REVISED PER DWQ COMMENTS	APRIL 2007	
SYM.	DESCRIPTION	DATE	APPROVED

REVISIONS

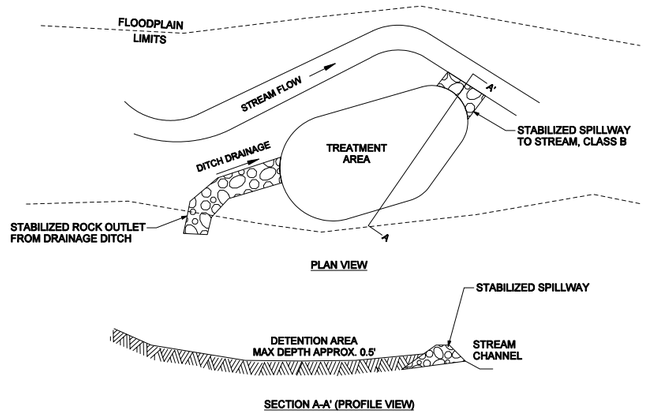
Ecosystem Enhancement Program

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

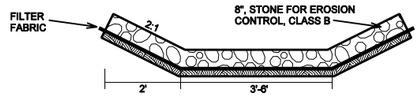
HARRELL SITE
STREAM RESTORATION PROJECT
EDGECOMBE CO., NORTH CAROLINA

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

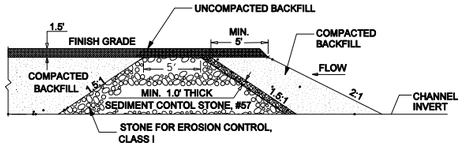
GENERAL NOTES & PROJECT LEGEND



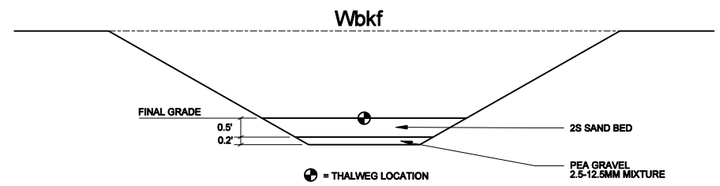
WATER QUALITY TREATMENT AREA
SCALE: NTS



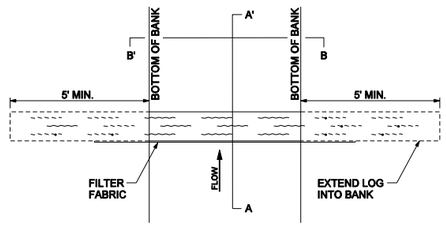
STABILIZED ROCK OUTLET
SCALE: NTS



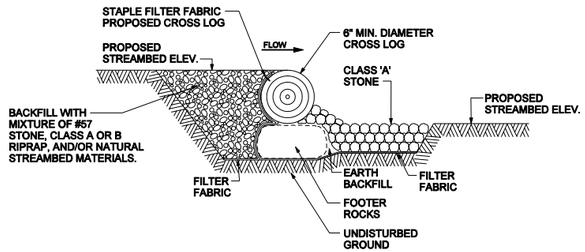
CHANNEL BLOCK
SCALE: NTS



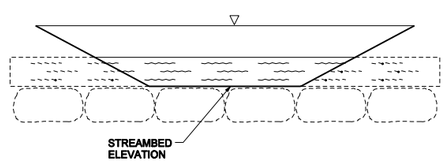
BED MATERIALS - PROPOSED CHANNEL
SCALE: NTS



PLAN VIEW



SECTION B-B' (PROFILE VIEW)



SECTION A-A' (CROSS SECTION VIEW)

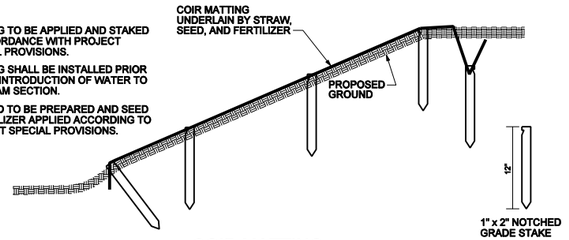
LOG DROP DETAIL
SCALE: NTS

NOTES:

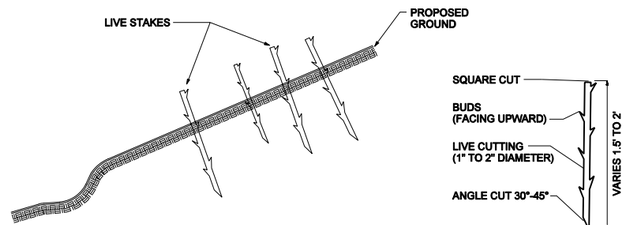
-MATTING TO BE APPLIED AND STAKED IN ACCORDANCE WITH PROJECT SPECIAL PROVISIONS.

-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.

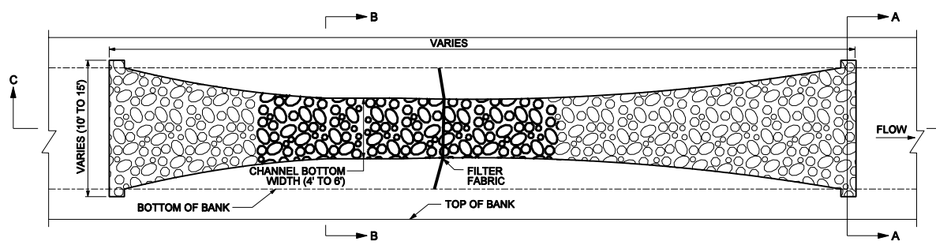


COIR MATTING
SCALE: NTS

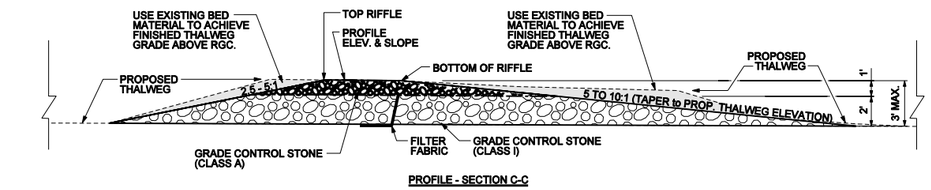


NOTE: LIVE STAKES TO BE INSTALLED IN ACCORDANCE WITH PROJECT SPECIAL PROVISIONS AND AS DIRECTED BY THE ENGINEER.

LIVE STAKES
SCALE: NTS

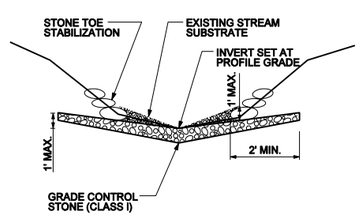


PLAN VIEW

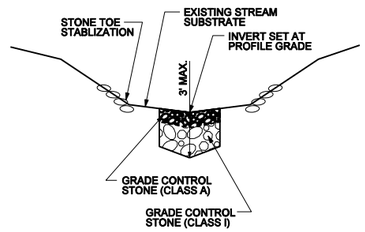


PROFILE - SECTION C-C

RIFFLE GRADE CONTROL
SCALE: NTS



SECTION A-A



SECTION B-B

A	SUBMITTED WITH RESTORATION PLAN	MAR 2007			
B	REVISED PER LAND QUALITY COMMENTS	APRIL 2007			
			STM.	DATE	APPROVED
				DESCRIPTION	

REVISIONS

Ecosystem Enhancement Program

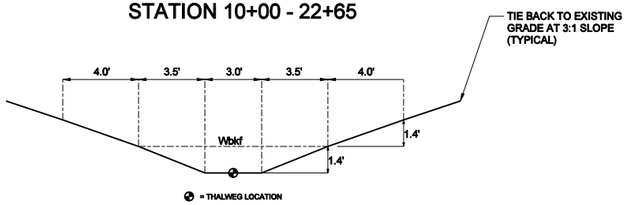
KCI ASSOCIATES OF NC
ENGINEERS • PLANNERS • SCIENTISTS
4601 SIX FORKS ROAD
RALEIGH, NORTH CAROLINA 27609

HARRELL SITE
STREAM RESTORATION PROJECT
EDGECOMBE CO., NORTH CAROLINA

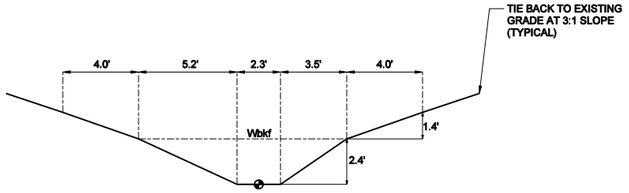
DATE: APRIL 2007
SCALE:

DETAILS: STREAM RESTORATION

HARRELL STREAM RESTORATION
TYPICAL CROSS-SECTION
"Bc" STREAM TYPE
REACH 1
STATION 10+00 - 22+65

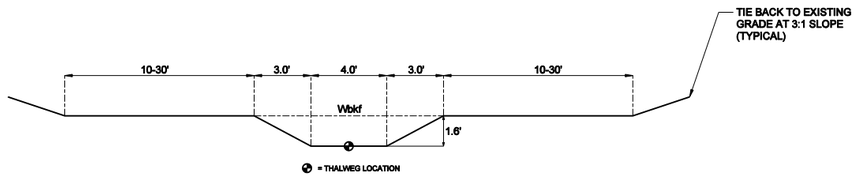


TYPICAL RIFFLE

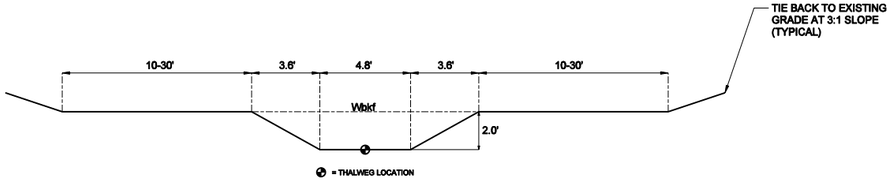


TYPICAL POOL - RIGHT MEANDER

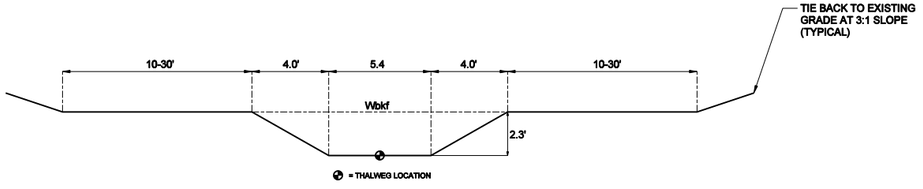
HARRELL STREAM RESTORATION
TYPICAL CROSS-SECTION
"C" STREAM TYPE
REACH 2
STATION 22+65 - 37+30

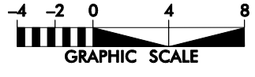


HARRELL STREAM RESTORATION
TYPICAL CROSS-SECTION
"C" STREAM TYPE
REACH 3
STATION 37+30 - 52+90



HARRELL STREAM RESTORATION
TYPICAL CROSS-SECTION
"C" STREAM TYPE
REACH 4
STATION 52+90 - 79+87





REVISIONS			
DESCRIPTION	DATE	APPROVED
A SUBMITTED WITH RESTORATION PLAN	MAR 2007	

Ecosystem Enhancement Program

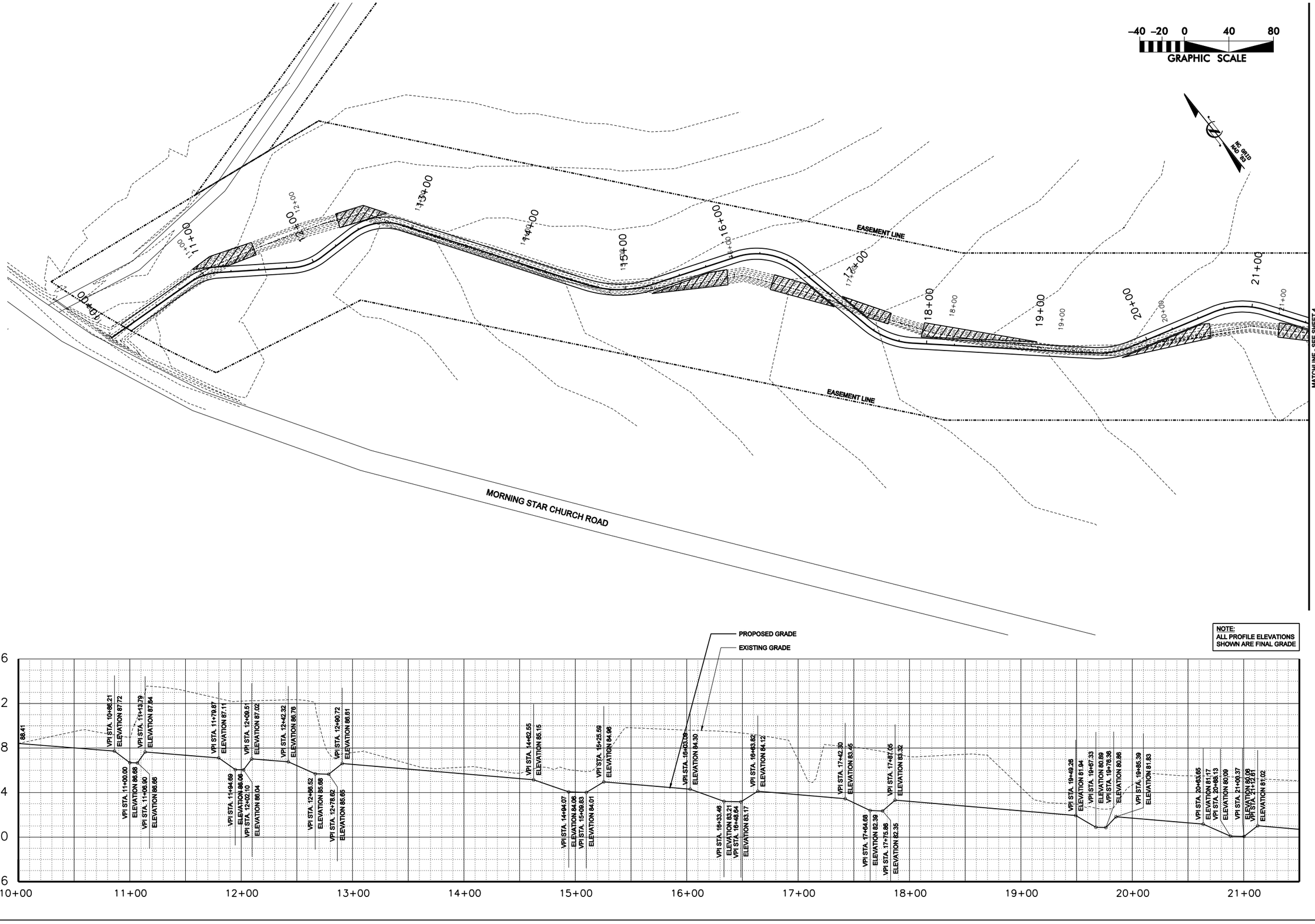
KCI ASSOCIATES OF NC
ENGINEERS • PLANNERS • SCIENTISTS
4601 SW FORKS ROAD
RALEIGH, NORTH CAROLINA 27609

HARRELL SITE
STREAM RESTORATION PROJECT
EDGECOMBE CO., NORTH CAROLINA

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

DETAILS:
TYPICAL XS

SHEET 2A OF 26



A	SUBMITTED WITH RESTORATION PLAN		MAR 2007	
SYM.	DESCRIPTION		DATE	APPROVED

REVISIONS

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RALEIGH, NORTH CAROLINA 27609

HARRELL SITE
STREAM RESTORATION PROJECT

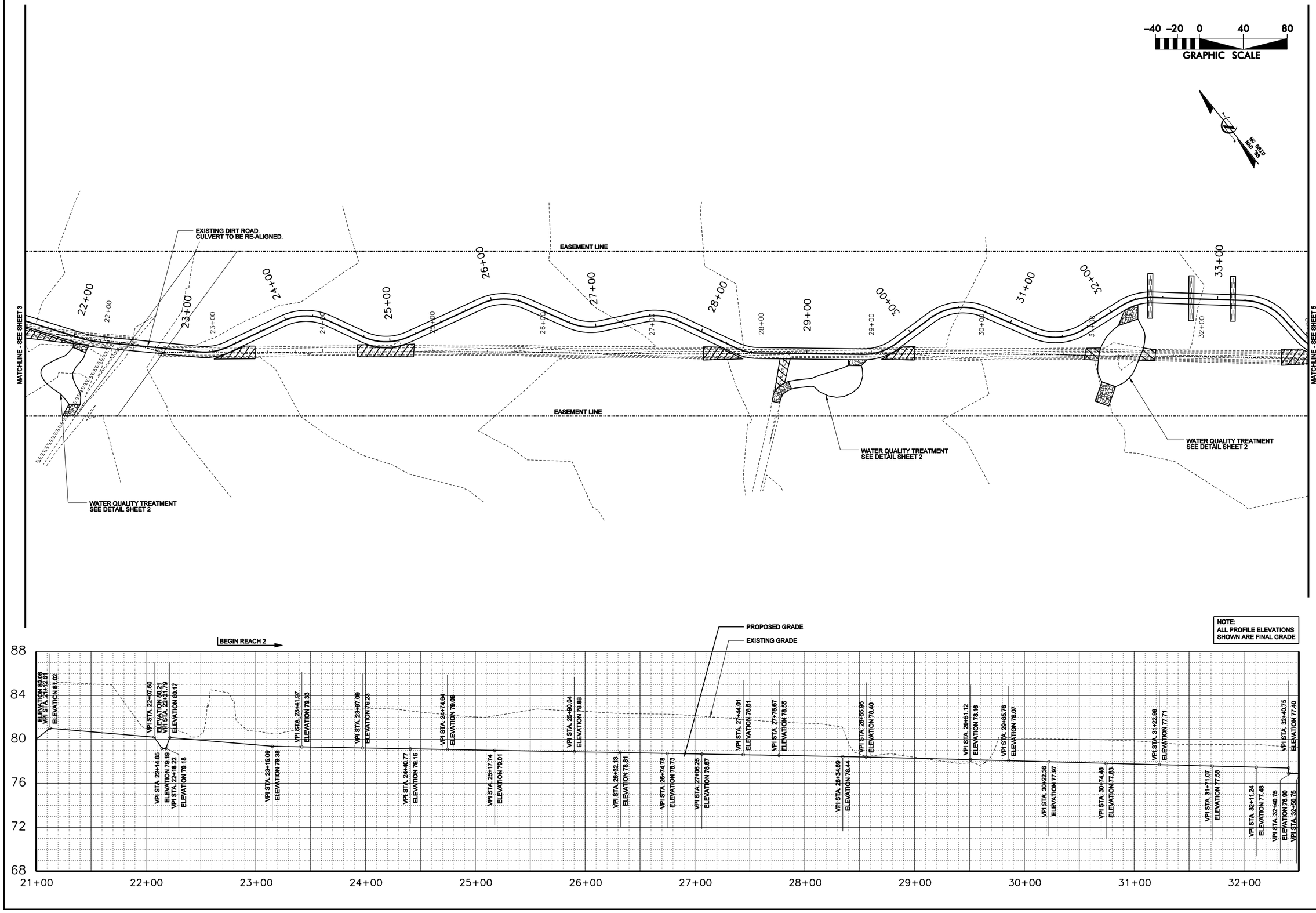
EDGECOMBE CO., NORTH CAROLINA

STATION 10+00 TO STATION 21+54

DATE: APRIL 2007

SCALE: 1"=40'

PLAN AND PROFILE



		DESCRIPTION	DATE	APPROVED
A	SUBMITTED WITH RESTORATION PLAN		MAR 2007	
C	REVISED PER DWQ COMMENTS		APRIL 2007	
SYM.		REVISIONS		

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RALEIGH, NORTH CAROLINA 27609

HARRELL SITE
STREAM RESTORATION PROJECT

EDGECOMBE CO., NORTH CAROLINA

STATION 21+54 TO STATION 33+98

DATE: APRIL 2007

SCALE: 1"=40'

PLAN AND PROFILE

MATCHLINE - SEE SHEET 4

EXISTING 36" CULVERT TO BE REMOVED

34+00 35+00 36+00 37+00 38+00 39+00 40+00 41+00 42+00 43+00 44+00 45+00

EASEMENT LINE

WATER QUALITY TREATMENT SEE DETAIL SHEET 2

EASEMENT LINE

MATCHLINE - SEE SHEET 6

–40 –20 0 40 80
GRAPHIC SCALE

NC GRID MAG "65"

NOTE:
ALL PROFILE ELEVATIONS SHOWN ARE FINAL GRADE

PROPOSED GRADE
EXISTING GRADE

BEGIN REACH 3

VPI STA. 32+11.24
ELEVATION 77.48
VPI STA. 32+40.75
ELEVATION 77.40
VPI STA. 32+40.75
ELEVATION 76.80
VPI STA. 32+50.75
ELEVATION 76.80
VPI STA. 32+78.75
ELEVATION 76.80
VPI STA. 32+78.75
ELEVATION 76.30
VPI STA. 32+98.75
ELEVATION 76.30
VPI STA. 33+14.74
ELEVATION 76.20
VPI STA. 33+14.74
ELEVATION 75.70
VPI STA. 33+24.74
ELEVATION 75.70
VPI STA. 33+64.86
ELEVATION 75.26
VPI STA. 33+86.44
ELEVATION 75.02
VPI STA. 34+31.16
ELEVATION 74.53
VPI STA. 35+57.40
ELEVATION 73.20
VPI STA. 35+86.59
ELEVATION 73.00
VPI STA. 36+44.64
ELEVATION 72.40
VPI STA. 36+65.05
ELEVATION 72.29
VPI STA. 37+05.30
ELEVATION 71.69
VPI STA. 37+49.60
ELEVATION 71.51
VPI STA. 37+70.70
ELEVATION 71.48
VPI STA. 38+15.84
ELEVATION 71.36
VPI STA. 38+67.86
ELEVATION 71.23
VPI STA. 39+35.77
ELEVATION 71.08
VPI STA. 39+50.00
ELEVATION 71.08
VPI STA. 39+50.00
ELEVATION 70.48
VPI STA. 39+89.33
ELEVATION 70.38
VPI STA. 40+74.93
ELEVATION 70.20
VPI STA. 41+52.13
ELEVATION 70.02
VPI STA. 42+31.82
ELEVATION 69.84
VPI STA. 43+02.29
ELEVATION 69.67
VPI STA. 43+25.00
ELEVATION 69.67
VPI STA. 43+25.00
ELEVATION 69.07

80 76 72 68 64 60
32+00 33+00 34+00 35+00 36+00 37+00 38+00 39+00 40+00 41+00 42+00 43+00

A	SUBMITTED WITH RESTORATION PLAN		MAR 2007	
C	REVISED PER DWQ COMMENTS		APRIL 2007	
		DESCRIPTION	DATE	APPROVED

REVISIONS

Ecosystem Enhancement Program

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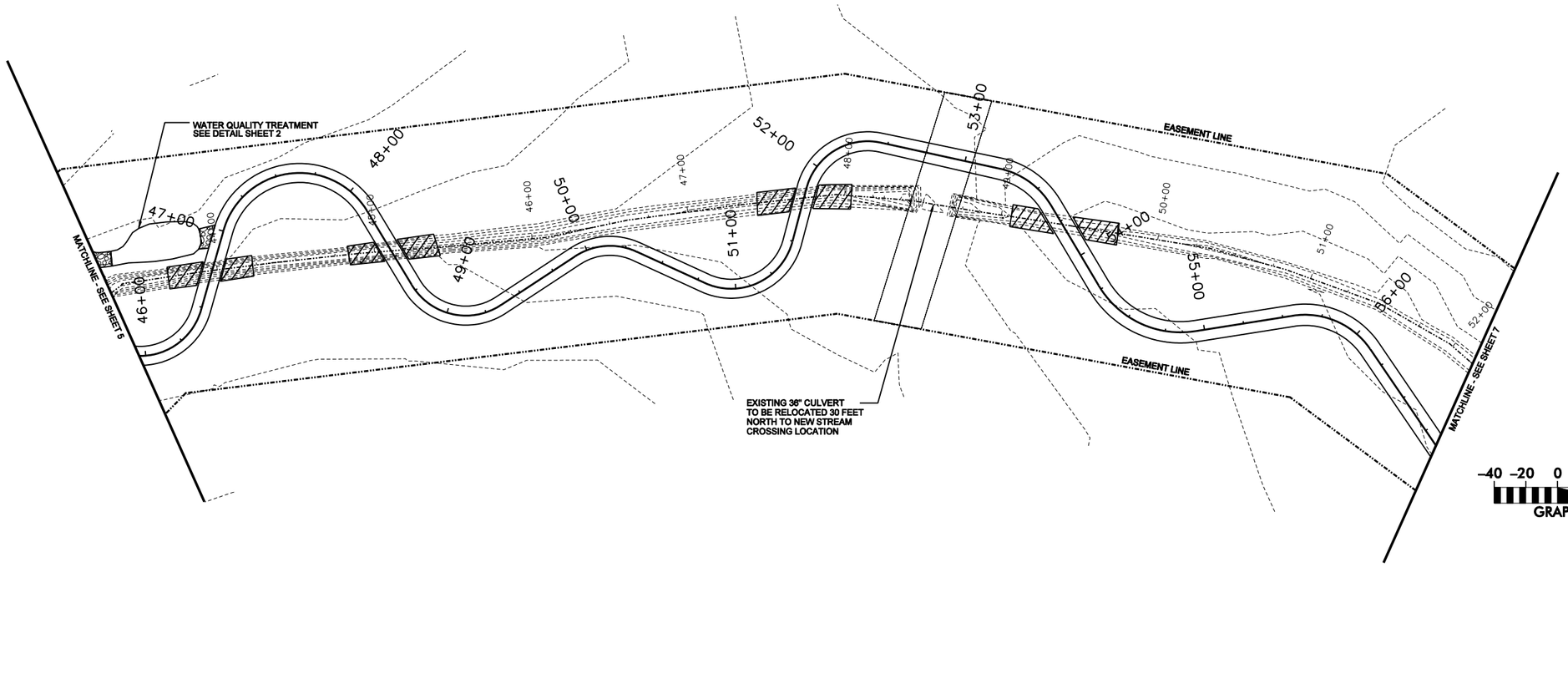
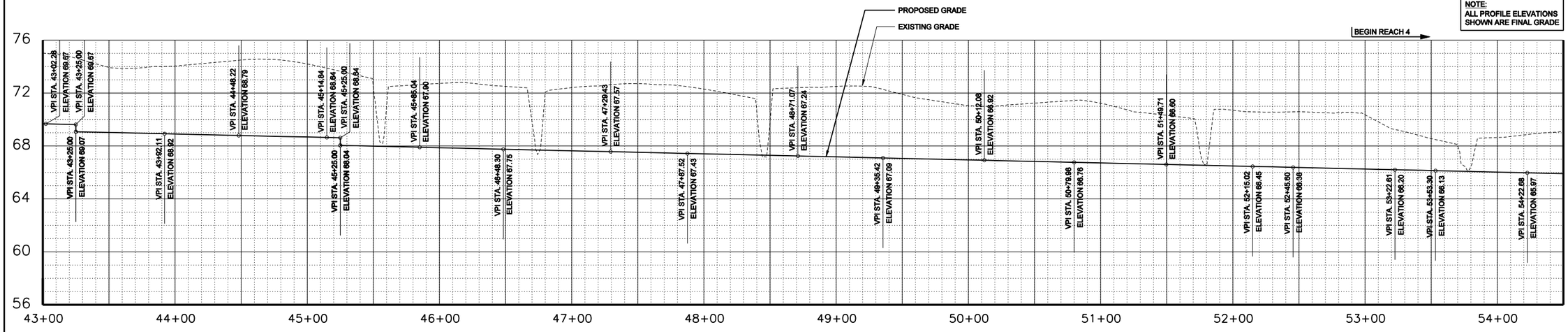
RALEIGH, NORTH CAROLINA 27609

HARRELL SITE
STREAM RESTORATION PROJECT
EDGECOMBE CO., NORTH CAROLINA
STATION 33+98 TO STATION 45+96

DATE: APRIL 2007
SCALE: 1"=40'

PLAN AND PROFILE





	DESCRIPTION	DATE
A	SUBMITTED WITH RESTORATION PLAN	MAR 2007
C	REVISED PER DWQ COMMENTS	APRIL 2007
SYM.		APPROVED

REVISIONS

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HARRELL SITE
STREAM RESTORATION PROJECT
EDGECOMBE CO., NORTH CAROLINA
STATION 45+96 TO STATION 56+87

DATE: APRIL 2007
SCALE: 1"=40'

PLAN
AND
PROFILE

A	SUBMITTED WITH RESTORATION PLAN	MAR 2007	
C	REVISED PER DWQ COMMENTS	APRIL 2007	
SYM.	DESCRIPTION	DATE	APPROVED

REVISIONS

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RALEIGH, NORTH CAROLINA 27609

HARRELL SITE
STREAM RESTORATION PROJECT

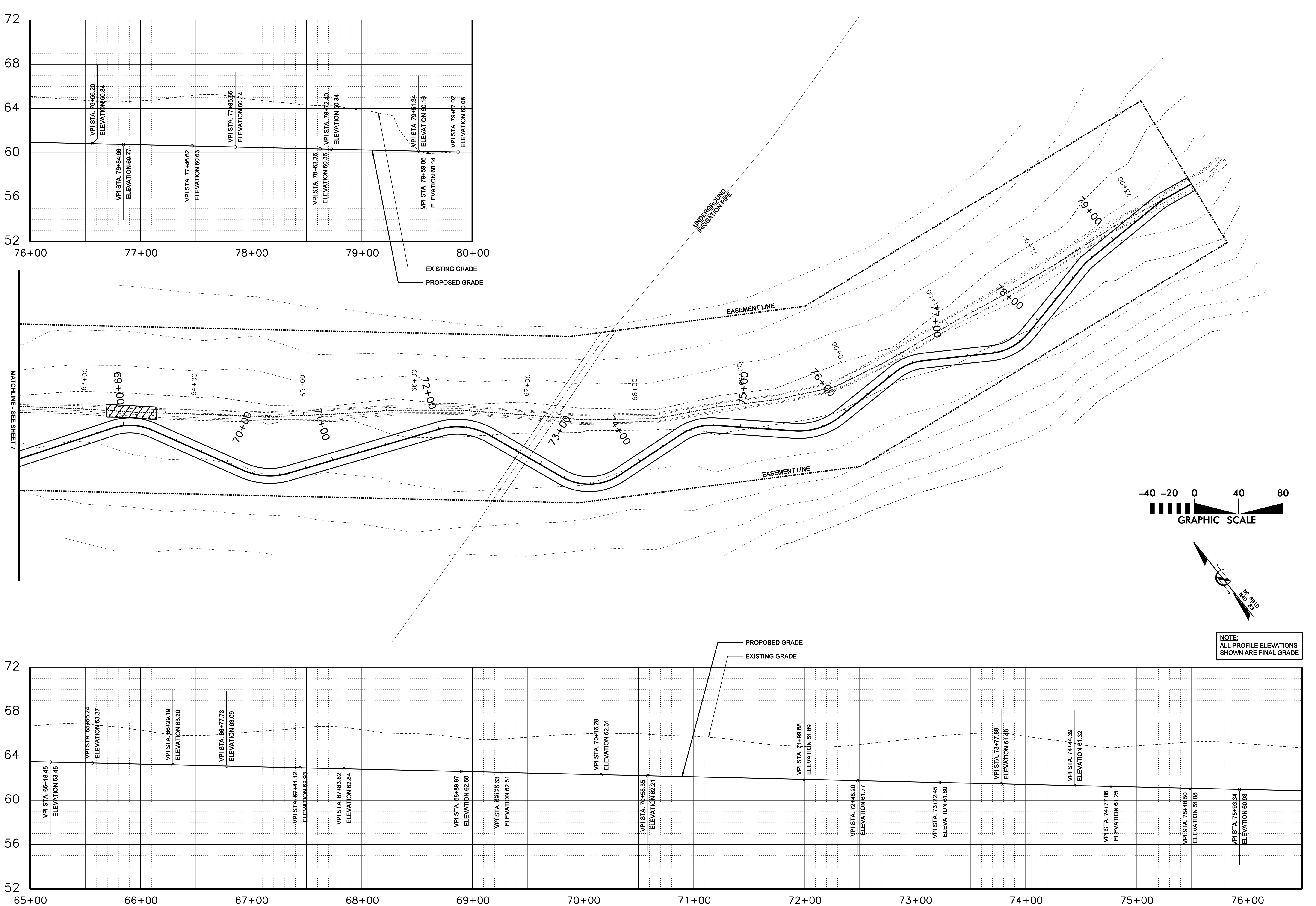
EDGECOMBE CO., NORTH CAROLINA

STATION 56+87 TO STATION 68+00

DATE: APRIL 2007

SCALE: 1"=40'

PLAN AND PROFILE



SYM.	DESCRIPTION	DATE	APPROVED
A	SUBMITTED WITH RESTORATION PLAN	MAR 2007	

REVISIONS

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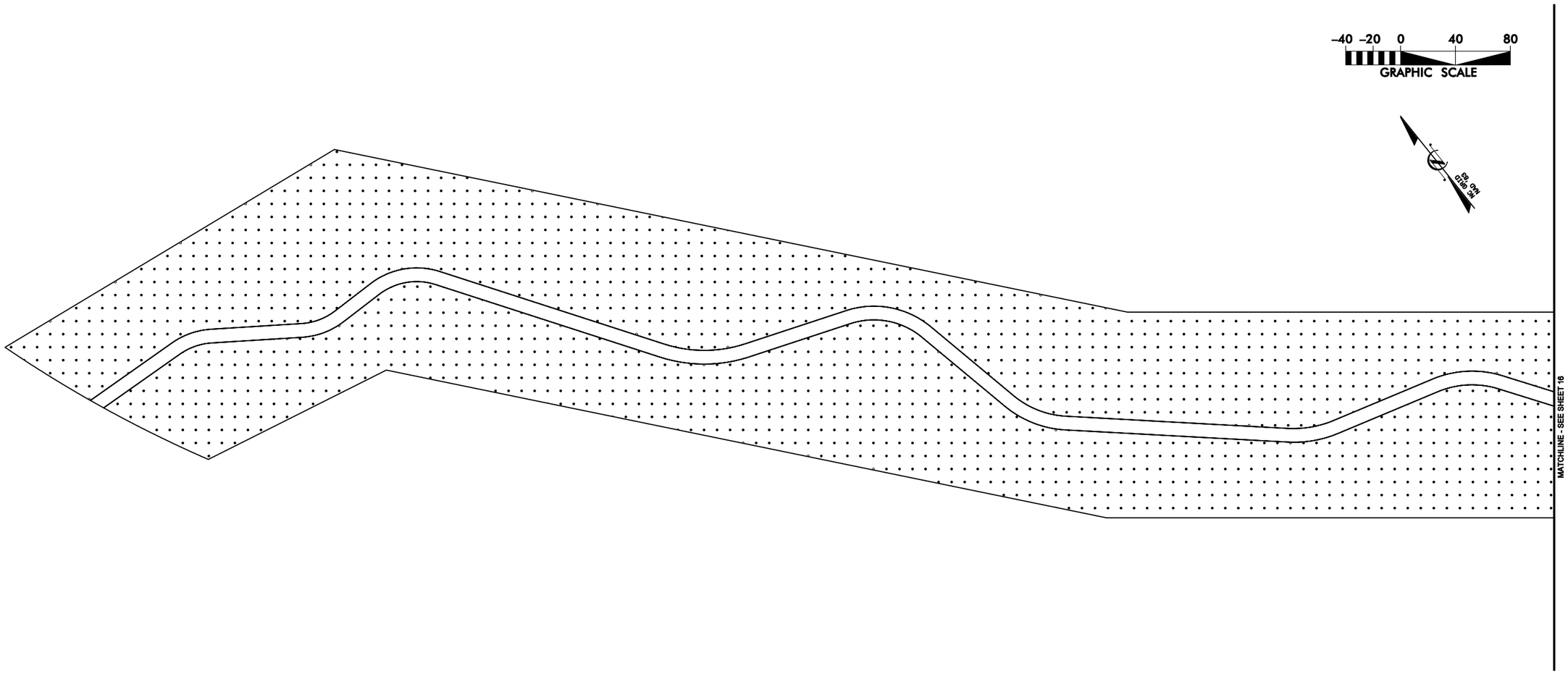
RALEIGH, NORTH CAROLINA 27609

HARRELL SITE STREAM RESTORATION PROJECT
EDGECOMBE CO., NORTH CAROLINA
STATION 68+00 TO STATION 79+87

DATE: APRIL 2007
SCALE: 1"=40'

PLAN AND PROFILE

SHEET 8 OF 26



PLANTING PLAN AND SPECIES COMPOSITION

ZONE A

STREAM ZONE = 1.32 - ACRE (57,508 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 7,360 TOTAL NUMBER OF LIVE STAKES TO BE INSTALLED

ZONE B

FLOODPLAIN PLANTING AREA = 7.62 ACRES

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

COMMON NAME	SCIENTIFIC NAME	% OF TOTAL	# OF PLANTS
BEAUTYBERRY	CALLICARPA AMERICANA	15	499
POSSUMHAW	VIBURNUM NUDUM	15	499
GREEN ASH	FRAXINUS PENNSYLVANICA	5	116
SYCAMORE	PLATANUS OCCIDENTALIS	10	333
SUGARBERRY	CELTIS LAEVIGATA	10	333
RIVER BIRCH	BETULA NIGRA	10	333
SWAMP CHESTNUT OAK	QUERCUS MICHAUXII	15	499
WILLOW OAK	QUERCUS PHELLOS	10	333
PERSIMMON	DIOSPYROS VIRGINIANA	10	333
		100	3328

ZONE C

RIPARIAN PLANTING AREA = 12.79 ACRES

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

COMMON NAME	SCIENTIFIC NAME	% OF TOTAL	# OF PLANTS
BEAUTYBERRY	CALLICARPA AMERICANA	5	279
POSSUMHAW	VIBURNUM NUDUM	5	279
PERSIMMON	PERSIMMON	25	1394
BLACK WALNUT	BLACK WALNUT	20	1115
SHAGBARK HICKORY	SHAGBARK HICKORY	20	1115
S. RED OAK	S. RED OAK	25	1394
		100	5576

PROPOSED CROSSING
(DO NOT PLANT IN THIS AREA)

A	SUBMITTED WITH RESTORATION PLAN	MAR 2007		
SYM.	DESCRIPTION	DATE	APPROVED	

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RALEIGH, NORTH CAROLINA 27609

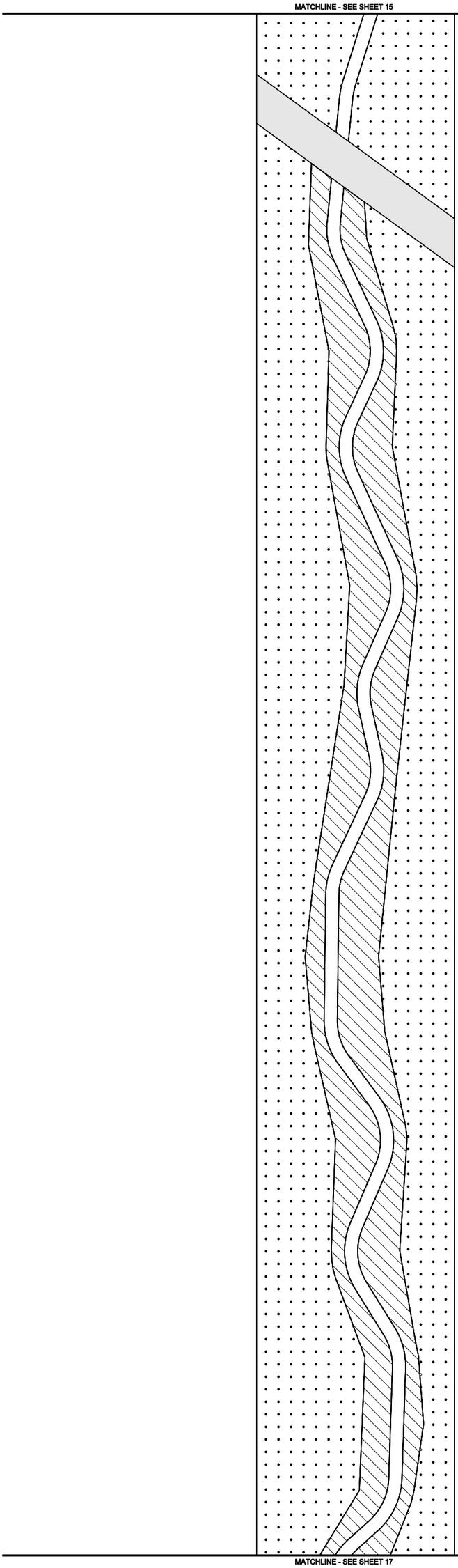
HARRELL SITE
STREAM RESTORATION PROJECT
EDGECOMBE CO., NORTH CAROLINA
STATION 10+00 TO STATION 21+54

DATE: MAR 2007
SCALE: 1"=40'

PLANTING PLAN

SHEET 15 OF 26

MATCHLINE - SEE SHEET 15



MATCHLINE - SEE SHEET 17

ZONE A
STREAM ZONE PLANTING AREA

ZONE B
FLOODPLAIN PLANTING AREA

ZONE C
RIPARIAN PLANTING AREA

PROPOSED CROSSING (DO NOT PLANT IN THIS AREA)

GRAPHIC SCALE
-40 -20 0 40 80

SHEET 16 OF 28

PLANTING PLAN

DATE: MAR 2007
SCALE: 1"=40'

HARRELL SITE
STREAM RESTORATION PROJECT

EDGECOMBE CO., NORTH CAROLINA

STATION 21+54 TO STATION 33+98

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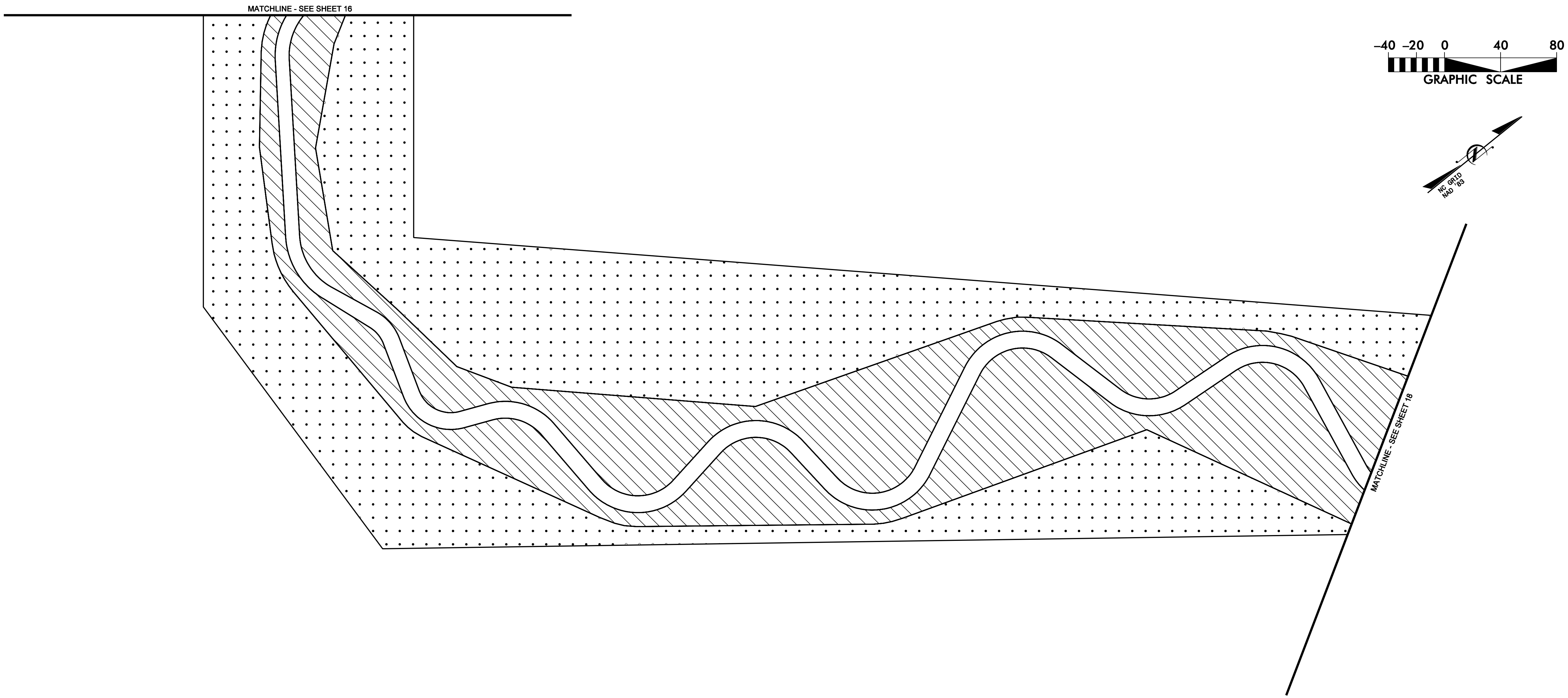
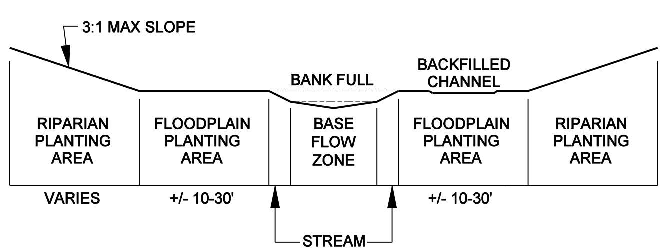
RALEIGH, NORTH CAROLINA 27609

Ecosystem Enhancement PROGRAM

SYM.	DESCRIPTION	DATE	APPROVED
A	SUBMITTED WITH RESTORATION PLAN	MAR 2007	

REVISIONS





TYPICAL PLANTING ZONES
NOT TO SCALE

ZONE A
STREAM ZONE PLANTING AREA

PROPOSED CROSSING
(DO NOT PLANT IN THIS AREA)

ZONE B
FLOODPLAIN PLANTING AREA

ZONE C
RIPARIAN PLANTING AREA

SYM.	DESCRIPTION	DATE	APPROVED
A	SUBMITTED WITH RESTORATION PLAN	MAR 2007	

REVISIONS

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RALEIGH, NORTH CAROLINA 27609

HARRELL SITE
STREAM RESTORATION PROJECT
EDGECOMBE CO., NORTH CAROLINA
STATION 33+98 TO STATION 45+96

DATE: MAR 2007
SCALE: 1"=40'

PLANTING PLAN

SHEET 17 OF 26

ZONE A
STREAM ZONE PLANTING AREA

ZONE B
FLOODPLAIN PLANTING AREA

ZONE C
RIPARIAN PLANTING AREA

PROPOSED CROSSING (DO NOT PLANT IN THIS AREA)

A	SUBMITTED WITH RESTORATION PLAN	MAR 2007		
SYM.	DESCRIPTION	DATE	APPROVED	

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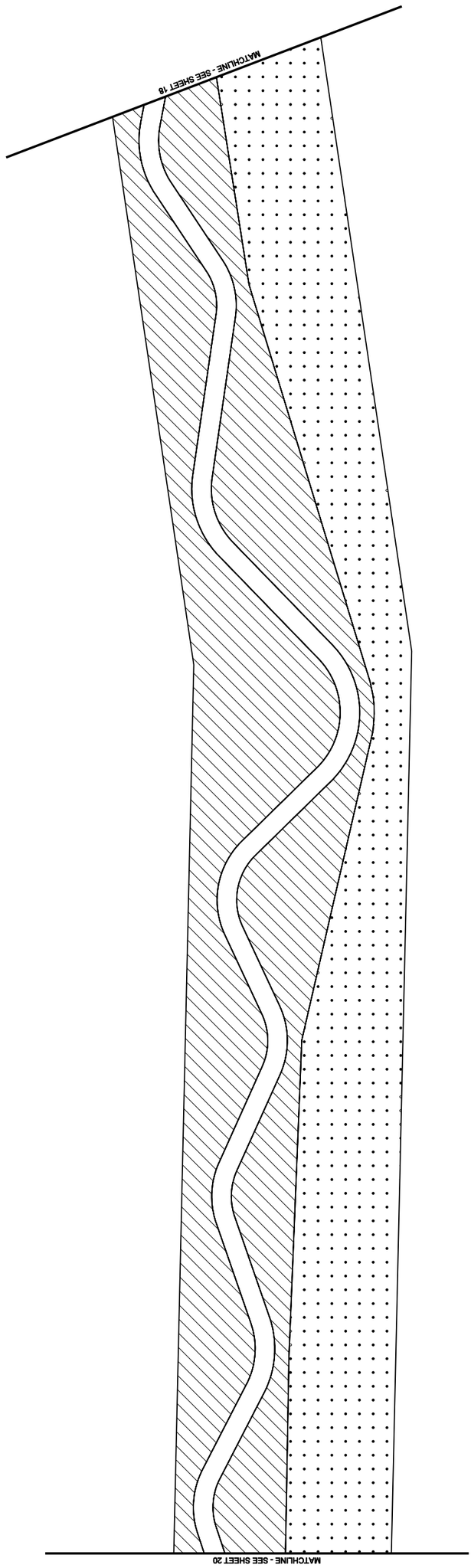
HARRELL SITE
STREAM RESTORATION PROJECT

EDGECOMBE CO., NORTH CAROLINA

STATION 45+96 TO STATION 56+87

DATE: MAR 2007
SCALE: 1"=40'

PLANTING PLAN



ZONE C
RIPARIAN PLANTING AREA

ZONE B
FLOODPLAIN PLANTING AREA

ZONE A
STREAM ZONE PLANTING AREA

PROPOSED CROSSING (DO NOT PLANT IN THIS AREA)

NC GRID NAD 83

GRAPHIC SCALE
-40 -20 0 40 80

SHEET 19 OF 28

PLANTING PLAN

DATE: MAR 2007
SCALE: 1"=40'

HARRELL SITE
STREAM RESTORATION PROJECT

EDGECOMBE CO., NORTH CAROLINA

STATION 56+87 TO STATION 68+00

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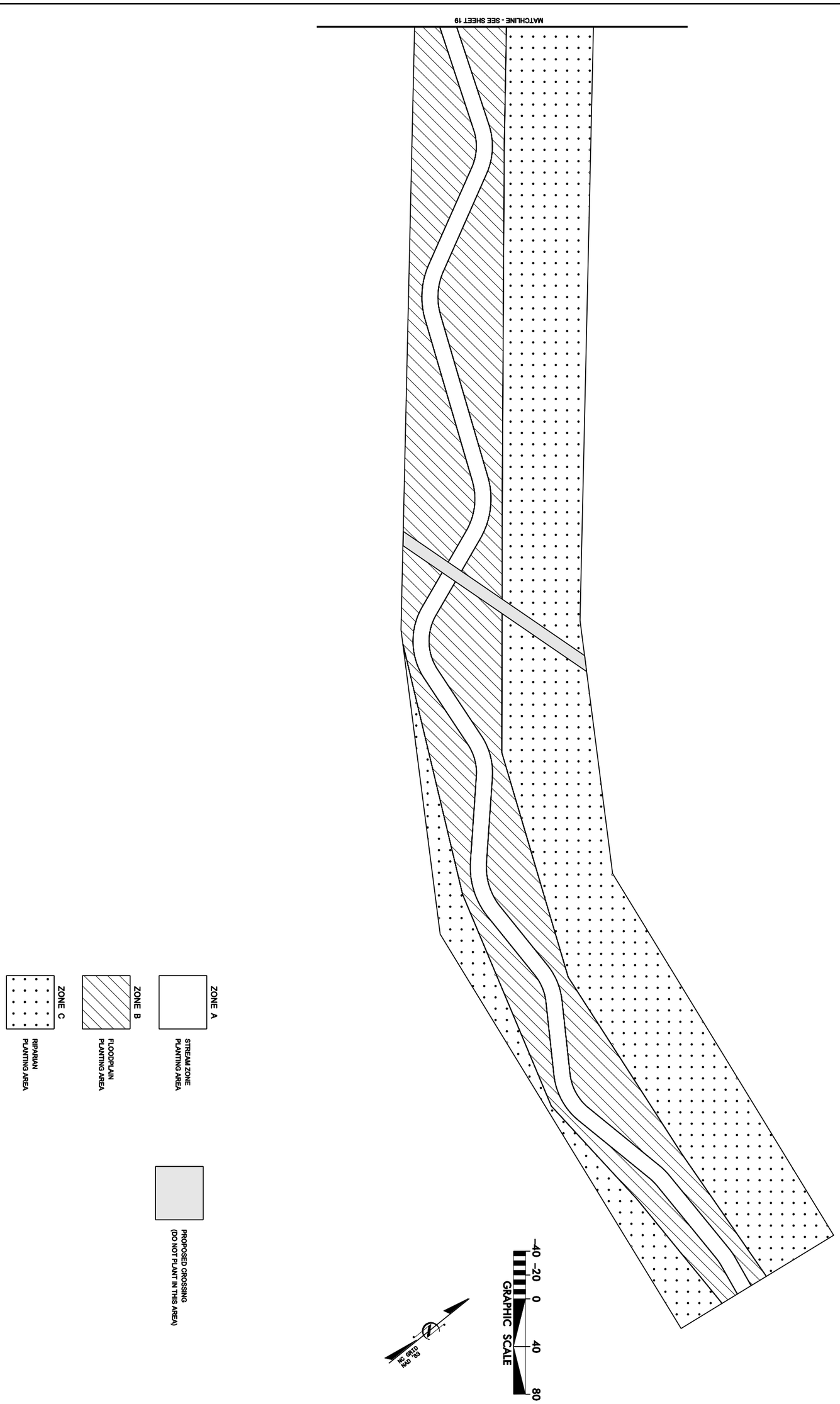
RALEIGH, NORTH CAROLINA 27609

Ecosystem Enhancement PROGRAM

SYM.	DESCRIPTION	DATE	APPROVED
A	SUBMITTED WITH RESTORATION PLAN	MAR 2007	

REVISIONS



SHEET 20 OF 28

PLANTING PLAN

DATE: MAR 2007

SCALE: 1"=40'

HARRELL SITE
STREAM RESTORATION PROJECT

EDGECOMBE CO., NORTH CAROLINA

STATION 68+00 TO STATION 79+87

KCI ASSOCIATES OF NC
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RALEIGH, NORTH CAROLINA 27609

Ecosystem Enhancement PROGRAM

SYM.	DESCRIPTION	DATE	APPROVED
A	SUBMITTED WITH RESTORATION PLAN	MAR 2007	

REVISIONS

Wetland Plan Sheets

KCI JOB# : 12054239

CONTRACT #: D05025-1

STATE OF NORTH CAROLINA
ECOSYSTEM ENHANCEMENT PROGRAM

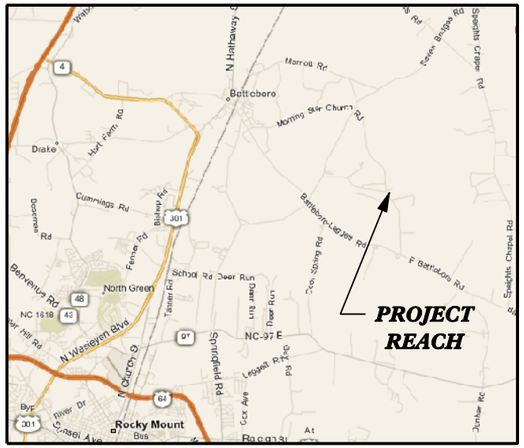
STATE	CONTRACT NUMBER	SHEET NO.	TOTAL SHEETS
N.C.	D05025-1	1	7

A	REVISIONS PER DLR COMMENTS	OCT 2006	
SYM.	DESCRIPTION	DATE	APPROVED
REVISIONS			

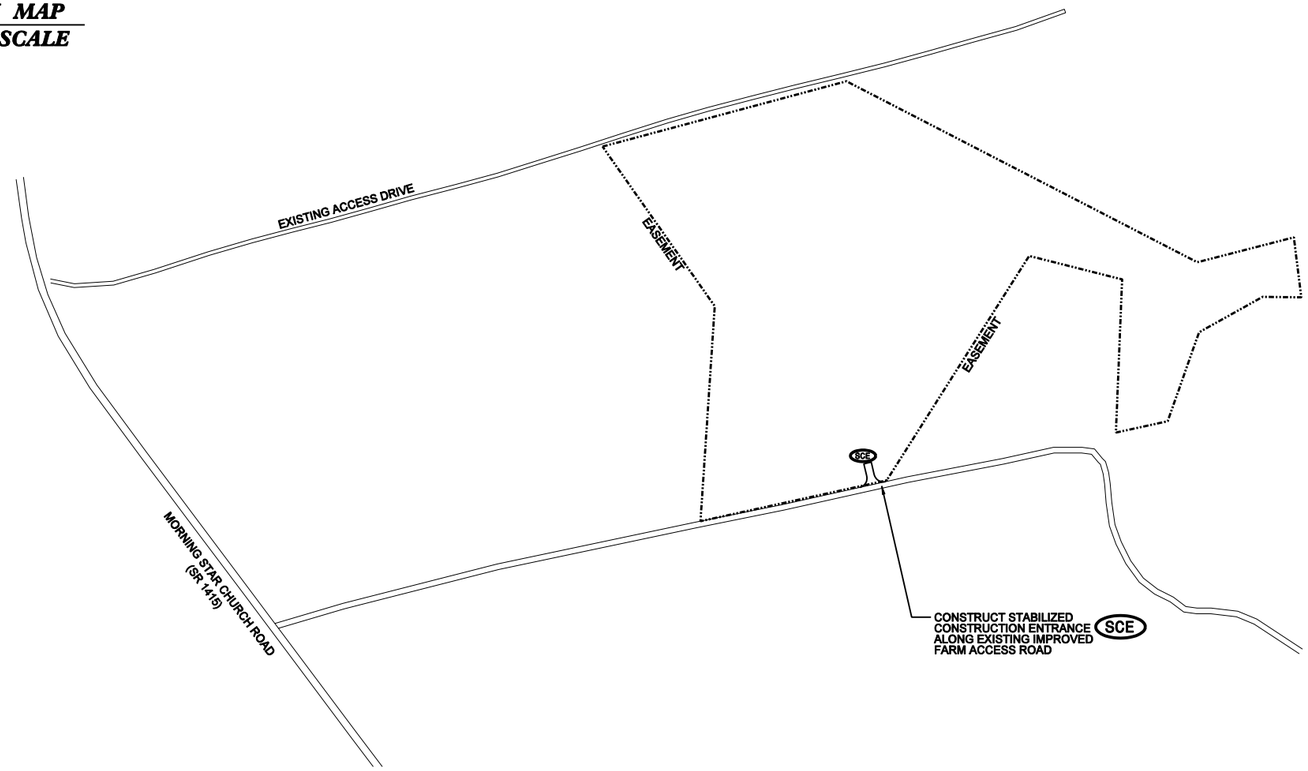
EDGECOMBE COUNTY

LOCATION: HARRELL SITE
MORNING STAR CHURCH ROAD
EDGECOMBE CO., NORTH CAROLINA

TYPE OF WORK: WETLAND RESTORATION SITE



VICINITY MAP
NOT TO SCALE



NC GRID NAD '83

INDEX OF SHEETS

GRAPHIC SCALES

–200 –100 0 200 400
TITLE SHEET

–60 –30 0 60 120
PLAN SHEET

PROJECT DATA

WETLAND RESTORATION AREA = 653,400 SQUARE FEET (15 ACRES)

PROJECT TOTAL AREA OF DISTURBANCE = 22.3 ACRES

Prepared in the Office of:

KCI TECHNOLOGIES
ENGINEERS•PLANNERS•ECOLOGISTS
SUITE 220 LANDMARK CENTER II
4601 SIX FORKS RD., RALEIGH, NC

LETTING DATE:

TIMOTHY P. DONOHUE
PROJECT ENGINEER

JOSEPH J. PFEIFFER, PWS
PROFESSIONAL WETLAND SCIENTIST

STEVEN F. STOKES, LSS
SOIL SCIENTIST

PROJECT ENGINEER

P.E.
SIGNATURE:

Prepared for:

Ecosystem Enhancement PROGRAM

GUY PEARCE
CONTRACT ADMINISTRATOR

SITE PLAN LEGEND

- EXISTING EASEMENT LINE
- EXISTING 5' CONTOUR LINES
- EXISTING 1' CONTOUR LINES
- EXISTING DRAINAGE DITCH
- EXISTING SPOIL PILES
- DITCH PLUG
- EXISTING DITCH TO BE FILLED
- ROCK STABILIZED OUTLET
- SURVEY CONTROL POINT
- PROPOSED MICROTOPOGRAPHY

NOTE:
CREATE MICROTOPOGRAPHY WITH DEPRESSIONS AND RISES APPROX. SIX INCHES PLUS OR MINUS THE EXISTING ELEVATIONS.

CONSERVATION EASEMENT

CONTRACTOR SHALL USE EXISTING SPOIL PILES TO FILL DRAINAGE DITCHES

KCI#8
N=828929.32
E=2389359.53
ELEV=77.21'

KCI#9
N=829124.07
E=2390222.47
ELEV=69.18'

KCI#10
N=829361.14
E=2390374.51
ELEV=68.04'

NC GRID MAG 83

–60 –30 0 60 120
GRAPHIC SCALE

REVISIONS

SYM.	DESCRIPTION	DATE	APPROVED

Ecosystem Enhancement Program

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4601 SIX FORKS RD., RALEIGH, NC

HARRELL - UT TO SWIFT CREEK WETLAND RESTORATION PROJECT
ROCKY MOUNT, EDGECOMBE COUNTY, NORTH CAROLINA

DATE: AUG 2006
SCALE: 1"=60'

SITE PLAN

MITIGATION PLAN LEGEND

WETLAND RESTORATION - 15.00 ACRES

CONSERVATION EASEMENT

CONSERVATION EASEMENT

NC GRID NAD 83

-60 -30 0 60 120

GRAPHIC SCALE

REVISIONS

SYM.	DESCRIPTION	DATE	APPROVED

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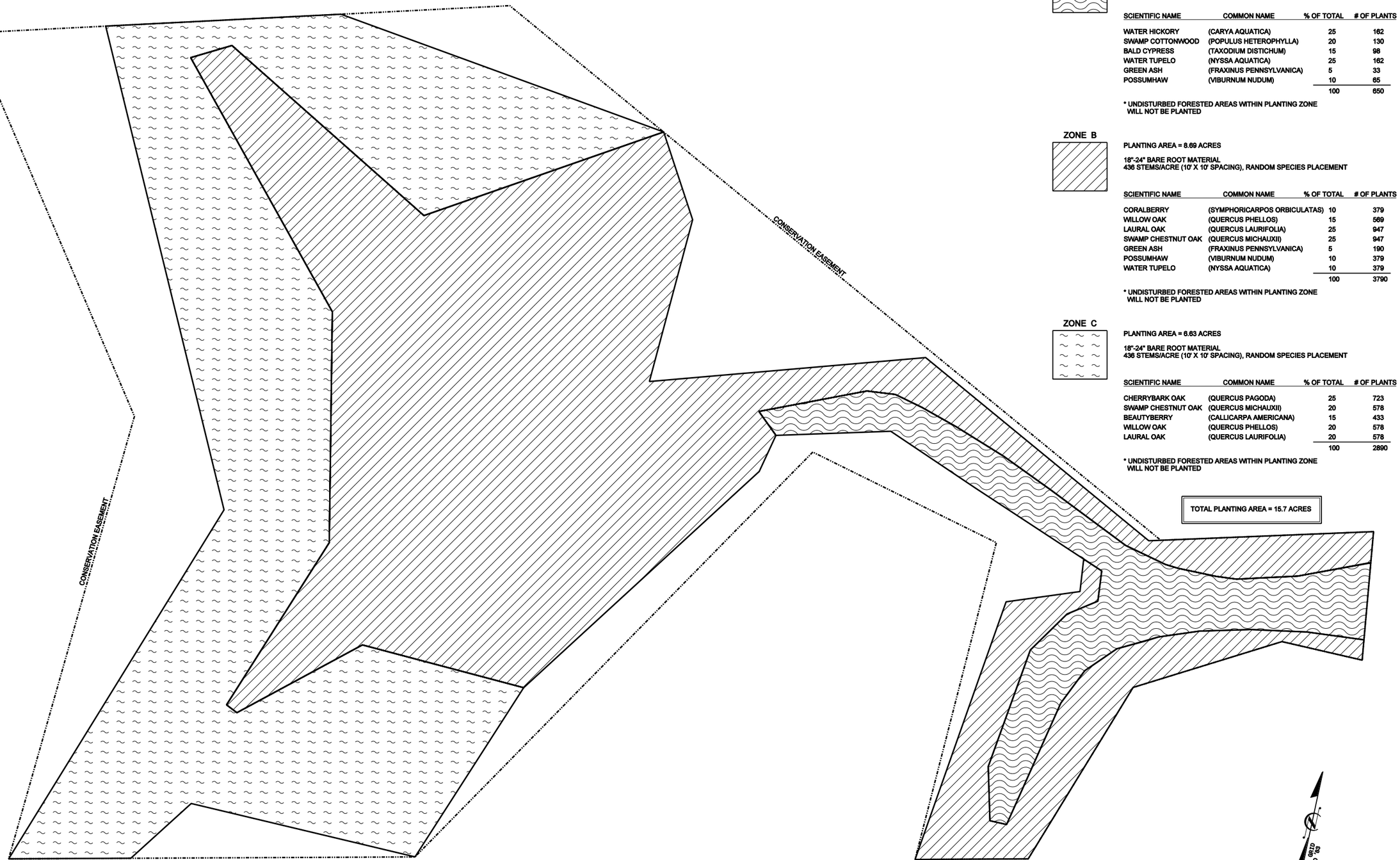
4601 SIX FORKS RD., RALEIGH, NC

HARRELL - UT TO SWIFT CREEK
WETLAND
RESTORATION PROJECT
ROCKY MOUNT, EDGECOMBE COUNTY, NORTH CAROLINA

DATE: AUG 2006
SCALE: 1"=60'

MITIGATION PLAN

SHEET 3 OF 7



ZONE A

PLANTING AREA = 1.49 ACRES

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

SCIENTIFIC NAME	COMMON NAME	% OF TOTAL	# OF PLANTS
WATER HICKORY	(CARYA AQUATICA)	25	162
SWAMP COTTONWOOD	(POPULUS HETEROPHYLLA)	20	130
BALD CYPRESS	(TAXODIUM DISTICHUM)	15	98
WATER TUPELO	(NYSSA AQUATICA)	25	162
GREEN ASH	(FRAXINUS PENNSYLVANICA)	5	33
POSSUMHAW	(VIBURNUM NUDUM)	10	65
		100	650

* UNDISTURBED FORESTED AREAS WITHIN PLANTING ZONE WILL NOT BE PLANTED

ZONE B

PLANTING AREA = 8.69 ACRES

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

SCIENTIFIC NAME	COMMON NAME	% OF TOTAL	# OF PLANTS
CORALBERRY	(SYMPHORICARPOS ORBICULATAS)	10	379
WILLOW OAK	(QUERCUS PHELLOS)	15	569
LAURAL OAK	(QUERCUS LAURIFOLIA)	25	947
SWAMP CHESTNUT OAK	(QUERCUS MICHAUXII)	25	947
GREEN ASH	(FRAXINUS PENNSYLVANICA)	5	190
POSSUMHAW	(VIBURNUM NUDUM)	10	379
WATER TUPELO	(NYSSA AQUATICA)	10	379
		100	3790

* UNDISTURBED FORESTED AREAS WITHIN PLANTING ZONE WILL NOT BE PLANTED

ZONE C

PLANTING AREA = 6.63 ACRES

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

SCIENTIFIC NAME	COMMON NAME	% OF TOTAL	# OF PLANTS
CHERRYBARK OAK	(QUERCUS PAGODA)	25	723
SWAMP CHESTNUT OAK	(QUERCUS MICHAUXII)	20	578
BEAUTYBERRY	(CALLICARPA AMERICANA)	15	433
WILLOW OAK	(QUERCUS PHELLOS)	20	578
LAURAL OAK	(QUERCUS LAURIFOLIA)	20	578
		100	2890

* UNDISTURBED FORESTED AREAS WITHIN PLANTING ZONE WILL NOT BE PLANTED

TOTAL PLANTING AREA = 15.7 ACRES

REVISIONS

NO.	DESCRIPTION	DATE	APPROVED
5			

Ecosystem Enhancement Program

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4601 SIX FORKS RD., RALEIGH, NC

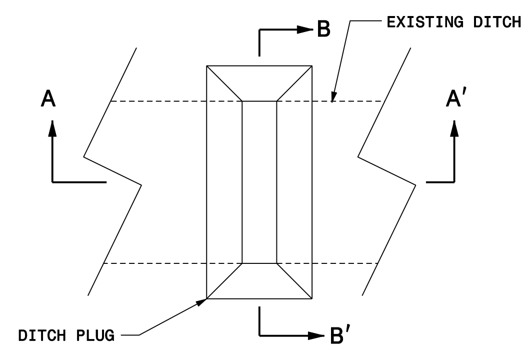
HARRELL - UT TO SWIFT CREEK WETLAND RESTORATION PROJECT

ROCKY MOUNT, EDGECOMBE COUNTY, NORTH CAROLINA

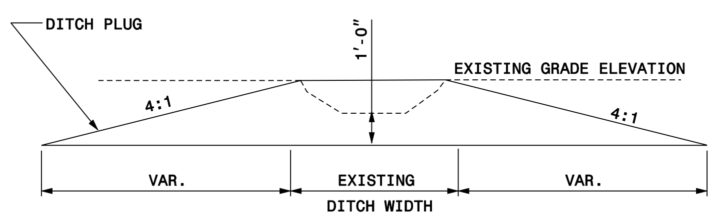
DATE: AUG 2006
SCALE: 1"=60'

PLANTING PLAN

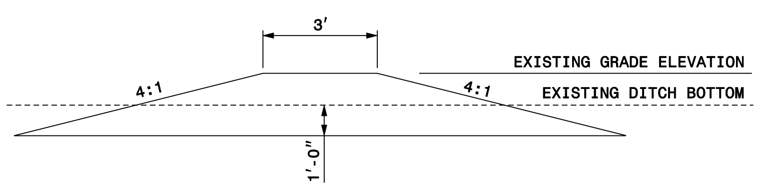
SHEET 4 OF 7



PLAN VIEW



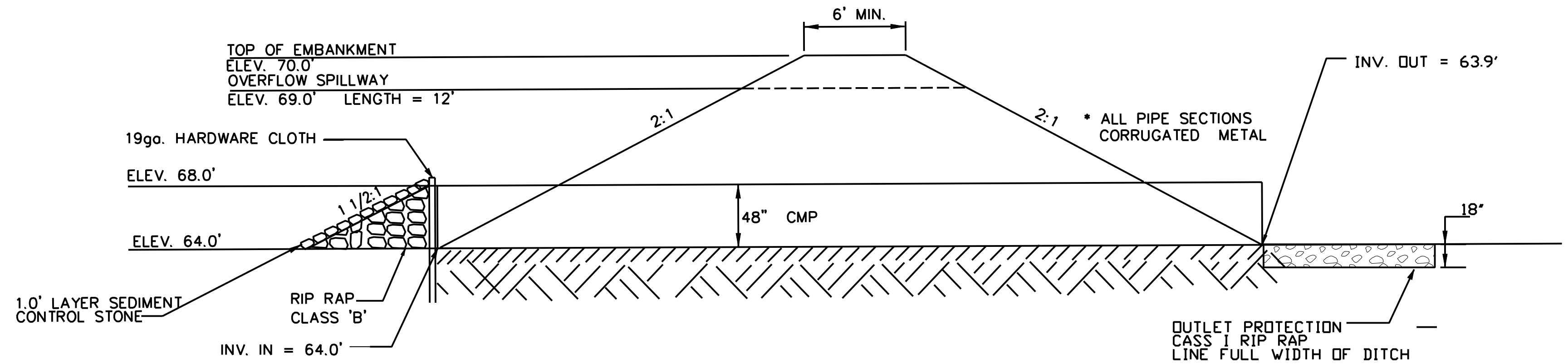
SECTION B-B'



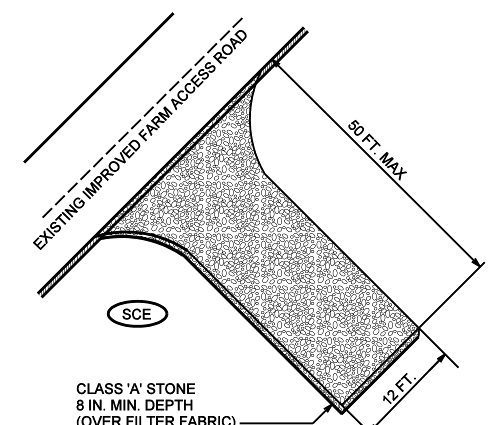
SECTION A-A'

DITCH PLUG DETAIL

NOTES:
SEE PLAN SHEETS FOR LOCATIONS OF DITCH PLUGS.
SEE PROJECT SPECIAL PROVISONS FOR MATERIAL SPECIFICATIONS.



TEMPORARY BERM DETAIL



NOTES:
1. TURNING RADIUS SUFFICIENT TO ACCOMODATE LARGE TRUCKS SHALL BE PROVIDED.
2. ENTRANCE(S) SHOULD BE LOCATED TO PROVIDE FOR UTILIZATION BY ALL CONSTRUCTION VEHICLES.
3. MUST BE MAINTAINED IN A CONDITION WHICH WILL PREVENT TRACKING OR DIRECT FLOW OF MUD ONTO STREETS. PERIODIC TOPDRESSING WITH STONE WILL BE NECESSARY.
4. ANY MATERIAL TRACKED ONTO THE ROADWAY MUST BE CLEANED UP IMMEDIATELY.
5. GRAVEL CONSTRUCTION ENTRANCE SHALL BE LOCATED AT ALL POINTS OF INGRESS AND EGRESS UNTIL SITE IS STABILIZED. FREQUENT CHECKS OF THE DEVICE AND TIMELY MAINTENANCE MUST BE PROVIDED.

STABILIZED CONSTRUCTION ENTRANCE (SCE)

SCALE: NTS

SYM.	DESCRIPTION	DATE	APPROVED
A	REVISIONS PER DLR COMMENTS	OCT 2006	

REVISIONS

Ecosystem Enhancement PROGRAM

KCI TECHNOLOGIES
ENGINEERS•PLANNERS•ECOLOGISTS
SUITE 220 LANDMARK CENTER II
4601 SIX FORKS RD., RALEIGH, NC

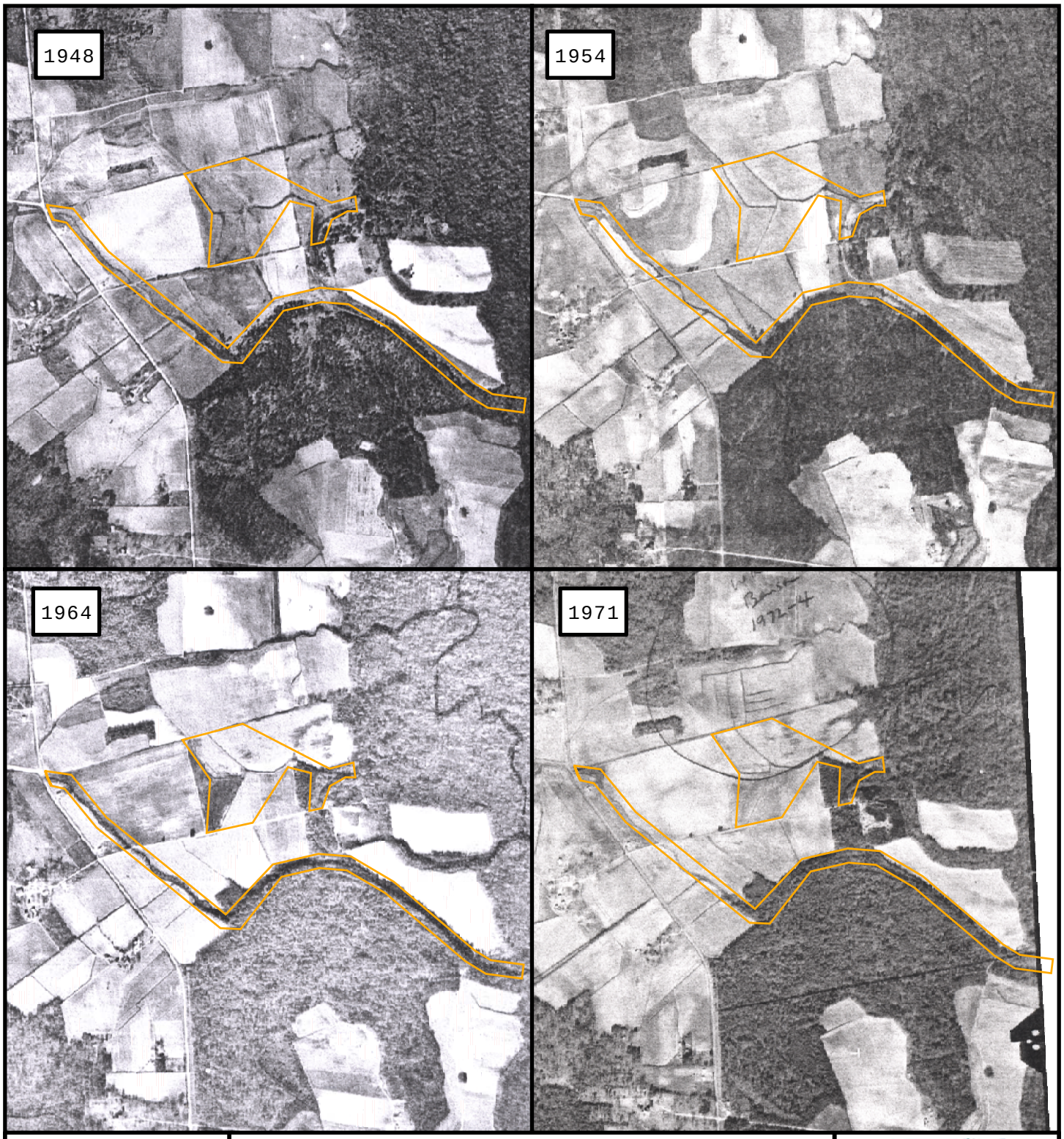
HARRELL - UT TO SWIFT CREEK WETLAND RESTORATION PROJECT
ROCKY MOUNT, EDGECOMBE COUNTY, NORTH CAROLINA

DATE: AUG 2006
SCALE: N.T.S.

DETAILS

SHEET 6 OF 7

Appendix A. Historical Aerial Photographs



Harrell Historic Aerials 1948 to 1971

Project Site Boundaries

N
W E
S

1:18,000

1 inch equals 1,500 feet

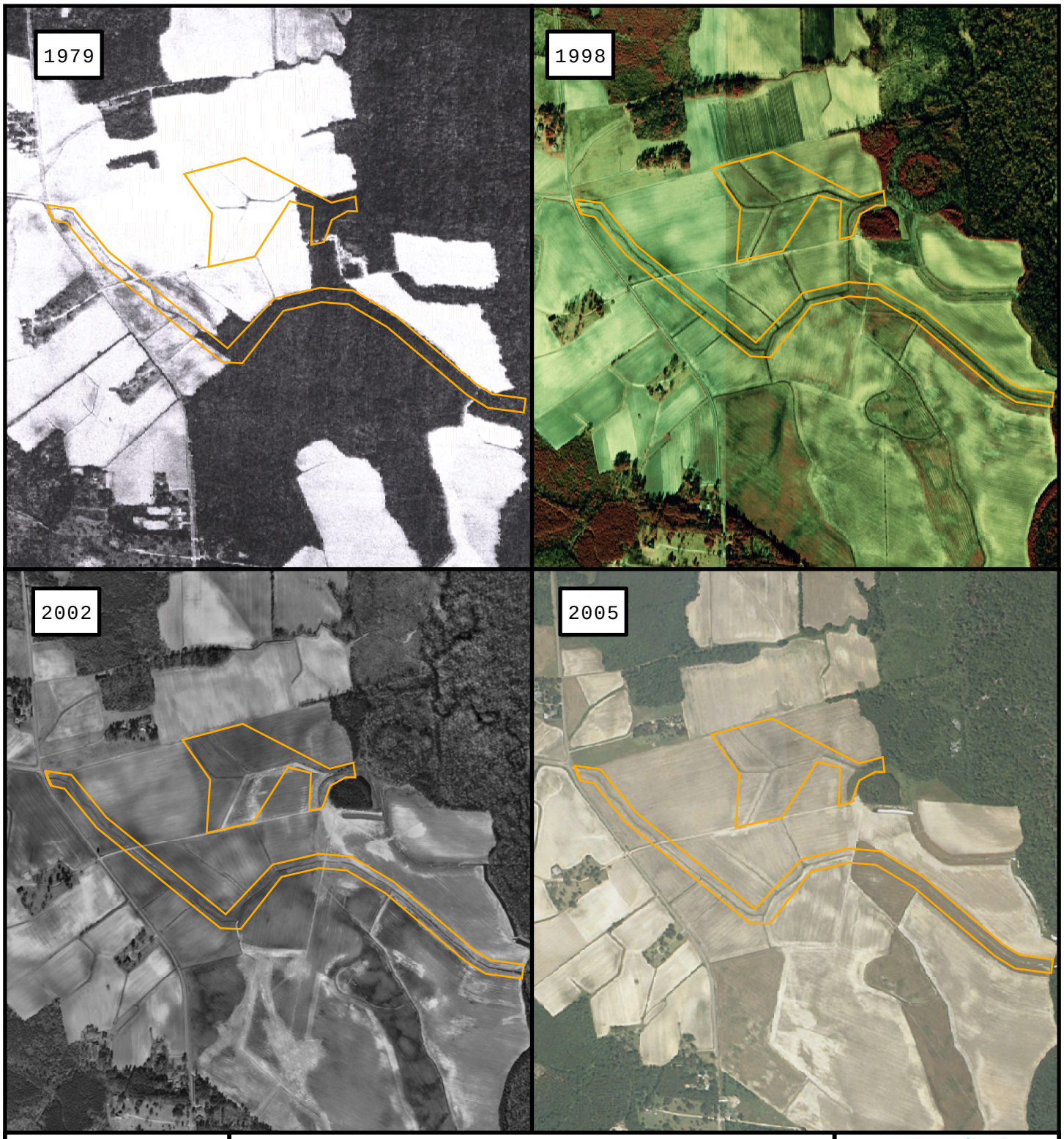
1,500 750 0 1,500 Feet

Source: USDA Natural Resource Conservation Service

KCI TECHNOLOGIES

KCI ASSOCIATES OF NC

ENVIRONMENTAL TECHNOLOGIES AND CONSTRUCTION, INC.



Harrell Historic Aerials 1979 to 2005

Project Site Boundaries

N
W E
S

1:18,000

1 inch equals 1,500 feet

1,500 750 0 1,500 Feet

Source: USDA Natural Resource Conservation Service

KCI TECHNOLOGIES

KCI ASSOCIATES OF NC

ENVIRONMENTAL TECHNOLOGIES AND CONSTRUCTION, INC.

Appendix B. Correspondence

KCI TECHNOLOGIES

ENGINEERS • SURVEYORS • SCIENTISTS • CONSTRUCTION MANAGERS

LANDMARK CENTER II • SUITE 220 • 4601 SIX FORKS ROAD • RALEIGH • NC 27609 • 919-783-9214 • FAX 919-783-9266

July 5, 2005

Ms. Renee Gledhill-Earley
Environmental Review Coordinator - SHPO
4617 Mail Service Center
Raleigh, NC 27699-4617

Attn: Juliana Hoekstra

Subject: Cultural Resources Review
Harrell Stream and Wetland Restoration Project
Project Number 12054239

Dear Ms. Hoekstra:

Please accept this information pertaining to the proposed Harrell Stream and Wetland Restoration Project, which is located off of Morning Star Road approximately six miles northeast of Rocky Mount in Edgecombe County, as a submittal for cultural resources review by the State Historic Preservation Office.

A portion of this property (refer to attached layout) is currently under investigation as a stream and wetland restoration project for the North Carolina Ecosystem Enhancement Program. The current land use in the project area includes predominantly Agricultural Crop Fields Forest with small patches of Coastal Plain Oak Bottomland Forest according to the 2003 NC GAP land cover dataset. The restoration would improve water quality and provide greater protection for aquatic ecosystems from surrounding agricultural lands. This type of work typically involves enhancing streams to create more natural and stable channels through minor grading, use of in-stream rock features, reforestation of riparian buffers, and restoration of wetland hydrology. An old spoil berm will also be removed, which is currently a barrier to flooding. No impacts to structures on the subject property are anticipated.

Following the review of the included documentation, please provide a determination regarding any potential impacts to cultural resources associated with this project.

Please feel free to contact me at (919) 783-9214, ext. 141, should you have any questions or require any further information to process this request. Thank you in advance for your assistance and attention.

Sincerely,

Michael B. Schlegel
Project Manager

North Carolina Department of Cultural Resources

State Historic Preservation Office

Peter B. Sandbeck, Administrator

Michael F. Easley, Governor
Lisbeth C. Evans, Secretary
Jeffrey J. Crow, Deputy Secretary

Office of Archives and History
Division of Historical Resources
David Brook, Director

July 18, 2005

Michael B. Schlegel
KCI Technologies
Landmark Center II, Suite 220
4601 Six Forks Road
Raleigh, NC 27609

Re: Harrell Stream & Wetland Restoration, # 12054239, Edgecombe County, ER 05-1536

Dear Mr. Schlegel:

Thank you for your letter of July 5, 2005, concerning the above project.

We have conducted a review of the proposed undertaking and are aware of no historic resources which would be affected by the project. Therefore, we have no comment on the undertaking as proposed.

The above comments are made pursuant to Section 106 of the National Historic Preservation Act and the Advisory Council on Historic Preservation's Regulations for Compliance with Section 106 codified at 36 CFR Part 800.

Thank you for your cooperation and consideration. If you have questions concerning the above comment, contact Renee Gledhill-Earley, environmental review coordinator, at 919/733-4763. In all future communication concerning this project, please cite the above referenced tracking number.

Sincerely,

Renee Gledhill-Earley

Peter Sandbeck

	Location	Mailing Address	Telephone/Fax
ADMINISTRATION	507 N. Blount Street, Raleigh NC	4617 Mail Service Center, Raleigh NC 27699-4617	(919)733-4763/733-8653
RESTORATION	515 N. Blount Street, Raleigh NC	4617 Mail Service Center, Raleigh NC 27699-4617	(919)733-6547/715-4801
SURVEY & PLANNING	515 N. Blount Street, Raleigh, NC	4617 Mail Service Center, Raleigh NC 27699-4617	(919)733-6545/715-4801

KCI TECHNOLOGIES

ENGINEERS • SURVEYORS • SCIENTISTS • CONSTRUCTION MANAGERS

LANDMARK CENTER II • SUITE 220 • 4601 SIX FORKS ROAD • RALEIGH • NC 27609 • 919-783-9214 • FAX 919-783-9266

July 5, 2005

Linda Pearsall, Program Head
North Carolina Natural Heritage Program
1601 Mail Service Center
Raleigh, NC 27529

Subject: Natural Heritage Review
Harrell Stream and Wetland Restoration Project
Project Number 12054239

Dear Ms. Pearsall:

Please accept this information pertaining to the proposed Harrell Stream and Wetland Restoration Project, which is located off of Morning Star Road approximately six miles northeast of Rocky Mount in Edgecombe County, as a submittal for natural communities and rare species review by the North Carolina Natural Heritage Program.

A portion of this property (refer to attached layout) is currently under investigation as a stream and wetland restoration project for the North Carolina Ecosystem Enhancement Program. The current land use in the project area includes predominantly Agricultural Crop Fields with small patches of Coastal Plain Oak Bottomland Forest according to the 2003 NC GAP land cover dataset. The restoration would improve water quality and provide greater protection for aquatic ecosystems from surrounding agricultural lands. This type of work typically involves enhancing streams to create more natural and stable channels through minor grading, use of in-stream rock features, reforestation of riparian buffers, and restoration of wetland hydrology. An old spoil berm will also be removed, which is currently a barrier to flooding. No impacts to structures on the subject property are anticipated.

Following the review of the included documentation, please provide a determination regarding any potential impacts to rare species or natural areas associated with this project.

Please feel free to contact me at (919) 783-9214, ext. 141, should you have any questions or require any further information to process this request. Thank you in advance for your assistance and attention.

Sincerely,

Michael B. Schlegel
Project Manager

NCDENR

North Carolina Department of Environment and Natural Resources

Michael F. Easley, Governor

William G. Ross Jr., Secretary

July 11, 2005

Mr. Michael B. Schlegel
KCI Technologies
Landmark Center II, Suite 220
4601 Six Forks Road
Raleigh, NC 27609

Subject: Harrell Stream and Wetland Restoration Project; Morning Star Road, Rocky Mount, Edgecombe County
Project No. 12054239

Dear Mr. Schlegel:

The Natural Heritage Program has no record of rare species, significant natural communities, or priority natural areas at the site nor within a mile of the project area. Although our maps do not show records of such natural heritage elements in the project area, it does not necessarily mean that they are not present. It may simply mean that the area has not been surveyed. The use of Natural Heritage Program data should not be substituted for actual field surveys, particularly if the project area contains suitable habitat for rare species, significant natural communities, or priority natural areas.

You may wish to check the Natural Heritage Program database website at <www.ncnhp.org> for a listing of rare plants and animals and significant natural communities in the county and on the topographic quad map. Please do not hesitate to contact me at 919-715-8697 if you have questions or need further information.

Sincerely,

Harry E. LeGrand Jr.

Harry E. LeGrand, Jr., Zoologist
Natural Heritage Program

HEL/hel

1601 Mail Service Center, Raleigh, North Carolina 27699-1601
Phone: 919-733-4984 • FAX: 919-715-3060 • Internet: www.enr.state.nc.us

KCI TECHNOLOGIES

ENGINEERS • SURVEYORS • SCIENTISTS • CONSTRUCTION MANAGERS

LANDMARK CENTER II • SUITE 220 • 4601 SIX FORKS ROAD • RALEIGH • NC 27609 • 919-783-9214 • FAX 919-783-9266

July 18, 2005

Mr. Gary Jordan
US Fish and Wildlife Service
Raleigh Field Office
P.O. Box 33726
Raleigh, NC 27636

Subject: Endangered Species Act, Fish and Wildlife Coordination Act, Migratory Bird Treaty Act
Harrell Stream and Wetland Restoration Project
Project Number 12054239

Dear Mr. Jordan

Please accept this information pertaining to the proposed Harrell Stream and Wetland Restoration Project, which is located off of Morning Star Road approximately six miles northeast of Rocky Mount in Edgecombe County, as a submittal for review of the Endangered Species Act, Fish and Wildlife Coordination Act, and Migratory Bird Treaty Act by the US Fish and Wildlife Service.

A portion of this property (refer to attached layout) is currently under investigation as a stream and wetland restoration project for the North Carolina Ecosystem Enhancement Program. The current land use in the project area includes predominantly Agricultural Crop Fields with small patches of Coastal Plain Bottomland Forest. The restoration would improve water quality and provide greater protection for aquatic ecosystems from surrounding agricultural lands. This type of work typically involves enhancing streams to create more natural and stable channels through minor grading, use of in-stream rock features, reforestation of riparian buffers and bottomland forest, and restoration of wetland hydrology. An old spoil berm will also be removed, which is currently a barrier to flooding. As part of the environmental documentation process (Categorical Exclusion), coordination with the USFWS is requested for compliance with the Endangered Species Act, Fish and Wildlife Coordination Act, and Migratory Bird Treaty Act.

Following the review of the included documentation, please provide a determination of the potential effects to endangered species, wildlife, or migratory birds associated with this project.

Please feel free to contact me at (919) 783-9214, ext. 141, should you have any questions or require any further information to process this request. Thank you in advance for your assistance and attention.

Sincerely,

Michael B. Schlegel
Project Manager

Michael F. Easley, Governor
William G. Ross Jr., Secretary
North Carolina Department of Environment and Natural Resources

Alan W. Klimek, P.E. Director
Colleen H. Sullins, Deputy Director
Division of Water Quality

September 13, 2005

TPBRRO#05-244
County: Edgecombe

KCI Assoc. of NC
Landmark Center II
Suite 200
4601 Six Forks Road
Raleigh, NC 27609

Attn: Mr. Steven Stokes

BASIN:

Neuse River	Tar-Pamlico X
(15A NCAC 2B .0233)	(15A NCAC 2B .0259)

Complaint	NOV	Buffer Determination X
Incident #		Appeal Call

Project Name: **Harrell Stream & Wetland Restoration Site (KCI Project # 12054239)**

Location/Directions: located off of Morning Star Rd approx. six miles NE of Rocky Mount

Subject Stream: UT to Swift Creek

Date of Determination: 7/27/05

Feature	Start Buffer GPS Points (if provided)	End Buffer	Stream Form	Appeal Call	Located on Soil Survey	Located on USGS Topographic
1	**Subject**				**X**	**X**
2	**Not Subject**					**X**
3	**Not Subject**					**X**

This on-site determination shall expire five (5) years from the date of this letter. Landowners or affected parties that dispute a determination made by the DWQ or Delegated Local Authority that a surface water exists and that it is subject to the buffer rule may request a determination by the Director. A request for a determination by the Director shall be referred to the Director in writing c/o Cyndi Karoly , DWQ Wetlands/401 Unit, 2321 Crabtree Blvd., Raleigh, NC 27604-2260. Individuals that dispute a determination by the DWQ or Delegated Local Authority that "exempts" a surface water from the buffer rule may ask for an ad judicatory hearing. You must act within 60 days of the date that you receive this letter. Applicants are hereby notified that the 60-day statutory appeal time does not start until the affected party (including downstream and adjacent landowners) is notified of this decision. DWQ recommends that the applicant conduct this notification in order to be certain that third party appeals are made in a timely manner. To ask for a hearing, send a written petition, which conforms to Chapter 150B of the North Carolina General Statutes to the Office of Administrative Hearings, 6714 Mail Service Center, Raleigh, N.C. 27699-6714. This determination is final and binding unless you ask for a hearing within 60 days.

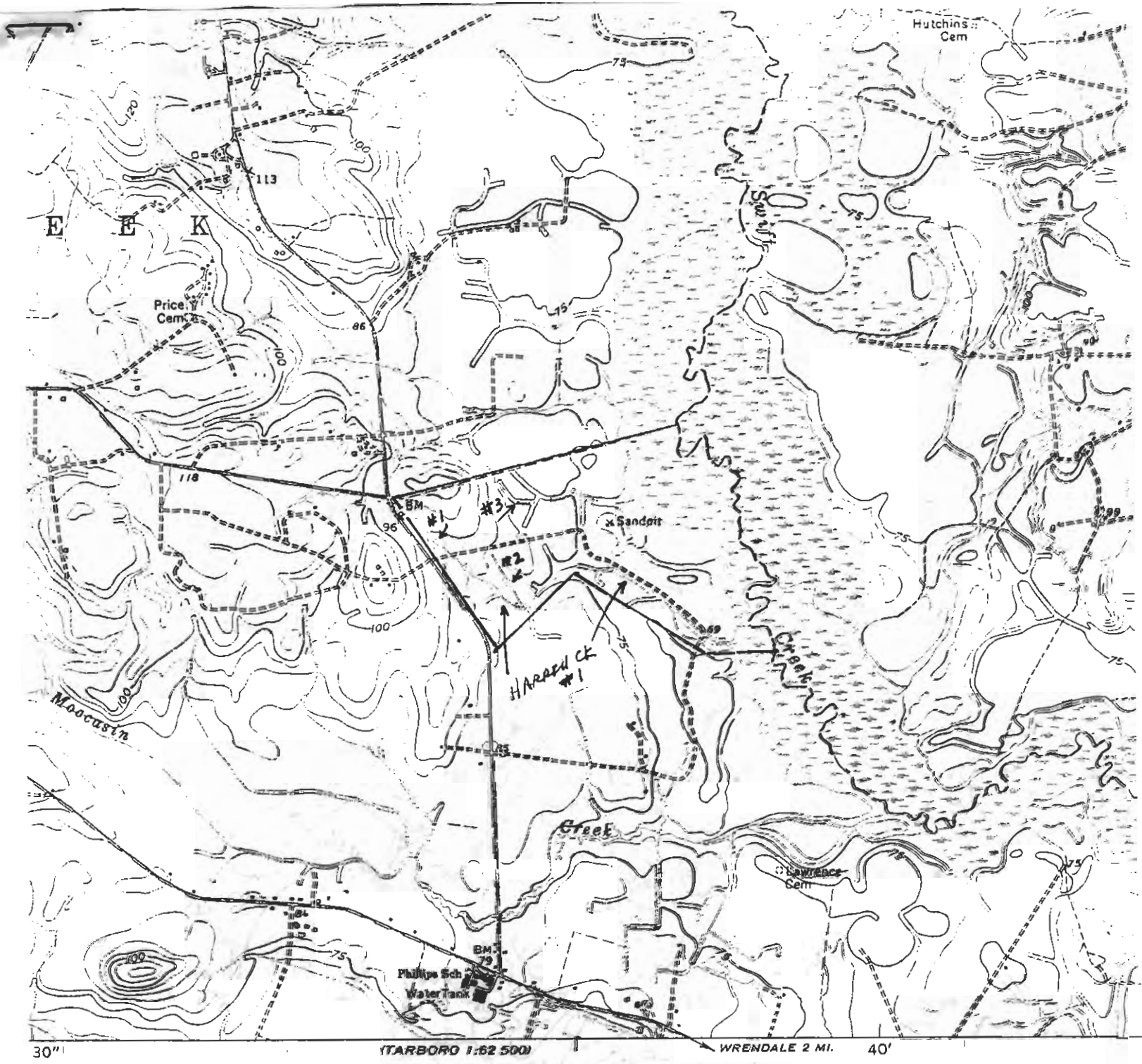
The (owner/future owners) should notify the Division of Water Quality (including any other Local, State, and Federal Agencies) of this decision concerning any future correspondences regarding the subject property (stated above). This project may require a Section 404/401 Permit for the proposed activity. Any inquiries should be directed to the Division of Water Quality (Central Office) at (919)-733-1786, and the US Army Corp of Engineers (Raleigh Regulatory Field Office) at (919)-876-8441.

Respectfully,

Michael Horan

Michael Horan
Environmental Spec. I

CC: Jean Maneule, US Army Corps of Engineers, Raleigh Regulatory Office
Debbie Edwards-Wetlands/ Stormwater Branch, 2321 Crabtree Blvd, Suite 250, Raleigh, NC 27604
File Copy
Central Files



SCALE 1:24 000

1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 KILOMETER

CONTOUR INTERVAL 5 FEET

DATUM IS MEAN SEA LEVEL

MCH 9/13/05

N.C.

QUADRANGLE LOCATION

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS

FOR SALE BY U. S. GEOLOGICAL SURVEY

DENVER, COLORADO 80225, OR RESTON, VIRGINIA 22092

A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

EDGECOMBE COUNTY, NORTH CAROLINA — SHEET NUMBER 6

mcb 9/13/05

Appendix C. Conservation Easement

CONSERVATION EASEMENT – PARCEL "A"

ALL THAT CERTAIN PARCEL OF LAND, SITUATE IN EDGECOMBE COUNTY, NORTH CAROLINA, BEING MORE PARTICULARLY DESCRIBED AS FOLLOWS:

BEGINNING AT THE NORTHWESTERLY CORNER OF TAX PARCEL NUMBER 3882-98-0552, MARKED BY AN IRON PIN, FOUND. FROM SAID BEGINNING POINT, CONTINUING THENCE;
(1) SOUTH 81°59'59" EAST, 280.15 FEET, TO A POINT, THENCE;
(2) SOUTH 39°24'37" EAST, 590.20 FEET, TO A POINT, THENCE;
(3) SOUTH 51°00'19" EAST, 1638.42 FEET, TO A POINT, THENCE;
(4) NORTH 43°22'12" EAST, 731.30 FEET, TO A POINT, THENCE;
(5) NORTH 77°03'02" EAST, 499.20 FEET, TO A POINT, THENCE;
(6) SOUTH 85°32'48" EAST, 348.85 FEET, TO A POINT, THENCE;
(7) SOUTH 59°26'04" EAST, 528.37 FEET, TO A POINT, THENCE;
(8) SOUTH 49°42'55" EAST, 1120.20 FEET, TO A POINT, THENCE;
(9) SOUTH 58°20'24" EAST, 214.16 FEET, TO A POINT, THENCE;
(10) SOUTH 82°25'53" EAST, 355.65 FEET, TO A POINT, THENCE;
(11) SOUTH 07°34'07" WEST, 150.00 FEET, TO A POINT, THENCE;
(12) NORTH 82°25'53" WEST, 387.66 FEET, TO A POINT, THENCE;
(13) NORTH 58°20'24" WEST, 257.48 FEET, TO A POINT, THENCE;
(14) NORTH 49°42'55" WEST, 1118.76 FEET, TO A POINT, THENCE;
(15) NORTH 59°26'04" WEST, 480.83 FEET, TO A POINT, THENCE;
(16) NORTH 85°32'48" WEST, 291.11 FEET, TO A POINT, THENCE;
(17) SOUTH 77°03'02" WEST, 415.08 FEET, TO A POINT, THENCE;
(18) SOUTH 38°08'55" WEST, 707.08 FEET, TO A POINT, THENCE;
(19) NORTH 87°32'58" WEST, 214.74 FEET, TO A POINT, THENCE;
(20) NORTH 51°00'19" WEST, 1703.18 FEET, TO A POINT, THENCE;
(21) NORTH 39°24'37" WEST, 536.02 FEET, TO A POINT, THENCE;
(22) NORTH 77°39'00" WEST, 145.23 FEET, TO A POINT, THENCE;
(23) ON A CURVE TO THE RIGHT, HAVING A RADIUS OF 909.82 FEET, AND ON AN ARC LEGTH OF 169.49 FEET, TO THE POINT AND PLACE OF BEGINNING.

SAID EASEMENT CONTAINING WITHIN SAID BOUNDS 971,538 SQUARE FEET OR 22.303 ACRES MORE OR LESS.

LESS AND EXCEPT

ALL THAT CERTAIN 30 FEET WIDE STRIP OF LAND BEING MORE PARTICULARLY DESCRIBED AS FOLLOWS:

BEGINNING AT A POINT, SAID POINT BEING SOUTH 51°00'19" EAST, 466.51 FEET FROM THE TERMINUS OF THE SECOND COURSE OF THE AFOREMENTIONED PARCEL 'A'. FROM SAID BEGINNING POINT, CONTINUING THENCE;
(L1) SOUTH 51°00'19" EAST, 37.13 FEET, TO A POINT, THENCE;
(L2) SOUTH 75°05'15" WEST, 185.63 FEET, TO A POINT, THENCE;
(L3) NORTH 51°00'19" WEST, 37.13 FEET, TO A POINT, THENCE;
(L4) NORTH 75°05'15" EAST, 185.63 FEET, TO THE POINT AND PLACE OF BEGINNING.

SAID 30 FEET WIDE STRIP OF LAND CONTAINING WITHIN SAID BOUNDS 5,569 SQUARE FEET OR 0.128 ACRES MORE OR LESS.

LESS AND EXCEPT

ALL THAT CERTAIN 30 FEET WIDE STRIP OF LAND BEING MORE PARTICULARLY DESCRIBED AS FOLLOWS:

BEGINNING AT A POINT, SAID POINT BEING SOUTH 85°32'48" EAST, 64.35 FEET FROM THE TERMINUS OF THE FIFTH COURSE OF THE AFOREMENTIONED PARCEL 'A'. FROM SAID BEGINNING POINT, CONTINUING THENCE;
(L5) SOUTH 85°32'48" EAST, 30.21 FEET, TO A POINT, THENCE;
(L6) SOUTH 11°12'11" WEST, 151.05 FEET, TO A POINT, THENCE;
(L7) NORTH 85°32'48" WEST, 30.21 FEET, TO A POINT, THENCE;
(L8) NORTH 11°12'11" EAST, 151.05 FEET, TO THE POINT AND PLACE OF BEGINNING.

SAID 30 FEET WIDE STRIP OF LAND CONTAINING WITHIN SAID BOUNDS 4,531 SQUARE FEET OR 0.104 ACRES MORE OR LESS.

LESS AND EXCEPT

ALL THAT CERTAIN 10 FEET WIDE STRIP OF LAND BEING MORE PARTICULARLY DESCRIBED AS FOLLOWS:

BEGINNING AT A POINT, SAID POINT BEING SOUTH 58°20'24" EAST, 28.71 FEET FROM THE TERMINUS OF THE EIGHTH COURSE OF THE AFOREMENTIONED PARCEL 'A'. FROM SAID BEGINNING POINT, CONTINUING THENCE;
(L9) SOUTH 58°20'24" EAST, 13.41 FEET, TO A POINT, THENCE;
(L10) SOUTH 73°24'52" WEST, 186.66 FEET, TO A POINT, THENCE;
(L11) NORTH 49°42'55" WEST, 11.94 FEET, TO A POINT, THENCE;
(L12) NORTH 73°24'52" EAST, 184.26 FEET, TO THE POINT AND PLACE OF BEGINNING.

SAID 10 FEET WIDE STRIP OF LAND CONTAINING WITHIN SAID BOUNDS 1,855 SQUARE FEET OR 0.043 ACRES MORE OR LESS.

30 FEET WIDE ACCESS EASEMENT – PARCEL "B"

ALL THAT CERTAIN 30 FEET WIDE STRIP OF LAND, SITUATE IN EDGECOMBE COUNTY, NORTH CAROLINA, BEING MORE PARTICULARLY DESCRIBED AS FOLLOWS:

BEGINNING AT A POINT, SAID POINT BEING SOUTH 81°59'59" EAST, 151.13 FEET FROM THE NORTHWESTERLY CORNER OF TAX PARCEL NUMBER 3882-98-0552, MARKED BY AN IRON PIN, FOUND. FROM SAID BEGINNING POINT, CONTINUING THENCE;
(1) NORTH 75°00'37" EAST, 1359.73 FEET, TO A POINT, THENCE;
(2) SOUTH 35°07'22" EAST, 31.95 FEET, TO A POINT, THENCE;
(3) SOUTH 75°00'37" WEST, 1300.02 FEET, TO A POINT, THENCE;
(4) NORTH 81°59'59" WEST, 76.81 FEET, TO THE POINT AND PLACE OF BEGINNING.

SAID 30 FEET WIDE ACCESS EASEMENT CONTAINING WITHIN SAID BOUNDS 39,896 SQUARE FEET OR 0.916 ACRES MORE OR LESS.

EASEMENT AREA TABLE	
EASEMENT PARCEL A	22.029 AC OR 959,583SF
EASEMENT PARCEL B	0.916 AC OR 39,896 SF
EASEMENT PARCEL C	22.261 AC OR 969,706 SF

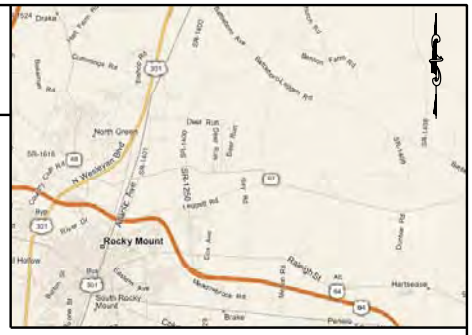
CONSERVATION EASEMENT – PARCEL "C"

ALL THAT CERTAIN PARCEL OF LAND, SITUATE IN EDGECOMBE COUNTY, NORTH CAROLINA, BEING MORE PARTICULARLY DESCRIBED AS FOLLOWS:

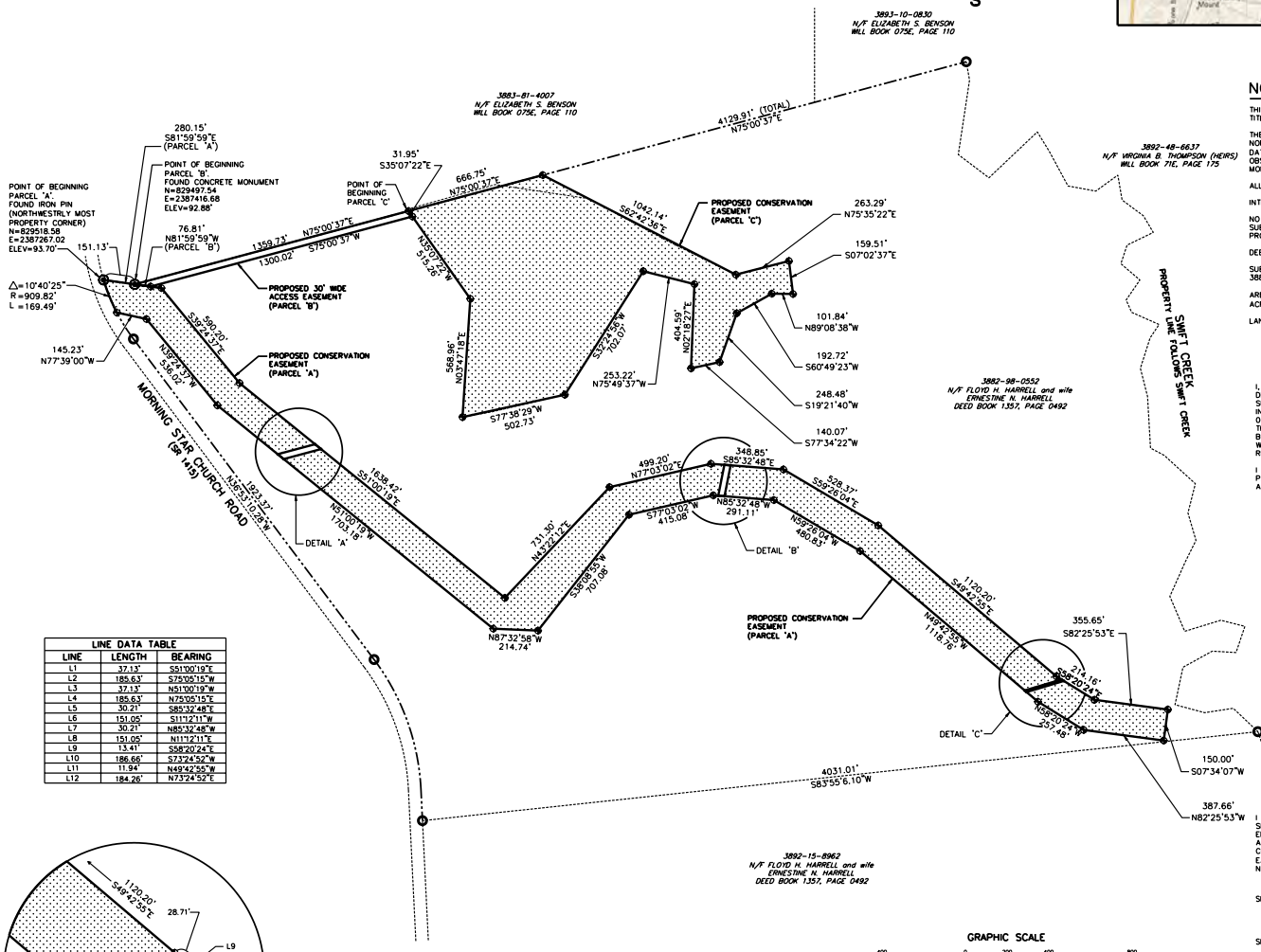
BEGINNING AT A POINT, SAID POINT BEING THE TERMINUS OF THE FIRST COURSE OF THE AFOREMENTIONED PARCEL 'B'. FROM SAID BEGINNING POINT, CONTINUING THENCE;
(1) NORTH 75°00'37" EAST, 666.75 FEET, TO A POINT, THENCE;
(2) SOUTH 62°42'36" EAST, 1042.14 FEET, TO A POINT, THENCE;
(3) NORTH 75°35'22" EAST, 263.29 FEET, TO A POINT, THENCE;
(4) SOUTH 07°02'37" EAST, 159.51 FEET, TO A POINT, THENCE;
(5) NORTH 89°08'38" WEST, 101.84 FEET, TO A POINT, THENCE;
(6) SOUTH 60°49'23" WEST, 192.72 FEET, TO A POINT, THENCE;
(7) SOUTH 19°21'40" WEST, 248.48 FEET, TO A POINT, THENCE;
(8) SOUTH 77°34'22" WEST, 140.07 FEET, TO A POINT, THENCE;
(9) NORTH 02°18'27" EAST, 404.59 FEET, TO A POINT, THENCE;
(10) NORTH 75°49'37" WEST, 253.22 FEET, TO A POINT, THENCE;
(11) SOUTH 32°24'56" WEST, 702.07 FEET, TO A POINT, THENCE;
(12) SOUTH 77°38'29" WEST, 502.73 FEET, TO A POINT, THENCE;
(13) NORTH 03°47'18" EAST, 568.96 FEET, TO A POINT, THENCE;
(14) NORTH 35°07'22" WEST, 515.26 FEET, TO THE POINT AND PLACE OF BEGINNING.

SAID EASEMENT CONTAINING WITHIN SAID BOUNDS 969,706 SQUARE FEET OR 22.261 ACRES MORE OR LESS.

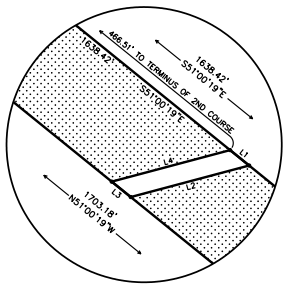
LEGEND
- EXISTING PROPERTY LINE (SURVEYED)
- EXISTING PROPERTY LINE (NOT SURVEYED)
- EASEMENT BOUNDARY LINE
- SET IRON PIN WITH NCDOT CAP AND CARSONITE
- CALCULATED CORNER (NO IRON SET OR FOUND)
- IRON PIN FOUND



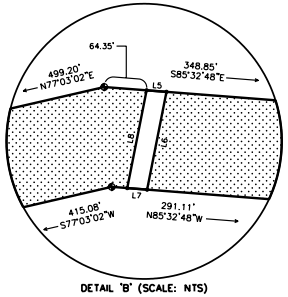
VICINITY MAP
(NOT TO SCALE)



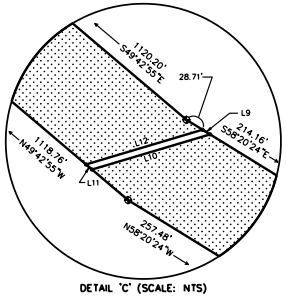
LINE DATA TABLE		
LINE	LENGTH	BEARING
L1	37.13'	S51°00'19"E
L2	185.63'	S75°05'15"W
L3	37.13'	N51°00'19"W
L4	185.63'	N75°05'15"E
L5	30.21'	S85°32'48"E
L6	151.05'	S11°12'11"W
L7	30.21'	N85°32'48"W
L8	151.05'	N11°12'11"E
L9	13.41'	S58°20'24"E
L10	186.66'	S73°24'52"W
L11	11.94'	N49°42'55"W
L12	184.26'	N73°24'52"E



DETAIL 'A' (SCALE: NTS)



DETAIL 'B' (SCALE: NTS)



DETAIL 'C' (SCALE: NTS)

NOTES:

THIS PLAN HAS BEEN PREPARED WITHOUT THE BENEFIT OF A REPORT OF TITLE.

THE BASIS OF THE MERIDIANS AND COORDIANTES FOR THIS PLAT IS THE NORTH CAROLINA STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM 1983 (N.C.S.P.C.S. NAD 83), BASED ON DIFFERENTIAL GPS OBSERVATIONS PERFORMED BY KCI ASSOCIATES OF NC DURING THE MONTH OF AUGUST 2005.

ALL DISTANCES ARE GROUND UNLESS OTHERWISE NOTED.

INTERIOR LOT IMPROVEMENTS NOT SHOWN ON THIS SURVEY.

NO GEODETIC MONUMENTS WERE RECOVERED WITHIN 2000 FEET OF SUBJECT PROPERTY.

DEED REFERENCE: BOOK 1357, PAGE 0492.

SUBJECT PROPERTY KNOWN AS TAX MAP PARCEL NUMBER 3882-98-0552.

AREA OF SUBJECT PROPERTY: 314.74 ACRES (BY TAX RECORD), 319.00 ACRES (BY DEED).

LANDOWNER INFORMATION:
FLOYD H. HARRELL AND WIFE
ERNESTINE N. HARRELL
ROUTE 4, BOX 575
TARBORO, NC 27886

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, AS DRAWN FROM INFORMATION FOUND IN BOOK 1357, PAGE 0492; 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 5TH DAY OF DECEMBER, 2005.

I FURTHER CERTIFY THAT THIS SURVEY IS OF AN EXISTING PARCEL OR PARCELS OF LAND AND DOES NOT CREATE A NEW STREET OR CHANGE AN EXISTING STREET.

NORTH CAROLINA REGISTRATION NUMBER L-3860
JAMES M. GELLENTHIN

NORTH CAROLINA, EDGECOMBE COUNTY

I, _____, A NOTARY PUBLIC OF THE COUNTY AND STATE AFORESAID, CERTIFY THAT _____ PERSONALLY APPEARED BEFORE ME THIS DAY AND ACKNOWLEDGED THE EXECUTION OF THE FOREGOING INSTRUMENT.

WITNESS MY HAND AND OFFICIAL STAMP OR SEAL THIS _____ DAY OF _____, 2005.

NOTARY PUBLIC

MY COMMISION EXPIRES

I HEREBY CERTIFY THAT I AM THE OWNER OF THE PROPERTY SHOWN AND DESCRIBED HEREON, WHICH IS LOCATED IN EDGECOMBE COUNTY, TOWNSHIP #7; THAT I HEREBY ACCEPT AND ADOPT THIS PLAN OF EASEMENT, WITH MY FREE CONSENT, ESTABLISH AND DEDICATE THE CONSERVATION EASEMENT(S), AS DEPICTED HEREON, TO THE STATE OF NORTH CAROLINA.

SIGNED: _____
FLOYD H. HARRELL

SIGNED: _____
ERNESTINE N. HARRELL

NORTH CAROLINA – EDGECOMBE COUNTY

THE FOREGOING CERTIFICATE(S) OF PAULINE KOSS, N.P. IS(ARE) CERTIFIED TO BE CORRECT. THIS INSTRUMENT WAS PRESENTED FOR REGISTRATION AND RECORDED IN THIS OFFICE AT BOOK _____, PAGE _____, THIS _____ DAY OF _____, A.D. 2005, AT _____ O'CLOCK __.M.

REGISTER OF DEEDS

NORTH CAROLINA – EDGECOMBE COUNTY

I, _____, REVIEW OFFICER OF THE COUNTY OF EDGECOMBE, CERTIFY THAT THE MAP OR PLAT TO WHICH THIS CERTIFICATION IS AFFIXED MEETS ALL STATUTORY REQUIREMENTS FOR RECORDING.

DATE

REVIEW OFFICER

12054239

KCI ASSOCIATES OF NORTH CAROLINA
KCI ASSOCIATES OF N.C.
ENGINEERS, SURVEYORS AND PLANNERS
4601 SIX FORKS ROAD, SUITE 200
RALEIGH, NC 27609
PHONE (919) 783-9214 • FAX (919) 783-9266

CONSERVATION EASEMENT PLAT
FOR
HARRELL STREAM AND WETLAND RESTORATION SITE
MORNING STAR CHURCH ROAD
NO.7 TOWNSHIP, EDGECOMBE CO., NORTH CAROLINA

DATE:	SCALE:	SHEET:
DEC 05, 2005	1" = 400'	1 OF 1

Appendix D. Project Site Photographs

STREAM SITE PHOTOGRAPHS

Beginning of the project stream as it leaves the culvert and enters the Harrell Property.

Looking upstream toward the first road crossing on the project stream.

A view downstream from the first road crossing; gauge 1 is seen on the left.

Looking downstream with agricultural fields bordering both sides of the stream.

Eroding banks along the project stream.

Looking upstream from the second road crossing.

STREAM SITE PHOTOGRAPHS

A view downstream from the second road crossing with gauge 2 on the left.

Exposed banks along the project stream.

A look upstream along the lower portion of the project stream.

Another view upstream along the lower portion of the project stream.

Looking upstream from the end of the project stream.

The downstream limit of the project stream where it enters a forested section before draining into Swift Creek.

WETLAND SITE PHOTOGRAPHS

An overview of the wetland site looking toward the southeast.

A look at the wetland site (to the left) from the upper northern boundary.

The entire wetland site is under agricultural production.

A look at the confluence of three ditches that currently drain the wetland site.

Looking upstream of the ditch that drains the southern portion of the wetland site.

Looking north-northeast over the site from the main ditch.

Appendix E. Existing Conditions Data

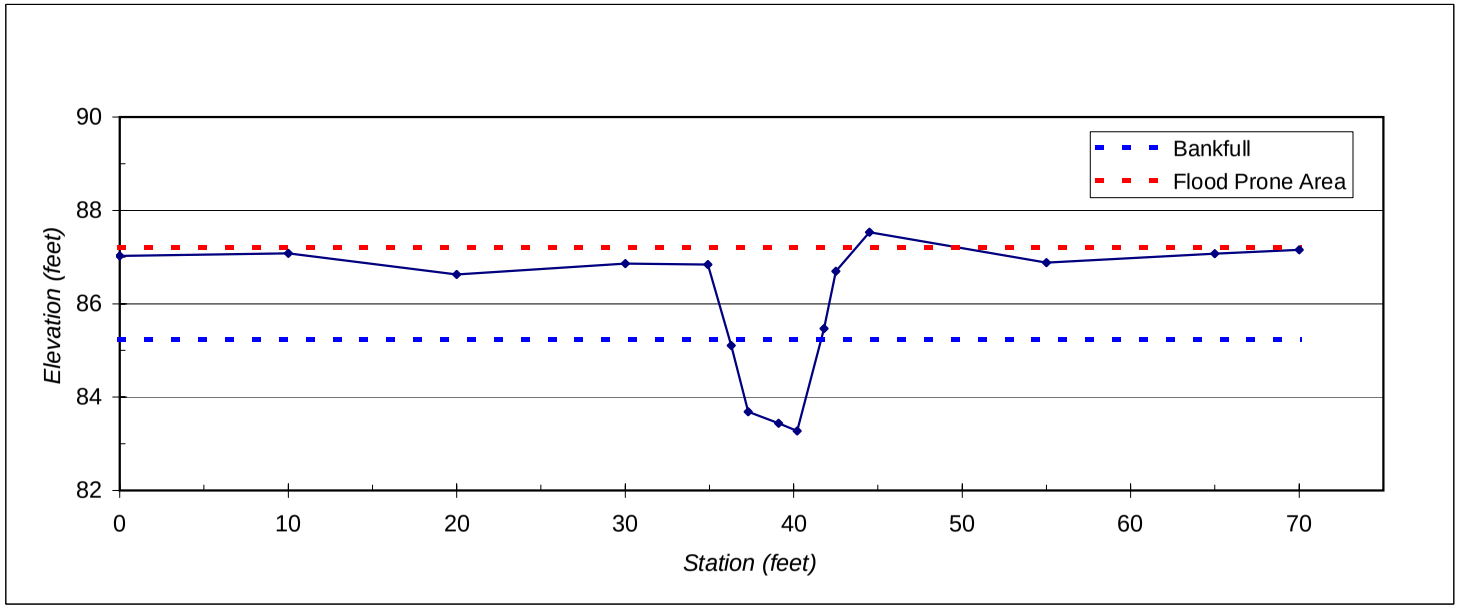
River Basin:	Tar-Pamlico
Watershed:	UTSC
XS ID	XS 1
Drainage Area (sq mi):	0.2
Date:	April 2006
Field Crew:	French, Hayes, Helms, Patterson

Station	Elevation
0	87.03
10	87.08
20	86.63
30	86.86
34.9	86.84
36.3	85.10
37.3	83.68
39.1	83.44
40.2	83.28
41.8	85.47
42.5	86.70
44.5	87.53
55	86.88
65	87.07
70	87.15

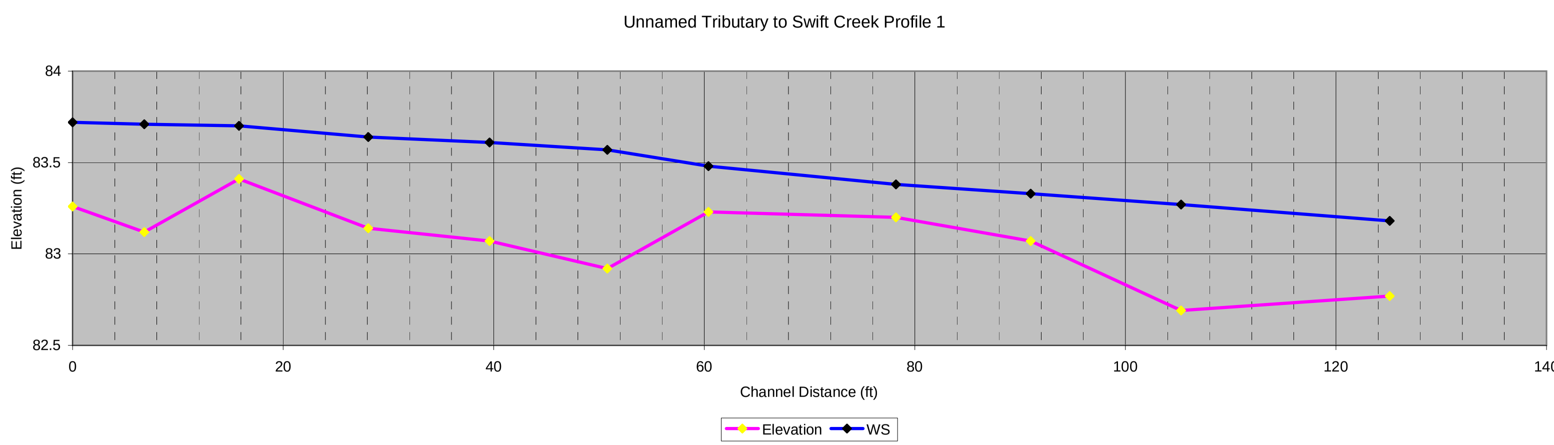
SUMMARY DATA	
Bankfull Elevation:	85.2
Bankfull Cross-Sectional Area:	7.3
Bankfull Width:	5.4
Flood Prone Area Elevation:	87.2
Flood Prone Width:	>70
Max Depth at Bankfull:	2.0
Mean Depth at Bankfull:	1.3
W / D Ratio:	4.1
Entrenchment Ratio:	13.0
Bank Height Ratio:	1.8
Slope (ft/ft):	0.004
Discharge (cfs)	24

No Photo

Stream Type:	E5



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														
		0.0		100									83.26					83.72
	6.8	6.8		100									83.12					83.71
	9.0	15.8		100									83.41					83.7
	12.3	28.1		100									83.14					83.64
	11.5	39.6		100									83.07					83.61
	11.2	50.8		100									82.92					83.57
	9.6	60.4		100									83.23					83.48
	17.8	78.2		100									83.20					83.38
	12.8	91.0		100									83.07					83.33
	14.3	105.3		100									82.69					83.27
	19.8	125.1		100									82.77					83.18
	0.0			100														
	0.0			100														
	0.0			100														
	0.0			100														
	0.0			100														
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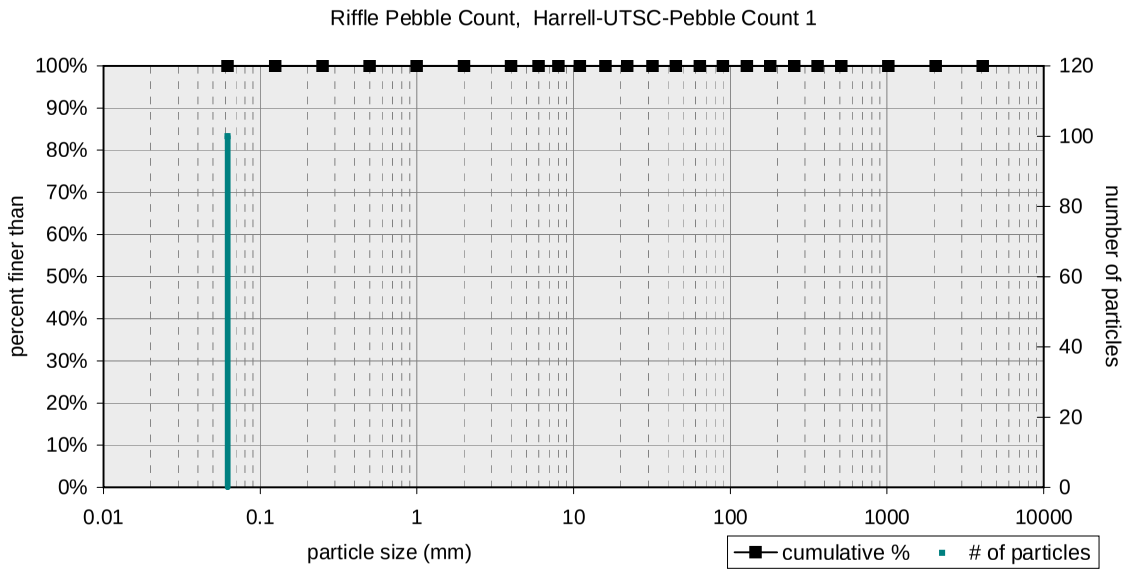
Riffle Pebble Count

Riffle Pebble Count,

Material	Size Range (mm)		Count	
silt/clay	0	0.062	**100**	#
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		#
very fine gravel	2	4		#
fine gravel	4	6		#
fine gravel	6	8		#
medium gravel	8	11		#
medium gravel	11	16		#
coarse gravel	16	22		#
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

	Harrell-UTSC-Pebble Count 1
	Tar Pamlico
Note:	**XS 1**



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	0.06	0.1	0	0	0	1.0	0.1	1.0

based on total count	percent by substrate type								
	silt/clay	sand	gravel	cobble	boulder	bedrock	hardpan	wood/det	artificial
	100%	0%	0%	0%	0%	0%	0%	0%	0%

Pebble Count of Channel Reach

Material	Size Range (mm)		Count	
silt/clay	0	0.062	**79**	##
very fine sand	0.062	0.13	**14**	##
fine sand	0.13	0.25	**6**	##
medium sand	0.25	0.5	**1**	##
coarse sand	0.5	1		##
very coarse sand	1	2		##
very fine gravel	2	4		##
fine gravel	4	6		##
fine gravel	6	8		##
medium gravel	8	11		##
medium gravel	11	16		##
coarse gravel	16	22		##
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	

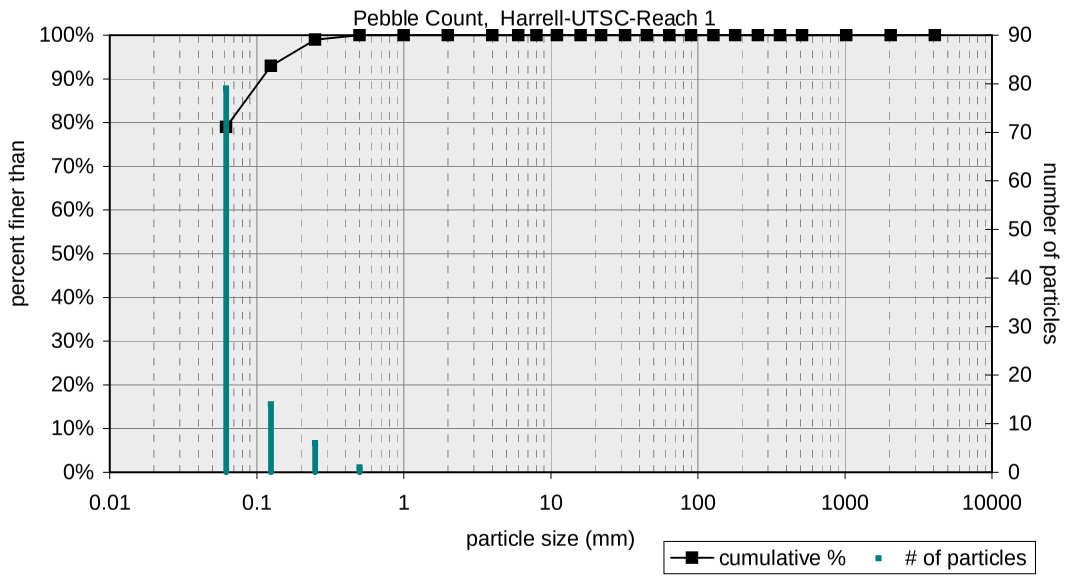
bedrock		
clay hardpan		
detritus/wood		
artificial		
	total count:	100

Pebble Count,

Harrell-UTSC-Reach 1

Tar Pamlico

Note: **XS 1**



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	0.06	0.1	0	0	0	1.1	0.1	1.1

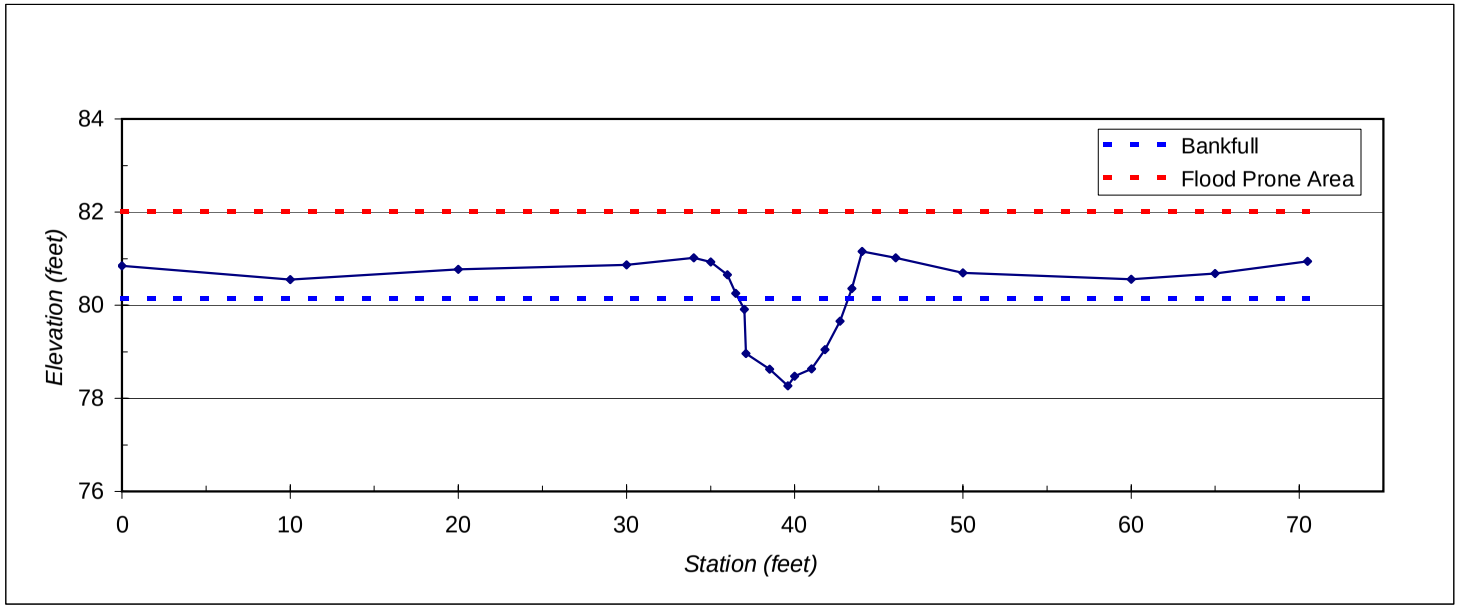
based on total count	percent by substrate type								
	silt/clay	sand	gravel	cobble	boulder	bedrock	hardpan	wood/det	artificial
	79%	21%	0%	0%	0%	0%	0%	0%	0%

River Basin:	Tar-Pamlico
Watershed:	UTSC
XS ID	XS 2
Drainage Area (sq mi):	0.23
Date:	April 2006
Field Crew:	Hayes, Helms, Patterson

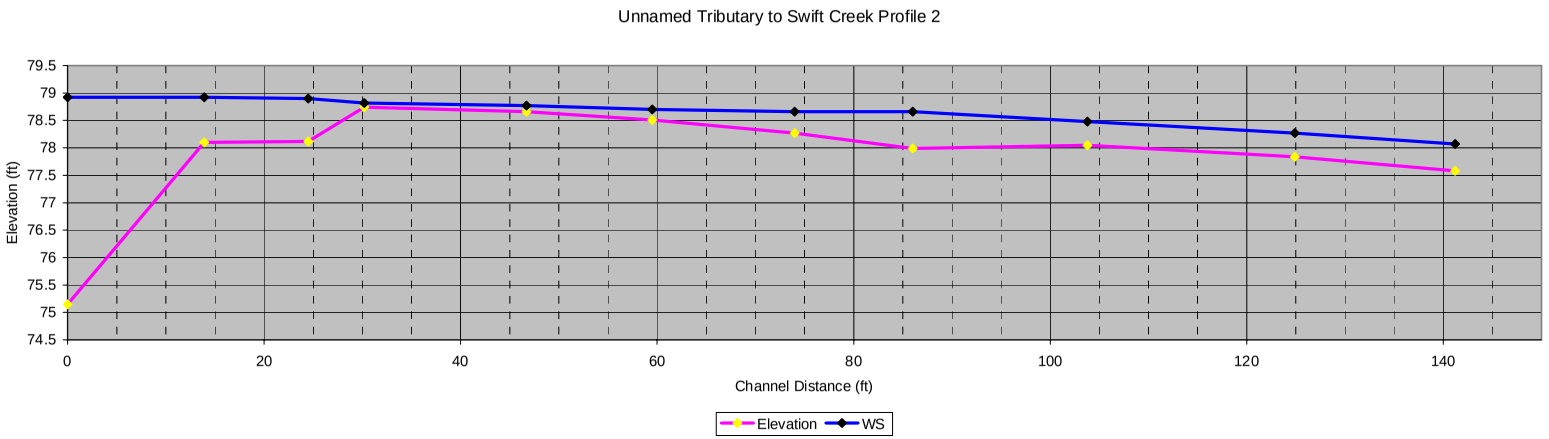
Station	Elevation
0	80.85
10	80.55
20	80.77
30	80.87
34	81.02
35	80.93
36	80.66
36.5	80.25
37	79.91
37.1	78.96
38.5	78.62
39.6	78.27
40	78.48
41	78.63
41.8	79.05
42.7	79.66
43.4	80.36
44	81.15
46	81.02
50	80.69
60	80.56
65	80.68
70.5	80.94

SUMMARY DATA	
Bankfull Elevation:	80.1
Bankfull Cross-Sectional Area:	8.0
Bankfull Width:	6.5
Flood Prone Area Elevation:	82.0
Flood Prone Width:	>70
Max Depth at Bankfull:	1.9
Mean Depth at Bankfull:	1.2
W / D Ratio:	5.3
Entrenchment Ratio:	10.8
Bank Height Ratio:	1.4
Slope (ft/ft):	0.006
Discharge (cfs)	31

Stream Type:	E5



Slope Profile


Unnamed Tributary to Swift Creek Profile 2

			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														
		0		100									75.15					78.92
	13.9	13.9		100									78.10					78.92
	10.6	24.5		100									78.12					78.9
	5.7	30.2		100									78.74					78.82
	16.5	46.7		100									78.66					78.77
	12.8	59.5		100									78.51					78.7
	14.5	74.0		100									78.27					78.66
	12.0	86.0		100									77.99					78.66
	17.8	103.8		100									78.05					78.48
	21.1	124.9		100									77.84					78.27
	16.3	141.2		100									77.58					78.07
	0.0			100														
	0.0			100														
	0.0			100														
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	0.0			100														

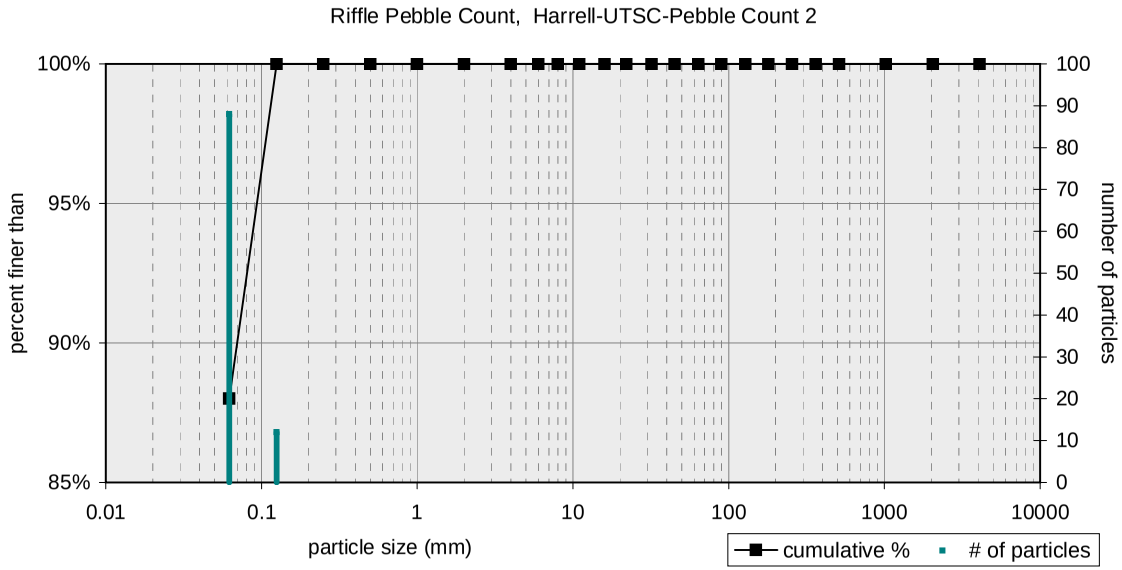
Riffle Pebble Count

Riffle Pebble Count,

Material	Size Range (mm)		Count	
silt/clay	0	0.062	**88**	#
very fine sand	0.062	0.13	**12**	#
fine sand	0.13	0.25		#
medium sand	0.25	0.5		#
coarse sand	0.5	1		#
very coarse sand	1	2		#
very fine gravel	2	4		#
fine gravel	4	6		#
fine gravel	6	8		#
medium gravel	8	11		#
medium gravel	11	16		#
coarse gravel	16	22		#
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

	Harrell-UTSC-Pebble Count 2
	Tar Pamlico
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
	0.062	0.06	0.1	0	0	0	1.0	0.1	1.0

based on total count	percent by substrate type								
	silt/clay	sand	gravel	cobble	boulder	bedrock	hardpan	wood/det	artificial
	88%	12%	0%	0%	0%	0%	0%	0%	0%

Pebble Count of Channel Reach

Material	Size Range (mm)		Count	
silt/clay	0	0.062	**93**	##
very fine sand	0.062	0.13	**7**	##
fine sand	0.13	0.25		##
medium sand	0.25	0.5		##
coarse sand	0.5	1		##
very coarse sand	1	2		##
very fine gravel	2	4		##
fine gravel	4	6		##
fine gravel	6	8		##
medium gravel	8	11		##
medium gravel	11	16		##
coarse gravel	16	22		##
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	

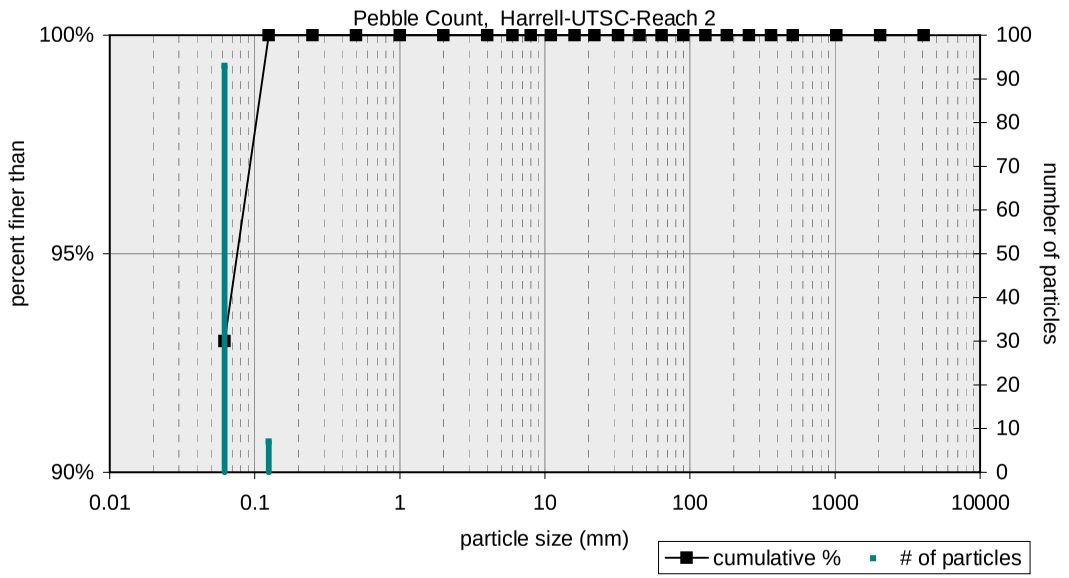
bedrock		
clay hardpan		
detritus/wood		
artificial		
	total count:	100

Pebble Count,

Harrell-UTSC-Reach 2

Tar Pamlico

Note: **XS 2**



based on sediment particles only	size percent less than (mm) D16	D35	D50	D65	D84	D95	particle size distribution gradation	geo mean	std dev
	0.062	0.06	0.1	0	0	0	1.0	0.1	1.0

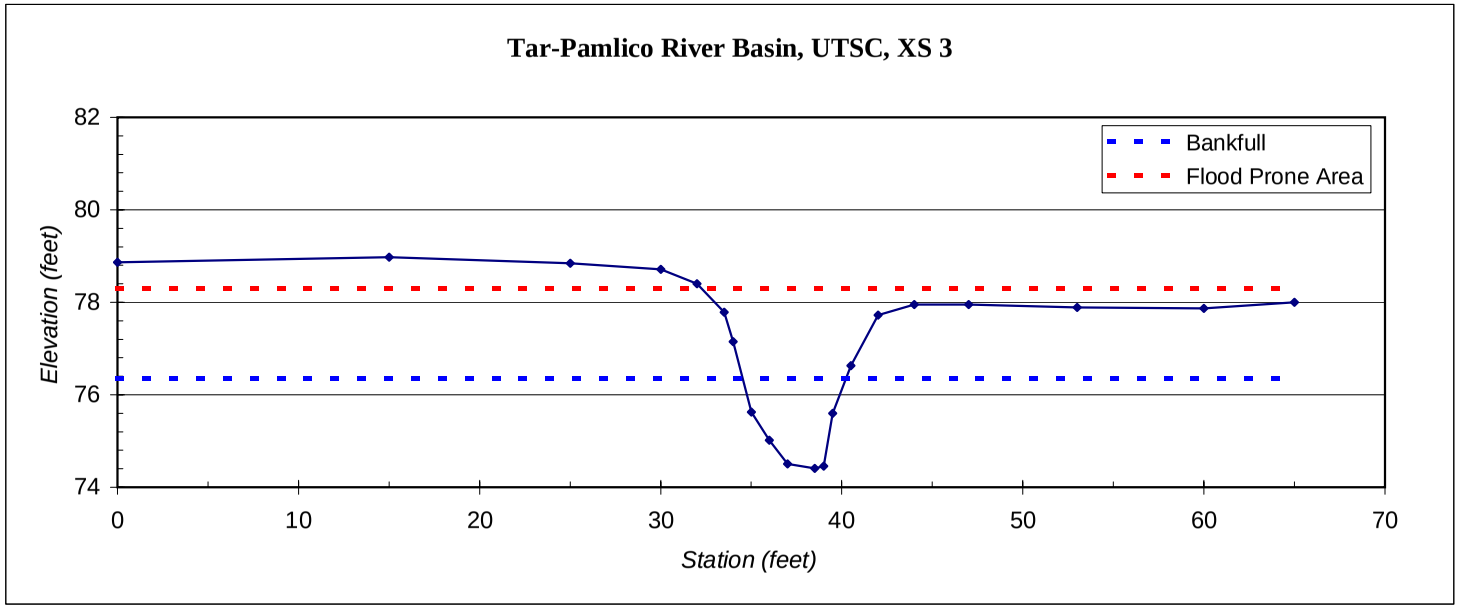
based on total count	percent by substrate type silt/clay	sand	gravel	cobble	boulder	bedrock	hardpan	wood/det	artificial
	93%	7%	0%	0%	0%	0%	0%	0%	0%

River Basin:	Tar-Pamlico
Watershed:	UTSC
XS ID	XS 3
Drainage Area (sq mi):	0.23
Date:	April 2006
Field Crew:	Hayes, Helms, Patterson

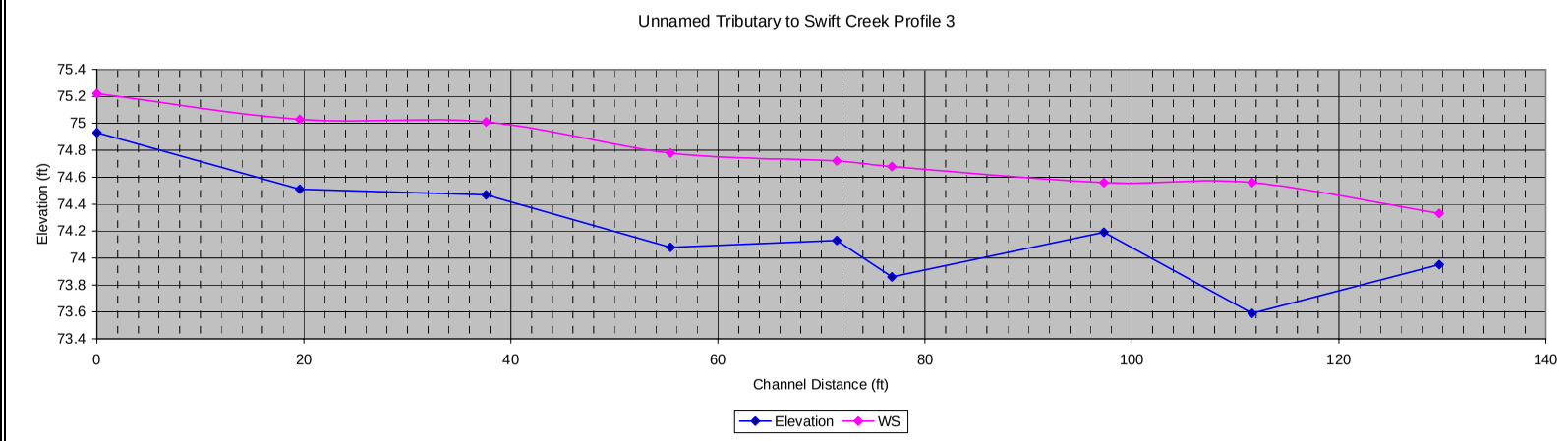
Station	Elevation
0	78.86
15	78.97
25	78.84
30	78.71
32	78.40
33.5	77.79
34	77.15
35	75.63
36	75.02
37	74.51
38.5	74.41
39	74.45
39.5	75.60
40.5	76.63
42	77.72
44	77.95
47	77.95
53	77.89
60	77.87
65	78.00

SUMMARY DATA	
Bankfull Elevation:	76.4
Bankfull Cross-Sectional Area:	7.5
Bankfull Width:	5.7
Flood Prone Area Elevation:	78.3
Flood Prone Width:	>65
Max Depth at Bankfull:	1.9
Mean Depth at Bankfull:	1.3
W / D Ratio:	4.3
Entrenchment Ratio:	11.4
Bank Height Ratio:	1.8
Slope (ft/ft):	0.007
Discharge (cfs)	31

Stream Type:	E5



Slope Profile



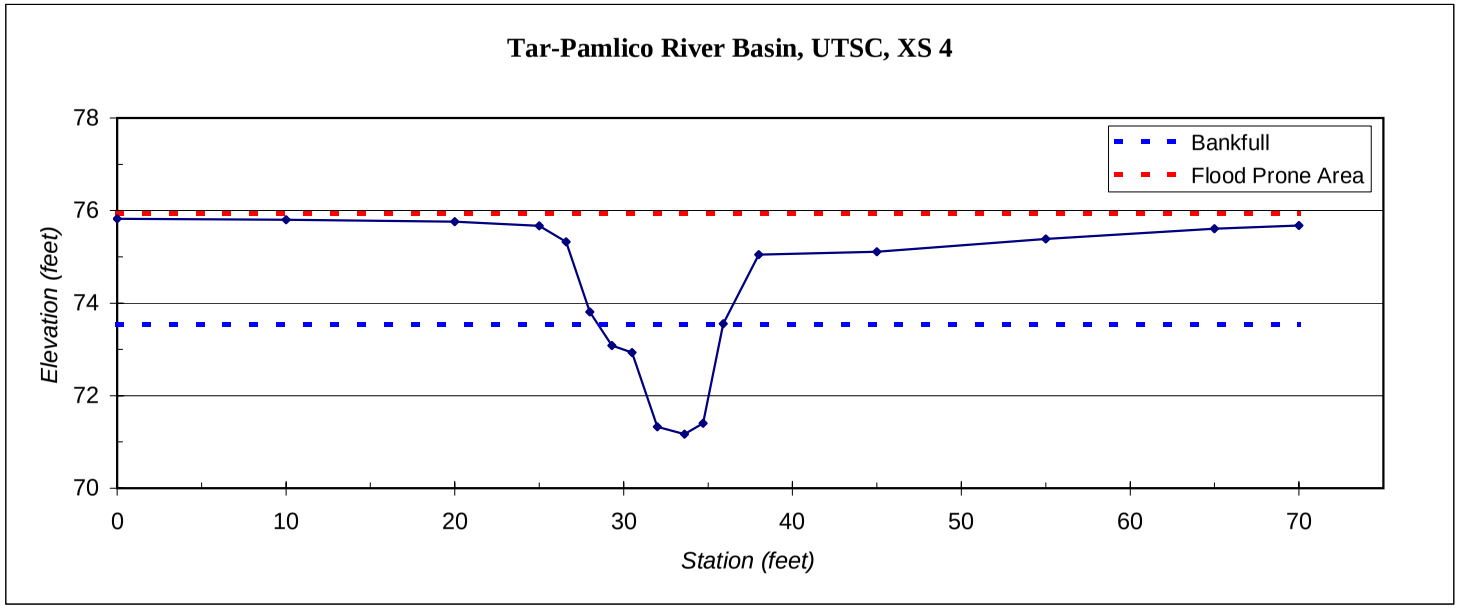
				Elevation BM:	100													
notes	inc distance	station	BS	HI	FS TP	FS bed	depth water	FS LB	FS RB	FS BKF	FS WS	AZ azimuth	ELEV bed	ELEV water srf	ELEV LF	ELEV RB	ELEV BKF	ELEV WS
		0		100									74.93					75.22
	19.6	19.6		100									74.51					75.03
	18.0	37.6		100									74.47					75.01
	17.8	55.4		100									74.08					74.78
	16.1	71.5		100									74.13					74.72
	5.3	76.8		100									73.86					74.68
	20.5	97.3		100									74.19					74.56
	14.3	111.6		100									73.59					74.56
	18.1	129.7		100									73.95					74.33
	0.0			100														
	0.0			100														
	0.0			100														
	0.0			100														
	0.0			100														
	0.0			100														
	0.0			100														

River Basin:	Tar-Pamlico
Watershed:	UTSC
XS ID	XS 4
Drainage Area (sq mi):	0.385
Date:	April 2006
Field Crew:	Hayes, Helms, Patterson

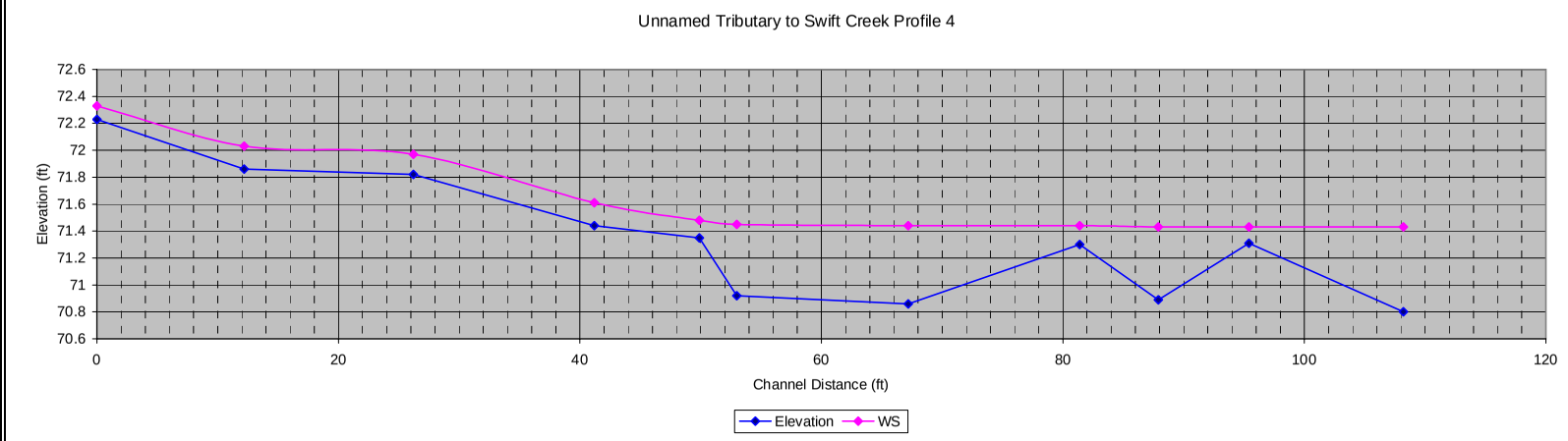
Station	Elevation
0	75.82
10	75.80
20	75.76
25	75.67
26.6	75.32
28	73.81
29.3	73.08
30.5	72.93
32	71.33
33.6	71.17
34.7	71.41
35.9	73.55
38	75.05
45	75.11
55	75.39
65	75.60
70	75.68

SUMMARY DATA	
Bankfull Elevation:	73.6
Bankfull Cross-Sectional Area:	10.4
Bankfull Width:	7.4
Flood Prone Area Elevation:	75.9
Flood Prone Width:	>70
Max Depth at Bankfull:	2.4
Mean Depth at Bankfull:	1.4
W / D Ratio:	5.3
Entrenchment Ratio:	9.5
Bank Height Ratio:	1.6
Slope (ft/ft):	0.008
Discharge (cfs)	50

Stream Type:	E5



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									72.23					72.33
	12.2	**12.2**		100									71.86					72.03
	14.0	**26.2**		100									71.82					71.97
	15.0	**41.2**		100									71.44					71.61
	8.7	**49.9**		100									71.35					71.48
	3.1	**53.0**		100									70.92					71.45
	14.2	**67.2**		100									70.86					71.44
	14.2	**81.4**		100									71.30					71.44
	6.5	**87.9**		100									70.89					71.43
	7.5	**95.4**		100									71.31					71.43
	12.8	**108.2**		100									70.80					71.43
	0.0			100														
	0.0			100														
	0.0			100														
	0.0			100														
	0.0			100														

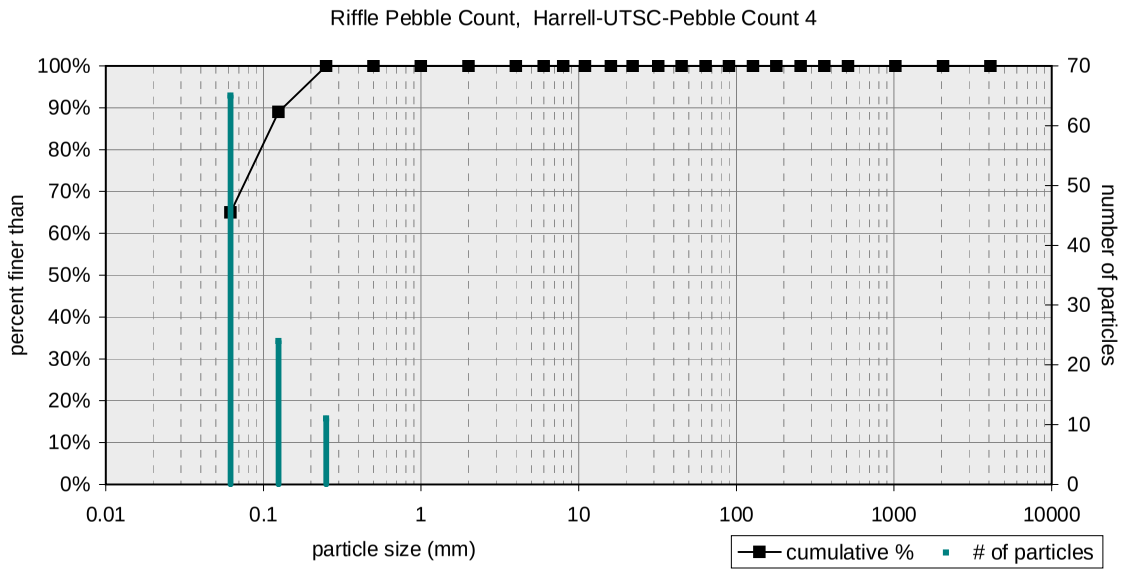
Riffle Pebble Count

Riffle Pebble Count,

Material	Size Range (mm)		Count	
silt/clay	0	0.062	**65**	#
very fine sand	0.062	0.13	**24**	#
fine sand	0.13	0.25	**11**	#
medium sand	0.25	0.5		#
coarse sand	0.5	1		#
very coarse sand	1	2		#
very fine gravel	2	4		#
fine gravel	4	6		#
fine gravel	6	8		#
medium gravel	8	11		#
medium gravel	11	16		#
coarse gravel	16	22		#
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

	Harrell-UTSC-Pebble Count 4
	Tar Pamlico
Note:	**XS 4**



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	0.06	0.1	0	0	0	1.4	0.1	1.3

based on total count	percent by substrate type								
	silt/clay	sand	gravel	cobble	boulder	bedrock	hardpan	wood/det	artificial
	65%	35%	0%	0%	0%	0%	0%	0%	0%

Pebble Count of Channel Reach

Material	Size Range (mm)		Count	
silt/clay	0	0.062	**68**	##
very fine sand	0.062	0.13	**4**	##
fine sand	0.13	0.25	**20**	##
medium sand	0.25	0.5	**8**	##
coarse sand	0.5	1		##
very coarse sand	1	2		##
very fine gravel	2	4		##
fine gravel	4	6		##
fine gravel	6	8		##
medium gravel	8	11		##
medium gravel	11	16		##
coarse gravel	16	22		##
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	

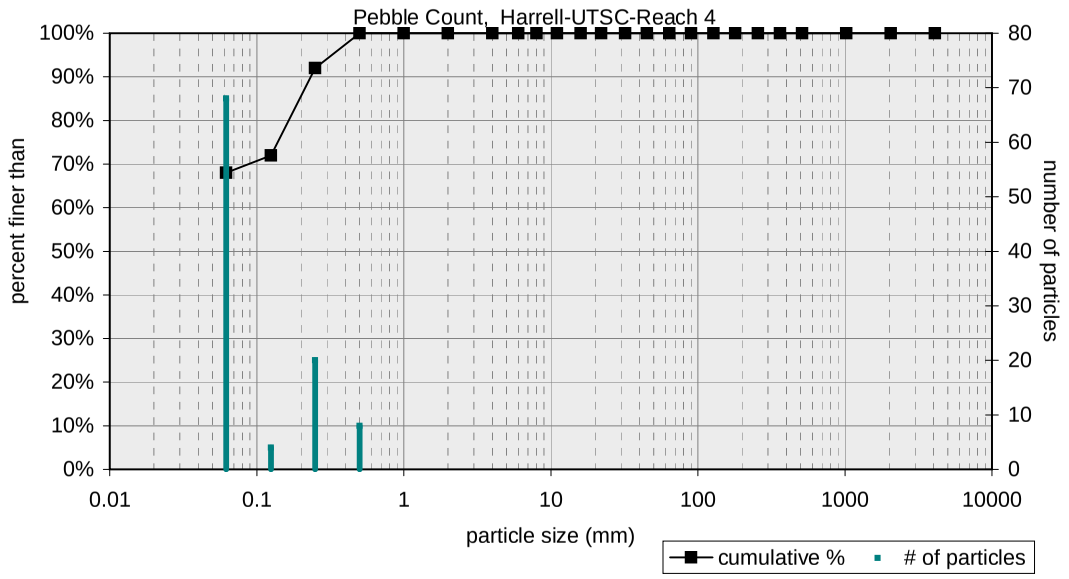
bedrock		
clay hardpan		
detritus/wood		
artificial		
	total count:	100

Pebble Count,

Harrell-UTSC-Reach 4

Tar Pamlico

Note: **XS 4**



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	0.06	0.1	0	0	0	2.0	0.1	1.7

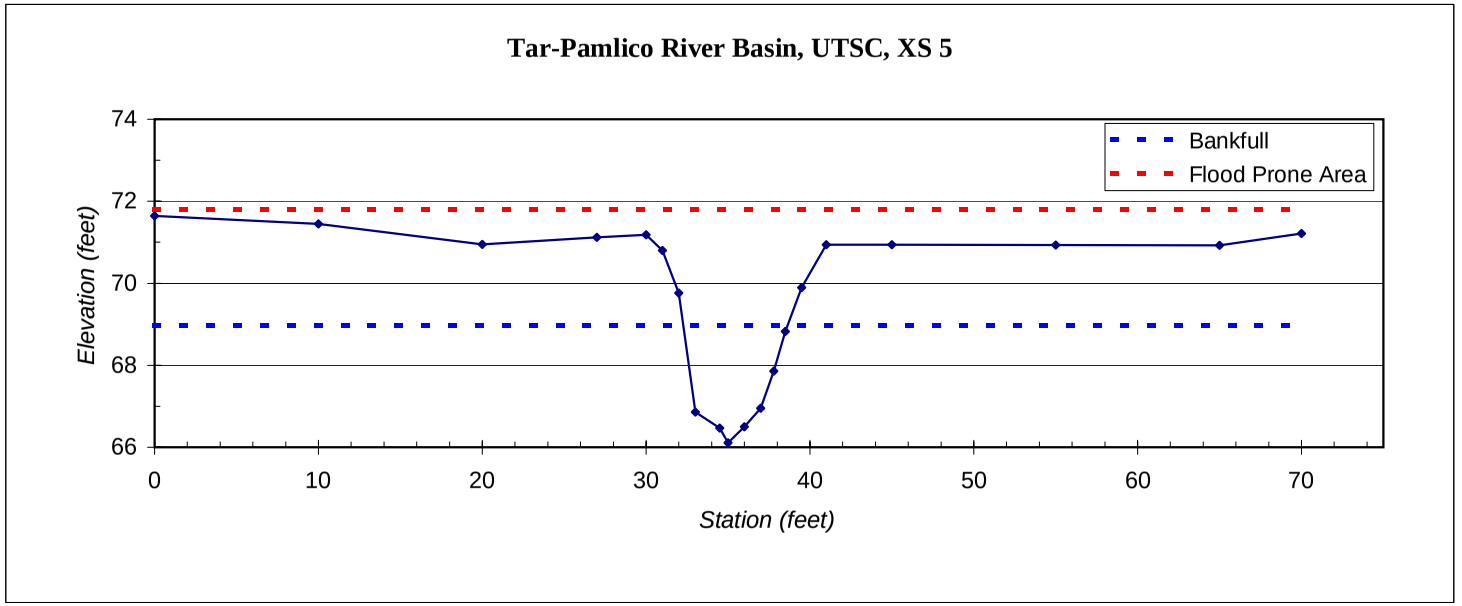
based on total count	percent by substrate type								
	silt/clay	sand	gravel	cobble	boulder	bedrock	hardpan	wood/det	artificial
	68%	32%	0%	0%	0%	0%	0%	0%	0%

River Basin:	Tar-Pamlico
Watershed:	UTSC
XS ID	XS 5
Drainage Area (sq mi):	0.424
Date:	April 2006
Field Crew:	Hayes, Helms, Patterson

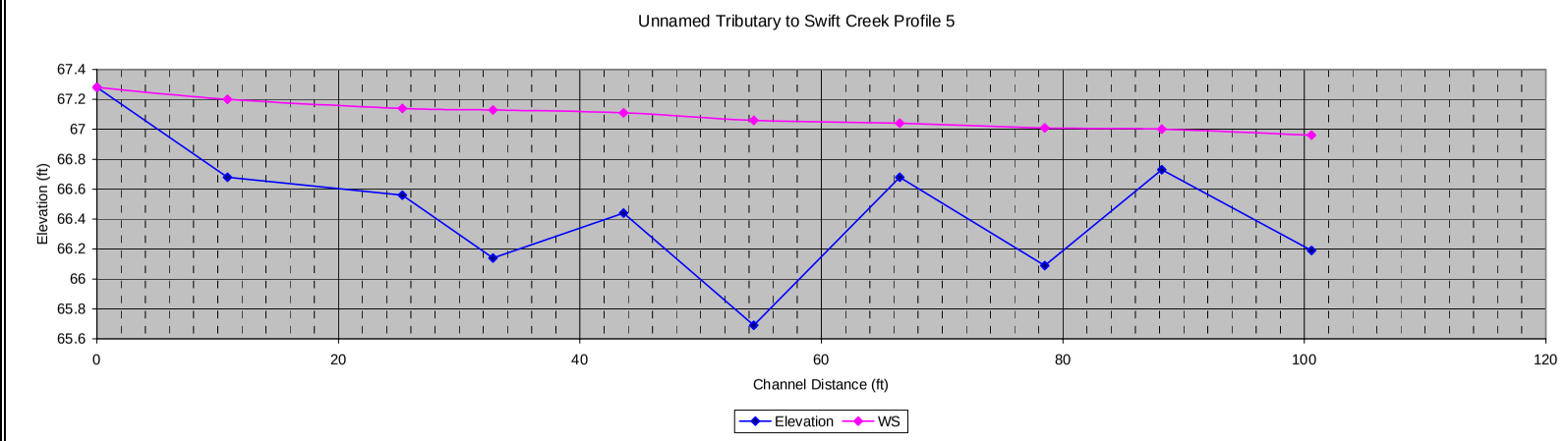
Station	Elevation
0	71.65
10	71.45
20	70.95
27	71.12
30	71.18
31	70.80
32	69.76
33	66.86
34.5	66.47
35	66.11
36	66.50
37	66.95
37.8	67.86
38.5	68.82
39.5	69.89
41	70.94
45	70.94
55	70.93
65	70.93
70	71.21

SUMMARY DATA	
Bankfull Elevation:	69.0
Bankfull Cross-Sectional Area:	12.1
Bankfull Width:	6.4
Flood Prone Area Elevation:	71.8
Flood Prone Width:	>70
Max Depth at Bankfull:	2.8
Mean Depth at Bankfull:	1.9
W / D Ratio:	3.3
Entrenchment Ratio:	10.9
Bank Height Ratio:	1.7
Slope (ft/ft):	0.006
Discharge (cfs)	41

Stream Type:	E5



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									67.28					67.28
	10.8	10.8		100									66.68					67.2
	14.5	25.3		100									66.56					67.14
	7.5	32.8		100									66.14					67.13
	10.8	43.6		100									66.44					67.11
	10.8	54.4		100									65.69					67.06
	12.1	66.5		100									66.68					67.04
	12.0	78.5		100									66.09					67.01
	9.7	88.2		100									66.73					67
	12.4	100.6		100									66.19					66.96
	0.0			100														
	0.0			100														
	0.0			100														
	0.0			100														
	0.0			100														
	0.0			100														

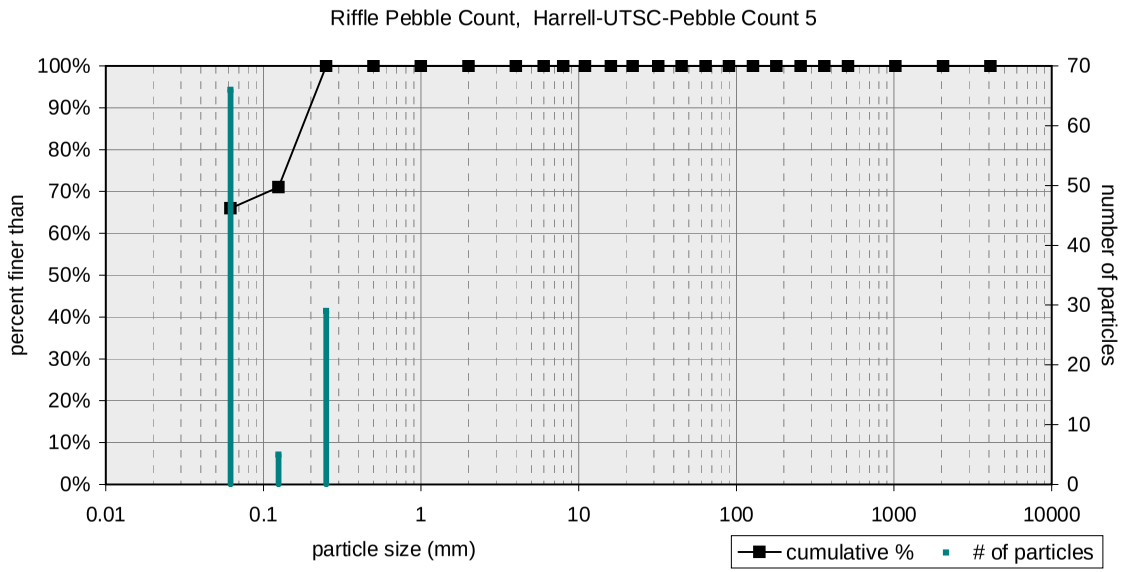
Riffle Pebble Count

Riffle Pebble Count,

Material	Size Range (mm)		Count	
silt/clay	0	0.062	**66**	#
very fine sand	0.062	0.13	**5**	#
fine sand	0.13	0.25	**29**	#
medium sand	0.25	0.5		#
coarse sand	0.5	1		#
very coarse sand	1	2		#
very fine gravel	2	4		#
fine gravel	4	6		#
fine gravel	6	8		#
medium gravel	8	11		#
medium gravel	11	16		#
coarse gravel	16	22		#
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

	Harrell-UTSC-Pebble Count 5
	Tar Pamlico
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
	0.062	0.06	0.1	0	0	0	1.9	0.1	1.7

based on total count	percent by substrate type								
	silt/clay	sand	gravel	cobble	boulder	bedrock	hardpan	wood/det	artificial
	66%	34%	0%	0%	0%	0%	0%	0%	0%

Pebble Count of Channel Reach

Material	Size Range (mm)		Count	
silt/clay	0	0.062	**42**	##
very fine sand	0.062	0.13	**7**	##
fine sand	0.13	0.25	**25**	##
medium sand	0.25	0.5	**26**	##
coarse sand	0.5	1		##
very coarse sand	1	2		##
very fine gravel	2	4		##
fine gravel	4	6		##
fine gravel	6	8		##
medium gravel	8	11		##
medium gravel	11	16		##
coarse gravel	16	22		##
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	

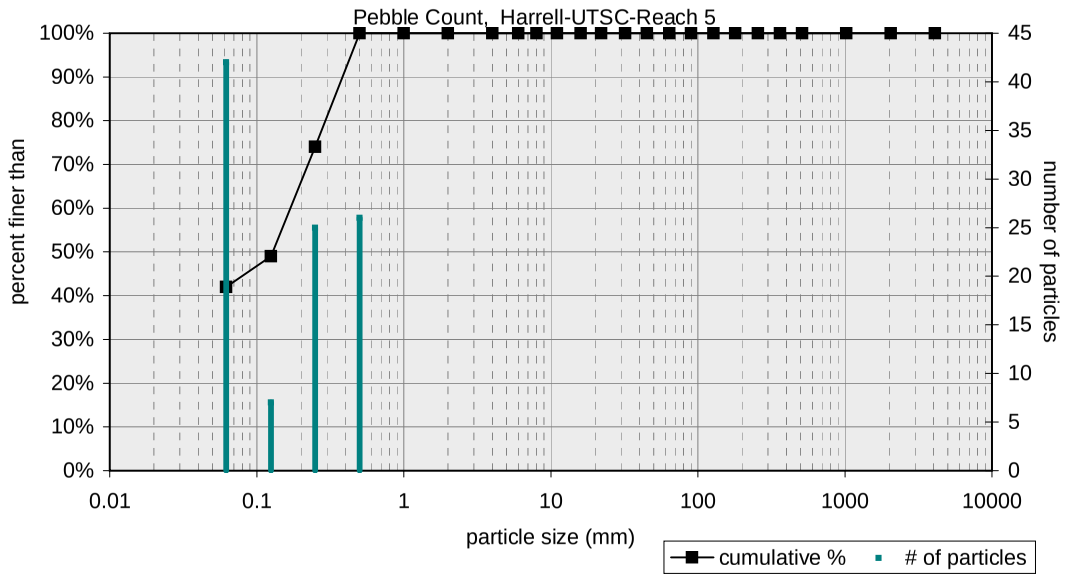
bedrock		
clay hardpan		
detritus/wood		
artificial		
	total count:	100

Pebble Count,

Harrell-UTSC-Reach 5

Tar Pamlico

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
	0.062	0.06	0.1	0	0	0	2.3	0.1	2.3

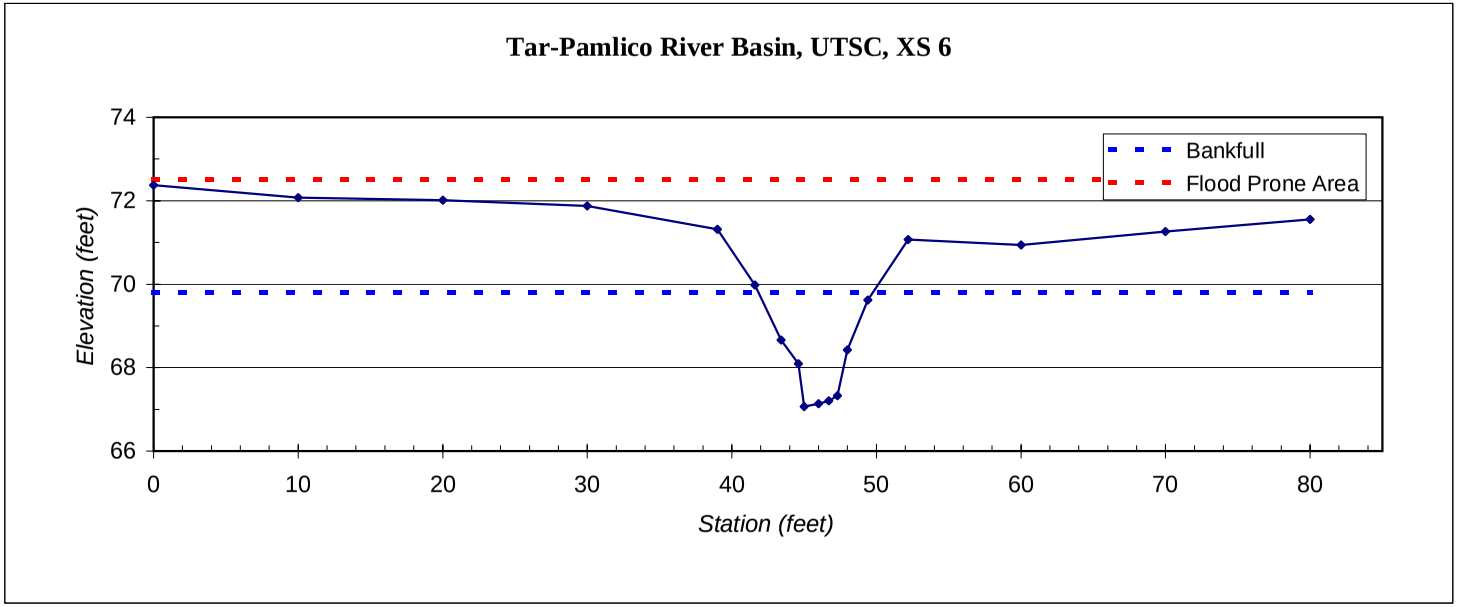
based on total count	percent by substrate type								
	silt/clay	sand	gravel	cobble	boulder	bedrock	hardpan	wood/det	artificial
	42%	58%	0%	0%	0%	0%	0%	0%	0%

River Basin:	Tar-Pamlico
Watershed:	UTSC
XS ID	XS 6
Drainage Area (sq mi):	0.424
Date:	April 2006
Field Crew:	Hayes, Helms, Patterson

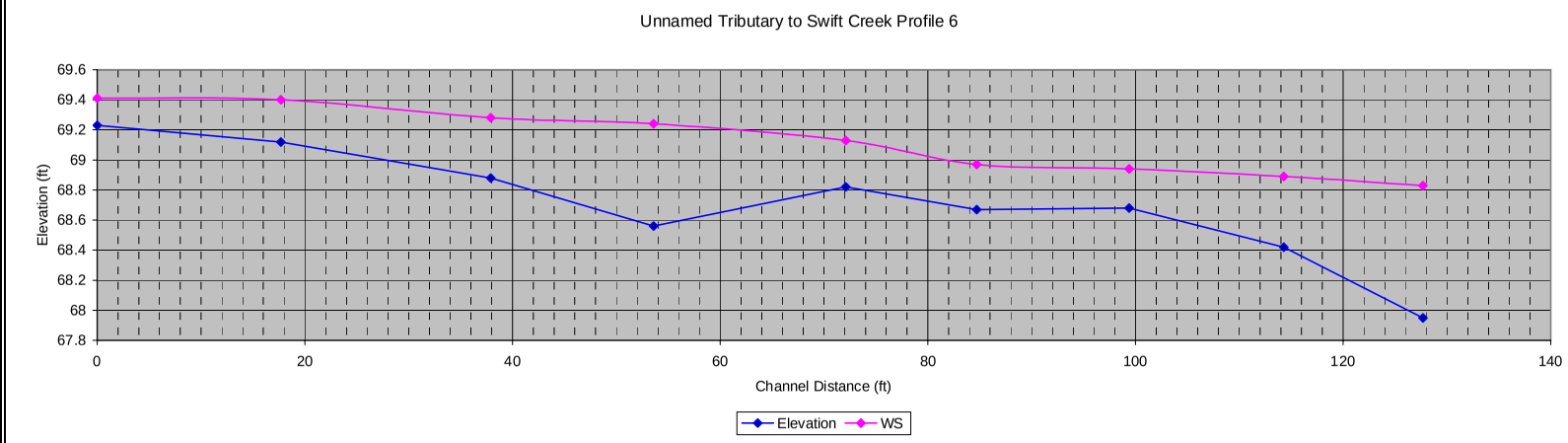
Station	Elevation
0	72.37
10	72.07
20	72.01
30	71.88
39	71.32
41.6	69.98
43.4	68.66
44.6	68.09
45	67.06
46	67.14
46.7	67.21
47.3	67.33
48	68.42
49.4	69.62
52.2	71.07
60	70.94
70	71.26
80	71.55

SUMMARY DATA	
Bankfull Elevation:	69.8
Bankfull Cross-Sectional Area:	11.9
Bankfull Width:	7.9
Flood Prone Area Elevation:	72.5
Flood Prone Width:	>80
Max Depth at Bankfull:	2.7
Mean Depth at Bankfull:	1.5
W / D Ratio:	5.2
Entrenchment Ratio:	10.1
Bank Height Ratio:	1.5
Slope (ft/ft):	0.005
Discharge (cfs)	44

Stream Type:	E5



Slope Profile



Elevation BM: 100

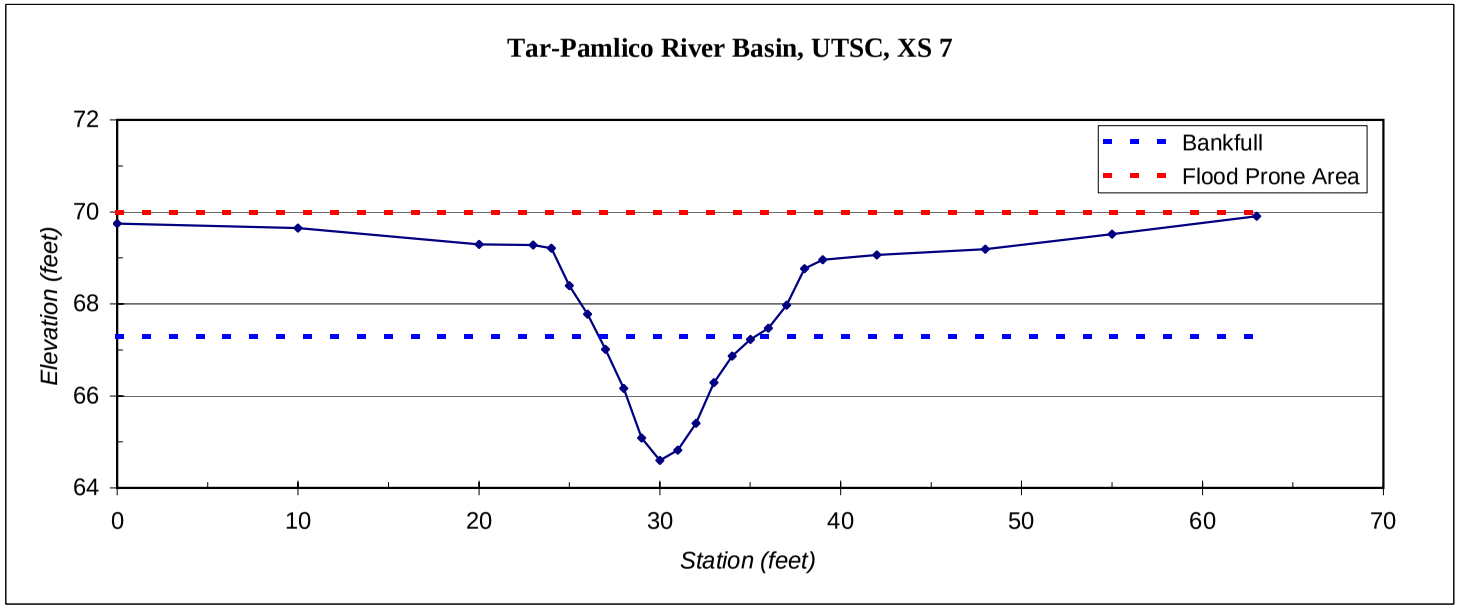
notes	inc distance	station	BS	HI	FS TP	FS bed	depth water	FS LB	FS RB	FS BKF	FS WS	AZ azimuth	ELEV bed	ELEV water srf	ELEV LF	ELEV RB	ELEV BKF	ELEV WS
		0		100									69.23					69.41
	17.7	17.7		100									69.12					69.4
	20.2	37.9		100									68.88					69.28
	15.7	53.6		100									68.56					69.24
	18.5	72.1		100									68.82					69.13
	12.6	84.7		100									68.67					68.97
	14.7	99.4		100									68.68					68.94
	14.9	114.3		100									68.42					68.89
	13.4	127.7		100									67.95					68.83
	0.0			100														
	0.0			100														
	0.0			100														
	0.0			100														
	0.0			100														
	0.0			100														
	0.0			100														

River Basin:	Tar-Pamlico
Watershed:	UTSC
XS ID	XS 7
Drainage Area (sq mi):	0.424
Date:	April 2006
Field Crew:	Hayes, Helms, Patterson

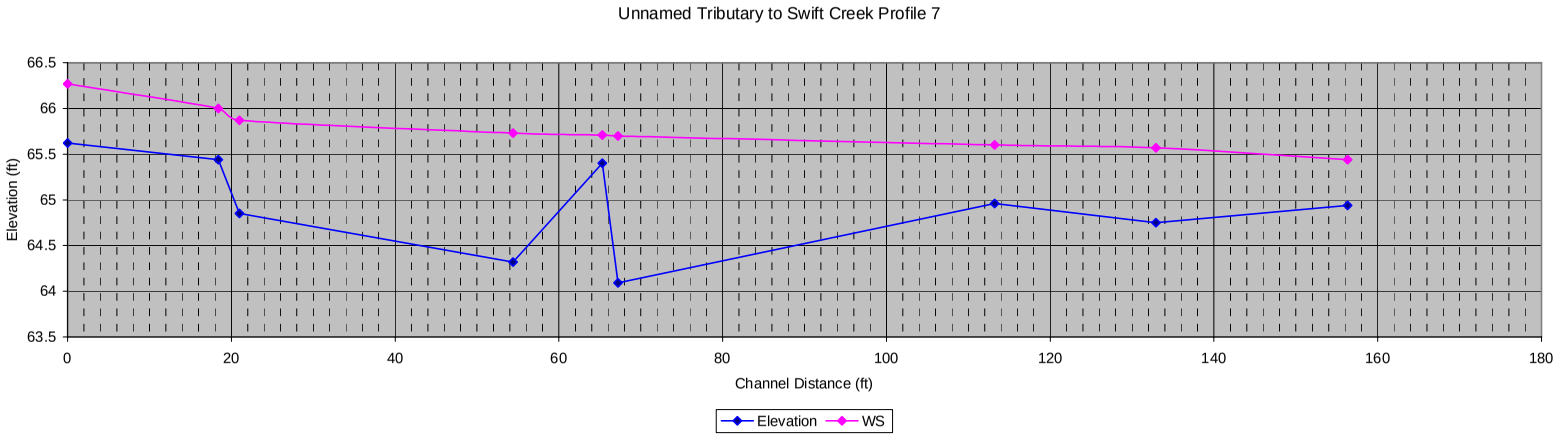
Station	Elevation
0	69.74
10	69.65
20	69.29
23	69.28
24	69.21
25	68.40
26	67.78
27	67.01
28	66.16
29	65.09
30	64.60
31	64.82
32	65.40
33	66.29
34	66.87
35	67.23
36	67.47
37	67.97
38	68.76
39	68.96
42	69.06
48	69.19
55	69.52
63	69.91

SUMMARY DATA	
Bankfull Elevation:	67.3
Bankfull Cross-Sectional Area:	12.0
Bankfull Width:	8.6
Flood Prone Area Elevation:	70.0
Flood Prone Width:	>65
Max Depth at Bankfull:	2.7
Mean Depth at Bankfull:	1.4
W / D Ratio:	6.2
Entrenchment Ratio:	7.6
Bank Height Ratio:	1.6
Slope (ft/ft):	0.005
Discharge (cfs)	48

Stream Type:	E5



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									65.62					66.27
	18.4	18.4		100									65.44					66
	2.6	21.0		100									64.85					65.87
	33.4	54.4		100									64.32					65.73
	10.9	65.3		100									65.40					65.71
	1.9	67.2		100									64.09					65.7
	46.0	113.2		100									64.96					65.6
	19.7	132.9		100									64.75					65.57
	23.4	156.3		100									64.94					65.44
	0.0			100														
	0.0			100														
	0.0			100														
	0.0			100														
	0.0			100														
	0.0			100														
	0.0			100														

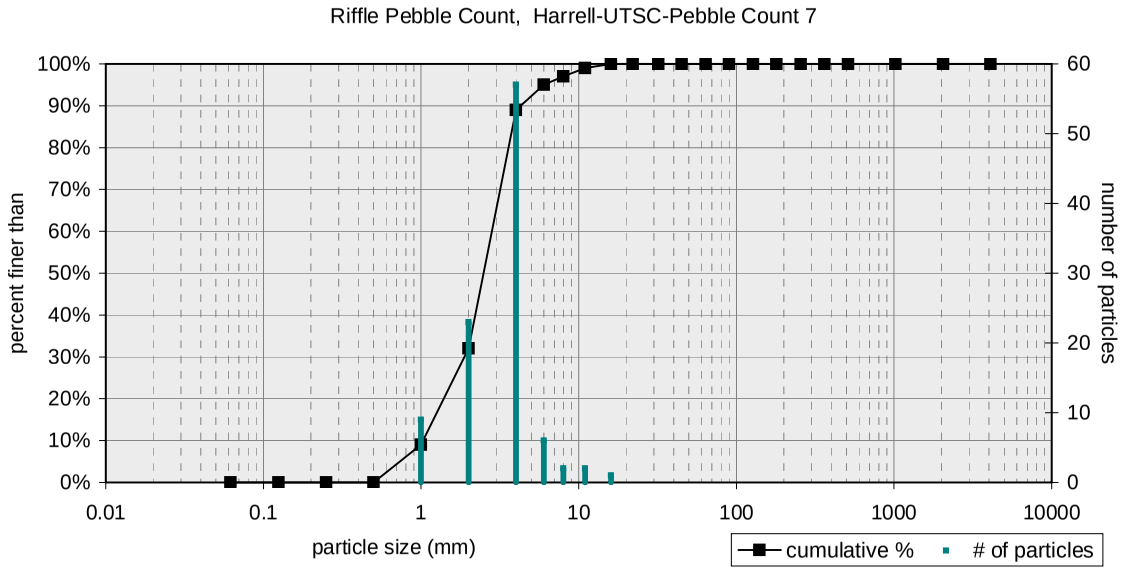
Riffle Pebble Count

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		#
medium sand	0.25	0.5		#
coarse sand	0.5	1	**9**	#
very coarse sand	1	2	**23**	#
very fine gravel	2	4	**57**	#
fine gravel	4	6	**6**	#
fine gravel	6	8	**2**	#
medium gravel	8	11	**2**	#
medium gravel	11	16	**1**	#
coarse gravel	16	22		#
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

	Harrell-UTSC-Pebble Count 7
	Tar Pamlico
Note:	**XS 7**



based on sediment particles only	size percent less than (mm)						particle size distribution		
	D16	D35	D50	D65	D84	D95	gradation	geo mean	std dev
	1.235	2.07	2.5	3	4	6	1.8	2.2	1.7

based on total count	percent by substrate type								
	silt/clay	sand	gravel	cobble	boulder	bedrock	hardpan	wood/det	artificial
	0%	32%	68%	0%	0%	0%	0%	0%	0%

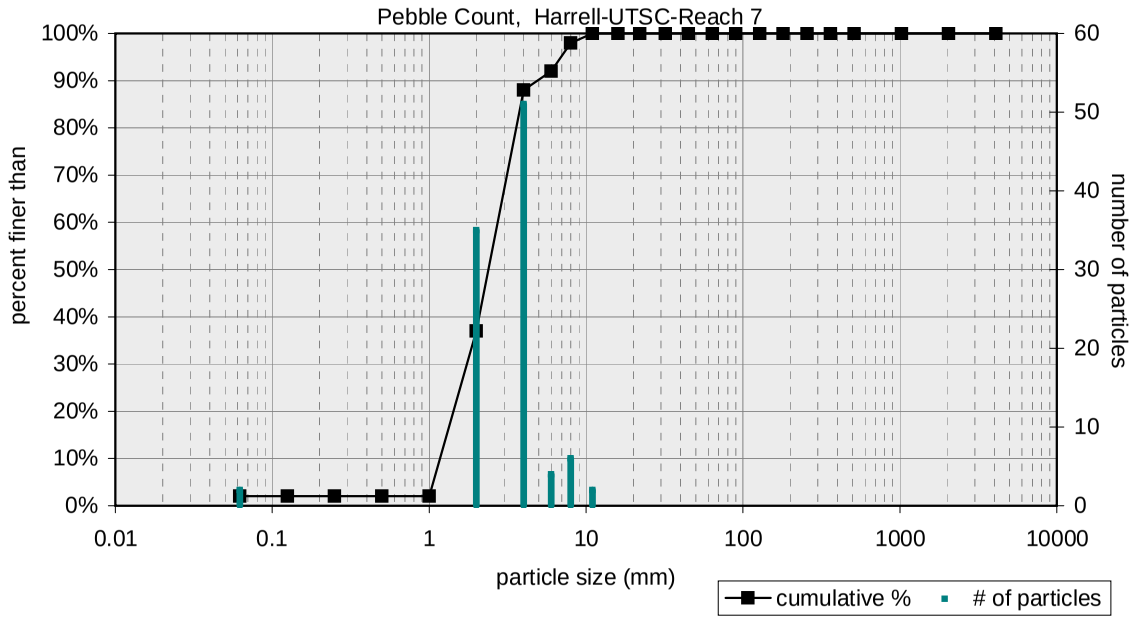
Pebble Count of Channel Reach

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	**35**
very fine gravel	2	4	**51**
fine gravel	4	6	**4**
fine gravel	6	8	**6**
medium gravel	8	11	**2**
medium gravel	11	16	
coarse gravel	16	22	
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

Pebble Count,
Harrell-UTSC-Reach 7
Tar Pamlico

Note: **XS 7**



based on sediment particles only	size percent less than (mm)						particle size distribution		
	D16	D35	D50	D65	D84	D95	gradation	geo mean	std dev
	1.320	1.92	2.4	3	4	7	1.7	2.2	1.7

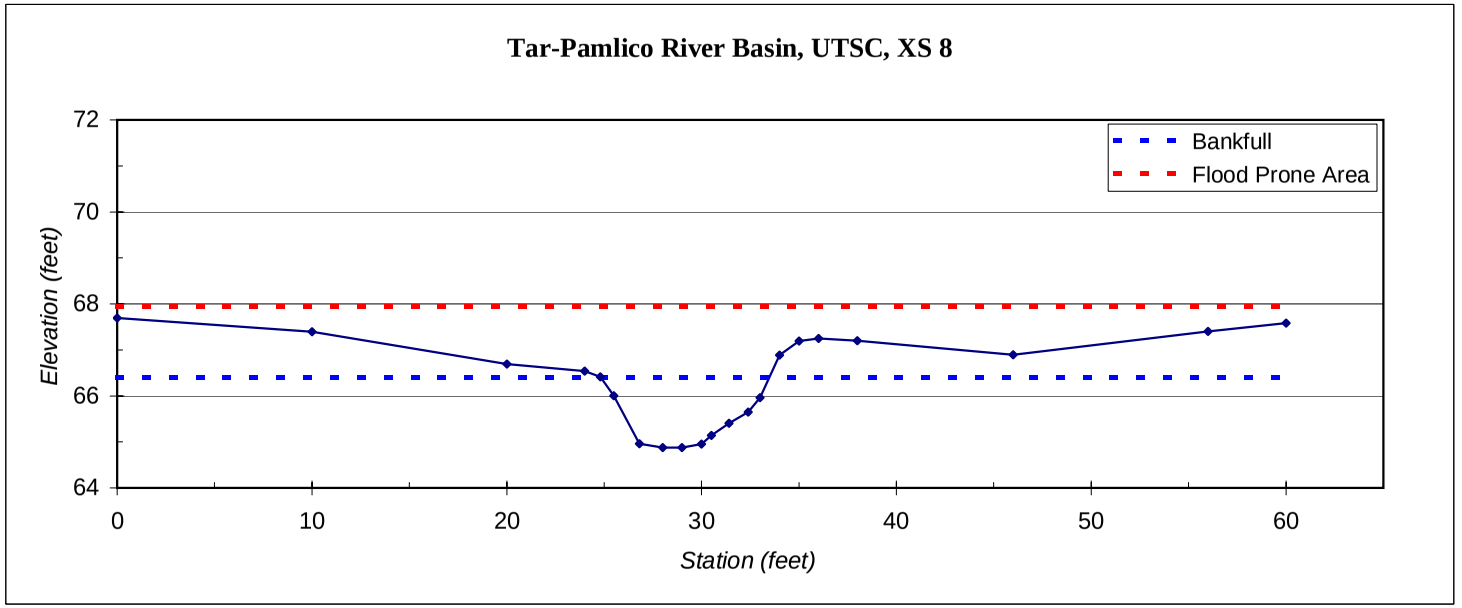
based on total count	percent by substrate type								
	silt/clay	sand	gravel	cobble	boulder	bedrock	hardpan	wood/det	artificial
	2%	35%	63%	0%	0%	0%	0%	0%	0%

River Basin:	Tar-Pamlico
Watershed:	UTSC
XS ID	XS 8
Drainage Area (sq mi):	0.605
Date:	April 2006
Field Crew:	Hayes, Helms, Patterson

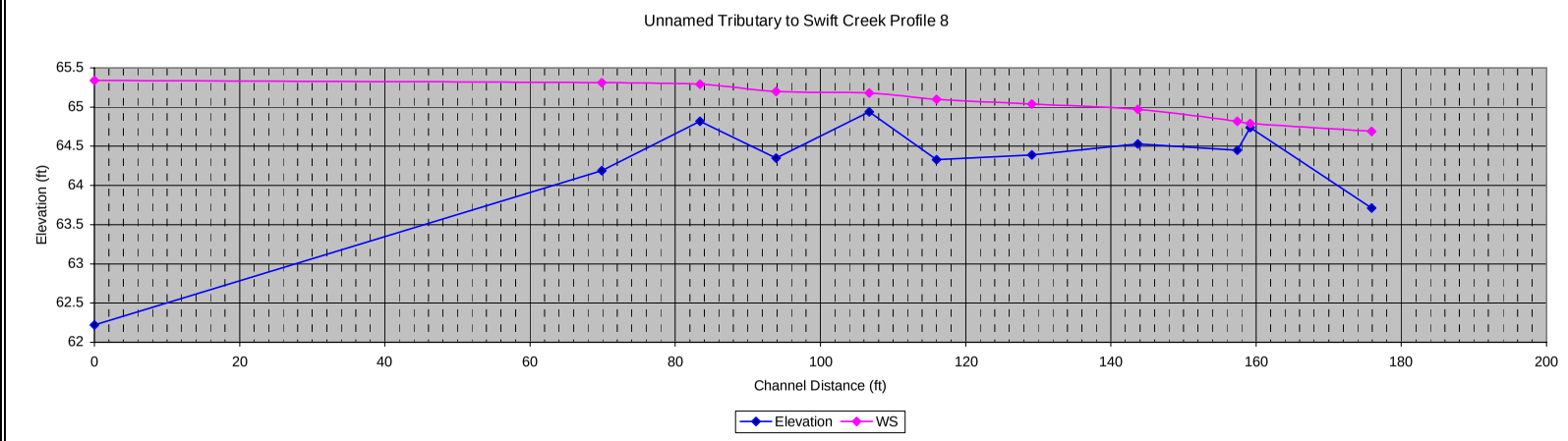
Station	Elevation
0	67.69
10	67.39
20	66.70
24	66.54
24.8	66.41
25.5	66.00
26.8	64.96
28	64.88
29	64.88
30	64.96
30.5	65.14
31.4	65.40
32.4	65.65
33	65.96
34	66.89
35	67.19
36	67.25
38	67.20
46	66.89
56	67.40
60	67.58

SUMMARY DATA	
Bankfull Elevation:	66.4
Bankfull Cross-Sectional Area:	10.4
Bankfull Width:	9.6
Flood Prone Area Elevation:	67.9
Flood Prone Width:	>70
Max Depth at Bankfull:	1.5
Mean Depth at Bankfull:	1.1
W / D Ratio:	8.8
Entrenchment Ratio:	7.3
Bank Height Ratio:	1.0
Slope (ft/ft):	0.004
Discharge (cfs)	31

Stream Type:	E5



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									62.22					65.34
	69.9	69.9		100									64.19					65.31
	13.5	83.4		100									64.82					65.29
	10.5	93.9		100									64.35					65.2
	12.8	106.7		100									64.94					65.18
	9.3	116.0		100									64.33					65.1
	13.1	129.1		100									64.39					65.04
	14.6	143.7		100									64.53					64.97
	13.7	157.4		100									64.45					64.82
	1.8	159.2		100									64.74					64.79
	16.7	175.9		100									63.71					64.69
	0.0			100														
	0.0			100														
	0.0			100														
	0.0			100														
	0.0			100														

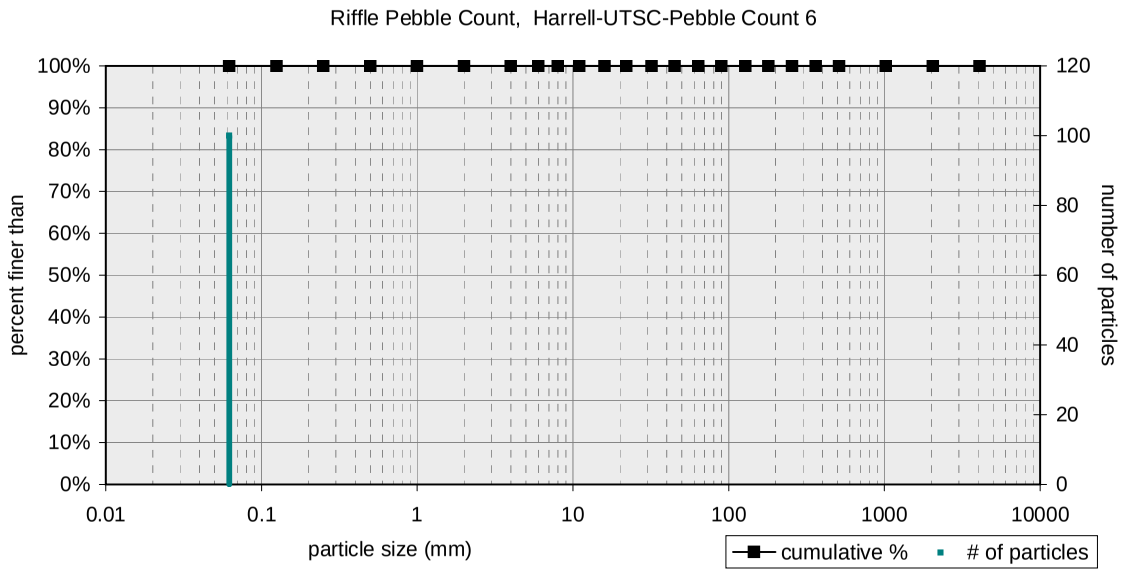
Riffle Pebble Count

Riffle Pebble Count,

Material	Size Range (mm)		Count	
silt/clay	0	0.062	**100**	#
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		#
very fine gravel	2	4		#
fine gravel	4	6		#
fine gravel	6	8		#
medium gravel	8	11		#
medium gravel	11	16		#
coarse gravel	16	22		#
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

	Harrell-UTSC-Pebble Count 6
	Tar Pamlico
Note:	**XS 8**



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	0.06	0.1	0	0	0	1.0	0.1	1.0

based on total count	percent by substrate type								
	silt/clay	sand	gravel	cobble	boulder	bedrock	hardpan	wood/det	artificial
	100%	0%	0%	0%	0%	0%	0%	0%	0%

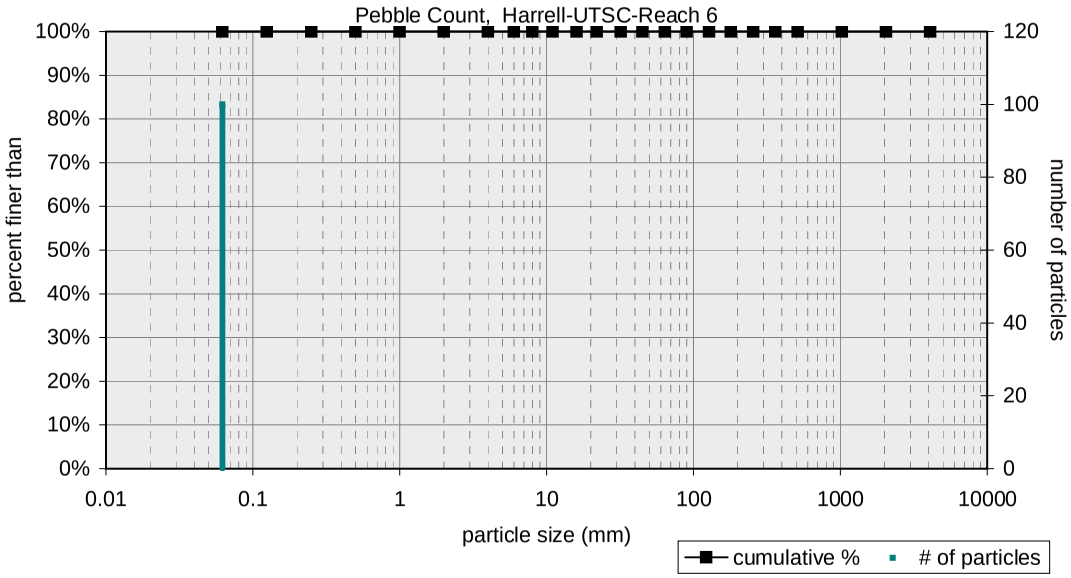
Pebble Count of Channel Reach

Material	Size Range (mm)		Count	
silt/clay	0	0.062	**100**	##
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		##
very fine gravel	2	4		##
fine gravel	4	6		##
fine gravel	6	8		##
medium gravel	8	11		##
medium gravel	11	16		##
coarse gravel	16	22		##
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

Pebble Count,
Harrell-UTSC-Reach 6
Tar Pamlico

Note: **XS 8**



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	0.06	0.1	0	0	0	1.0	0.1	1.0

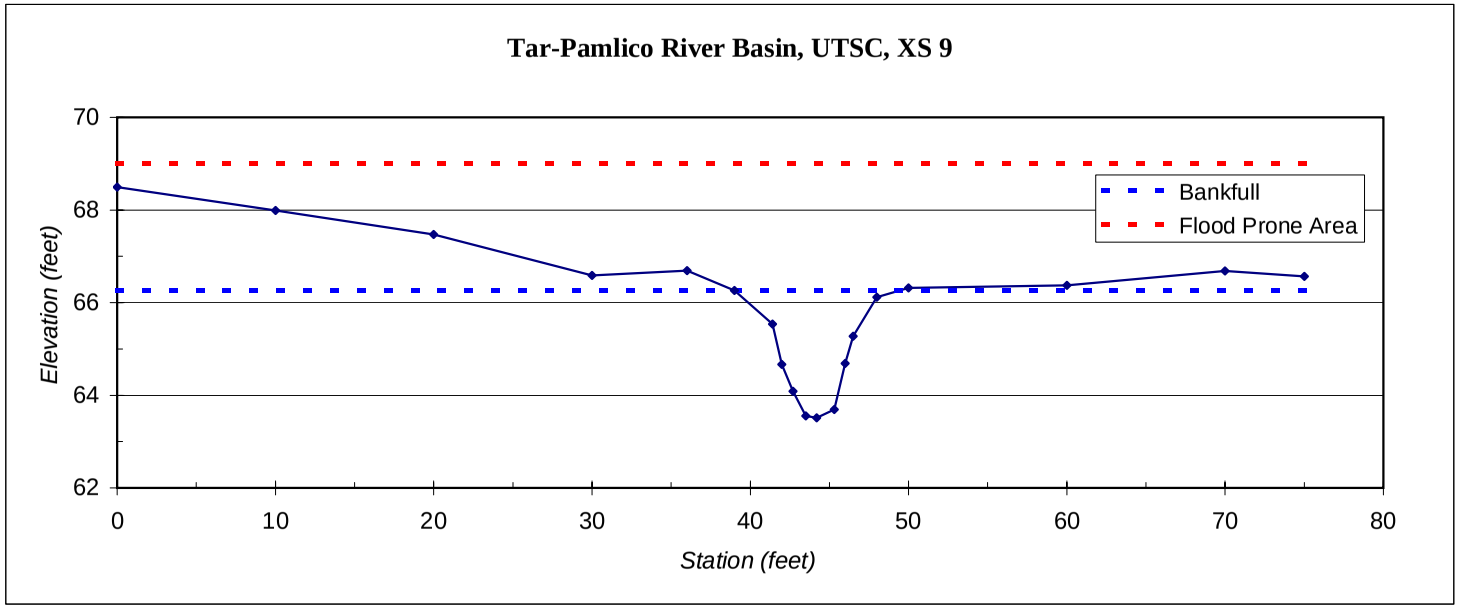
based on total count	percent by substrate type								
	silt/clay	sand	gravel	cobble	boulder	bedrock	hardpan	wood/det	artificial
	100%	0%	0%	0%	0%	0%	0%	0%	0%

River Basin:	Tar-Pamlico
Watershed:	UTSC
XS ID	XS 9
Drainage Area (sq mi):	0.605
Date:	April 2006
Field Crew:	Hayes, Helms, Patterson

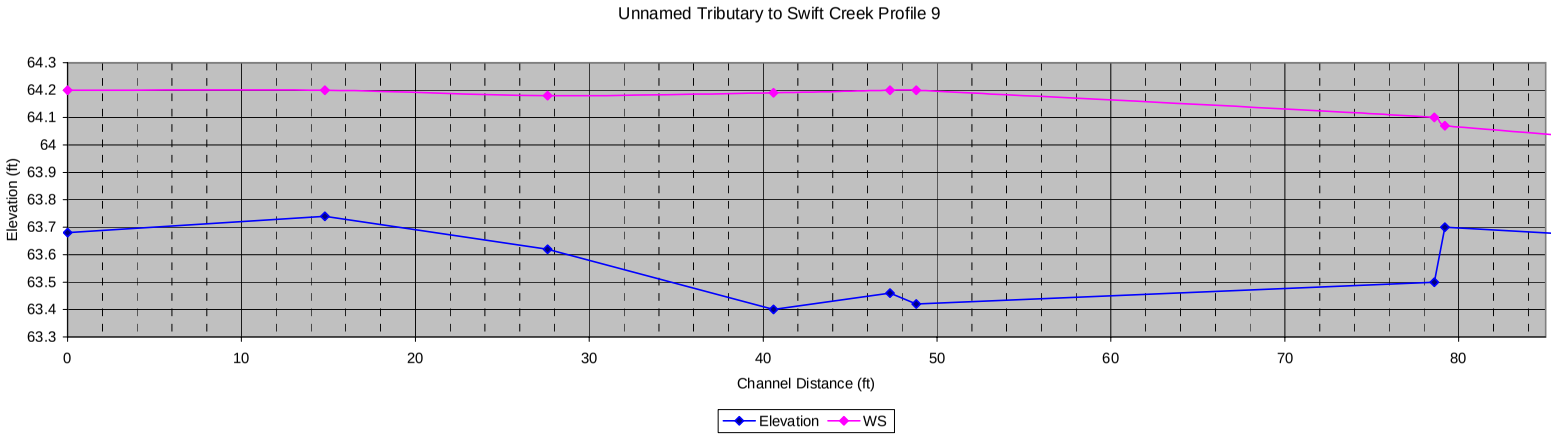
Station	Elevation
0	68.50
10	67.99
20	67.47
30	66.59
36	66.69
39	66.27
41.4	65.54
42	64.67
42.7	64.09
43.5	63.55
44.2	63.51
45.3	63.69
46	64.69
46.5	65.27
48	66.11
50	66.32
60	66.37
70	66.69
75	66.57

SUMMARY DATA	
Bankfull Elevation:	66.3
Bankfull Cross-Sectional Area:	12.7
Bankfull Width:	10.4
Flood Prone Area Elevation:	69.0
Flood Prone Width:	>75
Max Depth at Bankfull:	2.7
Mean Depth at Bankfull:	1.2
W / D Ratio:	8.5
Entrenchment Ratio:	7.2
Bank Height Ratio:	1.0
Slope (ft/ft):	0.003
Discharge (cfs)	32

Stream Type:	E5



Slope Profile



Elevation BM: 100

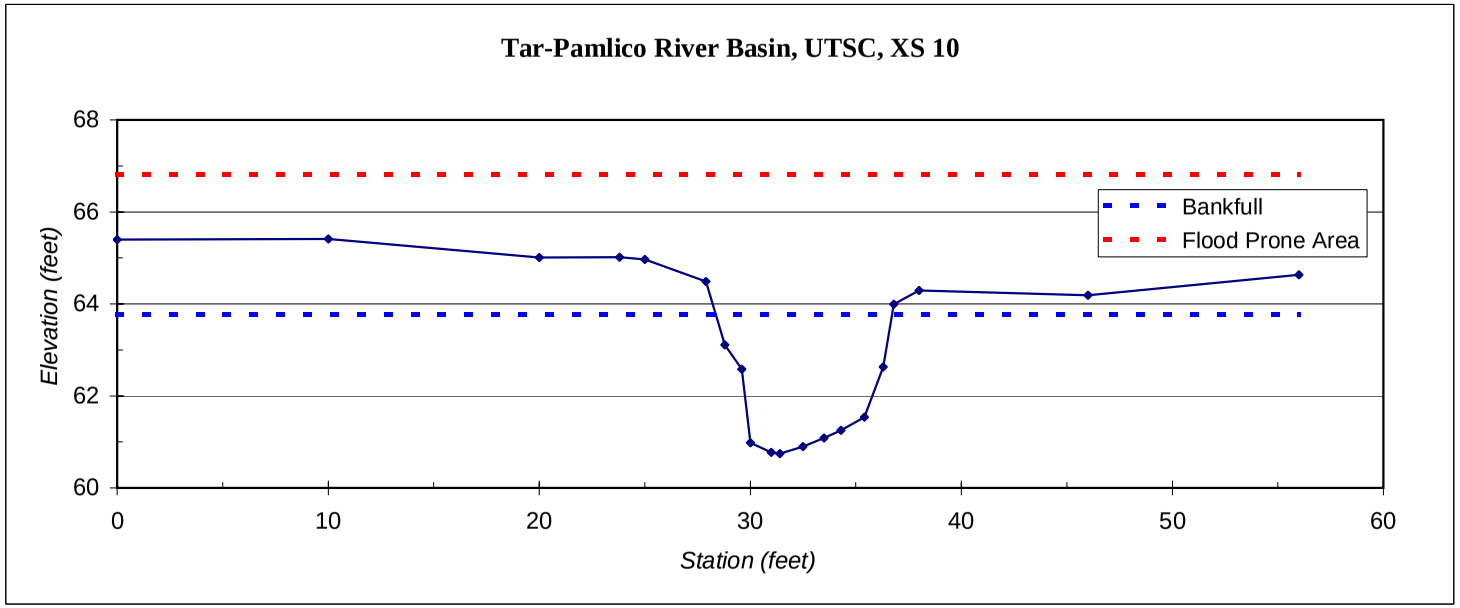
notes	inc distance	station	BS 0	HI 100	FS TP	FS bed	depth water	FS LB	FS RB	FS BKF	FS WS	AZ azimuth	ELEV bed	ELEV water srf	ELEV LF	ELEV RB	ELEV BKF	ELEV WS
		0		100									63.68					64.2
	14.8	14.8		100									63.74					64.2
	12.8	27.6		100									63.62					64.18
	13.0	40.6		100									63.40					64.19
	6.7	47.3		100									63.46					64.2
	1.5	48.8		100									63.42					64.2
	29.8	78.6		100									63.50					64.1
	0.6	79.2		100									63.70					64.07
	30.7	109.9		100									63.59					63.92
	0.0			100														
	0.0			100														
	0.0			100														
	0.0			100														
	0.0			100														
	0.0			100														
	0.0			100														

River Basin:	Tar-Pamlico
Watershed:	UTSC
XS ID	XS 10
Drainage Area (sq mi):	0.605
Date:	April 2006
Field Crew:	Hayes, Helms, Patterson

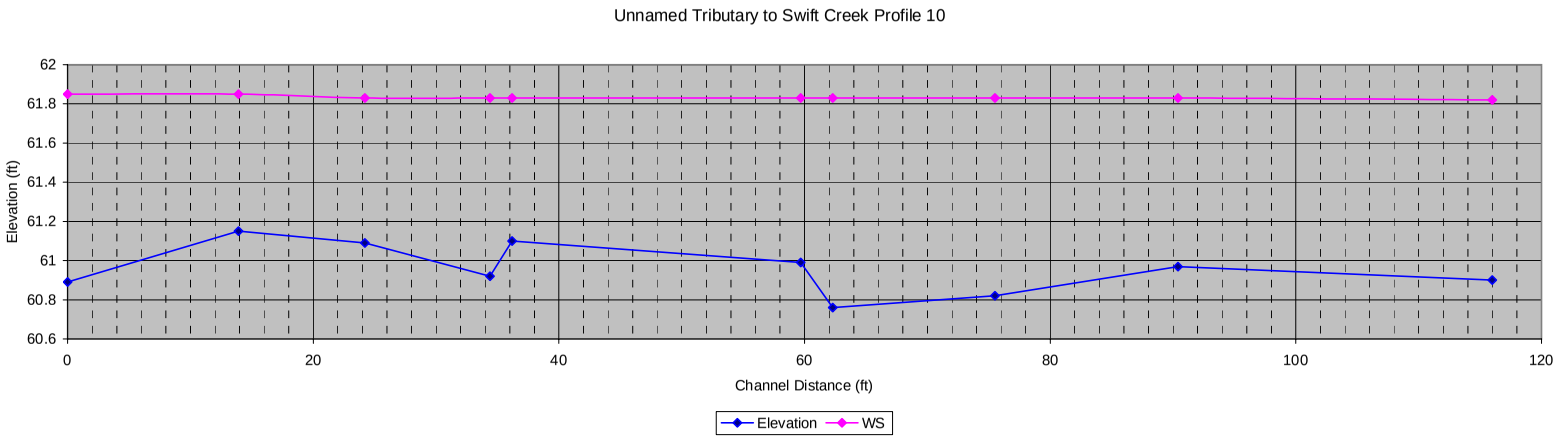
Station	Elevation
0	65.40
10	65.41
20	65.01
23.8	65.02
25	64.97
27.9	64.48
28.8	63.11
29.6	62.58
30	60.98
31	60.77
31.4	60.74
32.5	60.89
33.5	61.08
34.3	61.25
35.4	61.54
36.3	62.63
36.8	63.99
38	64.29
46	64.19
56	64.64

SUMMARY DATA	
Bankfull Elevation:	63.8
Bankfull Cross-Sectional Area:	18.4
Bankfull Width:	8.4
Flood Prone Area Elevation:	66.8
Flood Prone Width:	>60
Max Depth at Bankfull:	3.0
Mean Depth at Bankfull:	2.2
W / D Ratio:	3.8
Entrenchment Ratio:	7.1
Bank Height Ratio:	1.2
Slope (ft/ft):	0.00026
Discharge (cfs)	20

Stream Type:	E5



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									60.89					61.85
	13.9	13.9		100									61.15					61.85
	10.3	24.2		100									61.09					61.83
	10.2	34.4		100									60.92					61.83
	1.8	36.2		100									61.10					61.83
	23.5	59.7		100									60.99					61.83
	2.6	62.3		100									60.76					61.83
	13.2	75.5		100									60.82					61.83
	14.9	90.4		100									60.97					61.83
	25.6	116.0		100									60.90					61.82
	0.0			100														
	0.0			100														
	0.0			100														
	0.0			100														
	0.0			100														
	0.0			100														

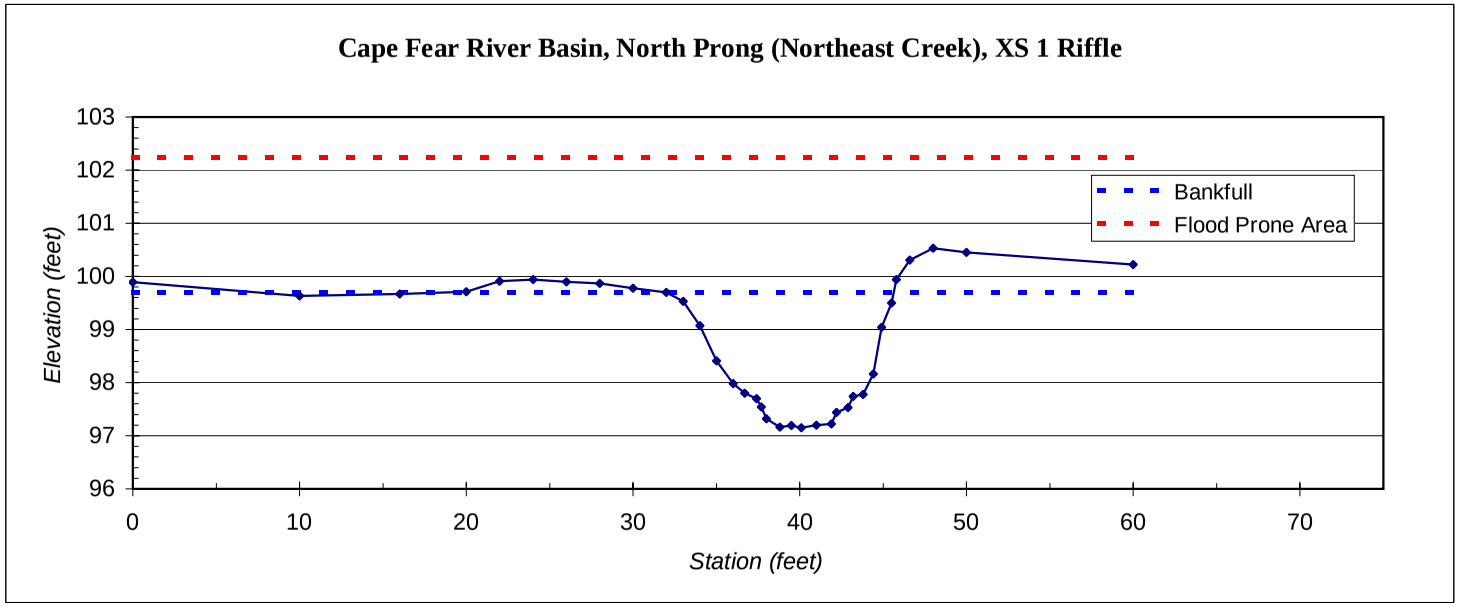
Appendix F. Reference Reach Data

River Basin:	Cape Fear
Watershed:	North Prong (Northeast Creek)
XS ID	XS 1 Riffle
Drainage Area (sq mi):	3.04
Date:	September 2002
Field Crew:	

Station	Elevation
0	99.89
10	99.63
16	99.67
20	99.71
22	99.91
24	99.94
26	99.90
28	99.87
30	99.78
32	99.70
33	99.53
34	99.07
35	98.41
36	97.98
36.7	97.80
37.4	97.70
37.7	97.54
38.0	97.32
38.8	97.16
39.5	97.19
40.1	97.15
41.0	97.20
41.9	97.22
42.2	97.44
42.9	97.53
43.2	97.74
43.8	97.78
44.4	98.16
44.9	99.04
45.5	99.50
45.8	99.94
46.6	100.31
48.0	100.53
50.0	100.45
60.0	100.22

SUMMARY DATA	
Bankfull Elevation:	99.7
Bankfull Cross-Sectional Area:	22.6
Bankfull Width:	13.6
Flood Prone Area Elevation:	102.3
Flood Prone Width:	325.0
Max Depth at Bankfull:	2.6
Mean Depth at Bankfull:	1.7
W / D Ratio:	8.2
Entrenchment Ratio:	23.8
Bank Height Ratio:	1.0
Slope (ft/ft):	0.002
Discharge (cfs)	70

Stream Type:	C5

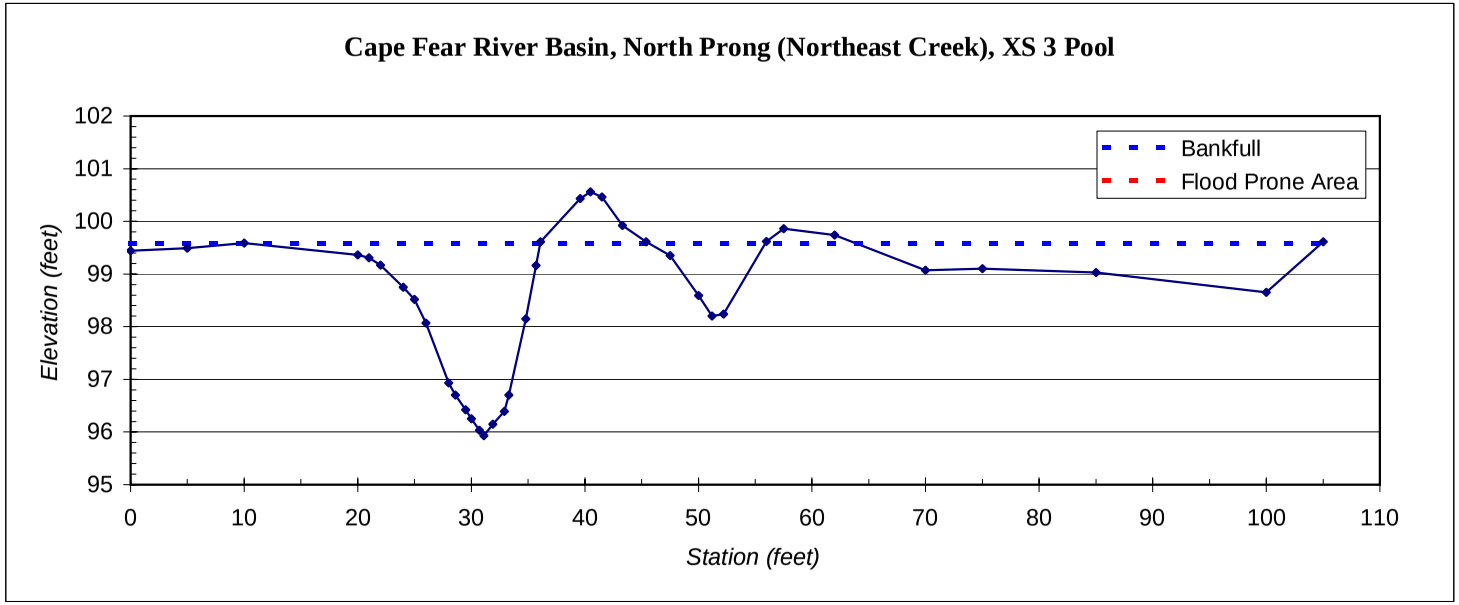


River Basin:	Cape Fear
Watershed:	North Prong (Northeast Creek)
XS ID	XS 3 Pool
Drainage Area (sq mi):	3.04
Date:	November 2002
Field Crew:	

Station	Elevation
0	99.44
5	99.49
10	99.59
20	99.36
21	99.31
22	99.17
24	98.75
25	98.52
26	98.07
28	96.93
28.6	96.70
29.5	96.42
30	96.25
30.7	96.03
31.1	95.93
31.9	96.15
32.9	96.39
33.3	96.70
34.8	98.15
35.7	99.16
36.1	99.61
39.6	100.43
40.5	100.56
41.5	100.46
43.3	99.92
45.4	99.61
47.5	99.35
50.0	98.59
51.2	98.20
52.2	98.24
56.0	99.62
57.5	99.86
62.0	99.74
70.0	99.07
75.0	99.10
85.0	99.03
100.0	98.65
105.0	99.61

SUMMARY DATA	
Bankfull Elevation:	99.6
Bankfull Cross-Sectional Area:	30.9
Bankfull Width:	26.1
Flood Prone Area Elevation:	
Flood Prone Width:	
Max Depth at Bankfull:	3.7
Mean Depth at Bankfull:	1.2
W / D Ratio:	21.8
Entrenchment Ratio:	
Bank Height Ratio:	1.0
Slope (ft/ft):	0.000
Discharge (cfs)	

Stream Type:	C5

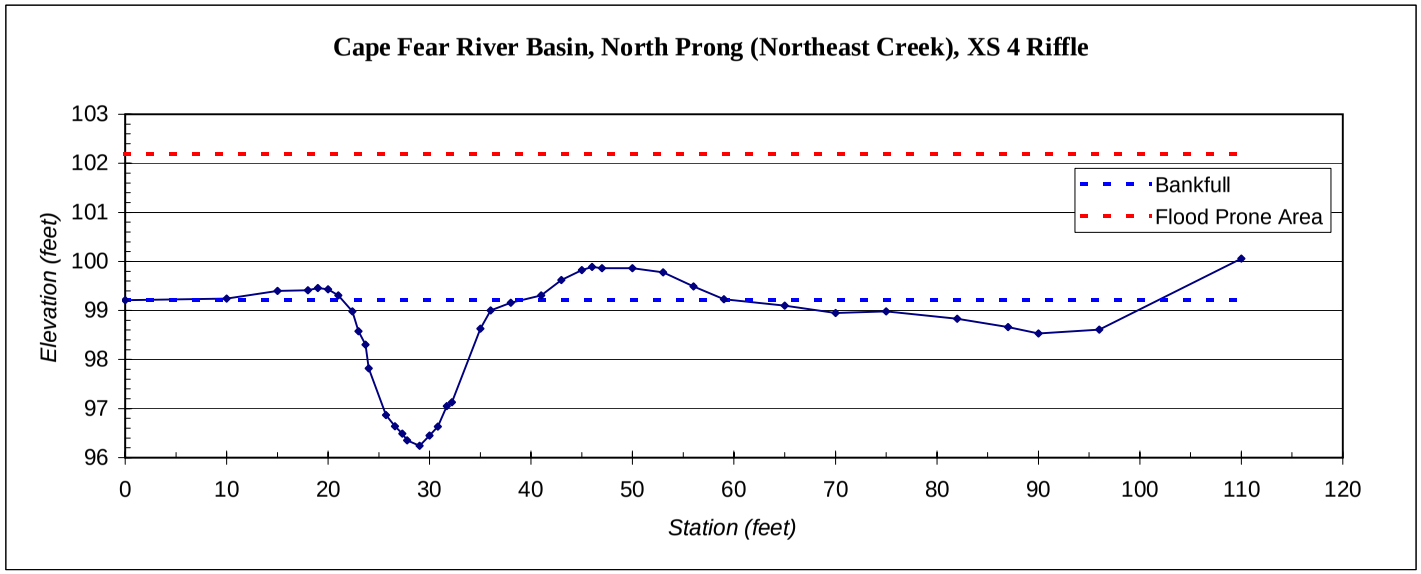


River Basin:	Cape Fear
Watershed:	North Prong (Northeast Creek)
XS ID	XS 4 Riffle
Drainage Area (sq mi):	3.04
Date:	September 2002
Field Crew:	

Station	Elevation
0	99.21
10	99.24
15	99.40
18	99.41
19	99.46
20	99.43
21	99.31
22.4	98.98
23	98.58
23.7	98.30
24	97.82
25.7	96.87
26.6	96.64
27.3	96.49
27.8	96.35
29	96.24
30	96.45
30.8	96.63
31.7	97.05
32.2	97.13
35.0	98.63
36.0	99.00
38.0	99.16
41.0	99.31
43.0	99.62
45.0	99.82
46.0	99.89
47.0	99.86
50.0	99.86
53.0	99.78
56.0	99.49
59.0	99.23
65.0	99.10
70.0	98.95
75.0	98.98
82.0	98.83
87.0	98.66
90.0	98.53
96.0	98.61
110.0	100.06

SUMMARY DATA	
Bankfull Elevation:	99.2
Bankfull Cross-Sectional Area:	26.2
Bankfull Width:	17.8
Flood Prone Area Elevation:	102.2
Flood Prone Width:	600.0
Max Depth at Bankfull:	3.0
Mean Depth at Bankfull:	1.5
W / D Ratio:	11.9
Entrenchment Ratio:	33.7
Bank Height Ratio:	1.0
Slope (ft/ft):	0.003
Discharge (cfs)	83

Stream Type:	C5

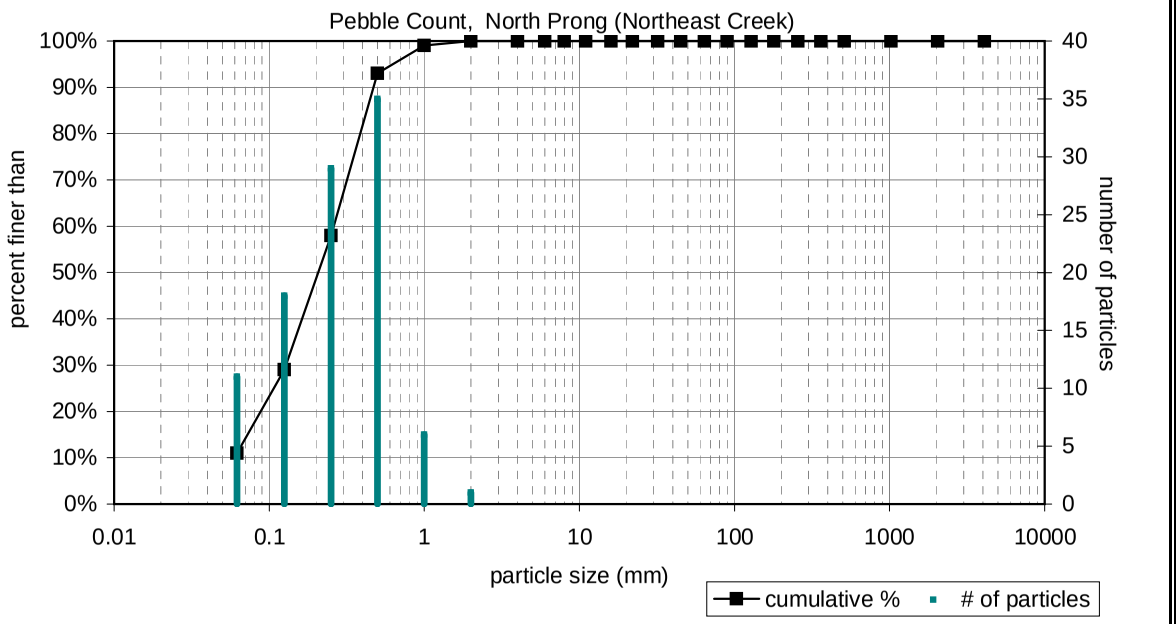


Reference Reach Data
Bed Materials

Pebble Count of Channel Reach				
Material	Size Range (mm)		Count	
silt/clay	0	0.062	**11**	11%
very fine sand	0.062	0.13	**18**	29%
fine sand	0.13	0.25	**29**	58%
medium sand	0.25	0.5	**35**	93%
coarse sand	0.5	1	**6**	99%
very coarse sand	1	2	**1**	100%
very fine gravel	2	4		100%
fine gravel	4	6		100%
fine gravel	6	8		100%
medium gravel	8	11		100%
medium gravel	11	16		100%
coarse gravel	16	22		100%
coarse gravel	22	32		100%
very coarse gravel	32	45		100%
very coarse gravel	45	64		100%
small cobble	64	90		100%
medium cobble	90	128		100%
large cobble	128	180		100%
very large cobble	180	256		100%
small boulder	256	362		100%
small boulder	362	512		100%
medium boulder	512	1024		100%
large boulder	1024	2048		100%
very large boulder	2048	4096		100%
		total particle count:	100	

bedrock			
clay hardpan			
detritus/wood			
artificial			
		total count:	100

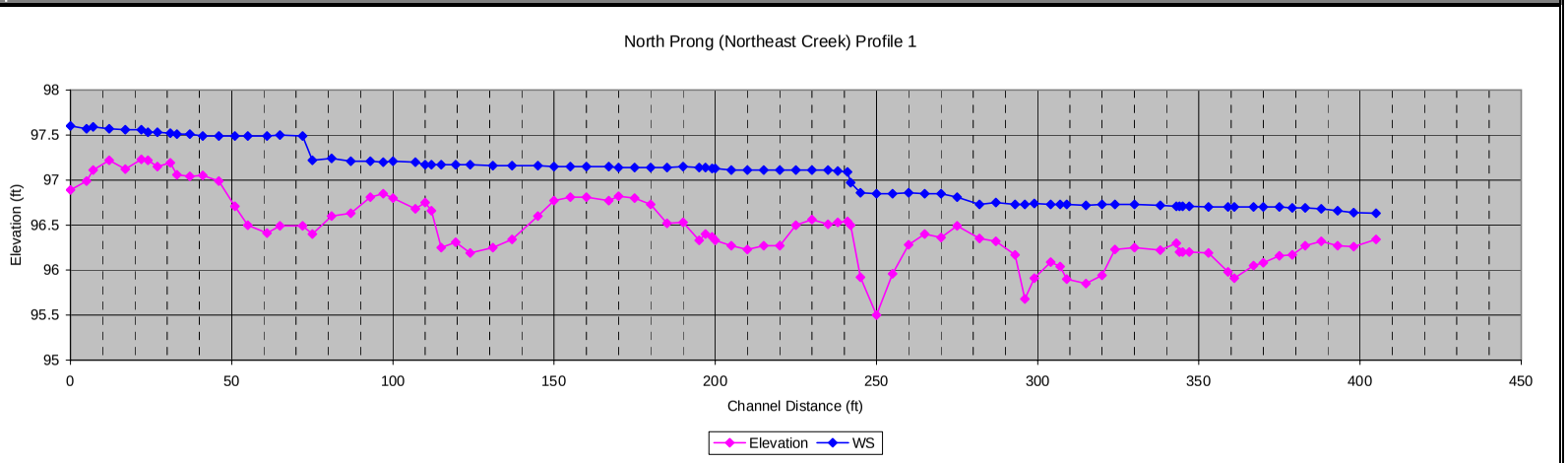
Pebble Count,
North Prong (Northeast Creek)
Durham, NC
Note: **Representative Riffle (XS-4)**



based on sediment particles only	size percent less than (mm)						particle size distribution		
	D16	D35	D50	D65	D84	D95	gradation	geo mean	std dev
	0.075	0.14	0.2	0.3	0.4	0.6	2.4	0.2	2.4

based on total count	percent by substrate type								
	silt/clay	sand	gravel	cobble	boulder	bedrock	hardpan	wood/det	artificial
	11%	89%	0%	0%	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		100									96.89					97.6
	5.0	5.0		100									96.99					97.57
	2.0	10.0		100									97.11					97.59
	5.0	12.0		100									97.22					97.57
	5.0	17.0		100									97.12					97.56
	5.0	22.0		100									97.23					97.56
	2.0	27.0		100									97.22					97.53
	3.0	29.0		100									97.15					97.53
	4.0	32.0		100									97.19					97.52
	2.0	36.0		100									97.06					97.51
	4.0	38.0		100									97.04					97.51
	4.0	42.0		100									97.05					97.49
	5.0	46.0		100									96.99					97.49
	5.0	51.0		100									96.71					97.49
	4.0	56.0		100									96.50					97.49
	6.0	60.0		100									96.41					97.49
	4.0	66.0		100									96.49					97.5
	7.0	70.0		100									96.49					97.49
	3.0	77.0		100									96.40					97.22
	6.0	80.0		100									96.60					97.24
	6.0	86.0		100									96.63					97.21
	6.0	92.0		100									96.81					97.21
	4.0	98.0		100									96.85					97.2
	3.0	102.0		100									96.80					97.21
	7.0	105.0		100									96.68					97.2
	3.0	112.0		100									96.75					97.17
	2.0	115.0		100									96.66					97.17
	3.0	117.0		100									96.25					97.17
	4.5	120.0		100									96.31					97.17
	4.5	124.5		100									96.19					97.17
	7.0	129.0		100									96.25					97.16
	6.0	136.0		100									96.34					97.16
	8.0	142.0		100									96.60					97.16
	5.0	150.0		100									96.77					97.15
	5.0	155.0		100									96.81					97.15
	5.0	160.0		100									96.81					97.15
	7.0	165.0		100									96.77					97.15
	3.0	172.0		100									96.82					97.14
	5.0	175.0		100									96.80					97.14
	5.0	180.0		100									96.73					97.14
	5.0	185.0		100									96.52					97.14

	5.0	190.0		100									96.53					97.15
	5	195.0		100									96.33					97.14
	2	200.0		100									96.4					97.14
	2	202.0		100									96.37					97.13
	1	204.0		100									96.33					97.13
	5	205.0		100									96.27					97.11
	5	210.0		100									96.23					97.11
	5	215.0		100									96.27					97.11
	5	220.0		100									96.27					97.11
	5	225.0		100									96.5					97.11
	5	230.0		100									96.56					97.11
	5	235.0		100									96.51					97.11
	3	240.0		100									96.53					97.1
	3	243.0		100									96.54					97.09
	1	246.0		100									96.5					96.97
	3	247.0		100									95.92					96.86
	5	250.0		100									95.5					96.85
	5	255.0		100									95.96					96.85
	5	260.0		100									96.28					96.86
	5	265.0		100									96.4					96.85
	5	270.0		100									96.36					96.85
	5	275.0		100									96.49					96.81
	7	280.0		100									96.35					96.73
	5	287.0		100									96.32					96.75
	6	292.0		100									96.17					96.73
	3	298.0		100									95.68					96.73
	3	301.0		100									95.91					96.74
	5	304.0		100									96.09					96.73
	3	309.0		100									96.04					96.73
	2	312.0		100									95.9					96.73
	6	314.0		100									95.85					96.72
	5	320.0		100									95.94					96.73
	4	325.0		100									96.23					96.73
	6	329.0		100									96.25					96.73
	8	335.0		100									96.22					96.72
	5	343.0		100									96.3					96.71
	1	348.0		100									96.2					96.71
	1	349.0		100									96.2					96.71
	2	350.0		100									96.2					96.71
	6	352.0		100									96.19					96.7
	6	358.0		100									95.98					96.7
	2	364.0		100									95.91					96.7
	6	366.0		100									96.05					96.7
	3	372.0		100									96.08					96.7
	5	375.0		100									96.16					96.7
	4	380.0		100									96.17					96.69
	4	384.0		100									96.27					96.69
	5	388.0		100									96.32					96.68
	5	393.0		100									96.27					96.66
	5	398.0		100									96.26					96.64
	7	403.0		100									96.34					96.63
	0	410.0		100									96.3					96.62

Appendix G. Jurisdictional Wetlands

U.S. ARMY CORPS OF ENGINEERS
WILMINGTON DISTRICT

Action ID. **SAW-2006-40345-233** County: **Edgecombe** USGS Quad: **Whitakers**

GENERAL PERMIT (REGIONAL AND NATIONWIDE) VERIFICATION

Property Owner / Authorized Agent: **KCI Technologies, Inc. attn: Steve Stokes**
Address: **Landmark Center II, Suite 220**
4601 Six Forks Rd.
Raleigh, NC 27609

Telephone No.: **919 783-9214 x 187**
Size and location of property (water body, road name/number, town, etc.): **22.3 acres of agricultural land draining to Swift Creek, just east of the intersection of SR1415 (Morningstar Church) and SR 1414 (Benson Farm), six miles northeast of Rocky Mount, NC.**

Description of projects area and activity: **Fill approximately 0.24 acres (~3,485 linear feet by 3 foot wide) agricultural drainage ditch bottoms to raise water table.**

Applicable Law: ☒ Section 404 (Clean Water Act, 33 USC 1344)
☐ Section 10 (Rivers and Harbors Act, 33 USC 403)
Authorization: Regional General Permit Number: ____
Nationwide Permit Number: 27

Your work is authorized by the above referenced permit provided it is accomplished in strict accordance with the attached conditions and your submitted plans. Any violation of the attached conditions or deviation from your submitted plans may subject the permittee to a stop work order, a restoration order and/or appropriate legal action.

This verification is valid until the NWP is modified, reissued, or revoked. All of the existing NWPs are scheduled to be modified, reissued, or revoked prior to March 18, 2007. It is incumbent upon you to remain informed of changes to the NWPs. We will issue a public notice when the NWPs are reissued. Furthermore, if you commence or are under contract to commence this activity before the date that the relevant nationwide permit is modified or revoked, you will have twelve (12) months from the date of the modification or revocation of the NWP to complete the activity under the present terms and conditions of this nationwide permit. If, prior to the expiration date identified below, the nationwide permit authorization is reissued and/or modified, this verification will remain valid until the expiration date identified below, provided it complies with all new and/or modified terms and conditions. The District Engineer may, at any time, exercise his discretionary authority to modify, suspend, or revoke a case specific activity's authorization under any NWP.

Activities subject to Section 404 (as indicated above) may also require an individual Section 401 Water Quality Certification. You should contact the NC Division of Water Quality (telephone (919) 733-1786) to determine Section 401 requirements.

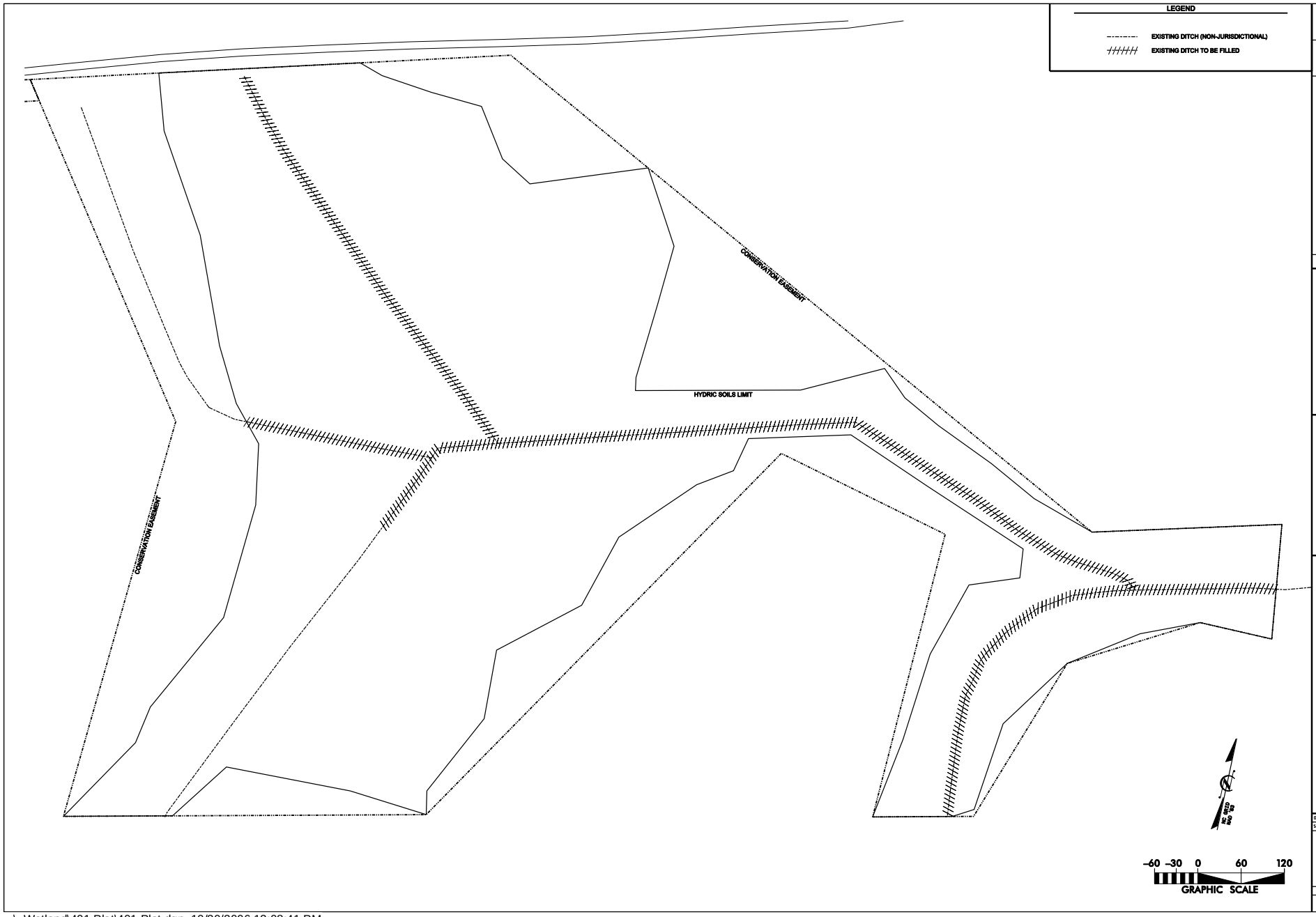
For activities occurring within the twenty coastal counties subject to regulation under the Coastal Area Management Act (CAMA), prior to beginning work you must contact the N.C. Division of Coastal Management .

This Department of the Army verification does not relieve the permittee of the responsibility to obtain any other required Federal, State or local approvals/permits.

If there are any questions regarding this verification, any of the conditions of the Permit, or the Corps of Engineers regulatory program, please contact Jamie Shern at 919 876-8441 x 31.

Corps Regulatory Official _____ Date: **8/16/06**

Expiration Date of Verification: **March 18, 2007**



REVISIONS

STA.	DESCRIPTION	DATE	APPROVED

KCI TECHNOLOGIES
ENGINEERS • PLANNERS • ECOLOGISTS
SUITE 220 LANDMARK CENTER II
4601 SIX FORKS RD., RALEIGH, NC

HARRELL - UT TO SWIFT CREEK WETLAND
RESTORATION PROJECT
ROCKY MOUNT, EDGECOMBE COUNTY, NORTH CAROLINA

DATE: AUG 2006
SCALE: 1"=60'

SITE PLAN

..._Wetland\401 Plat\401 Plat.dgn 10/30/2006 12:08:41 PM

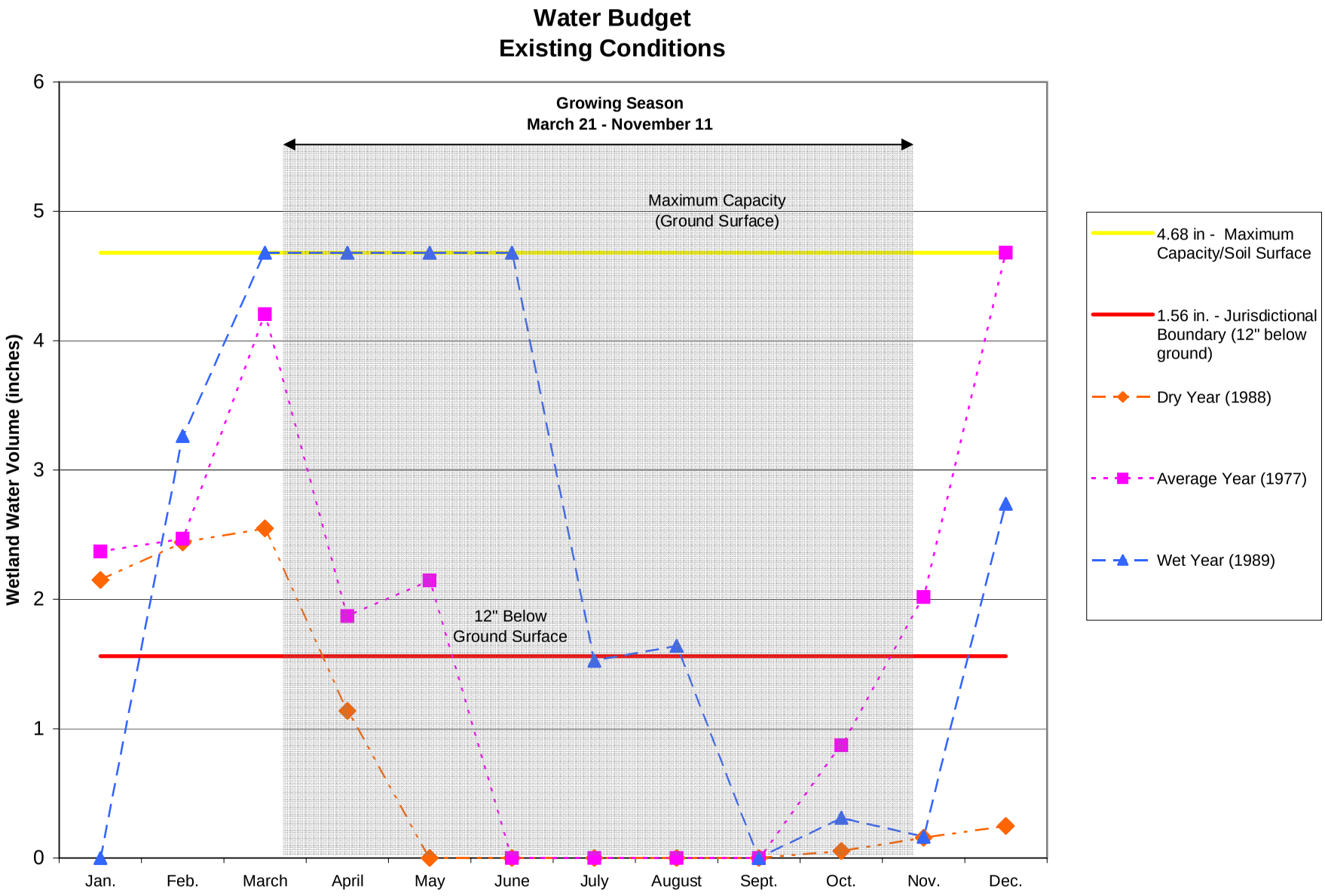
Appendix H. Wetland Water Budget

Harrell Farm - Existing Conditions

Dry Year	*Water Inputs*			*Water Outputs*				Change in	Excess	Wetland
1988	**P**	**Si ***	**Gi**	**PET**	**So**	**Go**	**Loss to Ditches**	**Storage**	**Water**	**Volume**
January	3.55	0.28	0.00	0.10	0.28	1.04	0.26	2.15	0.00	2.15
February	2.10	0.04	0.00	0.51	0.04	1.04	0.26	0.29	0.00	2.44
March	2.59	0.03	0.00	1.18	0.03	1.04	0.26	0.11	0.00	2.55
April	2.20	0.05	0.00	2.31	0.05	1.04	0.26	-1.41	0.00	1.14
May	3.64	0.31	0.00	3.84	0.31	1.04	0.26	-1.50	0.00	0.00
June	3.25	0.15	0.00	5.25	0.15	1.04	0.26	-3.30	0.00	0.00
July	2.24	0.07	0.00	6.44	0.07	1.04	0.26	-5.50	0.00	0.00
August	4.26	0.64	0.00	6.18	0.64	1.04	0.26	-3.22	0.00	0.00
September	2.40	0.04	0.00	3.97	0.04	1.04	0.26	-2.87	0.00	0.00
October	2.92	0.30	0.00	1.57	0.30	1.04	0.26	0.05	0.00	0.05
November	2.48	0.10	0.00	1.08	0.10	1.04	0.26	0.10	0.00	0.16
December	0.58	0.00	0.00	0.23	0.00	1.04	0.26	0.09	0.00	0.25
Annual Totals	**32.21**	**2.00**	**0.00**	**32.66**	**2.00**	**0.00**	**3.12**			

Avg. Year	*Water Inputs*			*Water Outputs*				Change in	Excess	Wetland
1977	**P**	**Si ***	**Gi**	**PET**	**So**	**Go**	**Loss to Ditches**	**Storage**	**Water**	**Volume**
January	3.95	0.72	0.00	0.00	0.72	1.04	0.54	2.37	0.00	2.37
February	2.02	0.06	0.00	0.34	0.06	1.04	0.54	0.10	0.00	2.47
March	4.83	0.23	0.00	1.51	0.23	1.04	0.54	1.74	0.00	4.20
April	2.04	0.14	0.00	2.80	0.14	1.04	0.54	-2.34	0.00	1.87
May	5.94	2.70	0.00	4.08	2.70	1.04	0.54	0.28	0.00	2.15
June	2.89	0.04	0.00	4.96	0.04	1.04	0.54	-3.65	0.00	0.00
July	1.70	0.01	0.00	6.80	0.01	1.04	0.54	-6.68	0.00	0.00
August	5.39	0.82	0.00	5.96	0.82	1.04	0.54	-2.15	0.00	0.00
September	3.73	1.63	0.00	4.58	1.63	1.04	0.54	-2.43	0.00	0.00
October	4.43	0.34	0.00	1.98	0.34	1.04	0.54	0.87	0.00	0.87
November	4.06	1.28	0.00	1.33	1.28	1.04	0.54	1.15	0.00	2.02
December	4.06	0.29	0.00	0.38	0.29	1.04	0.54	3.14	0.00	4.68
Annual Totals	**45.04**	**8.27**	**0.00**	**34.72**	**8.27**	**0.00**	**6.48**			

Wet Year	*Water Inputs*			*Water Outputs*				Change in	Excess	Wetland
1989	**P**	**Si ***	**Gi**	**PET**	**So**	**Go**	**Loss to Ditches**	**Storage**	**Water**	**Volume**
January	2.49	0.02	0.00	0.48	0.02	1.04	0.98	-0.01	0.00	0.00
February	5.70	0.52	0.00	0.42	0.52	1.04	0.98	3.26	0.00	3.26
March	6.25	0.48	0.00	1.08	0.48	1.04	0.98	3.15	1.01	4.68
April	7.74	1.18	0.00	2.11	1.18	1.04	0.98	3.61	2.89	4.68
May	5.72	0.49	0.00	3.47	0.49	1.04	0.98	0.23	0.00	4.68
June	8.36	1.17	0.00	6.16	1.17	1.04	0.98	0.18	0.00	4.68
July	5.16	1.35	0.00	6.29	1.35	1.04	0.98	-3.15	0.00	1.53
August	7.58	1.30	0.00	5.45	1.30	1.04	0.98	0.11	0.00	1.64
September	2.89	0.06	0.00	4.16	0.06	1.04	0.98	-3.29	0.00	0.00
October	4.47	0.75	0.00	2.14	0.75	1.04	0.98	0.31	0.00	0.31
November	2.90	0.19	0.00	1.03	0.19	1.04	0.98	-0.15	0.00	0.16
December	3.56	0.29	0.00	0.00	0.29	1.04	0.98	2.58	0.00	2.74
Annual Totals	**62.82**	**7.79**	**0.00**	**32.80**	**7.79**	**0.00**	**11.76**			

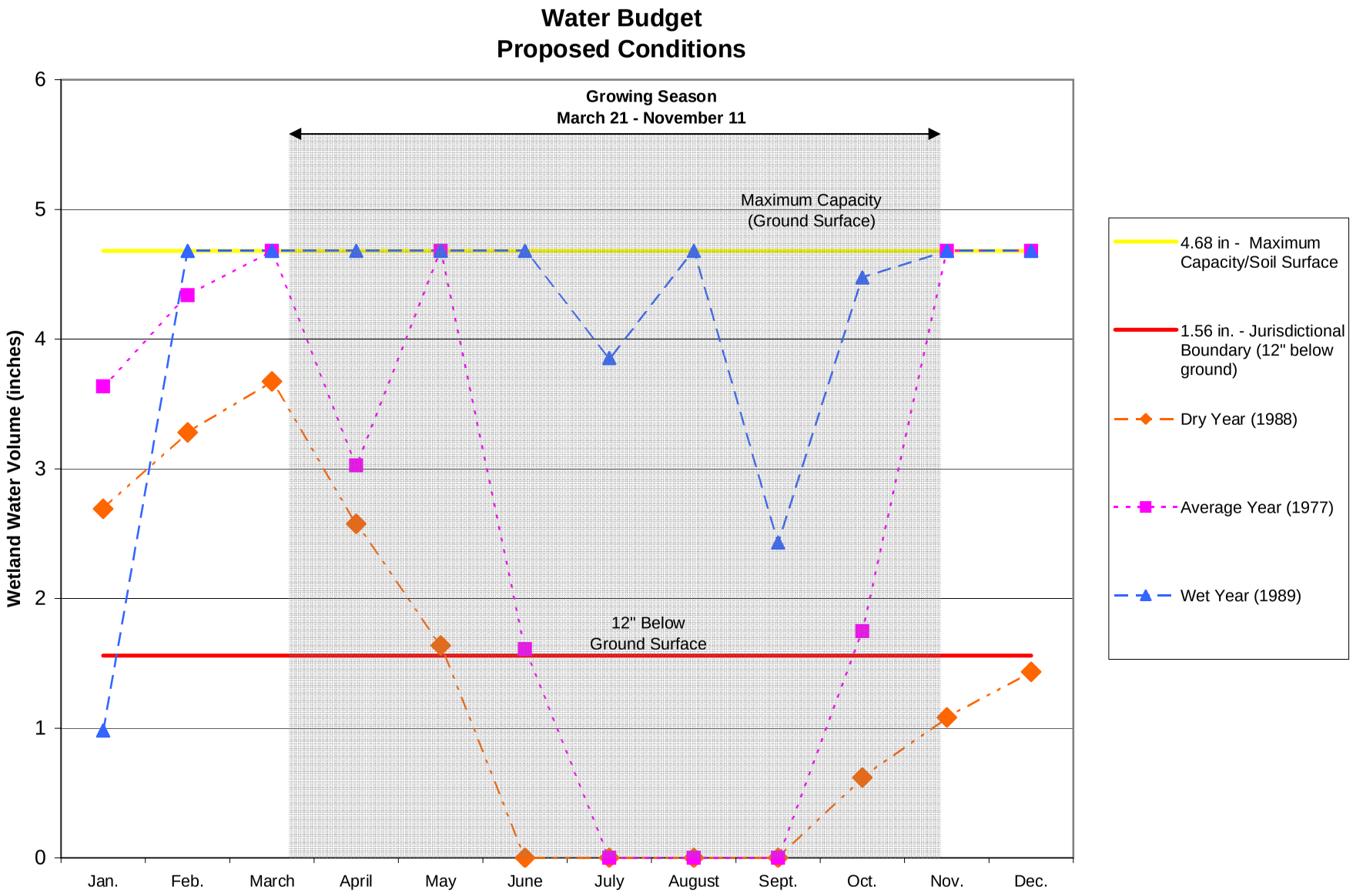

Water Budget
Existing Conditions
Growing Season
March 21 - November 11
Maximum Capacity
(Ground Surface)
12" Below
Ground Surface
Wetland Water Volume (inches)
0
1
2
3
4
5
6
Jan.
Feb.
March
April
May
June
July
August
Sept.
Oct.
Nov.
Dec.
4.68 in - Maximum Capacity/Soil Surface
1.56 in. - Jurisdictional Boundary (12" below ground)
Dry Year (1988)
Average Year (1977)
Wet Year (1989)

Harrell Farm - Proposed Conditions

Dry Year	*Water Inputs*			*Water Outputs*				Change in	Excess	Wetland
1988	**P**	**Si ***	**Gi**	**PET**	**So**	**Go**	**Loss to Ditches**	**Storage**	**Water**	**Volume**
January	3.55	0.28	0.00	0.10	0.00	1.04	0.00	2.69	0.00	2.69
February	2.10	0.04	0.00	0.51	0.00	1.04	0.00	0.59	0.00	3.28
March	2.59	0.03	0.00	1.18	0.00	1.04	0.00	0.39	0.00	3.67
April	2.20	0.05	0.00	2.31	0.00	1.04	0.00	-1.10	0.00	2.58
May	3.64	0.31	0.00	3.84	0.00	1.04	0.00	-0.94	0.00	1.64
June	3.25	0.15	0.00	5.25	0.00	1.04	0.00	-2.89	0.00	0.00
July	2.24	0.07	0.00	6.44	0.00	1.04	0.00	-5.18	0.00	0.00
August	4.26	0.64	0.00	6.18	0.00	1.04	0.00	-2.32	0.00	0.00
September	2.40	0.04	0.00	3.97	0.00	1.04	0.00	-2.57	0.00	0.00
October	2.92	0.30	0.00	1.57	0.00	1.04	0.00	0.62	0.00	0.62
November	2.48	0.10	0.00	1.08	0.00	1.04	0.00	0.46	0.00	1.08
December	0.58	0.00	0.00	0.23	0.00	1.04	0.00	0.35	0.00	1.43
Annual Total	**32.21**	**2.00**	**0.00**	**32.66**	**0.00**	**0.00**	**0.00**			

Avg. Year	*Water Inputs*			*Water Outputs*				Change in	Excess	Wetland
1977	**P**	**Si ***	**Gi**	**PET**	**So**	**Go**	**Loss to Ditches**	**Storage**	**Water**	**Volume**
January	3.95	0.72	0.00	0.00	0.00	1.04	0.00	3.63	0.00	3.63
February	2.02	0.06	0.00	0.34	0.00	1.04	0.00	0.70	0.00	4.34
March	4.83	0.23	0.00	1.51	0.00	1.04	0.00	2.51	0.00	4.68
April	2.04	0.14	0.00	2.80	0.00	1.04	0.00	-1.65	0.00	3.03
May	5.94	2.70	0.00	4.08	0.00	1.04	0.00	3.52	0.00	4.68
June	2.89	0.04	0.00	4.96	0.00	1.04	0.00	-3.07	0.00	1.61
July	1.70	0.01	0.00	6.80	0.00	1.04	0.00	-6.13	0.00	0.00
August	5.39	0.82	0.00	5.96	0.00	1.04	0.00	-0.78	0.00	0.00
September	3.73	1.63	0.00	4.58	0.00	1.04	0.00	-0.27	0.00	0.00
October	4.43	0.34	0.00	1.98	0.00	1.04	0.00	1.75	0.00	1.75
November	4.06	1.28	0.00	1.33	0.00	1.04	0.00	2.96	0.00	4.68
December	4.06	0.29	0.00	0.38	0.00	1.04	0.00	3.98	0.86	4.68
Annual Total	**45.04**	**8.27**	**0.00**	**34.72**	**0.00**	**0.00**	**0.00**			

Wet Year	*Water Inputs*			*Water Outputs*				Change in	Excess	Wetland
1989	**P**	**Si ***	**Gi**	**PET**	**So**	**Go**	**Loss to Ditches**	**Storage**	**Water**	**Volume**
January	2.49	0.02	0.00	0.48	0.00	1.04	0.00	0.98	0.00	0.98
February	5.70	0.52	0.00	0.42	0.00	1.04	0.00	4.76	0.00	4.68
March	6.25	0.48	0.00	1.08	0.00	1.04	0.00	4.61	1.49	4.68
April	7.74	1.18	0.00	2.11	0.00	1.04	0.00	5.78	2.66	4.68
May	5.72	0.49	0.00	3.47	0.00	1.04	0.00	1.70	0.00	4.68
June	8.36	1.17	0.00	6.16	0.00	1.04	0.00	2.33	0.00	4.68
July	5.16	1.35	0.00	6.29	0.00	1.04	0.00	-0.83	0.00	3.85
August	7.58	1.30	0.00	5.45	0.00	1.04	0.00	2.39	0.00	4.68
September	2.89	0.06	0.00	4.16	0.00	1.04	0.00	-2.25	0.00	2.43
October	4.47	0.75	0.00	2.14	0.00	1.04	0.00	2.04	0.00	4.47
November	2.90	0.19	0.00	1.03	0.00	1.04	0.00	1.02	0.00	4.68
December	3.56	0.29	0.00	0.00	0.00	1.04	0.00	3.84	0.72	4.68
Annual Total	**62.82**	**7.79**	**0.00**	**32.80**	**0.00**	**0.00**	**0.00**			


Water Budget
Proposed Conditions
Growing Season
March 21 - November 11
Maximum Capacity
(Ground Surface)
12" Below
Ground Surface
Wetland Water Volume (inches)
0
1
2
3
4
5
6
Jan.
Feb.
March
April
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July
August
Sept.
Oct.
Nov.
Dec.
4.68 in - Maximum Capacity/Soil Surface
1.56 in. - Jurisdictional Boundary (12" below ground)
Dry Year (1988)
Average Year (1977)
Wet Year (1989)

ADDENDUM
Harrell Stream and Wetland Restoration Plan
May 1, 2007

On March 30, 2007, KCI Technologies, Inc. (KCI) submitted the Restoration Plan for the Harrell Stream and Wetland Restoration Site to the Ecosystem Enhancement Program (EEP). The plan proposes restoring 6,987 linear feet on an Unnamed Tributary to Swift Creek (UTSC) and 15.0 acres of a Coastal Plain Small Stream Swamp wetland community. This addendum addresses the comments generated from the EEP review of the Restoration Plan.

The EEP comments are described below followed by the response from KCI that provides the requested information/justification.

1.) EEP Comment

Page 6, Section 5.0 – Reference reaches for the project includes the Mitchell River in Surry County and the North Prong Creek in Durham County. While it is understood that reference reach data is used to develop dimensionless ratios, the distance and geographic location of the Mitchell River site in particular to the proposed site is significant. Please provide justification of why these sites were chosen over reference reaches closer to the project site and within the same geographic area.

KCI Response

KCI has spent considerable time searching for suitable reference reaches throughout North Carolina. Finding a reference reach for the Reach 1 proved to be especially hard because there are few stable Bc streams with the appropriate slope in the proximity of the restoration site. Even though the Mitchell River site is not close to the project site geographically, the desired stream type and valley is the same as the designed stream. Published data have concluded that geographical proximity is less important in reference reach selection than stream and valley character.[1]

[1] Hey, R.D. 2006. Fluvial geomorphological methodology for natural stable channel design. Journal of the American Water Resources Association (JAWRA) 42(2): 357-374.

2.) EEP Comment

Page 8, Section 6.2.1 – Please reference the location of the documentation for the conclusions identified (assuming it relates to Appendix H).

KCI Response

The effect of ditching on wetland hydrology was evaluated using DRAINMOD, a groundwater model developed at North Carolina State University to simulate the effects of drainage networks on soils with shallow water tables. The model was subsequently modified with a counter goal of evaluating wetland hydrology. The model requires the following inputs: effective ditch/drain depth; ditch/drain spacing; soil-water characteristics; saturated hydraulic conductivities, and climatic data for the area consisting of daily rainfall, daily maximum and minimum temperatures, and growing season. Using information from the existing site conditions, the ditches in the model were set at 90 cm (3 ft) deep and spaced at 75 meters apart. The soil-water characteristic file was generated using the NRCS model Map Unit Users File (MUUF) for Roanoke soil. The MUUF was also used to set the saturated hydraulic conductivities. Daily rainfall and daily maximum and minimum temperatures for Rocky Mount and Tarboro for the period from 1950 to 2004 were used to generate the climatic dataset. The data were downloaded from the NOAA National Climatic Data Center website. Two datasets were obtained to allow for coverage in gaps in either set. Upon filling gaps, the Tarboro dataset covered the years from 1950 to 1997. The period modeled in the simulation was 1950 to 1990. The growing season for Edgecombe County is March 21 to November 11.

A model was created that simulated the existing conditions where ditch spacing is 75 meters apart and the ditch depth is 90 cm (HARR75.WET). Based on these existing conditions, the model indicates that wetland hydrology is not present on the site; the model showed that the site had jurisdictional hydrology only 18 out of 41 years. The impact from this ditching was calculated over the simulation period of 1950 to 1990 (HARR75B.YR in "drainage" column). Three years were chosen as representative: 1988, 1977, and 1989 as dry, average, and wet years, respectively.

Another model was created to analyze the conditions necessary to achieve jurisdictional hydrology. Multiple simulations were run using different spacing with a 10-meter interval, which indicated that at a spacing of 115 meters wetland hydrology (continuous saturation for 19 days or 8 percent of the growing season) was achieved 21 years of the time period (1950-1990). Further simulations for spacings from 110 to 115 meters at 1 meter intervals indicated that at a spacing of 114 meters or 57 meters on each side (187 feet) wetland hydrology was attained for 51 percent of the years modeled (HARRELL.WET).

A post-restoration simulation was conducted to predict the site groundwater hydrology after restoration activities have been completed. The existing ditch spacing was kept in the model, but the ditch depth was changed to 10 cm to indicate a minimal amount of drainage still exiting the site. The model indicated that successfully plugging and filling the ditches should restore jurisdictional wetland hydrology to the currently non-jurisdictional Roanoke soils with wetland hydrology 31 out of 41 years (HARRPST.WET).

To view the data from these analyses, please see the following pages (A-3 to A-9).

HARR75.WET

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ANALYSIS OF WETLAND HYDROLOGIC CRITERIA for Roanoke soil at Edgecombe Co, N.C.
for Ag field:75 m D/SPACING, STMAX=2.5cm, thwtd=30cm/12days, Ksat=8.8,.51,.05, 2
****

----------RUN STATISTICS ---------- time: 10/ 5/2006 @ 17:30
input file: C:\DRAINMOD\inputs\HARR75.PRJ
parameters: free drainage and yields not calculated
drain spacing = 7500. cm drain depth = 90.0 cm

D R A I N M O D --- HYDROLOGY EVALUATION
****** INTERIM EXPERIMENTAL RELEASE ******

Number of periods with water table closer than 30.00 cm
for at least 12 days. Counting starts on day
80 and ends on day 315 of each year

YEAR	Number of Periods of 12 days or more with WTD < 30.00 cm	Longest Consecutive Period in Days
1950	0.	0.
1951	0.	0.
1952	0.	0.
1953	0.	0.
1954	0.	0.
1955	2.	19.
1956	1.	20.
1957	0.	11.
1958	1.	29.
1959	1.	15.
1960	0.	10.
1961	0.	11.
1962	1.	12.
1963	0.	4.
1964	2.	21.
1965	1.	15.
1966	0.	6.
1967	1.	13.
1968	0.	2.
1969	2.	20.
1970	0.	10.
1971	3.	20.
1972	0.	0.
1973	0.	9.
1974	1.	16.
1975	0.	8.
1976	0.	0.
1977	0.	7.
1978	1.	23.
1979	1.	15.

1980	0.	8.
1981	0.	0.
1982	0.	6.
1983	1.	40.
1984	1.	25.
1985	0.	8.
1986	0.	0.
1987	1.	12.
1988	0.	0.
1989	3.	22.
1990	1.	15.

Number of Years with at least one period = 18. out of 41 years.

HARR75B.YR

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ANALYSIS OF WETLAND HYDROLOGIC CRITERIA for Roanoke soil at Edgecombe Co, N.C.
for Ag field:79 m D/SPACING, STMAX=2.5cm, thwtd=30cm/12days, Ksat=8.8,.51,.05, 2
****

----------RUN STATISTICS ---------- time: 2/ 9/2005 @ 10:38
input file: C:\DRAINMOD\inputs\HARR75B.PRJ
parameters: free drainage and yields not calculated
drain spacing = 7900. cm drain depth = 90.0 cm

YEAR	RAINFALL	INFILTRATION	ET	DRAINAGE	RUNOFF	SEW	TWLOSS	PUMPV
1950	100.89	100.89	95.49	.00	.00	.00	.00	.00
1951	91.41	91.41	86.29	.00	.00	.00	.00	.00
1952	121.41	121.41	89.42	.00	.00	.00	.00	.00
1953	103.84	103.84	89.09	.47	.00	.00	.48	.00
1954	104.01	94.20	88.26	7.59	9.82	.00	17.48	.00
1955	129.39	106.41	89.05	14.85	22.97	1106.72	37.86	.00
1956	129.82	121.91	99.45	21.33	7.90	1260.26	29.32	.00
1957	131.22	117.46	94.71	20.58	11.66	.00	32.33	.00
1958	139.55	117.62	88.05	29.57	22.02	1263.41	51.62	.00
1959	135.84	124.02	96.78	27.24	13.46	927.72	40.75	.00
1960	143.41	109.07	91.15	21.85	34.71	787.87	56.63	.00
1961	111.33	103.95	85.56	18.10	7.38	525.13	25.51	.00
1962	127.28	119.33	93.94	21.98	7.95	366.52	30.00	.00
1963	95.83	88.66	73.54	14.90	6.19	.00	21.13	.00
1964	138.79	107.57	84.46	23.11	30.49	744.86	53.62	.00
1965	107.37	97.62	92.32	19.54	11.46	394.43	31.06	.00
1966	121.41	112.13	87.62	12.11	9.28	225.95	21.48	.00
1967	121.03	103.86	85.56	16.46	16.28	592.14	32.78	.00
1968	102.39	98.51	88.17	13.58	4.76	.00	18.47	.00
1969	138.89	124.59	92.08	29.26	13.21	1217.32	42.52	.00
1970	110.41	108.83	92.07	18.79	2.68	110.05	21.55	.00
1971	137.16	116.72	94.94	24.90	20.44	1179.41	45.38	.00
1972	108.84	106.20	94.23	10.45	2.64	.00	13.14	.00
1973	117.47	112.17	95.09	13.94	5.30	226.37	19.33	.00
1974	121.44	120.48	104.38	16.48	.95	293.50	17.56	.00
1975	125.02	113.03	95.92	18.37	11.98	173.37	30.47	.00
1976	95.10	86.51	74.69	9.72	6.71	.00	16.48	.00
1977	114.40	108.31	91.81	16.50	6.30	47.12	22.92	.00
1978	115.11	101.45	82.22	20.40	15.33	668.67	35.82	.00
1979	151.10	122.89	93.64	30.50	28.21	1488.08	58.77	.00
1980	114.83	111.09	90.80	18.16	3.75	.00	22.02	.00
1981	88.21	88.07	79.82	10.65	.14	.00	10.84	.00
1982	127.79	120.53	97.83	20.01	6.63	148.15	26.72	.00
1983	114.45	99.23	77.11	22.12	15.29	608.15	37.43	.00
1984	115.93	109.03	100.28	22.60	7.46	570.45	30.16	.00
1985	113.89	110.59	87.81	11.27	3.30	397.21	14.64	.00
1986	84.25	84.25	81.57	4.87	.00	.00	4.93	.00
1987	111.84	95.22	80.13	16.06	16.62	343.95	32.74	.00
1988	81.81	81.81	77.43	7.85	.00	.00	7.89	.00
1989	159.56	131.90	93.14	29.79	26.91	2166.13	56.74	.00
1990	100.03	100.79	92.27	16.43	.00	316.83	16.54	.00
AVG	117.16	107.16	89.47	16.40	10.00	442.68	26.47	.00

HARRELL.WET

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ANALYSIS OF WETLAND HYDROLOGIC CRITERIA for Roanoke soil at Edgecombe Co, N.C.
for Ag field:87 m D/SPACING, STMAX=2.5cm, thwtd=30cm/12days, Ksat=8.8,.51,.05, 2
****

```
 ----------RUN STATISTICS ----------          time:  2/ 9/2005  @ 14: 7
 input file:   C:\DRAINMOD\inputs\HARRELL.PRJ
 parameters:    free drainage              and yields not calculated
               drain spacing =   11400. cm   drain depth =   90.0 cm
-------------------------------------------------------------------------
```

D R A I N M O D --- HYDROLOGY EVALUATION
****** INTERIM EXPERIMENTAL RELEASE ******

Number of periods with water table closer than 30.00 cm
for at least 19 days. Counting starts on day
80 and ends on day 315 of each year

YEAR	Number of Periods of 19 days or more with WTD < 30.00 cm	Longest Consecutive Period in Days
1950	0.	0.
1951	0.	0.
1952	0.	0.
1953	0.	0.
1954	0.	7.
1955	1.	35.
1956	1.	24.
1957	1.	22.
1958	1.	30.
1959	0.	17.
1960	1.	27.
1961	1.	33.
1962	0.	17.
1963	0.	7.
1964	2.	29.
1965	0.	18.
1966	0.	8.
1967	0.	16.
1968	0.	6.
1969	2.	30.
1970	1.	30.
1971	2.	42.
1972	0.	3.
1973	0.	18.
1974	1.	33.
1975	1.	20.
1976	0.	0.
1977	0.	10.
1978	1.	25.
1979	2.	27.

HARRELL.WET

1980	1.	21.
1981	0.	5.
1982	1.	19.
1983	1.	41.
1984	1.	41.
1985	0.	10.
1986	0.	0.
1987	1.	25.
1988	0.	4.
1989	2.	25.
1990	1.	23.

Number of Years with at least one period = 21. out of 41 years.

```
-----------------------------------------------------
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-----------------------------------------------------

ANALYSIS OF WETLAND HYDROLOGIC CRITERIA for Roanoke soil at Edgecombe Co, N.C.
for Ag field:75 m D/SPACING, STMAX=2.5cm, thwtd=30cm/12days, Ksat=8.8,.51,.05, 2
*****************************************************************************


  ----------RUN STATISTICS ----------          time:  2/ 9/2005  @ 16: 0
 input file:   C:\DRAINMOD\inputs\HARRPST.PRJ
 parameters:    free drainage              and yields not calculated
               drain spacing =    7500. cm   drain depth =   10.0 cm
-------------------------------------------------------------------------
```

D R A I N M O D --- HYDROLOGY EVALUATION
****** INTERIM EXPERIMENTAL RELEASE ******

Number of periods with water table closer than 30.00 cm
for at least 19 days. Counting starts on day
80 and ends on day 315 of each year

YEAR	Number of Periods of 19 days or more with WTD < 30.00 cm	Longest Consecutive Period in Days
1950	0.	0.
1951	0.	0.
1952	0.	0.
1953	0.	0.
1954	1.	20.
1955	2.	55.
1956	2.	47.
1957	1.	30.
1958	3.	41.
1959	2.	43.
1960	2.	36.
1961	1.	77.
1962	2.	39.
1963	0.	13.
1964	2.	41.
1965	2.	25.
1966	1.	21.
1967	1.	46.
1968	0.	15.
1969	4.	39.
1970	1.	34.
1971	2.	42.
1972	2.	32.
1973	1.	32.
1974	3.	39.
1975	1.	37.
1976	0.	0.
1977	0.	15.
1978	1.	29.
1979	3.	68.

HARRPST.WET

1980	1.	34.
1981	1.	24.
1982	2.	28.
1983	1.	52.
1984	3.	62.
1985	1.	37.
1986	0.	2.
1987	1.	55.
1988	0.	15.
1989	4.	72.
1990	2.	29.

Number of Years with at least one period = 31. out of 41 years.

3.) EEP Comment

Page 8, Section 6.2.2 – Please provide a graphic to document the conclusions within these sections.

KCI Response

An initial boundary between non-riparian and riparian wetlands was set at 74 feet based on interpolation of available FEMA maps at the time of the project proposal. The definition of non-riparian wetland was based on that provided in RFP 16-D05025. In the most recent DFIRM maps from the Flood Insurance Study (FIS) for Edgecombe County (11/3/2004), FEMA provides elevations of 72.5 and 75.4 feet for 10-year and 100-year flood events, respectively. A boundary of 72.5 feet for a 10-year event shows that only a small portion of the site receives flooding input from Swift Creek during an event of this magnitude (Figure A-1).

Additional hydrologic analysis on the site has concluded that the site hydrology is derived from precipitation and groundwater, which is currently drained from the site by a series of drainage ditches. The site topography, in particular the surface slope at the eastern transition into the floodway of Swift Creek, allows any floodwaters to readily drain from the site and thus inhibits extended periods of floodwater retention in the restoration area.

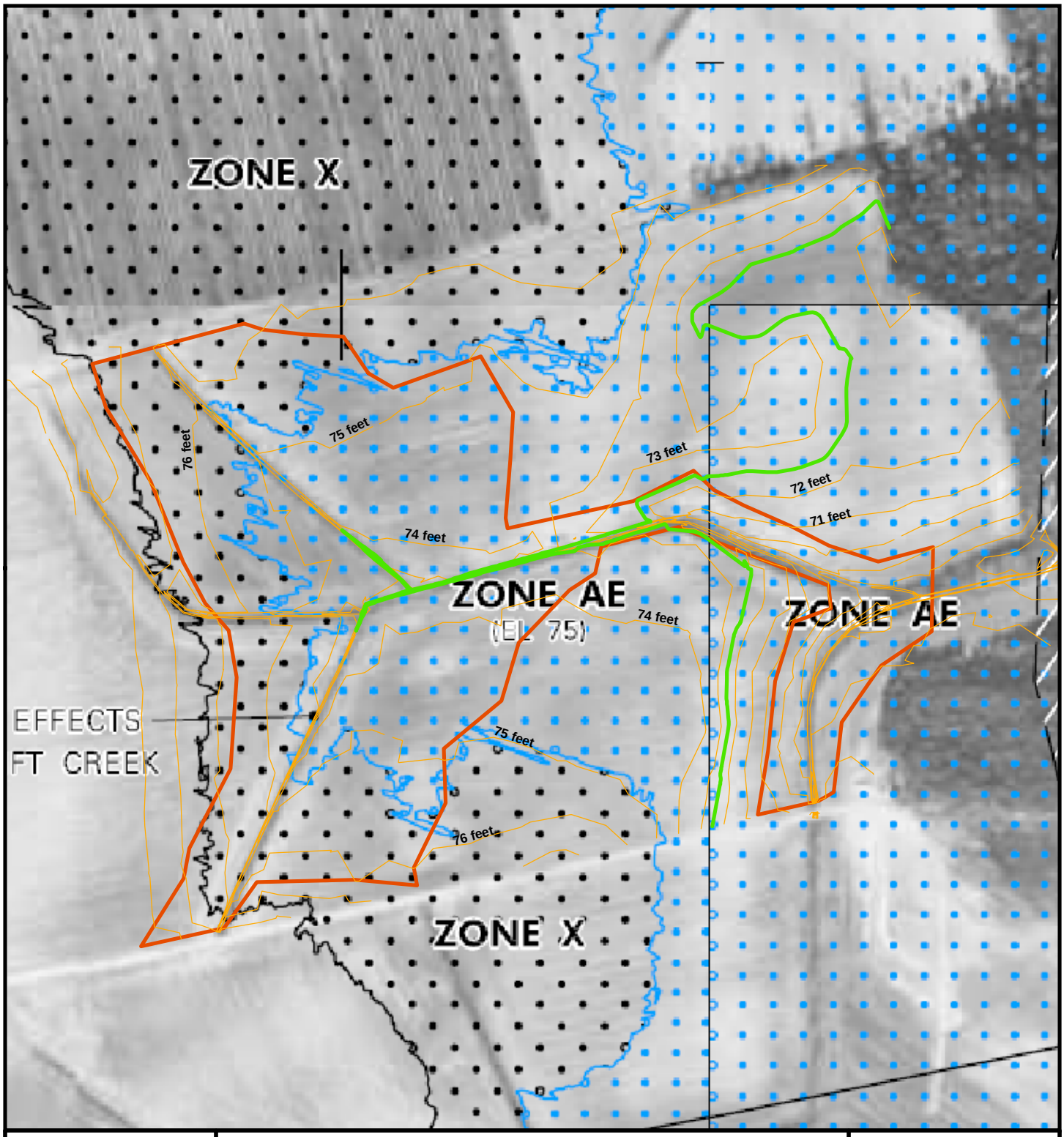

Figure A-1. Harrell Non-riverine Wetland Boundary

Wetland Restoration Boundary

10-year Flood Elevation (72.5 ft)

Wetland Site Contours (1 ft)

N
W E
S

1:3,000
1 inch equals 250 feet

250 125 0 250 Feet

Source: FEMA Panels 3882, 3883, 3892, and 3893

KCI TECHNOLOGIES

KCI ASSOCIATES OF NC

ENVIRONMENTAL TECHNOLOGIES AND CONSTRUCTION, INC.

4.) EEP Comment

Page 11-12, Sections 8.1.1 and 8.2 – The discussion in Section 8.1.1 and 8.2 indicates that the existing and the proposed stream system base sediment transport on the ability to move sand and finer material. Please address the effect, if any, the addition of pea gravel into the system will have on the streams ability to move bed load.

KCI Response

The gravel layer on the bed will serve as a stable substrate for the mechanism of the dune/anti-dune formation on top of the gravel. It will also help protect the streambed from extreme flow conditions where all of the sand becomes suspended in the flow. The gravel will not have any type of negative impact on the stream transport capacity.

5.) EEP Comment

Page 11, Section 8.1.1 – Please provide clarification and explanation of why a B5c channel was selected within Reach 1.

KCI Response

Without a well-defined floodplain/terrace adjacent to the channel, a Priority III restoration of a B5c channel is the most appropriate design in this landscape setting. A meandering channel with a large belt width could not be restored without excessive manipulation (changing the valley to a floodplain) to accommodate this form.

6.) EEP Comment

The Restoration Plan states that the Hydrologic Success Criteria will be saturated soil conditions within 12 inches of the ground surface (continuously) for 5% of the growing season. This is the MINIMUM duration to be considered wetland by USACE, but does not necessarily demonstrate the site hydrology has been restored. The Hydrologic Success Criteria should be based on the soil type and the proposed wetland type (Coastal Plain Small Stream Swamp), not the minimum needed to be considered wetland by USACE. Please revise your Restoration Plan to address this issue.

KCI Response

The Hydrologic Success Criterion for the site is saturated soil conditions within 12 inches of the ground surface (continuously) for 5% of the growing season. This is the criterion because this is the duration required by USACE. There is a lack of published data on hydrologic requirements for wetlands by community type. In the Third Approximation of the Classification of the Natural Communities of North Carolina (1990), Schafale and Weakley describe the hydrology of Coastal Plan Small Stream Swamp as "intermittently, temporarily, or seasonally flooded." This description does not convert to a quantifiable percentage of the growing season experiencing saturated soil conditions. The description of the soils at the site, Roanoke loam series, is also vague on percentage of the growing season experiencing soil saturation. The soil description describes the apparent high water table at a depth of 0-1.0 feet from the surface with the highest water table levels from November through May. Each annual monitoring report will discuss the site conditions, especially the site hydrology, and evaluate whether or not the site's objectives are being met. This will provide a better assessment of how the site is progressing toward the desired community type. Creating a quantifiable Hydrologic Success Criterion that is not based on documented scientific evidence would not be plausible given the limited evaluation period.