RESTORATION PLAN

CANE CREEK RESTORATION SITE
RUTHERFORD COUNTY, NORTH CAROLINA
(Contract #16-D06027-E)

FULL DELIVERY PROJECT
TO PROVIDE STREAM AND WETLAND MITIGATION
IN THE BROAD RIVER BASIN
CATALOGING UNIT 03050105

Prepared for:

NORTH CAROLINA DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES
ECOSYSTEM ENHANCEMENT PROGRAM
RALEIGH, NORTH CAROLINA 27604

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EXECUTIVE SUMMARY

Restoration Systems, LLC is developing stream and wetland restoration plans for the **Cane Creek Restoration Site** (Site) designed specifically to assist in fulfilling the restoration goals of the North Carolina Department of Environment and Natural Resources' Ecosystem Enhancement Program (EEP). The Site is located in northern Rutherford County within 14-digit Hydrologic Unit 03050105060020 less than 0.2 mile south of the Rutherford/McDowell County line along the eastern edge of Highway 64. The Site encompasses approximately 38.1 acres consisting of 8830 linear feet of existing stream (will be increased to 11,184 linear feet of stream as the result of Site mitigation activities), riparian buffer along Cane Creek and unnamed tributaries to Cane Creek, and 9.4 acres of drained hydric soils. Approximately 4600 linear feet of stream restoration, 5078 linear feet of stream enhancement (Level II), 1506 linear feet of stream preservation, 4.4 acres of riverine wetland restoration, and 5.0 acres of nonriverine wetland restoration are being proposed at the Site. Once implemented, mitigation activities described in this document will ultimately proved approximately 6,748 stream mitigation units (SMUs), 4.4 riverine wetland mitigation units (WMUs) and 5.0 nonriverine WMUs.

Site drainage features provide water quality functions to an approximately 8.7-square mile watershed (measured at the Site outfall). The watershed is characterized by agricultural land, timber land, and sparse industrial/residential development. Impervious surfaces account for less than 5 percent of the drainage basin surface area. The Site consists of Cane Creek and three unnamed tributaries to Cane Creek, adjacent floodplains, slopes, and hydric soils.

Restoration, enhancement and preservation of Site streams and wetlands will result in positive benefits for water quality and biological diversity in the Cane Creek watershed. Targeted mitigation efforts will achieve the following goals:

1. Remove nonpoint and point sources of pollution associated with agricultural practices including a) cessation of broadcasting fertilizer, pesticides, and other agricultural chemicals into and adjacent to the Site and b) provide a forested riparian buffer to treat surface runoff.
2. Reduce sedimentation within onsite and downstream receiving waters by a) reducing bank erosion associated with vegetation maintenance and agricultural plowing up to Site streams, and b) planting a forested riparian buffer adjacent to Site streams.
3. Reestablish stream stability and the capacity to transport watershed flows and sediment loads by restoring a stable dimension, pattern, and profile supported by natural in-stream habitat and grade/bank stabilization structures.
4. Promote floodwater attenuation by a) reconnecting bankfull stream flows to the abandoned floodplain terrace; b) restoring secondary, dredged, straightened, and entrenched tributaries, thereby reducing floodwater velocities within smaller catchment basins; and c) revegetating Site floodplains to increase frictional resistance on floodwaters.
5. Restore onsite wetlands, thereby promoting flood storage, nutrient cycling, and aquatic wildlife habitat.
6. Improve aquatic habitat with bed variability and the use of in-stream structures.
7. Provide a terrestrial wildlife corridor and refuge in an area that is developed for agricultural and timber production.
8. Provide connectivity to a State Nature Preserve northeast of the Site.

9. Provide approximately 4.4 riverine WMUs.
10. Provide approximately 5.0 nonriverine WMUs.
11. Provide approximately 6,748 SMUs.

These goals will be achieved by:

- Restoring approximately 4600 linear feet of stream channel through construction of a stable E-type channel (Priority I), thereby reestablishing stable dimension, pattern, and profile.
- Enhancing (Level II) approximately 5078 linear feet of stream channel by supplemental planting with native forest vegetation and removal of invasive species.
- Preserving approximately 1506 linear feet of stream channel along a stable, forested reach.
- Restoring approximately 4.4 acres of riverine wetlands by reconstructing Site tributaries within the floodplain, filling ditched channels, rehydrating floodplain soils, and planting with native wetland forest vegetation.
- Restoring approximately 5.0 acres of nonriverine wetlands by filling ditched channels, rehydrating soils, and planting with native wetland forest vegetation.
- Planting a native forested riparian buffer adjacent to restored streams and within Site floodplains.
- Protecting the Site in perpetuity with a conservation easement.

This project complies with interagency guidelines outlined in *Information Regarding Stream Restoration with Emphasis on the Coastal Plain – Draft* (USACE et al. 2007), *Stream Mitigation Guidelines* (USACE et al. 2003), Mitigation Site Type (MiST) documentation (USEPA 1990), and *Compensatory Hardwood Mitigation Guidelines* (DOA 1993). Specifically, Site selection, restoration goals, and monitoring procedures/objectives comply with project design considerations outlined by interagency guidance.

This document represents a detailed restoration plan summarizing activities proposed within the Site. The plan includes 1) details of existing conditions; 2) reference stream, wetland, and forest studies; 3) restoration plans; and 4) monitoring and success criteria. Upon approval of this plan, ecologically relevant construction plans will be prepared and activities implemented as outlined. Proposed restoration activities may be modified during the civil design stage due to constraints such as access issues, sediment-erosion control measures, drainage needs (floodway constraints), or other design considerations.

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1.0 PROJECT SITE IDENTIFICATION AND LOCATION

Restoration Systems, LLC is developing stream and wetland restoration plans for the Cane Creek Restoration Site (hereafter referred to as the "Site") designed specifically to assist in fulfilling the North Carolina Department of Environment and Natural Resources' Ecosystem Enhancement Program (EEP) restoration goals. The Site is located in northern Rutherford County less than 0.2 mile south of the Rutherford/McDowell County line along the eastern edge of Highway 64 (Figure 1, Appendix A).

The Site encompasses approximately 38.1 acres of land that is used for agricultural purposes. Approximately 8830 linear feet of the existing Cane Creek and three unnamed tributaries to Cane Creek and 9.4 acres of hydric soils exhibit restoration potential as riparian (4.4 acres of riverine and 5.0 acres of non-riparian) wetlands. Agricultural practices including the maintenance and removal of riparian vegetation and relocation, dredging, and straightening of onsite streams have resulted in degraded water quality, unstable channel characteristics (stream entrenchment, erosion, and bank collapse), and reduced storage capacity and floodwater attenuation. Table 1 outlines project features and objectives.

Table 1. Project Restoration Structures and Objectives

Restoration Segment/ Reach ID	Station Range	Restoration Type	Priority Approach	Existing Linear Footage/ Acreage	Designed Linear Footage/ Acreage	Comment
Cane Creek	0+00-50+78	Enhancement Level II	--	5078	5078	Entails planting riparian buffers with native forest vegetation and invasive species control.
Tributary 1	0+00-9+25	Restoration	I	1220	925	Entails restoration of a dredged, straightened, and rerouted channel on new location.
	0+00-15+06	Preservation	--	1506	1506	Will preserve a relatively stable, forested reach and provide connectivity to a state nature preserve.
Tributary 2	0+00-18+71	Restoration	I	610	1871	Entails restoration of a dredged, straightened, and rerouted channel on new location.
Tributary 3	0+00-18+04	Restoration	I	415	1804	Entails restoration of a dredged, straightened, and rerouted channel on new location.
Riparian/ Riverine Wetlands	--	Restoration	--	--	4.4	Entails reconstructing site tributaries, filling ditched channels, rehydrating floodplain soils, and planting with native forest vegetation.
Nonriparian/ Nonriverine Wetlands	--	Restoration	--	--	5.0	Entails filling ditchs, rehydrating soils, and planting with native forest vegetation.

1.1 Directions to the Site

From Rutherfordton, North Carolina:

- Travel northeast on Highway 64 East for approximately 11 miles
- The Site is approximately 0.2 miles south of the Rutherford/McDowell County line on the eastern side of Highway 64
- Latitude, Longitude of Site: 35.5342°N, 81.8541°W (NAD83/WGS84)

1.2 USGS Hydrologic Unit Code and NCDWQ River Basin Designation

The Site is located within the Broad River Basin in 14-digit United States Geological Survey (USGS) Hydrologic Unit 03050105060020 of the South Atlantic/Gulf Region (North Carolina Division of Water Quality [NCDWQ] subbasin number 03-08-02) [Figure 2, Appendix A]). The Site is not located within a Targeted Local Watershed (NCWRP 2003).

2.0 WATERSHED CHARACTERIZATION

2.1 Drainage Area

Cane Creek has a watershed area of approximately 8.7 square miles at the Site outfall (Table 2 and Figure 3, Appendix A). The upstream watershed is dominated by forest, agricultural land, and sparse industrial/residential development. Impervious surfaces account for less than 5 percent of the upstream watershed land surface. Onsite elevations range from a high of 1020 feet National Geodetic Vertical Datum (NGVD) on slopes at the top of the Site to a low of approximately 960 feet NGVD at the Site outlet (USGS Dysartsville, North Carolina 7.5-minute topographic quadrangle).

Table 2. Drainage Areas

Reach	Drainage Area	
	Acreage	Square Miles
Tributary 1	253	0.4
Tributary 2	82	0.1
Tributary 3	45	0.1
Cane Creek (at Site outfall)	5548	8.7

2.2 Surface Water Classification/Water Quality

Cane Creek and its tributaries have been assigned Stream Index Number 9-41-12-(0.3), a Best Usage Classification of **WS-V**, and are "Fully Supporting" their intended uses (NCDWQ 2005). Streams with a designation **WS-V** are waters protected as water supplies, which are generally upstream and draining to Class WS-IV waters or waters used by industry to supply their employees with drinking water or as waters formerly used as water supply. These waters are also protected for Class C uses. Class C waters are suitable for aquatic life propagation and survival, fishing, wildlife, secondary recreation, and agriculture. Unlike other WS classifications, WS-V waters have no categorical restrictions on watershed development or wastewater discharges and local governments are not required to adopt watershed protection ordinances.

Cane Creek and its tributaries are not listed on the NCDWQ final 2004 or draft 2006 303(d) lists (NCDWQ 2006a, 2006b).

2.3 Physiography, Geology, and Soils

The Site is located in the Eastern Blue Ridge Foothills ecoregion of North Carolina within USGS Cataloging Unit 03050105 of the Broad River Basin. Regional physiography is characterized by low mountains and rolling foothills, gently rounded to steep slopes, and moderate gradient streams with bedrock, boulder, cobble, and gravel substrates (Griffith 2002).

Soils that occur within the Site, according to the *Soil Survey of Rutherford County, North Carolina* (USDA 2005) are depicted in Figure 4 (Appendix A) and are described in Table 3.

Detailed soil mapping conducted on January 25, 2007 by a licensed soil scientist indicate that restorable portions of the Site are underlain by hydric Wehadkee soils (inclusions within areas mapped as the Chewacla soil series). Floodplain soils have been impacted by plowing, land clearing, agricultural production, in addition to landscape alterations associated with dredging and straightening of stream channels.

Table 3. Soils Mapped within the Site

Soil Series	Hydric Status	Family	Description
Chewacla	Class B	*Fluvaquentic Dystrochrepts*	This series consists of frequently flooded, somewhat poorly drained, moderately permeable soils of floodplains adjacent to stream channels. Slopes are generally between 0 and 2 percent. Depth to seasonal high water table occurs at 0.5 to 1.5 feet. Soft bedrock occurs at a depth of more than 60 inches.
Wehadkee (inclusions within Chewacla series)	Class A	*Typic Fluvaquents*	This series consists of very deep, poorly drained and very poorly drained soils on flood plains along streams. Slopes are generally between 0 and 2 percent. Depth to season high water table occurs at or near the soil surface.
Fannin	Nonhydric	*Typic Hapludults*	This series consists of very deep, well-drained soils on gently sloping to very steep ridges and side slopes. Slopes are generally between 30 and 50 percent.
Skyuka	Nonhydric	*Ultic Hapludalfs*	This series consists of gently sloping to strongly sloping, very deep, well drained soils on stream terraces. Slopes are generally between 2 and 8 percent. Soft bedrock occurs at a depth of more than 72 inches.

2.4 Historical Land Use and Development Trends

Land use within the Site watershed is dominated by forest, agricultural land, and sparse industrial/residential development (Table 4). Impervious surfaces account for less than 5 percent of the upstream watershed land surface.

Table 4. Drainage Areas

Land Use	Acreage	Percentage
Forest Land	5378	96.9
Agricultural Land	105	1.9
Industrial/Residential Development	25	0.5
Impervious Surface	40	0.7
Total	**5548**	**100**

Onsite land use is characterized by agricultural land utilized primarily for row crop and hay production and hardwood forest (Figure 4, Appendix A). Riparian vegetation adjacent to Site streams is sparse and disturbed due to plowing and regular maintenance. Row crop areas are subject to the broadcast application of various agricultural chemicals. In addition, the Site hydric soils are evidence of the historical presence of palustrine wetlands. Soils within these areas have been disturbed due to agricultural activities including regular plowing and vegetation maintenance, in addition to the removal of groundwater hydrology inputs from the rerouting and straightening of Site tributaries.

2.5 Threatened and Endangered Species

Based on the most recently updated county-by-county database of federally listed species in North Carolina as posted by the United States Fish and Wildlife Service (USFWS) at http://nc-es.fws.gov/es/countyfr.html, four federally protected species are listed in Rutherford County. Table 5 lists the federally protected species for Rutherford County and indicates if potential habitat exists within the Site for each species.

Table 5. Federally Protected Species for Rutherford County

Common Name	Scientific Name	Status*	Habitat Present Within Site	Biological Conclusion
Indiana bat	*Myotis sodalis*	Endangered	Yes	May Affect, Not Likely to Adversely Effect
Dwarf-flowered heartleaf	*Hexastylis naniflora*	Threatened	Yes	No Effect
Small-whorled pogonia	*Isotria medeoloides*	Threatened	Yes	May Affect, Not Likely to Adversely Effect
White irisette	*Sisyrinchium dichotomum*	Endangered	Yes	No Effect

*Endangered = a taxon "in danger of extinction throughout all or a significant portion of its range"; Threatened = a taxon "likely to become endangered within the foreseeable future throughout all or a significant portion of its range"

The scope of project work includes stream enhancement (Level II), stream channel restoration, stream preservation and wetland restoration (riverine and non-riverine). In addition, the contractor will establish haul routes and material storage areas throughout the easement. Earthwork (grubbing, grading, filling) will accompany the stream restoration efforts and, to some extent, the wetland restoration effort. Fortunately, these land-disturbing activities will be concentrated in the agricultural landscape where row crop production of squash is the predominant land-use activity; however, some earthwork will occur immediately adjacent to existing streams within forested communities. To ensure that adequate field investigations were performed to determine if listed species or their habitat were present, natural history and morphological descriptions of each listed species were researched before conducting field investigations. Intensive field investigations throughout the entire easement were conducted on August 2 and August 8, 2006. These surveys included an evaluation of all habitats as well as searches for evidence of listed species. The investigator is Randy Turner, who has more than 35 years direct experience in field survey methodologies. The investigator has found numerous populations of rare species over the years.

Indiana bat

Indiana bat summer roosting habitat consists of caves, tree hollows or trees with large, exfoliating bark such as bitternut and shagbark hickory. Foraging habitat includes stream valley in close proximity to roosting or nesting sites.. Methodical, walking surveys of all forested habitat within 500 feet of the Site were conducted along roughly Parallel transects. Searches covered a band of forest at least 500 feet deep. The goal of the search was to look for any caves, large bitternut (*Carya cordiformis*), shagbark hickory (*Carya ovata*), or other species with exfoliating bark that could serve as a roosting location for the species.

Biological Conclusion: Since the work to be undertaken will not result in removal of any roosting or hibernacula sites (suitable habitat) and since intensive walking surveys confirmed the absence of suitable roosting sites throughout the Site or within close proximity to Cane Creek, it is reasonable to conclude the project will have **No Effect** on the species.

Dwarf-flowered heartleaf

This small herbaceous member of the birthwort family (Aristolochiacea) occurs in a several county area in the western and central piedmont. The species is closely allied with *H. lewisii* and *H. heterophylla*. An interesting soil-plant correlation appears to exist between the species and soils of the Pacolet series (or Madison and Musella), which are sandy-to-gravelly substrates. The habitat where this species occurs is

often associated with escarpments into drainages including acidic hardwood embankments. It is often reported in association with *Kalmia latifolia*.

Although no soils of the Pacolet, Madison or Musella series occur within the site, surveys were conducted at streamside habitats within mixed hardwood forest fragments, because the investigator is not convinced that the soil-plant relationship is absolute. The only members of the birthwort family growing within the construction limits of the project are *Asarum canadense* and *Aristolochia* sp., although an abundance of *Hexastylis arifolia* was observed within the forested hillside community along the eastern boundary of the site, but outside the Site.

Biological Conclusion: Intensive surveys throughout all suitable habitat within the Site confirms that the species is not present; therefore, it is reasonable to conclude the project will have **No Effect** on the species.

Small-whorled Pogonia

The small-whorled pogonia is a member of the orchid family. It is a perennial with a smooth, hollow stem approximately 4-10 inches tall terminating in a whorl of green, elliptical leaves that are somewhat pointed and measure up to 3 by 1.5 inches. A flower, or occasionally two flowers, is produced at the top of the stem. The hollow stem is an important morphological element when attempting to distinguish the *Isotria medeoloides* from other *Isotria* species and even Indian cucumber-root (*Medeola virginiana*). Flowering may occur from about mid-May to mid-June, but then the population may lie dormant for an unspecified period of time, which is similar to other members of the orchid family and is thought to be associated with complex soil-fungal relationships. Habitats where this plant has been observed include montane oak-hickory or acidic cove forests, but it has also been found in an apple orchard. Sites currently or historically known to support this species range from 2000 to 4000 feet in elevation. Except for the crane crane-fly orchid, *Tipularia discolor*, intensive surveys confirmed that no other orchidaceous species occur within the Site.

Biological Conclusion: Intensive surveys of the entire easement confirms that small-whorled pogonia does not occur within the Site. As a consequence of such efforts, it is reasonable to conclude the project will have **No Effect** on the species.

White Irisette

This herbaceous member of the *Iris* family occurs on rich, basic soils. It grows in clearings and along the edges of upland woods where the canopy is thin and often where down-slope runoff has removed much of the deep litter layer ordinarily present on these sites. The irisette is dependent on some form of disturbance to maintain the open quality of its habitat. Vegetative portions of the plant are dichotomously branched. Small, white flowers occur from May through July.

Biological Conclusion: Surveys throughout the Site carefully examined all suitable habitat for individuals of this species.Based on the results of intensive surveys, it is reasonable to conclude the project will have **No Effect** on the species.

North Carolina Natural Heritage Program (NCNHP) records were reviewed on March 7, 2006 and no element occurrences are documented at or near the Site. One Significant Natural Heritage Area, Lone Mountain, and several Natural Communities including Chestnut Oak Forest, Dry-Mesic Oak Forest, Low Elevation Rocky Summit, and Piedmont/Mountain Low Alluvial Forest occur immediately northeast of the Site at the State Nature Preserve. In addition, one Significant Natural Heritage Area, Biggerstaff Mountain, and several Natural Communities including Montane Oak-Hickory Forest, Chestnut Oak

Forest, and Low Elevation Rocky Summit occur approximately 1.5 miles southeast of the Site near Yellowtop Mountain.

Designated Critical Habitat for federally protected species does not occur in Rutherford County.

2.6 Cultural Resources

Archaeological surveys were completed at the Site on September 13-15 and 19-22, 2006 by Legacy Research Associates, Inc. to locate, document, and conduct National Register of Historic Places (NRHP) eligibility evaluations for archaeological resources that may be affected by this project.

A review of state and local survey data was completed prior to the archaeological survey. Files at the North Carolina Office of State Archaeology (OSA) and collections held at the North Carolina State Library in Raleigh, North Carolina were reviewed. Research identified no previously recorded archaeological sites within 1 mile of the project. However, based on the topographic and hydrological situation, the North Carolina State Historic Preservation Office (NCSHPO) determined there to be a high probability for the presence of prehistoric and/or historic archaeological sites within the project boundaries.

One archaeological site, 31RF176, was recorded within the project Area of Potential Effects (APE) during the survey. The site consists of a Woodland period lithic and ceramic scatter located on the first terrace above the Cane Creek floodplain east of US Highway 64. The terrace features a cultivated squash field. Site 31RF176 is recommended as being potentially eligible for the NRHP based on the landform, abundance of artifacts, and the high probability of subsurface features. The archeological Site is located just outside of the Site and will not be disturbed by ground disturbing activities. There is a small portion of this archeological Site that is located within the project easement boundary that will be protected in perpetuity.

In consultation with the NCSHPO, Restoration Systems LLC developed a mitigation plan to help protect this valuable archeological site and to avoid impacting site 31RF167. The plan of action includes the following tasks:

1. Locate and flag the boundary of site 31RF167
2. Install orange construction safety fencing around the area prior to commencing construction
3. Dry-excavate the stream south of the existing channel in the dry. Building this section of the stream in the dry allows for little or no sediment loss and allows more flexibility for contractor mobilization.
4. Upon completion of dry channel excavation and stabilization, construction of the northern stream channel will take place. Machinery will work from the northern banks of existing stream to avoid encroachment upon site 31RF167.
5. Once the construction activities have been completed and the Site is stabilized, the construction safety fence will be removed and the easement area will be planted with riparian vegetation.

2.7 Interagency Guidance

This project complies with interagency guidelines outlined in *Information Regarding Stream Restoration with Emphasis on the Coastal Plain – Draft* (USACE et al. 2007), *Stream Mitigation Guidelines* (USACE et al. 2003), Mitigation Site Type (MiST) documentation (USEPA 1990), and *Compensatory Hardwood Mitigation Guidelines* (DOA 1993). Specifically Site selection, restoration goals, and monitoring procedures/objectives comply with project design considerations outlined by interagency guidance.

2.7.1 Site Selection

Site selection considerations including 8-digit Cataloging Unit; 14-digit Hydrologic Unit; physiographic region; wildlife habitat uplift; biological, chemical, and physical integrity; and flow regime were considered during Site selection and design. In addition, the Site is located in a Targeted Local Watershed (06010108010020), a water supply watershed, and based on a meeting with North Carolina Wildlife Resources (NCWRC) representatives, is upstream from a reach of Threemile Creek that supports naturally reproducing populations of rainbow trout.

Based on recent guidance from USACE and NCDWQ (USACE et al. 2007), the primary Site selection metric is flow regime and/or the historic presence of a stream prior to ditching or other impacts. This guidance suggests a minimum drainage basin of 50 acres, the presence of a defined valley with latitudinal and longitudinal slope, and soils conducive of natural stream formation.

Stream restoration reaches are characterized by drainage areas ranging from 0.02 to 5.1 square miles (10 to 3264 acres) which are situated in steeply sloped alluvial/colluvial floodplains. Although some Site tributaries are characterized by drainage areas smaller than 50 acres, mountain streams such as Site tributaries frequently originate at spring heads, which are perennial. Onsite tributaries support characteristics (benthic macroinvertabrates, defined valleys, substrate different from the adjacent landscape, and hydrologic flow) indicative of a perennial flow regime.

2.7.2 Project Design Considerations

Site evaluations and goals focus on functional uplift associated with project implementation. Agency guidance indicates that in the Mountain and Piedmont regions, deforestation, stream channelization, and/or damage to the riparian buffer are most often targeted as potential restoration sites. Decreasing sinuosity and bank destabilization are primary indicators of increased sediment input and unnatural sediment transport, leading to degradation of water quality and habitat (USACE et al. 2007). In addition elevated water temperatures and lack of well-developed structures and pools have a direct effect on resident and downstream trout populations.

2.7.3 Site Monitoring

In Mountain and Piedmont settings it is widely accepted that restoring historic pattern, dimension, and profile to impacted stream reaches and replacing structures will result in improved stability, water quality, and habitat (USACE et al. 2007). In these systems, measuring physical properties of pattern, dimension, and profile is typically appropriate for estimating function. Stream monitoring and success criteria associated with this project conform to these fundamental tenets.

2.8 Potential Constraints

The presence of conditions or characteristics that have the potential to hinder restoration activities on the Site was evaluated. The evaluation focused primarily on the presence of hazardous materials, utilities and restrictive easements, rare/threatened/endangered species, historic or archaeological resources or critical habitats, and the potential for hydrologic trespass. Existing information regarding Site constraints was acquired and reviewed. In addition, any Site conditions that have the potential to restrict the restoration design and implementation were documented during the field investigation.

Habitat for Indiana bat and small-whorled pogonia is present within mature forest portions of the Site. Mature forest within the Site is proposed for preservation or supplemental planting; therefore, Site restoration activities will benefit habitat for these species by restoring and providing additional forest habitat within the remainder of the Site.

Investigations on behalf of Section 106 were conducted and a site was identified, which must be avoided during construction activities. Avoidance measures have been identified and were submitted to SHPO for

their approval. SHPO responded by letter on November 27, 2006 concurring with the archaeologists recommendations that no further archaeological investigation be conducted.

No other evidence of natural or man-made conditions was identified that have the potential to impede the proposed restoration activities.

2.8.1 Property Ownership and Boundaries

The Site is located within five parcels owned by Restoration Systems, L.L.C., Mr. Miles Whisnant, Mr. Charles Harris, Mr. Clifford Strassenburg, and Mr. William Curry. A permanent conservation easement totaling approximately 38.1 acres encompasses Site restoration activities.

2.8.2 Project Access

The Site is located immediately adjacent to Highway 64. A transportation plan, including the location of access routes and staging areas will be designed to minimize disturbance to the maximum extent feasible. The number of transportation access points into the floodplain will be maximized to avoid traversing long distances through the Site interior.

2.8.3 Utilities

A powerline is located adjacent to US Highway 64; however, Site restoration activities will not disturb the powerline.

2.8.4 FEMA/Hydrologic Trespass

The HEC-RAS analysis indicates that the restoration design will result in a no-rise in the 100-year floodplain water surface elevations outside of the Site. The results of the analysis affirm that hydrologic trespass to adjacent properties will not occur. The HEC-RAS is discussed in more detail in Section 6.4 (HEC-RAS Analysis).

3.0 SITE STREAMS (EXISTING CONDITIONS)

Cane Creek, which is targeted for enhancement (level II), is a fourth-order, bank-to-bank stream system characterized by eroding banks, excessive sediment transport, and a disturbed riparian buffer. Due to its large size, potential for upstream impacts, and mature streamside vegetation Enhancement Level II has been selected as the proposed mitigation alternative for this reach. Three unnamed tributaries to the Cane Creek (Tributaries 1-3), targeted for restoration, are first- and second-order streams that have been dredged, straightened, and rerouted within the Site.

Current Site conditions have resulted in degraded water quality, a loss of aquatic habitat, reduced nutrient and sediment retention, and unstable channel characteristics (loss of horizontal flow vectors that maintain pools, an increase in erosive forces to channel bed and banks, and sediment loading). In addition, the lack of deep-rooted riparian vegetation and continued clearing and dredging of Site streams have exacerbated erosion adjacent to Site channels. Site restoration activities will restore riffle-pool morphology, aid in energy dissipation, increase aquatic habitat, stabilize channel banks, and greatly reduce sediment loss from channel banks.

3.1 Channel Classification

Stream geometry and substrate data have been evaluated to classify existing stream conditions based on a classification utilizing fluvial geomorphic principles (Rosgen 1996a). This classification stratifies streams into comparable groups based on pattern, dimension, profile, and substrate characteristics. Primary components of the classification include degree of entrenchment, width-depth ratio, sinuosity, channel slope, and stream substrate composition. Existing Site reaches are classified as G-type (entrenched, low width-depth ratio) streams with the exception of Tributary 3, which is classified as an Eg-type stream (moderately entrenched, low width-depth ratio). Each stream type is modified by a

number 1 through 6 (e. g., E5), denoting a stream type which supports a substrate dominated by 1) bedrock, 2) boulders, 3) cobble, 4) gravel, 5) sand, or 6) silt/clay. Locations of existing stream reaches and cross-sections are depicted in Figure 4 (Appendix A). Stream geometry measurements under existing conditions are summarized in the Morphological Stream Characteristics Table (Table 6) and Appendix B.

G-type (entrenched, low width-to-depth ratio) streams are generally in a mode of degradation derived from near continuous channel adjustments resulting from very high bank erosion. Bed and bank erosion typically leads to channel downcutting and evolution from a stable E-type channel into a G-type (gully) channel. Continued erosion eventually results in lateral extension of the G-type channel into an F-type (widened gully) channel. The F-type channel will continue to widen laterally until the channel is wide enough to support a stable C-type or E-type channel at a lower elevation so that the original floodplain is no longer subject to regular flooding. Existing stream characteristics are summarized below.

3.2 Discharge

Cane Creek has an approximately 8.7-square mile watershed at the Site outfall and a bankfull discharge of 134 cubic feet per second. Site Tributaries 1-3 have drainage areas of 0.4, 0.1, and 0.1-square mile, respectively and bankfull discharges of 14.0, 6.0, and 4.0 cubic feet per second, respectively.

3.3 Channel Morphology

Site streams have been impacted by land clearing, erosive flows, plowing, and manipulation of channels including straightening and rerouting. Plowing and deforestation for row crop production near stable streams typically leads to channel adjustments including increases in bank erosion, width/depth ratio, stream gradient, and sediment supply. In addition, these impacts may lead to decreases in channel sinuosity, meander-width-ratios, and sediment transport capacity (Rosgen 1996b). Onsite streams are expected to continue to erode and deposit sediment into receiving streams until a stable stream pattern has been carved from the adjacent floodplain.

Dimension: Site streams have been dredged and straightened and are classified as G-type reaches with the exception of Tributary 3, which is classified as a Eg-type reach. Cross-sectional areas of Tributaries 1-3 currently range from 17.5 to 167.7 square feet (compared to 3.2 to 10.3 square feet predicted by this study). Channel incision is indicated by bank-height ratios ranging from 2.3 to 7.4. The channels are currently characterized by eroding banks as the channels attempt to enlarge to a stable cross-sectional area as described in the evolutionary process outlined above.

Pattern: Straightening of the channels has resulted in a loss of pattern variables such as belt-width, meander wavelength, pool-to-pool spacing, and radius of curvature. The channel is currently characterized by a low sinuosity of 1.0 to 1.1 (thalweg distance/straight-line distance) with no distinct repetitive pattern of riffles and pools present.

Profile: The average water surface slope for the dredged and straightened reaches measure 0.0112 for Tributary 1 and 0.0243 to 0.0244 for Tributaries 2-3 (rise/run). These values are nearly equal to the valley slopes resulting in sinuosities of 1.0 to 1.1. Typically, dredging and straightening will oversteepen a channel reducing channel length over a particular drop in valley slope, as is depicted in this case. In addition, dredging and straightening channels disturbs perpendicular flow vectors that maintain riffles and pools, resulting in headcuts, oversteepened riffles, and loss of pools.

Substrate: Channel substrate is characterized by gravel-sized particles typical of this region of North Carolina with the exception of Tributary 3, which is characterized by sand-sized particles.

Table 6. Morphological Stream Characteristics Table
Cane Creek Stream and Wetland Restoration Site

Variables	Exisiting Channel		REFERENCE	PROPOSED
	Tributary 2	Tributary 3		
Stream Type	G4	Eg5	E4	E4
Drainage Area (mi^2)	0.13	0.07	0.3	0.07 - 0.13
Bankfull Discharge (cfs)	6.0	4.0	11.5	4.0 - 6.0
Dimension Variables				
Bankfull Cross-Sectional Area (A_{bkf})	4.8	3.2	8.5	4.1
Existing Cross-Sectional Area ($A_{existing}$)	41.3 - 104.2	17.5 - 47.3	7.7 -9.3	4.1 - 4.1
Bankfull Width (W_{bkf})	Mean: 5.0	Mean: 5.6	Mean: 8.4	Mean: 5.0
	Range: 4.3 - 5.5	Range: 5.1 - 6.0	Range: 8.1 - 8.7	Range: 4.5 -= 6.7
Bankfull Mean Depth (D_{bkf})	Mean: 1.0	Mean: 0.6	Mean: 1.1	Mean: 0.8
	Range: 0.9 - 1.1	Range: 0.5 - 0.6	Range: 0.9 - 1.2	Range: 0.6 - 1.0
Bankfull Maximum Depth (D_{max})	Mean: 1.2	Mean: 1.1	Mean: 1.4	Mean: 1.1
	Range: 1.1 - 1.4	Range: 0.9 - 1.3	Range: 1.3 - 1.4	Range: 0.7 - 1.4
Pool Width (W_{pool})	No distinctive repetitive pattern of riffles and pools due to staightening activities		Mean: 11.3	Mean: 6.5
			Range: 10.7 - 11.8	Range: 5.2 - 9.1
Maximum Pool Depth (D_{pool})			Mean: 2.1	Mean: 1.7
			Range: 1.9 - 2.3	Range: 1.4 - 2.4
Width of Floodprone Area (W_{fpa})	Mean: 6.7	Mean: 15.0	Mean: 87.5	Mean: 150
	Range: 6.0 - 7.0	Range: 10.0 - 20.0	Range: 25 - 150	Range: 80 - 200
Dimension Ratios				
Entrenchment Ratio (W_{fpa}/W_{bkf})	Mean: 1.4	Mean: 2.7	Mean: 10.7	Mean: 30.0
	Range: 1.18 - 1.63	Range: 1.96 - 3.33	Range: 2.9 - 18.5	Range: 16 - 40
Width / Depth Ratio (W_{bkf}/D_{bkf})	Mean: 5.2	Mean: 9.6	Mean: 8.4	Mean: 7.0
	Range: 3.8 - 6.3	Range: 8.0 - 11.2	Range: 7.1 - 9.7	Range: 5.0 - 10.0
Max. D_{bkf} / D_{bkf} Ratio	Mean: 1.3	Mean: 2.1	Mean: 1.3	Mean: 1.4
	Range: 1.2 - 1.3	Range: 1.5 - 2.6	Range: 1.2 - 1.4	Range: 1.2 - 1.8
Low Bank Height / Max. D_{bkf} Ratio	Mean: 5.3	Mean: 3.2	Mean: 1.0	Mean: 1.0
	Range: 3.9 - 7.4	Range: 2.3 - 4.1	Range: 1.0 - 1.0	Range: 1.0 - 1.3
Maximum Pool Depth / Bankfull	No distinctive repetitive pattern of riffles and pools due to staightening activities		Mean: 2.0	Mean: 2.2
Mean Depth (D_{pool}/D_{bkf})			Range: 1.9 - 2.1	Range: 1.8 - 3.0
Pool Width / Bankfull			Mean: 1.3	Mean: 1.3
Width (W_{pool}/W_{bkf})			Range: 1.3 - 1.5	Range: 1.0 - 1.5
Pool Area / Bankfull			Mean: 1.6	Mean: 1.6
Cross Sectional Area			Range: 1.5 - 1.7	Range: 1.1 - 2.1
Pattern Variables				
Pool to Pool Spacing (L_{p-p})	No distinctive repetitive pattern of riffles and pools due to staightening activities	No distinctive repetitive pattern of riffles and pools due to staightening activities	Mean: 42.3	Mean: 25.0
			Range: 23.2 - 89.3	Range: 15.0 - 50.0
Meander Length (L_m)			Mean: 58.9	Mean: 35.0
			Range: 36.5 - 87.9	Range: 25.0 - 55.0
Belt Width (W_{belt})			Mean: 37.0	Mean: 20.0
			Range: 19.0 - 60.0	Range: 10.0 - 35.0
Radius of Curvature (R_c)			Mean: 12.9	Mean: 11.0
			Range: 7.0 - 26	Range: 10.0 - 20.0
Sinuosity (Sin)	1.1	1.0	1.5	1.3 - 1.4
Pattern Ratios				
Pool to Pool Spacing/	No distinctive repetitive pattern of riffles and pools due to staightening activities	No distinctive repetitive pattern of riffles and pools due to staightening activities	Mean: 5.0	Mean: 5
Bankfull Width (L_{p-p}/W_{bkf})			Range: 2.8 - 10.6	Range: 3.0 - 10.0
Meander Length/			Mean: 7.0	Mean: 7.0
Bankfull Width (L_m/W_{bkf})			Range: 4.3 - 10.5	Range: 5.0 - 11.0
Meander Width Ratio			Mean: 4.4	Mean: 4
(W_{belt}/W_{bkf})			Range: 2.3 - 7.1	Range: 2 - 7
Radius of Curvature/			Mean: 1.5	Mean: 2.2
Bankfull Width (Rc/W_{bkf})			Range: 0.8 - 4.3	Range: 2 - 4
Profile Variables				
Average Water Surface Slope (S_{ave})	0.0243	0.0244	0.0161	0.0049
Valley Slope (S_{valley})	0.0267	0.0244	0.0229	0.0064
Riffle Slope (S_{riffle})	No distinctive repetitive pattern of riffles and pools due to staightening activities	No distinctive repetitive pattern of riffles and pools due to staightening activities	Mean: 0.0284	Mean: 0.0078
			Range: 0.0148 - 0.0492	Range: 0.0049 - 0.0147
Pool Slope (S_{pool})			Mean: 0.0013	Mean: 0.0025
			Range: 0 - 0.004	Range: 0 - 0.0049
Run Slope (S_{run})			Mean: 0.0448	Mean: 0.0123
			Range: 0 - 0.2453	Range: 0 - 0.049
Glide Slope (S_{glide})			Mean: 0.0057	Mean: 0.0025
			Range: 0 - 0.0299	Range: 0 - 0.0093
Profile Ratios				
Riffle Slope/ Water Surface	No distinctive repetitive pattern of riffles and pools due to staightening activities	No distinctive repetitive pattern of riffles and pools due to staightening activities	Mean: 1.76	Mean: 1.6
Slope (S_{riffle}/S_{ave})			Range: 0.92 - 3.06	Range: 1.0 - 3.0
Pool Slope/Water Surface			Mean: 0.08	Mean: 0.5
Slope (S_{pool}/S_{ave})			Range: 0 - 0.25	Range: 0 - 1.0
Run Slope/Water Surface			Mean: 2.78	Mean: 2.5
Slope (S_{run}/S_{ave})			Range: 0 - 15.2	Range: 0 - 10.0
Glide Slope/Water Surface			Mean: 0.35	Mean: 0.5
Slope (S_{glide}/S_{ave})			Range: 0 - 1.86	Range: 0 - 1.9

Exisiting Channel	REFERENCE	PROPOSED
Tributary 1		
G4	E4	E4
0.40	0.3	0.4
14.0	11.5	14.0
Dimenstion Variables		
10.3	8.5	10.3
62.7 - 167.7	7.7 - 9.3	10.3 - 10.3
Mean: 9.8	Mean: 8.4	Mean: 10.6
Range: 6.9 - 12.0	Range: 8.1 - 8.7	Range: 9.6 - 11.1
Mean: 1.1	Mean: 1.1	Mean: 1.0
Range: 0.9 - 1.5	Range: 0.9 - 1.2	Range: 0.9 - 1.1
Mean: 1.8	Mean: 1.4	Mean: 1.5
Range: 1.3 - 2.1	Range: 1.3 - 1.4	Range: 1.3 - 1.9
No distinctive repetitive pattern of riffles and pools due to straightening activites	Mean: 11.3	Mean: 13.8
	Range: 10.7 - 11.8	Range: 10.6 - 15.9
	Mean: 2.1	Mean: 2.2
	Range: 1.9 - 2.3	Range: 1.8 - 3.0
Mean: 14.9	Mean: 87.5	Mean: 150
Range: 9.0 - 18.0	Range: 25 - 150	Range: 80 - 200
Dimension Ratios		
Mean: 1.5	Mean: 10.7	Mean: 14.2
Range: 1.30 - 1.64	Range: 2.9 - 18.5	Range: 7.8 - 18.9
Mean: 9.6	Mean: 8.4	Mean: 11.0
Range: 4.6 - 14.0	Range: 7.1 - 9.7	Range: 9.0 - 12.0
Mean: 1.6	Mean: 1.3	Mean: 1.5
Range: 1.3 - 1.9	Range: 1.2 - 1.4	Range: 1.3 - 1.9
Mean: 3.8	Mean: 1.0	Mean: 1.0
Range: 2.9 - 4.6	Range: 1.0 - 1.0	Range: 1.0 - 1.3
No distinctive repetitive pattern of riffles and pools due to staightening activities	Mean: 2.0	Mean: 2.2
	Range: 1.9 - 2.1	Range: 1.8 - 3.0
	Mean: 1.3	Mean: 1.3
	Range: 1.3 - 1.5	Range: 1.0 - 1.5
	Mean: 1.6	Mean: 1.6
	Range: 1.5 - 1.7	Range: 1.1 - 2.1
Pattern Variables		
No distinctive repetitive pattern of riffles and pools due to staightening activities	Mean: 42.3	Mean: 53.0
	Range: 23.2 - 89.3	Range: 31 - 106
	Mean: 58.9	Mean: 74.0
	Range: 36.5 - 87.9	Range: 53 - 117
	Mean: 37.0	Mean: 42.0
	Range: 19.0 - 60.0	Range: 21 - 74
	Mean: 12.9	Mean: 23.0
	Range: 7.0 - 26	Range: 21 - 42
1.1	1.5	1.3 - 1.4
Pattern Ratios		
No distinctive repetitive pattern of riffles and pools due to staightening activities	Mean: 5.0	Mean: 5
	Range: 2.8 - 10.6	Range: 3.0 - 10.0
	Mean: 7.0	Mean: 7.0
	Range: 4.3 - 10.5	Range: 5.0 - 11.0
	Mean: 4.4	Mean: 4
	Range: 2.3 - 7.1	Range: 2 - 7
	Mean: 1.5	Mean: 2.2
	Range: 0.8 - 4.3	Range: 2 - 4
Profile Variables		
0.0112	0.0161	0.0113
0.0123	0.0229	0.0147
No distinctive repetitive pattern of riffles and pools due to staightening activities	Mean: 0.0284	Mean: 0.0181
	Range: 0.0148 - 0.0492	Range: 0.0113 - 0.0339
	Mean: 0.0133	Mean: 0.0057
	Range: 0 - 0.0819	Range: 0 - 0.0113
	Mean: 0.0048	Mean: 0.0283
	Range: 0 - 0.0107	Range: 0 - 0.113
	Mean: 0.0057	Mean: 0.0057
	Range: 0 - 0.0299	Range: 0 - 0.0215
No distinctive repetitive pattern of riffles and pools due to staightening activities	Mean: 1.76	Mean: 1.6
	Range: 0.92 - 3.06	Range: 1.0 - 3.0
	Mean: 0.08	Mean: 0.5
	Range: 0 - 0.25	Range: 0 - 1.0
	Mean: 2.78	Mean: 2.5
	Range: 0 - 15.2	Range: 0 - 10.0
	Mean: 0.35	Mean: 0.5
	Range: 0 - 1.86	Range: 0 - 1.9

3.4 Channel Stability Assessment

3.4.1 Stream Power

Stability of a stream refers to its ability to adjust itself to inflowing water and sediment load. One form of instability occurs when a stream is unable to transport its sediment load, leading to aggradation, or deposition of sediment onto the stream bed. Conversely, when the ability of the stream to transport sediment exceeds the availability of sediments entering a reach, and/or stability thresholds for materials forming the channel boundary are exceeded, erosion or degradation occurs.

Stream power is the measure of a stream's capacity to move sediment over time. Stream power can be used to evaluate the longitudinal profile, channel pattern, bed form, and sediment transport of streams. Stream power may be measured over a stream reach (total stream power) or per unit of channel bed area. The total stream power equation is defined as:

$$\Omega = \rho g Q s$$

where Ω = total stream power (ft-lb/s-ft), ρ = density of water (lb/ft^3), g = gravitational acceleration (ft/s^2), Q = discharge (ft^3/sec), and s = energy slope (ft/ft). The specific weight of water (γ = 62.4 lb/ft^3) is equal to the product of water density and gravitational acceleration, ρg. A general evaluation of power for a particular reach can be calculated using bankfull discharge and water surface slope for the reach. As slopes become steeper and/or velocities increase, stream power increases and more energy is available for reworking channel materials. Straightening and clearing channels increases slope and velocity and thus stream power. Alterations to the stream channel may conversely decrease stream power. In particular, over-widening of a channel will dissipate energy of flow over a larger area. This process will decrease stream power, allowing sediment to fall out of the water column, possibly leading to aggradation of the stream bed.

The relationship between a channel and its floodplain is also important in determining stream power. Streams that remain within their banks at high flows tend to have higher stream power and relatively coarser bed materials. In comparison, streams that flood over their banks onto adjacent floodplains have lower stream power, transport finer sediments, and are more stable. Stream power assessments can be useful in evaluating sediment discharge within a stream and the deposition or erosion of sediments from the stream bed.

3.4.2 Shear Stress

Shear stress, expressed as force per unit area, is a measure of the frictional force that flowing water exerts on a streambed. Shear stress and sediment entrainment are affected by sediment supply (size and amount), energy distribution within the channel, and frictional resistance of the stream bed and bank on water within the channel. These variables ultimately determine the ability of a stream to efficiently transport bedload and suspended sediment.

For flow that is steady and uniform, the average boundary shear stress exerted by water on the bed is defined as follows:

$$\tau = \gamma R s$$

where τ = shear stress (lb/ft^2), γ = specific weight of water, R = hydraulic radius (ft), and s = the energy slope (ft/ft). Shear stress calculated in this way is a spatial average and does not necessarily provide a

good estimate of bed shear at any particular point. Adjustments to account for local variability and instantaneous values higher than the mean value can be applied based on channel form and irregularity. For a straight channel, the maximum shear stress can be assumed from the following equation:

$$\tau_{max} = 1.5\tau$$

for sinuous channels, the maximum shear stress can be determined as a function of plan form characteristics:

$$\tau_{max} = 2.65\tau(R_c / W_{bkf})^{-0.5}$$

where R_c = radius of curvature (ft) and W_{bkf} = bankfull width (ft).

Shear stress represents a difficult variable to predict due to variability of channel slope, dimension, and pattern. Typically, as valley slope decreases channel depth and sinuosity increase to maintain adequate shear stress values for bedload transport. Channels that have higher shear stress values than required for bedload transport will scour bed and bank materials, resulting in channel degradation. Channels with lower shear stress values than needed for bedload transport will deposit sediment, resulting in channel aggradation.

The actual amount of work accomplished by a stream per unit of bed area depends on the available power divided by the resistance offered by the channel sediments, plan form, and vegetation. The stream power equation can thus be written as follows:

$$\omega = \rho g Q s = \tau v$$

where ω = stream power per unit of bed area (N/ft-sec, Joules/sec/ft^2), τ = shear stress, and v = average velocity (ft/sec). Similarly,

$$\omega = \Omega / W_{bkf}$$

where W_{bkf} = width of stream at bankfull (ft).

3.4.3 Stream Power and Shear Stress Methods and Results

Channel degradation or aggradation occurs when hydraulic forces exceed or do not approach the resisting forces in the channel. The amount of degradation or aggradation is a function of relative magnitude of these forces over time. The interaction of flow within the boundary of open channels is only imperfectly understood. Adequate analytical expressions describing this interaction have yet to be developed for conditions in natural channels. Thus, means of characterizing these processes rely heavily upon empirical formulas.

Traditional approaches for characterizing stability can be placed in one of two categories: 1) maximum permissible velocity and 2) tractive force, or stream power and shear stress. The former is advantageous in that velocity can be measured directly. Shear stress and stream power cannot be measured directly and must be computed from various flow parameters. However, stream power and shear stress are generally better measures of fluid force on the channel boundary than velocity.

Using these equations, stream power and shear stress were estimated for 1) existing dredged and straightened reaches, 2) the reference reach, and 3) proposed Site conditions. Important input values and

output results (including stream power, shear stress, and per unit shear power and shear stress) are presented in Table 7. Average stream velocity and discharge values were calculated for the existing Site stream reaches, the reference reach, and proposed conditions.

In order to maintain sediment transport functions of a stable stream system, the proposed channel should exhibit stream power and shear stress values so that the channel is neither aggrading nor degrading.

Table 7. Stream Power (Ω) and Shear Stress (τ) Values

	Discharge (ft^2/s)	Water Surface Slope (ft/ft)	Total Stream Power (Ω)	Ω/W	Hydraulic Radius	Shear Stress (□)	Velocity (v)	τ v	τ_{max}
Existing Conditions									
Tributary 1	14.0	0.0112	9.78	1.00	0.86	0.60	1.36	0.82	0.90
Tributaries 2-3	5.0	0.0243	7.58	1.52	0.59	0.89	1.22	1.08	1.33
Reference Reach	11.5	0.0161	11.55	1.38	0.80	0.81	1.35	1.09	1.21
Proposed Conditions									
Tributary 1	14.0	0.0113	9.87	0.93	0.82	0.58	1.36	0.78	0.86
Tributaries 2-3	5.0	0.0049	1.53	0.31	0.66	0.20	1.22	0.25	0.30

Stream power and shear stress values are higher for the existing, dredged and straightened, G- and Eg-type reaches than for proposed E-type channels. Existing reaches are degrading as evidenced by bank erosion, channel incision, low width-depth ratios, and bank-height ratios ranging from 2.3 to 7.4; degradation has resulted from a combination of water surface slopes that have been steepened and channels that have been straightened and rerouted across the floodplain.

Stream power and shear stress values for the proposed channels should be lower than for existing channels to effectively transport sediment through the Site without eroding and downcutting, resulting in stable channel characteristics. This results from a reduction in channel size and water surface slope in the design channel as compared to the existing, eroding channel. In addition, the project will effectively reduce valley slope, by redirecting proposed channels down the historic floodplain/valley, thereby reducing stream power and shear stress even further.

Reference reach values for stream power and shear stress are slightly higher than for the proposed channels; however, the discharge and water surface slopes are higher for the reference reach resulting in higher stream power and shear stress values. The reference reach is characterized by fully forested riparian fringes and is therefore able to resist stream power and shear stress of these magnitudes. However, the proposed channels will be devoid of deep rooted vegetation; therefore, proposed targets for stream power and shear stress values should be slightly less than predicted for the reference reach.

3.5 Bankfull Verification

Discharge estimates for the Site utilize an assumed definition of "bankfull" and the return interval associated with that bankfull discharge. For this study, the bankfull channel is defined as the channel dimensions designed to support the "channel forming" or "dominant" discharge (Gordon et al. 1992). Current research also estimates the bankfull discharge would be expected to occur approximately every 1.3 to 1.5 years (Rosgen 1996a, Leopold 1994).

The Site is located in the Mountain Physiographic province; therefore, regional curves for the Mountains (Harman et al. 2001) were utilized and verified by regional regression equations, Cowan's roughness equation method, and reference stream data.

Based on available Mountain regional curves, the bankfull discharge for the reference reach averages approximately 13.3 cubic feet per second (Harman et al. 2001). The USGS regional regression equation for the Blue Ridge-Piedmont region indicates that bankfull discharge for the reference reach at a 1.3 to 1.5 year return interval averages approximately 30 to 38 cubic feet per second (USGS 2003), which is way above estimates based on field indicators and regional curves as discussed below (Appendix C). In addition, a stream roughness coefficient (n) was estimated using a version of Arcement and Schneider's (1989) weighted method for Cowan's (1956) roughness component values and applied to the following equation (Manning 1891) to obtain a bankfull discharge estimate.

$$Qbkf = [1.486/n] * [A*R2/3*S1/2]$$

where, A equals bankfull area, R equals bankfull hydraulic radius, and S equals average water surface slope. The Manning's "n" method indicates that bankfull discharge for the reference reach averages approximately 36.7 cubic feet per second, which is also way above estimates based on field indicators and regional curves as discussed below.

Field indicators of bankfull and riffle cross-sections were utilized to obtain an average bankfull cross-sectional area for the reference reach. The Mountain regional curves were then utilized to plot the watershed area and discharge for the reference reach cross-sectional area. Field indicators of bankfull approximate an average discharge of 11.5 cubic feet per second for the reference reach.

To verify regional curves and USGS regression models, two gauged streams (Jacobs Fork and First Broad River) were analyzed to determine a return interval for momentary peak discharges. Momentary peak discharges (return interval between 1.3 and 1.5 years) were calculated from the USGS gauge data and plotted against the regional curve (Appendix C). The stations were within close proximity to the Site; however, stations with a similar drainage area were not available; gauged streams had drainage areas of 25.7 and 60.5 square miles, respectively, compared to the 0.3-square mile onsite reference. Jacobs Fork plotted just below and First Broad River plotted just above predicted discharges based on mountain regional curves (Harman et al. 2001).

Based on the above analysis of methods to determine bankfull discharge, proposed conditions at the Site will be based on bankfull indicators found on the onsite reference reach, which resulted in an area 86 percent of the size indicated by Mountain regional curves. Table 8 summarizes all methods analyzed for estimating bankfull discharge.

Table 8. Reference Reach Bankfull Discharge Analysis

Method	Watershed Area (square miles)	Return Interval (years)	Discharge (cfs)
Mountain Regional Curves (Harman et al. 2001)	0.3	1.3 – 1.5	13.3
Blue Ridge-Piedmont Regional Regression Model (USGS 2003)	0.3	1.3 – 1.5	30 - 38
Manning's "n" using Cowan's Method (1956)	0.3	NA	36.7
Field Indicators of Bankfull	0.3	1.3 – 1.5	11.5

3.6 Vegetation

The Site is characterized predominately by agricultural land with mature hardwood forest adjacent to the preservation reach (Figure 4, Appendix A). Agricultural areas are regularly maintained and plowed for row crops leaving soils disturbed and exposed to the edges of the stream banks. Riparian vegetation adjacent to Site streams is predominantly disturbed.

The preservation reach (upstream reach of Tributary 1) is characterized by mature hardwood forest. Species include American beech (*Fagus grandifolia*), white oak (*Quercus alba*), dogwood (*Cornus florida*), ironwood (*Carpinus caroliniana*), sycamore (*Platanus occidentalis*), eastern red cedar (*Juniperus virginiana*), mockernut hickory (*Carya alba*), red maple (*Acer rubrum*), northern red oak (Q*uercus rubra*), black cherry (*Prunus serotina*), persimmon (*Diospyros virginiana*), hickory (*Carya* sp.), mountain laurel (*Kalmia latifolia*), and doghobble (*Leucothoe fontanesiana*).

4.0 REFERENCE STREAM

The reference stream reach is located onsite on the preservation reach (upstream reach of Tributary 1) (Figure 4, Appendix A). Distinct bankfull indicators were present within the channel. In addition, dimension, pattern, and profile variables have not been altered or degraded, allowing for assistance with the proposed restoration reaches (Figure 5, Appendix A).

4.1 Watershed Characterization

The reference stream watershed is characterized almost entirely by mature hardwood forest and is located just downstream of a North Carolina State Nature Preserve. Alterations, development, and impervious surfaces within the watershed are minimal.

4.2 Channel Classification

Stream geometry and substrate data have been evaluated to classify the reference reach based on a classification utilizing fluvial geomorphic principles (Rosgen 1996a). This classification stratifies streams into comparable groups based on pattern, dimension, profile, and substrate characteristics. The reference reach is characterized as an E-type, sinuous (1.5) channel with a gravel dominated substrate. E-type streams are characterized as slightly entrenched, riffle-pool channels exhibiting high sinuosity (1.3 to greater than 1.5). E-type streams typically exhibit a sequence of riffles and pools associated with a sinuous flow pattern. In North Carolina, E-type streams often occur in narrow to wide valleys with well-developed alluvial floodplains (Valley Type VIII). E-type channels are typically considered stable; however, these streams are sensitive to upstream drainage basin changes and/or channel disturbance, and may rapidly convert to other stream types.

4.3 Discharge

The reference stream has an approximately 0.3-square mile watershed and a bankfull discharge of 11.5 cubic feet per second based on bankfull indicators.

4.4 Channel Morphology

Stream cross-sections and profiles were measured along the reference stream (Figure 5, Appendix A). The stream reach is transporting its sediment supply while maintaining stable dimension, pattern, and profile. Stream geometry measurements for the reference stream are summarized in the Morphological Stream Characteristics Table (Table 6).

Dimension: Data collected at the reference reach indicates a bankfull cross-sectional area of 8.5 square feet, a bankfull width of 8.4 feet, a bankfull depth of 1.1 feet, and a width-to-depth ratio of 8.4. Regional curves predict that the stream should exhibit a bankfull cross-sectional area of approximately 9.9 square feet for the approximate 0.3-square mile watershed (Harman et al. 2001), slightly above the 8.5-square feet displayed by channel bankfull indicators identified in the field. However, this is within the range of statistical error for present Mountain regional curves. Since the reference reach was located on the Site and bankfull indicators were present, proposed conditions at the Site will be based on bankfull indicators found on the reference reach, which resulted in an area 86 percent of the size indicated by Mountain regional curves. For a more detailed discussion on bankfull verification see Section 3.5 (Bankfull Verification).

The reference reach exhibits a bank-height ratio of 1.0, which is representative of a stable E-type channel. In addition, the width of the floodprone area ranges from 25 to 150 feet giving the channel an entrenchment ratio of 2.9 to 18.5, typical of a stable E-type channel.

Pattern: In-field measurements of the reference reach have yielded an average sinuosity of 1.5 (thalweg distance/straight-line distance). Other channel pattern attributes include an average pool-to-pool spacing ratio (L_{p-p}/W_{bkf}) of 5.0, a meander wavelength ratio (L_m/W_{bkf}) of 7.0, and a radius of curvature ratio (R_c/W_{bkf}) of 1.5. These variables were measured within a stable, forested reach, which did not exhibit any indications of pattern instability such as shoot cutoffs, abandoned channels, or oxbows.

Profile: Based on elevational profile surveys, the reference reach is characterized by a valley slope of 0.0229 (rise/run). Ratios of the reference reach riffle, run, pool, and glide slopes to average water surface slope are 1.6, 2.5, 0.5, and 0.5, respectively. Steep run slopes result from structure drops (log jams, bed rock, or course material) at the bottom of the riffle, leading to deep pool formation at the upper extent of the pool. Design channel profiles should mimic the reference profile, with structures being located at the base of the riffle and steep drops occurring in the run facet.

Substrate: The channel is characterized by a channel substrate dominated by gravel-sized particles.

4.5 Channel Stability Assessment

Channel stability assessments for existing and proposed conditions, and the reference stream are outlined above in Section 3.4 (Channel Stability Assessment).

4.6 Bankfull Verification

Methods to verify bankfull are outlined above in Section 3.5 (Bankfull Verification). Ultimately, proposed conditions at the Site will be based on bankfull indicators found on the onsite reference reach (preservation reach/upstream reach of Tributary 1) (Figure 4, Appendix A), which resulted in an area 86 percent of the size indicated by Mountain regional curves.

4.7 Reference Forest Ecosystem

According to Mitigation Site Classification (MiST) guidelines (USEPA 1990), a Reference Forest Ecosystem (RFE) must be established for restoration sites. RFEs are forested areas on which to model restoration efforts of the restoration site in relation to soils and vegetation. RFEs should be ecologically stable climax communities and should represent believed historical (predisturbance) conditions of the restoration site. Quantitative data describing plant community composition and structure are collected at the RFEs and subsequently applied as reference data for design of the restoration Site planting scheme.

The RFE for this project is located on the Site preservation reach (upstream reach of Tributary 1) (Figure 4, Appendix A). The RFE supports plant community and landform characteristics that restoration efforts will attempt to emulate. Tree and shrub species identified within the reference forest and outlined in Table 9 will be used, in addition to other relevant species in appropriate Schafale and Weakley (1990) community descriptions.

Table 9. Reference Forest Ecosystem

Piedmont/Mountain Bottomland Forest Piedmont/Low Mountain Alluvial Forest	
Canopy Species	**Understory Species**
American beech (*Fagus grandifolia*)	dogwood (*Cornus florida*)
white oak (*Quercus alba*)	ironwood (*Carpinus caroliniana*)
sycamore (*Platanus occidentalis*)	eastern red cedar (*Juniperus virginiana*)
mockernut hickory (*Carya alba*)	mountain laurel (*Kalmia latifolia*)
red maple (*Acer rubrum*)	doghobble (*Leucothoe fontanesiana*)
northern red oak (Q*uercus rubra*)	
black cherry (*Prunus serotina*)	
persimmon (*Diospyros virginiana*)	
hickory (*Carya* sp.)	

5.0 SITE WETLAND (EXISTING CONDITIONS)

5.1 Jurisdictional Wetlands

Jurisdictional wetland limits are defined using criteria set forth in the Corps of Engineers Wetlands Delineation Manual (Environmental Laboratory 1987). As stipulated in this manual, the presence of three clearly defined parameters (hydrophytic vegetation, hydric soils, and evidence of wetland hydrology) are required for a wetland jurisdictional determination.

Hydric soil limits were mapped in the field during January 2007 by a Licensed Soil Scientist. Based on field surveys and groundwater models discussed below, jurisdictional wetlands do not currently occur within the Site restoration areas (Figure 4, Appendix A). Areas within the Site, which historically contained jurisdictional wetlands, have been significantly disturbed by compaction due to agricultural practices; relocation, dredging, straightening, and rerouting of Site streams; ditching of fields; and removal of vegetation and are currently effectively drained below jurisdictional wetland hydrology thresholds.

5.2 Hydrological Characterization

Areas of the Site targeted for riverine wetland restoration will receive hydrological inputs from periodic overbank flooding of the restored tributaries, groundwater migration into the wetlands, upland/stormwater runoff, and, to a lesser extent, direct precipitation.

Hydrology of areas targeted for nonriverine wetland restoration occur outside of the tributary floodplains and will primarily be driven by precipitation with additional inputs from upland/stormwater runoff and slope seepage. Cane Creek is a controlled flow stream; the existing Cane Creek floodplain is acting as a terrace; therefore, Cane Creek will not provide hydrological input to these areas.

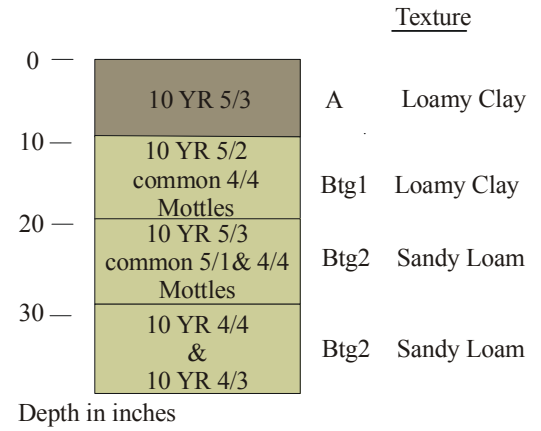
5.3 Soil Characteristics

Restorable portions of the Site are underlain by hydric Wehadkee soils (inclusions within areas mapped as the Chewacla soil series). Soils have been impacted by plowing, land clearing, ditching, agricultural production, in addition to landscape alterations associated with dredging and straightening of stream channels. A typical profile is as follows.

Soil Profiles (Boring Log)

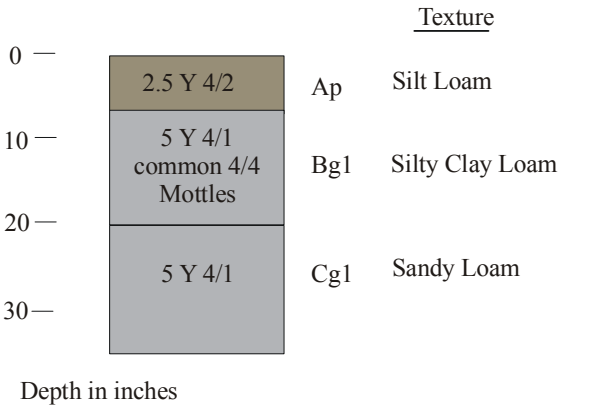
Wehadkee

Hydric Soil as Observed in the Field



Wehadkee

Hydric Soil as Described in Rutherford Co. Soil Survey (USDA 2005)



5.4 Plant Community Characterization

Historically, Site wetlands may have supported communities similar to a Piedmont/Mountain Bottomland Forest (riverine wetlands) and a Nonriverine Wet Hardwoods Forest (nonriverine wetlands) (Schafale and Weakley 1990). Piedmont/Mountain Bottomland Forest communities typically occur on floodplain ridges and terraces other than active levees adjacent to the river channel and are intermittently flooded. Nonriverine Wet Hardwood Forests are typically located on poorly drained interstream flats not associated with a stream.

Despite the landscape position difference between the riverine and nonriverine areas of the Site, vegetative communities are similar and historically may have been dominated by species contained within the reference forest located on the Site as outlined in Section 4.7 (Reference Forest Communities). Typical species of these communities, according to Schafale and include cherrybark oak (*Quercus pagoda*), swamp chestnut oak (*Quercus michauxii*), sweetgum (*Liquidambar styraciflua*), tulip poplar (*Liriodendron tulipifera*), American elm (*Ulmus americana*), hackberry (*Celtis laevigata*), loblolly pine (*Pinus taeda*), green ash (*Fraxinus pennsylvanica*), bitternut hickory (*Carya cordiformis*), and shagbark hickory (*Carya ovata*). Understory species typically include ironwood, flowering dogwood, red maple, pawpaw (*Asiminia triloba*), and American holly (*Ilex opaca*).

6.0 SITE RESTORATION PLAN

6.1 Project Goals

Restoration of Site streams and wetlands will result in positive benefits for water quality and biological diversity in the Cane Creek watershed. Restoration of onsite streams and wetlands will achieve the following goals:

1. Remove nonpoint and point sources of pollution associated with agricultural practices including a) cessation of broadcasting fertilizer, pesticides, and other agricultural chemicals into and adjacent to the Site and b) provide a forested riparian buffer to treat surface runoff.
2. Reduce sedimentation within onsite and downstream receiving waters by a) reducing bank erosion associated with vegetation maintenance and agricultural plowing up to Site streams, and b) planting a forested riparian buffer adjacent to Site streams.

3. Reestablish stream stability and the capacity to transport watershed flows and sediment loads by restoring a stable dimension, pattern, and profile supported by natural in-stream habitat and grade/bank stabilization structures.
4. Promote floodwater attenuation by a) reconnecting bankfull stream flows to the abandoned floodplain terrace; b) restoring secondary, dredged, straightened, and entrenched tributaries, thereby reducing floodwater velocities within smaller catchment basins; and c) revegetating Site floodplains to increase frictional resistance on floodwaters.
5. Restore onsite wetlands, thereby promoting flood storage, nutrient cycling, and aquatic wildlife habitat.
6. Improve aquatic habitat with bed variability and the use of in-stream structures.
7. Provide a terrestrial wildlife corridor and refuge in an area that is developed for agricultural and timber production.
8. Provide connectivity to a State Nature Preserve northeast of the Site.
9. Provide approximately 4.4 riverine WMUs.
10. Provide approximately 5.0 nonriverine WMUs.
11. Provide approximately 6,748 SMUs.

These goals will be achieved by:

- Restoring approximately 4600 linear feet of stream channel through construction of a stable E-type channel (Priority I), thereby reestablishing stable dimension, pattern, and profile.
- Enhancing (Level II) approximately 5078 linear feet of stream channel by supplemental planting with native forest vegetation and removal of invasive species.
- Preserving approximately 1506 linear feet of stream channel along a stable, forested reach.
- Restoring approximately 4.4 acres of riverine wetlands by reconstructing Site tributaries within the floodplain, filling ditched channels, rehydrating floodplain soils, and planting with native wetland forest vegetation.
- Restoring approximately 5.0 acres of nonriverine wetlands by filling ditched channels, rehydrating soils, and planting with native wetland forest vegetation.
- Planting a native forested riparian buffer adjacent to restored streams and within Site floodplains.
- Protecting the Site in perpetuity with a conservation easement.

6.2 Restoration Plan

The complete restoration plan is depicted in Figures 6A-6C (Appendix A). Components of this plan may be modified based on construction or access constraints. Primary activities proposed at the Site include 1) stream restoration, 2) wetland restoration, 3) soil scarification, and 4) plant community restoration. A monitoring plan and contingency plan are outlined in Section 7 (Performance Criteria) of this document.

6.2.1 Stream Restoration

This stream restoration effort is designed to restore a stable, meandering stream on new location that approximates hydrodynamics, stream geometry, and local microtopography relative to reference conditions. Geometric attributes for the existing, degraded channel and the proposed, stable channel are listed in Table of Morphological Stream Characteristics (Table 6).

An erosion control plan and construction/transportation plan are expected to be developed during the next phase of this project. Erosion control will be performed locally throughout the Site and will be incorporated into construction sequencing. Exposed surficial soils at the Site are unconsolidated, alluvial sediments, which do not revegetate rapidly after disturbance; therefore, seeding with appropriate grasses and immediate planting with disturbance-adapted shrubs will be employed following the earth-moving

process. In addition, onsite root mats (seed banks) and vegetation will be stockpiled and redistributed after disturbance.

A transportation plan, including the location of access routes and staging areas will be designed to minimize disturbance to existing vegetation and soils to the extent feasible. The number of transportation access points into the floodplain will be maximized to avoid traversing long distances through the Site's interior.

6.2.1.1 Reconstruction on New Location

Tributaries 1-3 are located within a floodplain suitable for design channel excavation on new location. The streams will be constructed on new location and the old dredged, straightened, and rerouted channels will be abandoned and backfilled. Primary activities designed to restore the channels on new location include 1) belt-width preparation and grading, 2) floodplain bench excavation, 3) channel excavation, 4) installation of channel plugs, and 5) backfilling of the abandoned channel.

Belt-width Preparation and Grading

Care will be taken to avoid the removal of existing, deeply rooted vegetation within the belt-width corridor, which may provide design channel stability. Material excavated during grading will be stockpiled immediately adjacent to channel segments to be abandoned and backfilled. These segments will be backfilled after stream diversion is completed.

Spoil material may be placed to stabilize temporary access roads and to minimize compaction of the underlying floodplain. However, all spoil will be removed from floodplain surfaces upon completion of construction activities.

After preparation of the corridor, the design channel and updated profile survey will be developed and the location of each meander wavelength plotted and staked along the profile. Pool locations and relative frequency configurations may be modified in the field based on local variations in the floodplain profile.

Floodplain Bench Excavation

The creation of a bankfull, floodplain bench is expected to 1) remove the eroding material and collapsing banks, 2) promote overbank flooding during bankfull flood events, 3) reduce the erosive potential of flood waters, and 4) increase the width of the active floodplain. Bankfull benches may be created by excavating the adjacent floodplain to bankfull elevations or filling eroded/abandoned channel areas with suitable material. After excavation, or filling of the bench, a relatively level floodplain surface is expected to be stabilized with suitable erosion control measures. Planting of the bench with native floodplain vegetation is expected to reduce erosion of bench sediments, reduce flow velocities in flood waters, filter pollutants, and provide wildlife habitat.

Channel Excavation

The channel will be constructed within the range of values depicted in Table of Morphological Stream Characteristics in Table 6. Figure 7 (Appendix A) provides typical cross-sections, plan views, and profiles for the constructed channel.

The stream banks and local belt-width area of constructed channels will be immediately planted with shrub and herbaceous vegetation. Deposition of shrub and woody debris into and/or overhanging the constructed channel is encouraged.

Particular attention will be directed toward providing vegetative cover and root growth along the outer bends of each stream meander. Live willow stake revetments, available root mats, and/or biodegradable, erosion-control matting may be embedded into the break-in-slope to promote more rapid development of

an overhanging bank. Willow stakes will be purchased and/or collected onsite and inserted through the root/erosion mat into the underlying soil.

Channel Plugs
Impermeable plugs will be installed along abandoned channel segments. The plugs will consist of low-permeability materials or hardened structures designed to be of sufficient strength to withstand the erosive energy of surface flow events across the Site. Dense clays may be imported from off-site or existing material, compacted within the channel, may be suitable for plug construction. The plug will be of sufficient width and depth to form an imbedded overlap in the existing banks and channel bed.

Channel Backfilling
After impermeable plugs are installed, the abandoned channel will be backfilled. Backfilling will be performed primarily by pushing stockpiled materials into the channel. The channel will be filled to the extent that onsite material is available and compacted to maximize microtopographic variability, including ruts, ephemeral pools, and hummocks in the vicinity of the backfilled channel.

A deficit of fill material for channel backfill may occur. If so, a series of closed, linear depressions may be left along confined channel segments. Additional fill material for critical areas may be obtained by excavating shallow depressions along the banks of these planned, open-channel segments. These excavated areas will represent closed linear, elliptical, or oval depressions. In essence, the channel may be converted to a sequence of shallow, ephemeral pools adjacent to effectively plugged and backfilled channel sections. These pools are expected to stabilize and fill with organic material over time. Vegetation debris (root mats, top soils, shrubs, woody debris, etc.) will be redistributed across the backfill area upon completion.

6.2.1.2 In-Stream Structures
Stream restoration under natural stream design techniques normally involves the use of in-stream structures for bank stabilization, grade control, and habitat improvement. Primary activities designed to achieve these objectives may include the installation of log vanes, J-hook vanes, cross-vanes, and or a step-pool structure. Details for the structures are depicted on Figures 8A-8B (Appendix A).

6.2.1.3 Forded Channel Crossing
Landowner requirements will necessitate the installation of channel fords to allow access to portions of the property isolated by the conservation easement and stream restoration activities. The approximate location of the proposed channel fords are depicted on Figures 6A-6C (Appendix A). The fords are expected to consist of a shallow depression in the stream banks where vehicular and livestock crossings can be made. The fords will be constructed of hydraulically stable rip-rap or suitable rock and will be large enough to handle the weight of anticipated vehicular traffic. Approach grades to the fords will be at a minimum 15:1 slope and constructed of hard, scour-resistant crushed rock or other permeable material, which is free of fines (Figure 8B, Appendix A). The bed elevation of the fords will equal the floodplain elevation above and below the fords to reduce the risk of headcutting.

6.2.2 Stream Enhancement (Level II)
Stream enhancement (Level II) on Cane Creek will entail planting riparian buffers with native forest vegetation and removal of invasive species, where necessary. Particular attention will be directed toward providing vegetative cover and root growth along the outer bends of each stream meander. Riparian buffers will extend a minimum of 30 feet from the top of stream banks to facilitate stream recovery and prevent further degradation of Site streams. In addition, water quality functions and aquatic and wildlife habitat associated with stable riparian corridors/streams will be improved.

6.2.3 Stream Preservation

Preservation is being proposed on the forested/upstream reach of Tributary 1 (Figure 6A, Appendix A). Based on preliminary analysis and field investigations, this reach is stable due to a lack of human-induced impacts and a well-developed riparian buffer. These areas will be protected in perpetuity through the establishment of a conservation easement including a minimum 30-foot forested buffer adjacent to each bank of the stream. The easement will provide a natural riparian corridor between the Site and a State Nature Preserve.

6.3 Sediment Transport Analysis

Channel stability assessments and sediment transport analysis for existing and proposed conditions, and the reference stream are outlined above in Section 3.4 (Channel Stability Assessment).

6.4 HEC-RAS Analysis

Surface drainage on the Site and surrounding areas are in the process of being analyzed to predict the feasibility of manipulating existing surface drainage patterns without adverse effects to the Site or adjacent properties. The following presents a summary of hydrologic and hydraulic analyses along with provisions designed to maximize groundwater recharge and wetland restoration while reducing potential for impacts to adjacent properties.

The purpose of the analysis is to predict flood extents for the 1-, 2-, 5-, 10-, 50-, and 100-year storms under existing and proposed conditions after stream and wetland restoration activities have been implemented. The comparative flood elevations are evaluated by simulating peak flood flows for Site features using the WMS (Watershed Modeling System, BOSS International) program and regional regression equations. Once the flows are determined, the river geometry and cross-sections are digitized from a DTM (Digital Terrain Model) surface (prepared by a professional surveyor) using the HEC-GeoRAS component of ArcView. The cross-sections are adjusted as needed based on field-collected data. Once corrections to the geometry are performed, the data is imported into HEC-RAS.

Watersheds and land use estimations were measured from existing DEM (Digital Elevation Model) data and an aerial photograph. Field surveyed cross-sections and water surfaces were obtained along Site features. Valley cross-sections were obtained from both onsite cross-sections and detailed topographic mapping to 1-foot contour intervals using the available DTM. Observations of existing hydraulic characteristics will be incorporated into the model and the computed water surface elevations will be calibrated using engineering judgment.

The HEC-RAS will be completed prior to completion of detailed construction plans for Site restoration activities. A primary objective of the stream and wetland restoration design is maintenance of a no-rise in the 100-year floodplain; therefore, a Conditional Letter of Map Revision (CLOMR) or Letter of Map Revision (LOMR) are not expected to be necessary at this time. However, coordination with FEMA will be conducted, if necessary, prior to initiating Site construction activities.

6.5 Wetland Restoration

Alternatives for wetland restoration are designed to restore a fully functioning wetland system which will provide surface water storage, nutrient cycling, removal of imported elements and compounds, and will create a variety and abundance of wildlife habitat. Restoration activities are expected to restore a minimum of 4.4 acres of jurisdictional riverine wetland and a minimum of 5.0 acres of jurisdictional nonriverine wetlands (Figures 6A-6C, Appendix A).

Portions of the Site underlain by hydric soils have been impacted by drainage ditch excavation, vegetative clearing, and earth movement associated with agricultural practices. Wetland restoration options should focus on the removal of fill materials, restoration of vegetative communities, filling drainage ditches, the

reestablishment of soil structure and microtopographic variations, and redirecting normal surface hydrology from ditches back to Site floodplains. In addition, the construction of (or provisions for) surface water storage depressions (ephemeral pools) will also add an important component to groundwater restoration activities. These activities will result in the restoration of 4.4 acres of jurisdictional riverine floodplain wetlands that will receive overbanking from the three restored tributaries (Tributaries 1-3). An additional 5.0 acres of jurisdictional nonriverine wetland will be restored within the Site. These areas of hydric soils will not receive overbanking from Site tributaries or Cane Creek; Cane Creek is a controlled flow stream. The existing Cane Creek floodplain is acting as a terrace; therefore, Cane Creek will not provide hydrological inputs to these areas.

Reestablishment of Historic Groundwater Elevations

The existing Tributaries 1-3 depths average 3-5 feet, while the depth for the proposed Tributaries 1-3 average approximately 0.6-1 foot. Hydric soils adjacent to the incised channels have been drained due to 1) redirecting tributaries from flowing across hydric soil depressions to flow directly into Cane Creek, 2) lowering of the groundwater tables, and 3) a lateral drainage effect from existing stream reaches. Restoration of historic flow patterns across the floodplain and reestablishment of channel inverts are expected to rehydrate soils adjacent to Site streams, resulting in the restoration of jurisdictional hydrology to riverine wetlands.

In addition, drainage ditches are effectively removing wetland hydrology within the interstream flat. Filling of these ditches is expected to rehydrate hydric soils within the Site, resulting in the restoration of jurisdictional hydrology to nonriverine wetlands.

Redirecting Roadside Drainage

Roadside drainage, which historically would have percolated through Site soils has been captured and directed through a drainage network across the Site. Redistribution of roadside drainage will rehydrate nonriverine hydric soils, as well as treat potentially harmful, nonpoint pollutants prior to discharging into water supply watershed mainstem channel.

Excavation and Grading of Elevated Spoil and Sediment Embankments

Some areas adjacent to the existing channel and area ditches have experienced both natural and unnatural sediment deposition. Spoil piles were likely cast adjacent to the channel during dredging, straightening, and rerouting of Site streams, and ditching of the adjacent floodplain. Major flood events may have also deposited additional sediment adjacent to stream banks from onsite eroding banks and upstream agricultural fields. The removal of these spoil materials and/or filling of onsite ditches with spoil material represents a critical element of Site wetland restoration.

Hydrophytic Vegetation

Site wetland areas have endured significant disturbance from land use activities such as land clearing, agriculture, and other anthropogenic maintenance. Wetland areas will be revegetated with native vegetation typical of wetland communities in the region. Emphasis will focus on developing a diverse plant assemblage. Section 6.7 (Plant Community Restoration) provides detailed information concerning community species associations.

Reconstructing Stream Corridors

The stream restoration plan involves the reconstruction of Tributaries 2-3 and the downstream reach of Tributary 1. The existing tributaries were rerouted through the fields into Cane Creek; the tributary lengths were shortened by excavating a linear channel through the most direct path to Cane Creek. Restoration activities revolve around diverting this stream flow through the floodplain. Existing channels will be backfilled so that the water table may be restored to historic conditions. However, some portions of the existing channels may remain open for the creation of wetland “oxbow lake-like” features. These

features will be plugged on each side of the open channel and will function as open water systems. They are expected to provide habitat for a variety of wildlife as well as create small pockets of open water/freshwater marsh within the Site.

6.6 Floodplain Soil Scarification

Microtopography and differential drainage rates within localized floodplain areas represent important components of floodplain functions. Reference forests in the region exhibit complex surface microtopography. Small concavities, swales, exposed root systems, seasonal pools, oxbows, and hummocks associated with vegetative growth and hydrological patterns are scattered throughout these systems. As discussed in the stream reconstruction section, efforts to advance the development of characteristic surface microtopography will be implemented.

In areas where soil surfaces have been compacted, ripping or scarification will be performed. After construction, the soil surface is expected to exhibit complex microtopography ranging to 1 foot in vertical asymmetry across local reaches of the landscape. Subsequently, community restoration will be initiated on complex floodplain surfaces.

6.7 Plant Community Restoration

Restoration of floodplain forest and stream-side habitat allows for development and expansion of characteristic species across the landscape. Ecotonal changes between community types contribute to diversity and provide secondary benefits, such as enhanced feeding and nesting opportunities for mammals, birds, amphibians, and other wildlife.

Reference Forest Ecosystem (RFE) data, onsite observations, and community descriptions from *Classification of the Natural Communities of North Carolina* (Schafale and Weakley 1990) were used to develop the primary plant community associations that will be promoted during community restoration activities.

Stream-side trees and shrubs include species with high value for sediment stabilization, rapid growth rate, and the ability to withstand hydraulic forces associated with bankfull flow and overbank flood events. Stream-side trees and shrubs will be planted within 15 feet of the channel throughout the meander belt-width. Shrub elements will be planted along the reconstructed stream banks, concentrated along outer bends. A combined Piedmont/Mountain Bottomland Forest and Nonriverine Wet Hardwoods Forest community is targeted for the Site wetland restoration areas and Piedmont/Low Mountain Alluvial Forest is targeted for the remainder of the Site (Figure 9, Appendix A). The following planting plan is the blueprint for community restoration.

6.7.1 Planting Plan

The purpose of a planting plan is to reestablish vegetative community patterns across the landscape. The plan consists of 1) acquisition of available plant species, 2) implementation of proposed Site preparation, and 3) planting of selected species.

Species selected for planting will be dependent upon availability of regional seedling sources. Advance notification to nurseries (1 year) will facilitate availability of various noncommercial elements.

Bare-root seedlings of tree species will be planted within specified map areas at a density of approximately 680 stems per acre on 8-foot centers. Shrub species in the stream-side assemblage will be planted at a density of 2720 stems per acre on 4-foot centers. Table 10 depicts the total number of stems and species distribution within each vegetation association. Planting will be performed between December 1 and March 15 to allow plants to stabilize during the dormant period and set root during the spring season. A total of 31,822 diagnostic tree and shrub seedlings may be planted during restoration.

Table 10. Planting Plan

Vegetation Association	Bottomland Forest/Nonriverine Wet Hardwoods		Piedmont/Low Mountain Alluvial Forest		Stream-side Assemblage		TOTAL
Area (acres)	**6.7**		**17.7**		**5.6**		**23.13**
Species	**Number planted***	**% of total**	**Number planted***	**% of total**	**Number planted****	**% of total**	**Number planted**
Swamp chestnut oak (*Quercus michauxii*)	683	15	--	--	--	--	683
Cherrybark oak (*Quercus pagoda*)	683	15	--	--	--	--	683
Sycamore (*Platanus occidentalis*)	683	15	1204	10	--	--	1887
Hackberry (*Celtis laevigata*)	683	15	--	--	--	--	683
American elm (*Ulmus americana*)	683	15	--	--	--	--	683
Green ash (*Fraxinus pennsylvanica*)	456	10	--	--	--	--	456
Pawpaw (*Asimina triloba*)	364	8	1204	10	--	--	1568
American beech (*Fagus grandifolia*)	--	--	1805	15	--	--	1805
Mockernut hickory (*Carya alba/tomentosa*)	--	--	1805	15	--	--	1805
Northern red oak (*Quercus rubra*)	--	--	1805	15	--	--	1805
White oak (*Quercus alba*)	--	--	1805	15	--	--	1805
Black cherry (*Prunus serotina*)	--	--	1204	10	--	--	1204
Persimmon (*Diospyros virginiana*)	--	--	1204	10	--	--	1204
Silky dogwood (*Cornus amomum*)	319	7	--	--	4570	30	4889
Black willow (*Salix nigra*)	--	--	--	--	4570	30	4570
Buttonbush (*Cephalanthus occidentalis*)	--	--	--	--	3046	20	3046
Elderberry (*Sambucus canadensis*)	--	--	--	--	3046	20	3046
TOTAL	**4554**	**100**	**12,036**	**100**	**15,232**	**100**	**31,822**

* Planted at a density of 680 stems/acre.
** Planted at a density of 2720 stems/acre.

6.7.2 Nuisance Species Management

Prior to the revegetation phase of the project, nonnative floral species will be removed, if necessary. At this stage of project development, no nonnative species have been identified at the Site; therefore, the methods for eradication of nuisance species have not been determined. However, if control if necessary, it is likely that both manual removal by cutting and grubbing, in addition to chemical herbicide treatment will be required.

The Site will be monitored over the course of the 5-year monitoring period for potential nuisance species such as beaver or other nonnative floral species. Appropriate actions will be taken to ameliorate any negative impacts regarding vegetation development and/or water management as necessary.

7.0 PERFORMANCE CRITERIA

Monitoring of Site restoration efforts will be performed for five years or until agreed upon success criteria are fulfilled. Monitoring is proposed for the stream channel, hydrology, and vegetation.

7.1 Stream Monitoring Plan

Annual fall monitoring will include development of channel cross-sections on riffles and pools, pebble counts, and a water surface profile of the restoration reaches. This will include 3000 linear feet of longitudinal profile and a minimum of ten cross-sections. The data will be presented in graphic and tabular format. Data to be presented will include 1) cross-sectional area, 2) bankfull width, 3) average depth, 4) maximum depth, 5) width-to-depth ratio, 6) meander wavelength, 7) belt-width, 8) water surface slope, 9) sinuosity, and 10) stream substrate composition. A photographic record of preconstruction and post-construction pictures will also be compiled. Preconstruction photographs are included in Appendix D.

Photographs of the enhancement (level II) reach will be taken for each year of the monitoring period and on the preservation reach in the first year.

Stream Success Criteria

Success criteria for stream restoration will include 1) successful classification of the reach as a functioning stream system (Rosgen 1996a) and 2) channel variables indicative of a stable stream system.

Visual assessment of in-stream structures will be conducted to determine if failure has occurred. Failure of a structure may be indicated by collapse of the structure, undermining of the structure, abandonment of the channel around the structure, and/or stream flow beneath the structure.

7.2 Hydrology Monitoring Plan

A minimum of 4 groundwater monitoring gauges will be installed to take measurements after hydrological modifications are performed at the Site. In addition, a groundwater gauge will be installed within a reference wetland. Hydrological sampling will continue throughout the growing season at intervals necessary to satisfy the jurisdictional hydrology success criteria within each wetland restoration area (USEPA 1990).

Hydrology Success Criteria

Target hydrological characteristics include saturation or inundation for 5 to 12.5 percent of the growing season, during average climatic conditions. During growing seasons with atypical climatic conditions, groundwater gauges in reference wetlands may dictate threshold hydrology success criteria (75 percent of reference). These areas are expected to support hydrophytic vegetation. If wetland parameters are marginal as indicated by vegetation and/or hydrology monitoring, a jurisdictional determination will be performed.

7.3 Vegetation Monitoring

Restoration monitoring procedures for vegetation are designed in accordance with USEPA guidelines enumerated in Mitigation Site Type (MiST) documentation (USEPA 1990), *Compensatory Hardwood Mitigation Guidelines* (DOA 1993), Stream Mitigation Guidelines (USACE 2003), and CVS-EEP Protocol for Recording Vegetation Level 1-2 Plot Sampling Only (Version 4.0) (Lee et al. 2006). A general discussion of the restoration monitoring program is provided. A photographic record of plant growth should be included in each annual monitoring report.

After planting has been completed in winter or early spring, an initial evaluation will be performed to verify planting methods and to determine initial species composition and density. Supplemental planting and additional Site modifications will be implemented, if necessary.

During the first year, vegetation will receive a cursory, visual evaluation on a periodic basis to ascertain the degree of overtopping of planted elements by nuisance species. Subsequently, quantitative sampling of vegetation will be performed between June 1 and September 30, after each growing season, until the vegetation success criteria are achieved.

During quantitative vegetation sampling in early fall of the first year, up to 14 sample plots (10 meters by 10 meters) will be randomly placed within the Site. Best professional judgment may be necessary to establish vegetative monitoring plots upon completion of construction activities. In each sample plot, vegetation parameters to be monitored include species composition and species density.

Vegetation Success Criteria

Success criteria have been established to verify that the vegetation component supports community elements necessary for forest development. Success criteria are dependent upon the density and growth of characteristic forest species. Additional success criteria are dependent upon density and growth of "Characteristic Tree Species." Characteristic Tree Species include planted species, species identified through visual inventory of an approved reference (relatively undisturbed) forest community, and species outlined in Schafale and Weakley (1990).

An average density of 320 stems per acre of Characteristic Tree Species must be surviving in the first three monitoring years. Subsequently, 290 Characteristic Tree Species per acre must be surviving in year 4 and 260 Characteristic Tree Species per acre in year 5.

7.4 Contingency

7.4.1 Stream Contingency

In the event that stream success criteria are not fulfilled, a mechanism for contingency will be implemented. Stream contingency may include, but may not be limited to 1) structure repair and/or installation; 2) repair of dimension, pattern, and/or profile variables; and 3) bank stabilization. The method of contingency is expected to be dependent upon stream variables that are not in compliance with success criteria. Primary concerns, which may jeopardize stream success, include 1) structure failure, 2) head-cut migration through the Site, and/or 3) bank erosion.

Structure Failure

In the event that onsite structures are compromised, the affected structure will be repaired, maintained, or replaced. Once the structure is repaired or replaced, it must function to stabilize adjacent stream banks and/or maintain grade control within the channel. Structures which remain intact, but exhibit flow around, beneath, or through the header/footer pilings will be repaired by excavating a trench on the upstream side of the structure and reinstalling filter fabric in front of the pilings. Structures which have been compromised, resulting in shifting or collapse of header/footer pilings, will be removed and replaced with a structure suitable for onsite flows.

Headcut Migration through the Site

In the event that a headcut occurs within the Site (identified visually or through onsite measurements [i.e. bank-height ratios exceeding 1.4]), provisions for impeding headcut migration and repairing damage caused by the headcut will be implemented. Headcut migration may be impeded through the installation of in-stream grade control structures (rip-rap sill and/or log cross-vane weir) and/or restoring stream

geometry variables until channel stability is achieved. Channel repairs to stream geometry may include channel backfill with coarse material and stabilizing the material with erosion control matting, vegetative transplants, and/or willow stakes.

Bank Erosion

In the event that severe bank erosion occurs at the Site resulting in elevated width-to-depth ratios, contingency measures to reduce bank erosion and width-to-depth ratio will be implemented. Bank erosion contingency measures may include the installation of cross-vane weirs and/or other bank stabilization measures. If the resultant bank erosion induces shoot cutoffs or channel abandonment, a channel may be excavated which will reduce shear stress to stable values.

7.4.2 Hydrologic Contingency

Hydrologic contingency may include floodplain surface modifications such as construction of ephemeral pools, deep ripping of the soil profile, and installation of berms to retard surface water flows. Recommendations for contingency to establish wetland hydrology may be implemented and monitored until hydrology success criteria are achieved.

7.4.3 Vegetation Contingency

If vegetation success criteria are not achieved based on average density calculations from combined plots over the entire restoration area, supplemental planting will be performed with tree species approved by regulatory agencies. Supplemental planting will be performed as needed until achievement of vegetation success criteria.

7.5 Reporting Schedule

The first year monitoring report will be submitted at the end of December after Site implementation. Monitoring will continue for five years or until agreed upon success criteria are achieved, with a report submitted by the end of December for each monitoring year.

8.0 REFERENCES

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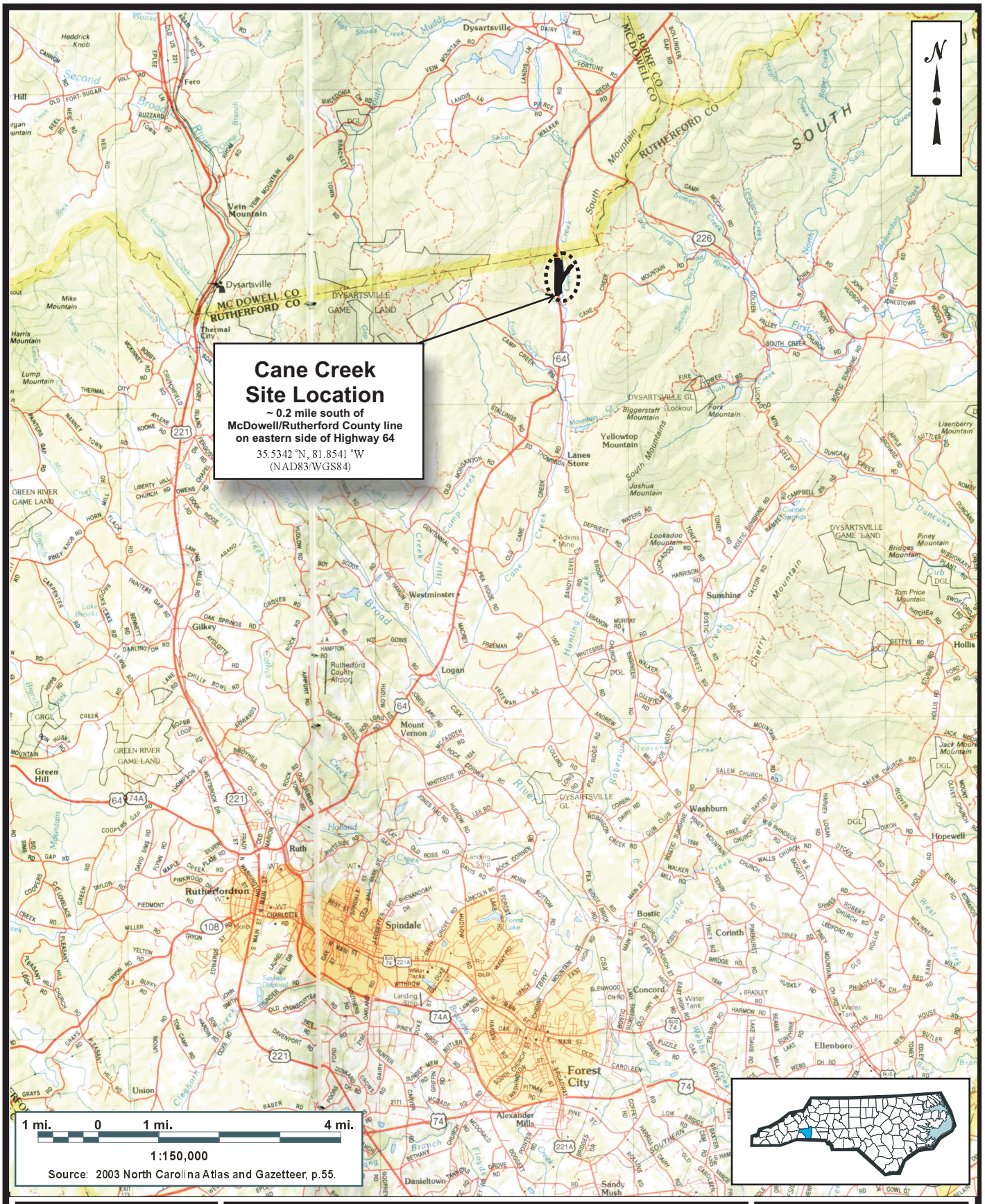
Appendix A. Figures



Axiom Environmental, Inc.
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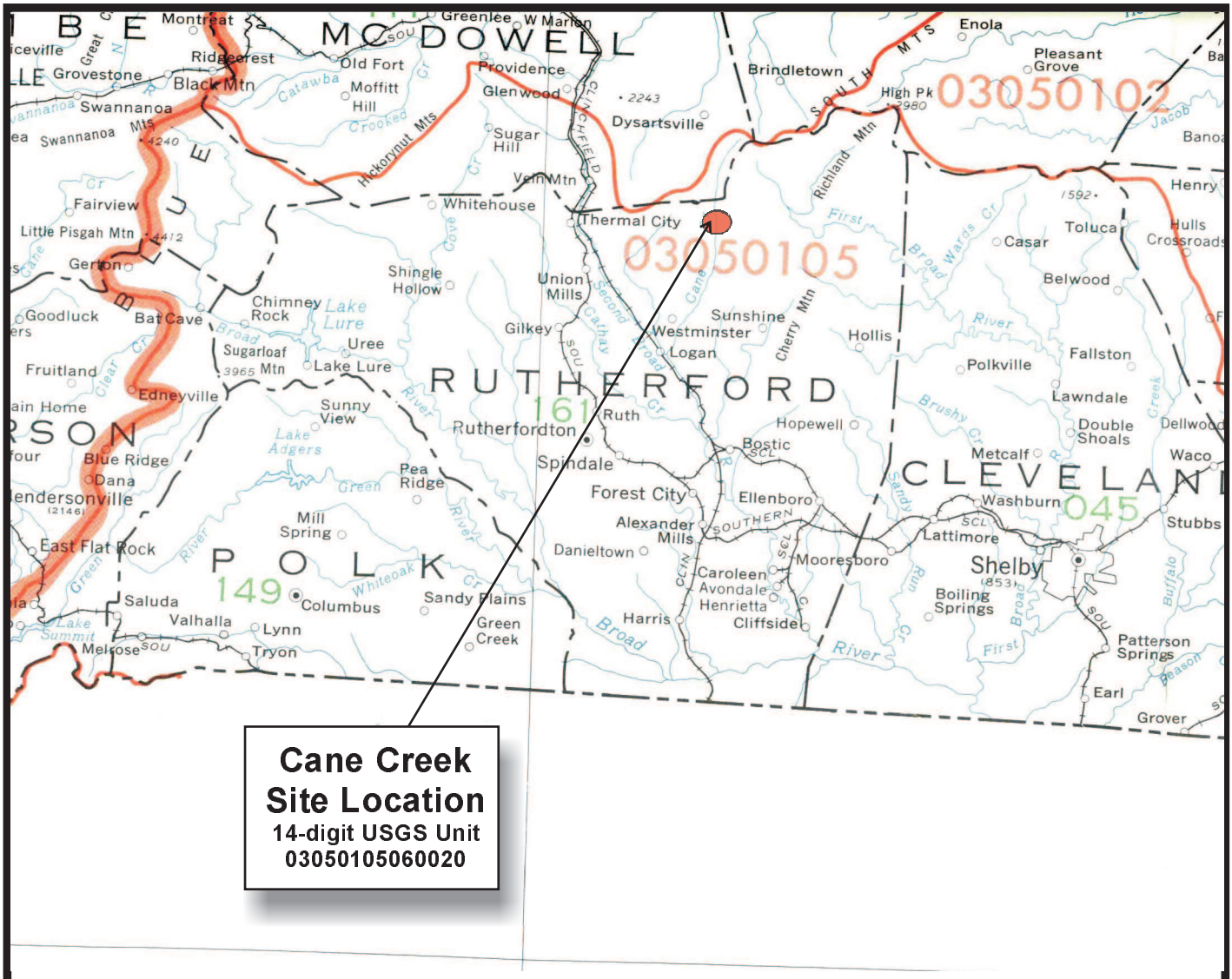
Willow Spring, NC 27529
(919) 215-1693
(919) 341-3839 fax

SITE LOCATION
CANE CREEK RESTORATION SITE
Rutherford County, North Carolina

Dwn. by: CLF	FIGURE 1
Date: April 2007	
Project: 06-022	



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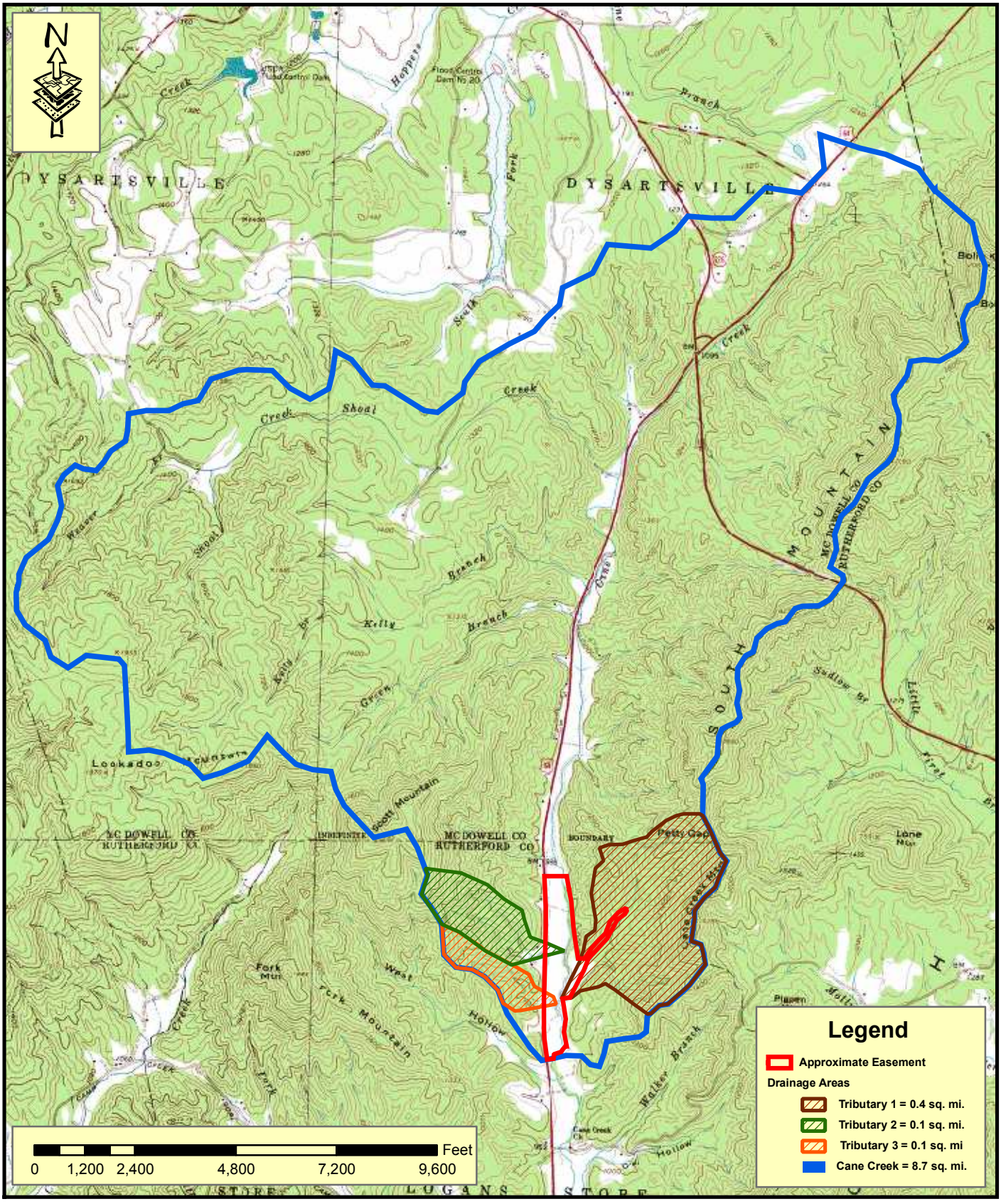
USGS HYDROLOGIC UNIT MAP
CANE CREEK RESTORATION SITE
Rutherford County, North Carolina

Dwn. by: CLF	FIGURE 2
Date: April 2007	
Project: 06-002	



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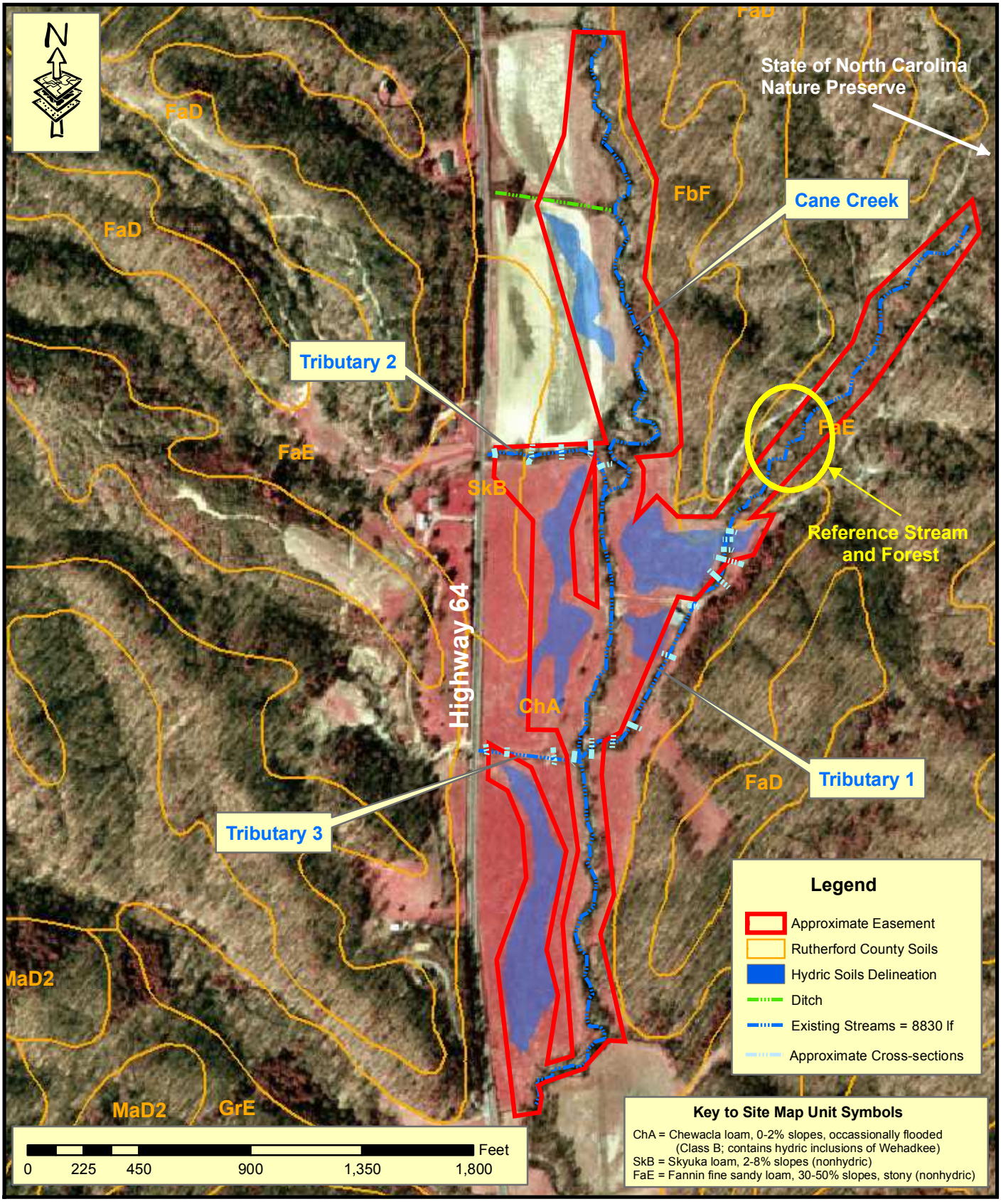
WATERSHED MAP
CANE CREEK RESTORATION SITE
Rutherford County, North Carolina

Dwn. by.	FIGURE
CLF	3
Date: April 2007	
Project: 06-022	



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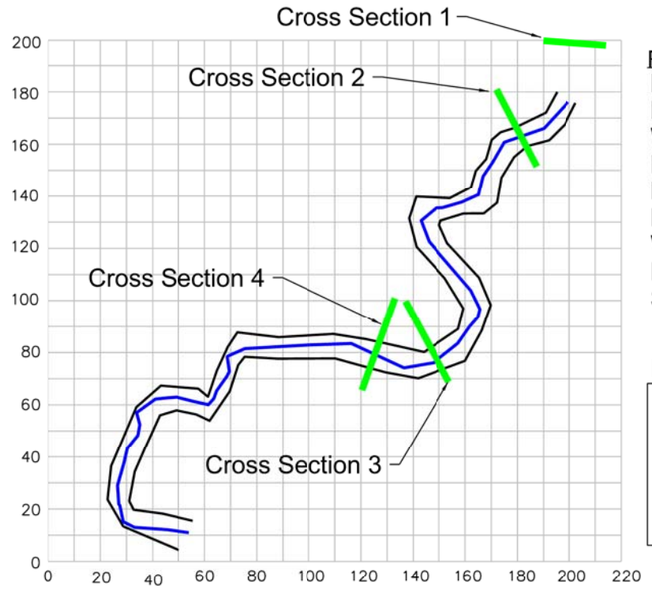
(919) 341-3839 fax

SOILS AND EXISTING CONDITIONS
CANE CREEK RESTORATION SITE
Rutherford County, North Carolina

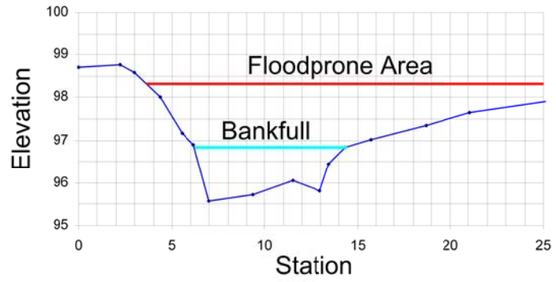
Dwn. by: CLF
Date: May 2007
Project: 06-022

FIGURE
4

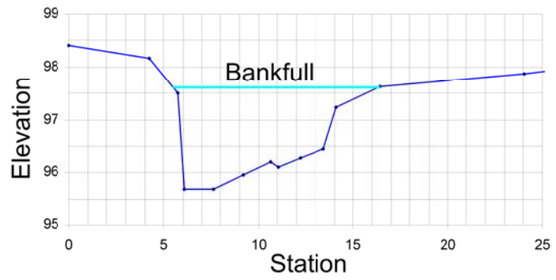


Reference Pattern
Lp-p = 42 (23 - 89) ft
Lm = 59 (36 - 88) ft
Wbelt = 37 (19 - 60) ft
Rc = 12.9 (7 - 26) ft
Lp-p/Wbkf = 5 (2.8 - 10.6)
Lm/Wbkf = 7 (4.3 - 10.5)
Wbelt/Wbkf = 4.4 (2.3 - 7.1)
Rc/Wbkf = 1.5 (0.8 - 4.3)
SIN = 1.5

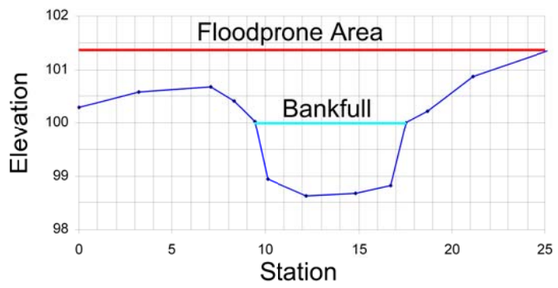
Pattern Legend
- Top of Bank
- Thalweg
- Cross Section



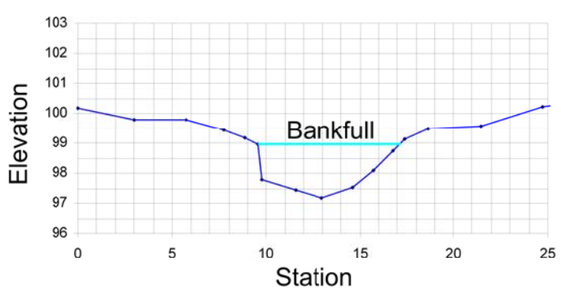
Cross Section 1 - Riffle
Abkf = 7.7 ft
Dave = 0.9 ft
Wbkf = 8.7 ft
Dmax = 1.3 ft
Bank Height = 1.3 ft
W/D = 9.7
FPA = 25
ENT = 2.9
Stream Type = E



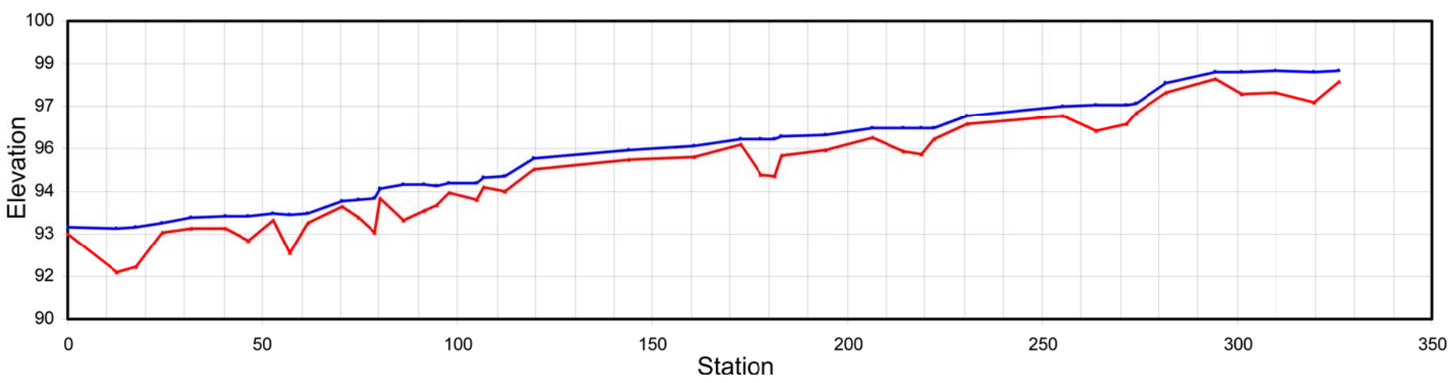
Cross Section 2 - Pool
Abkf = 12.9 ft
Wbkf = 10.7 ft
Dmax = 1.9 ft



Cross Section 4 - Riffle
Abkf = 9.3 ft
Dave = 1.2 ft
Wbkf = 8.1 ft
Dmax = 1.4 ft
Bank Height = 1.4 ft
W/D = 7.1
FPA = 150
ENT = 18.5
Stream Type = E



Cross Section 3 - Pool
Abkf = 14.1 ft
Wbkf = 11.8 ft
Dmax = 2.3 ft



Profile (Reference Reach)
Save = 0.0161 rise/run
Svalley = 0.0229 rise/run
Sriffle = 0.0284 (0.0148 - 0.0492) rise/run
Spool = 0.0013 (0 - 0.0040) rise/run
Srun = 0.0448 (0 - 0.2453) rise/run
Sglide = 0.0057 (0 - 0.0299) rise/run

Profile Legend
- Reference Bed
- Reference Water Surface

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NOTES/REVISIONS

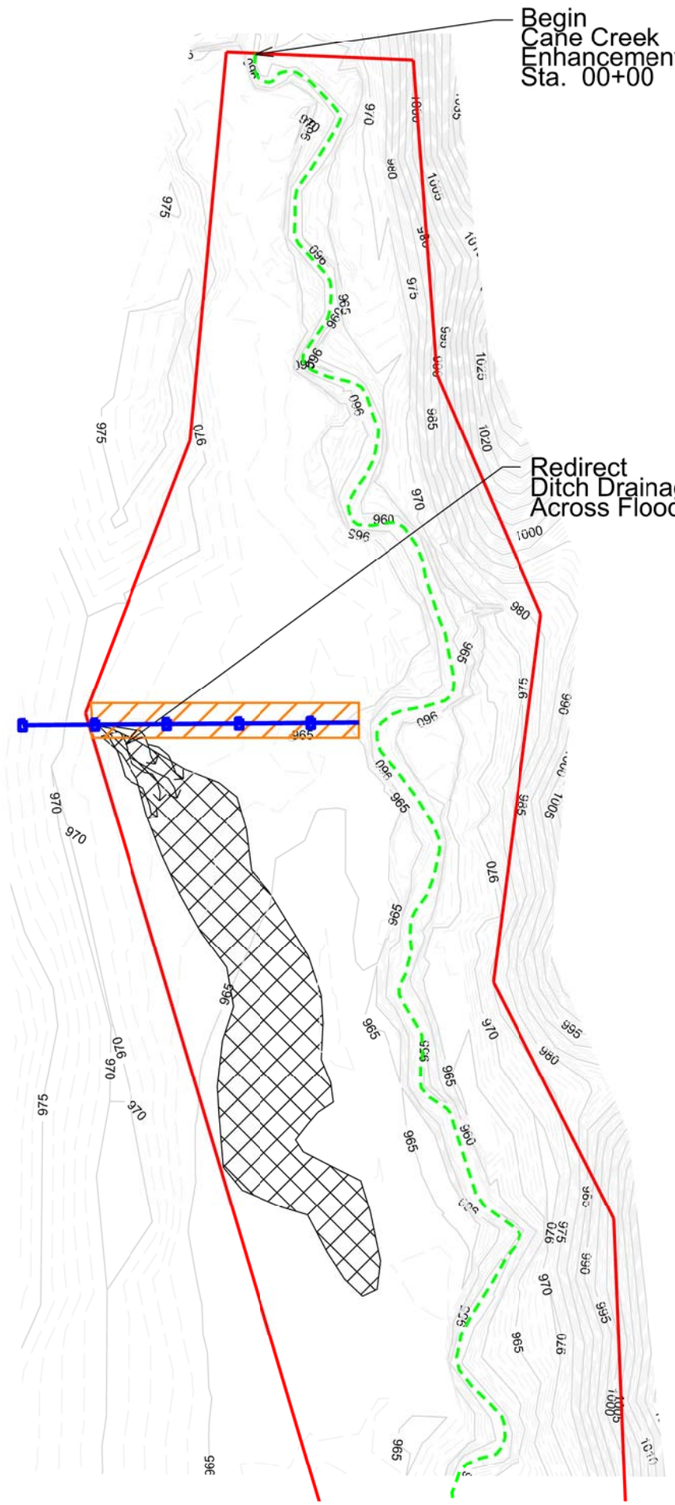
Project:
Cane Creek Restoration Site

Rutherford County
North Carolina

Title:
Reference Dimension, Pattern, and Profile

Scale: NA
Date: May 2007
Project No.: 06-022

FIGURE NO.
5



Mitigation Legend		
	Easement Boundary	38.1 ac
	Stream Restoration	4,600 ft
	Stream Enchancement II	5,078 ft
	Stream Preservation	1,506 ft
	Riverine Wetland Restoration	4.4 ac
	Nonriverine Wetland Restoration	5.0 ac
	Old Channel Backfill	

General Legend
Major Contour
Minor Contour
Existing Channel to be Backfilled
Bridge

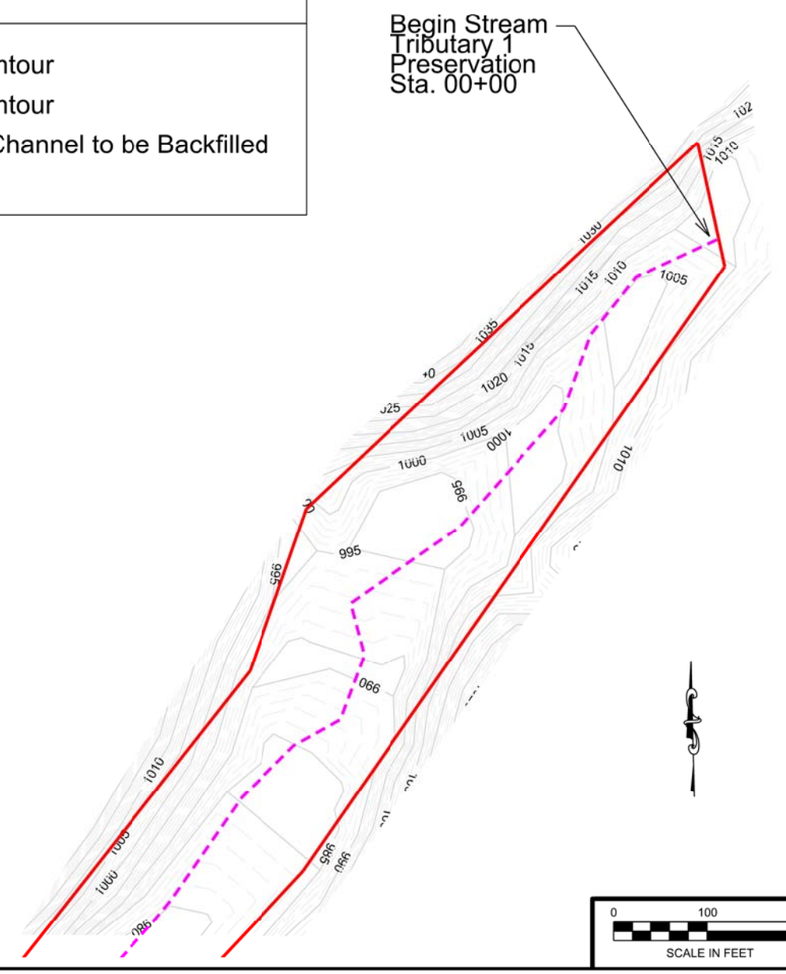


Figure 6A

Figure 6B

Figure 6C

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NOTES/REVISIONS

Project:

Cane Creek
Restoration
Site

Rutherford County
North Carolina

Title:

Restoration Plan

Scale:	FIGURE NO.
1 in. = 160 ft.	6A
Date: May 2007	
Project No.: 06-022	

0 100 200
SCALE IN FEET

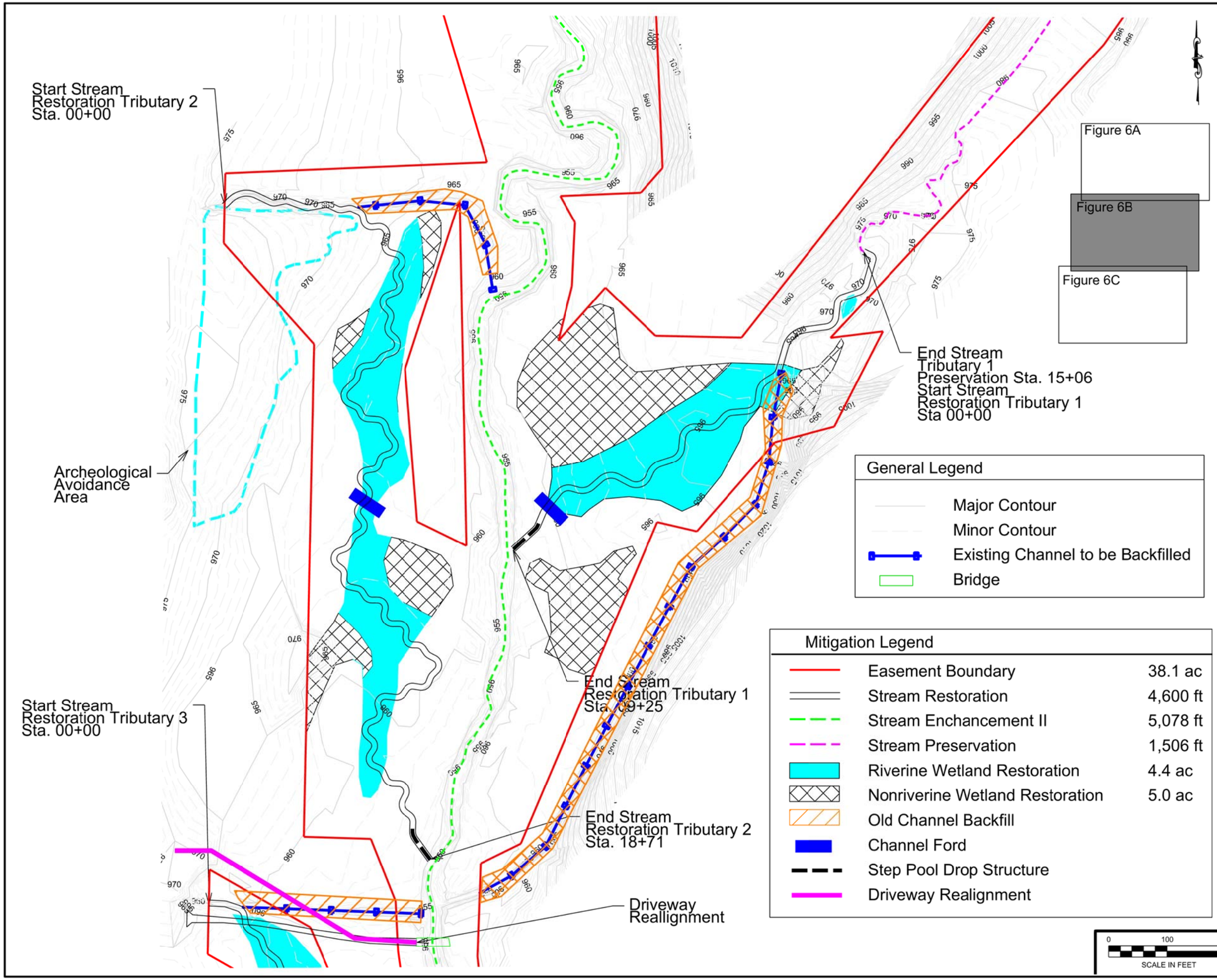


Figure 6A

Figure 6B

Figure 6C

General Legend

- Major Contour
- Minor Contour
- Existing Channel to be Backfilled
- Bridge

Mitigation Legend

Easement Boundary	38.1 ac
Stream Restoration	4,600 ft
Stream Enchancement II	5,078 ft
Stream Preservation	1,506 ft
Riverine Wetland Restoration	4.4 ac
Nonriverine Wetland Restoration	5.0 ac
Old Channel Backfill	
Channel Ford	
Step Pool Drop Structure	
Driveway Realignment	

0 100 200
SCALE IN FEET

Axiom Environmental, Inc.

NOTES/REVISIONS

Project:

Cane Creek
Restoration
Site

Rutherford County
North Carolina

Title:

Restoration Plan

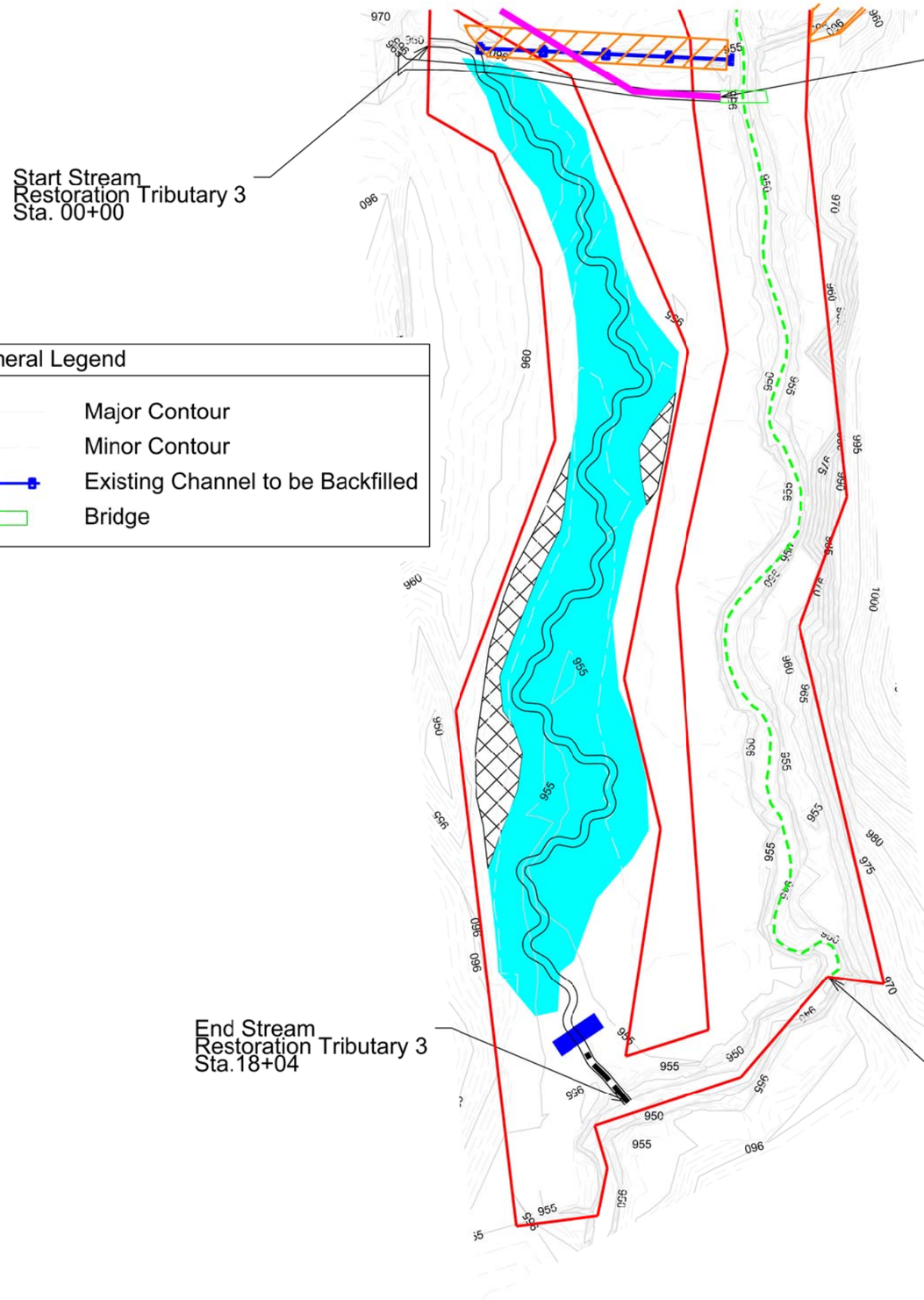
Scale: 1 in. = 160 ft.

Date: May 2007

Project No.: 06-022

FIGURE NO.

6B



General Legend

- Major Contour
- Minor Contour
- Existing Channel to be Backfilled
- Bridge

Mitigation Legend

Easement Boundary	38.1 ac
Stream Restoration	4,600 ft
Stream Enchancement II	5,078 ft
Stream Preservation	1,506 ft
Riverine Wetland Restoration	4.4 ac
Nonriverine Wetland Restoration	5.0 ac
Old Channel Backfill	
Channel Ford	
Step Pool Drop Structure	
Driveway Realignment	

Figure 6A

Figure 6B

Figure 6C

0 100 200
SCALE IN FEET

Axiom Environmental, Inc.

NOTES/REVISIONS

Project:

Cane Creek Restoration Site

Rutherford County North Carolina

Title:

Restoration Plan

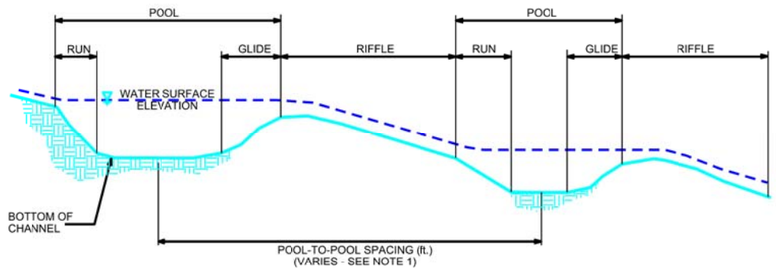
Scale: 1 in. = 160 ft.

Date: May 2007

Project No.: 06-022

FIGURE NO.

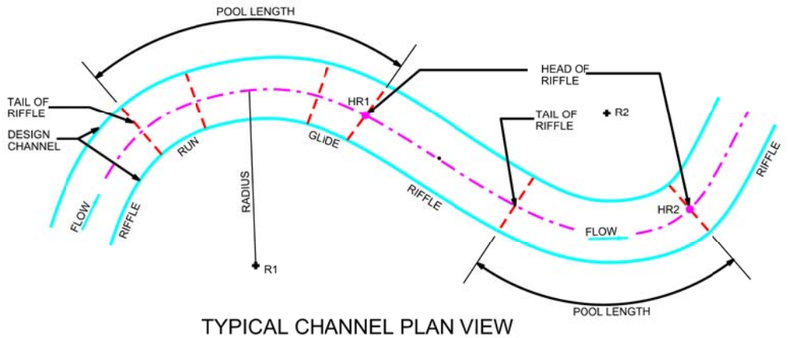
6C



TYPICAL CHANNEL PROFILE

NOTES:

1. POOL-TO-POOL SPACING IS MEASURED FROM CENTER OF POOL BEND TO CENTER OF POOL BEND.

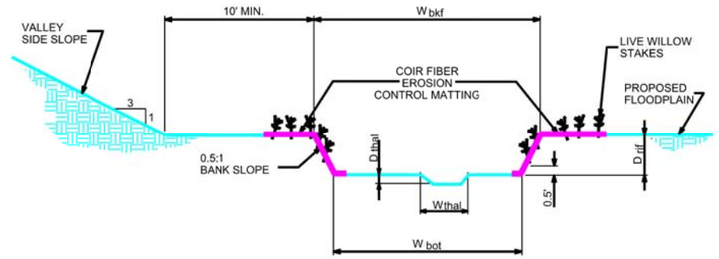


TYPICAL CHANNEL PLAN VIEW

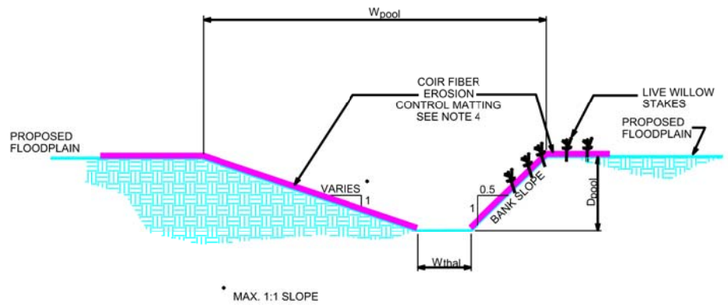
CHANNEL PLAN VIEW NOTES:

1. THE CONTRACTOR SHALL LAYOUT THE CHANNEL ALIGNMENT BY LOCATING THE RADII AND SCRIBING THE CENTER LINE FOR EACH POOL BEND. THE CONNECTING TANGENT SECTIONS SHALL COMPLETE THE LAYOUT OF THE CHANNEL.

2. FIELD ADJUSTMENTS OF THE ALIGNMENT MAY BE REQUIRED TO SAVE TREES OR AVOID OBSTACLES. THE STAKE-OUT SHALL BE APPROVED BY THE CONSTRUCTION MANAGER BEFORE CONSTRUCTION OF THE CHANNEL.



TYPICAL RIFFLE CROSS-SECTION



TYPICAL POOL CROSS-SECTION

CHANNEL CONSTRUCTION NOTES:

1. MATERIAL EXCAVATED FROM CHANNEL AND FLOODPLAIN SHALL BE USED TO BACKFILL EXISTING CHANNEL.

2. BANK PROTECTION SHALL CONSIST OF NATURAL COIR FIBER MATTING.

CROSS-SECTION DIMENSIONS

REACH	Wbkf (ft.)	Wbot (ft.)	Driff (ft.)	Dthal (ft.)	Dpool (ft.)	Wpool (ft.)	Wthal (ft.)
Tributary 1	10.6	9.1	1.5	0.2	1.9	13.8	0.5
Tributary 2 and 3	5.0	0.6	1.1	0.2	1.7	6.5	0.0

Axiom Environmental, Inc.

NOTES/REVISIONS

Project:

Cane Creek Restoration Site

Rutherford County North Carolina

Title:

PROPOSED DIMENSION, PATTERN, AND PROFILE

Scale: NA

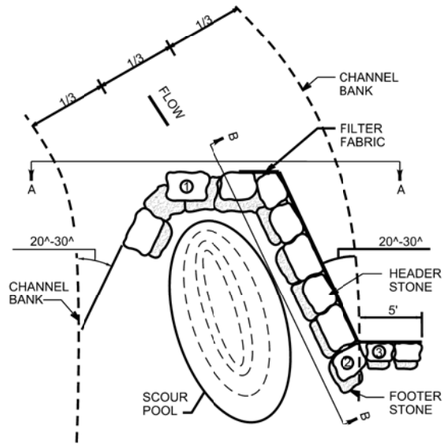
Date: May 2007

Project No.: 06-022

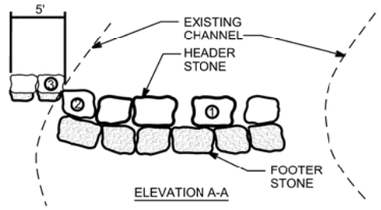
FIGURE NO.

7

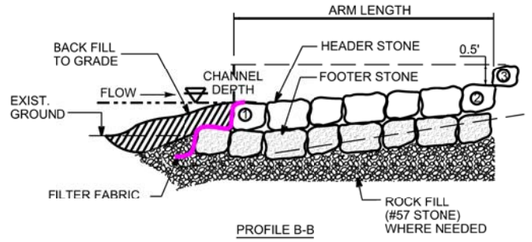
NOTE:
HEADER AND FOOTER STONES ARE LARGE, ANGULAR BOULDERS MEASURING A MINIMUM OF 24" ALONG THE SHORTEST DIMENSION.



PLAN VIEW



ELEVATION A-A

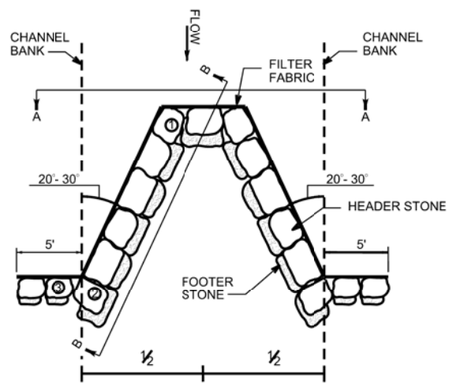


PROFILE B-B

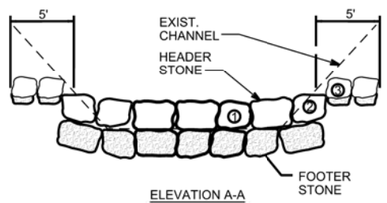
TYPICAL J-HOOK VANE

REACH	ARM LENGTH (FT.)	CHANNEL DEPTH (FT.)
TRIBUTARY 1	10.0	1.5
TRIBUTARIES 2 AND 3	7.0	0.8

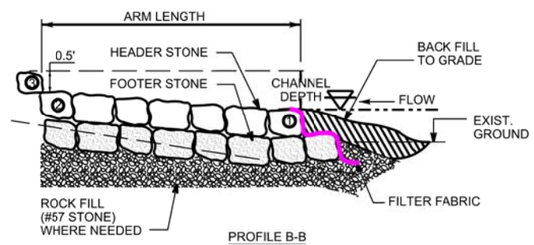
NOTE:
HEADER AND FOOTER STONES ARE LARGE, ANGULAR BOULDERS MEASURING A MINIMUM OF 24" ALONG THE SHORTEST DIMENSION.



PLAN VIEW



ELEVATION A-A



PROFILE B-B

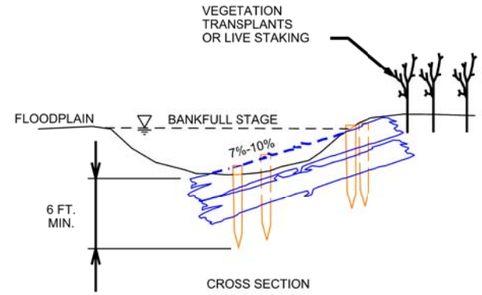
TYPICAL CROSS-VANE

NOTES:
1. EXPOSED VANE OCCUPIES 1/3 OF THE BANKFULL WIDTH OF THE CHANNEL.

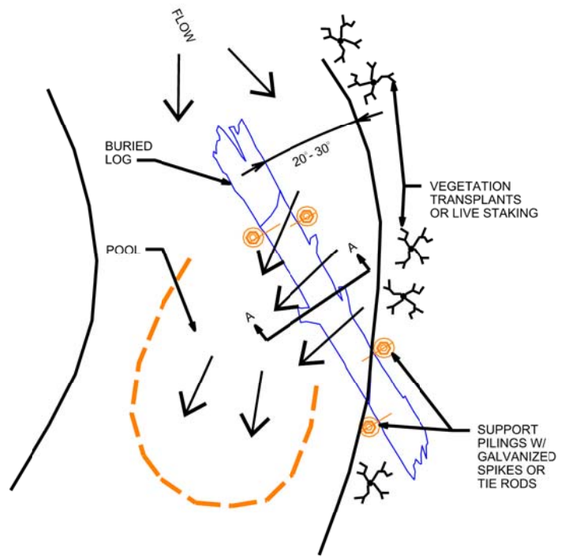
2. SUPPORT PILINGS SHALL BE PENCIL SHARPENED, UNTREATED, PEELED, A MINIMUM OF 4 INCHES IN TOP DIAMETER, AND 8 FEET LONG.

3. LOGS SHALL CONSIST OF NATIVE HARDWOOD SPECIES, RELATIVELY STRAIGHT WITH A MINIMUM DIAMETER OF 15 INCHES AND APPROXIMATELY 35 FEET IN LENGTH.

4. USE FILTER FABRIC TO SEAL GAPS BETWEEN LOGS.

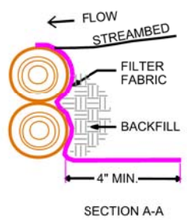


CROSS SECTION

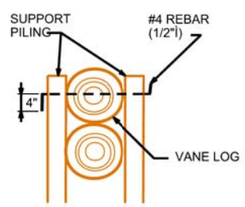


PLAN VIEW

TYPICAL LOG VANE



SECTION A-A



CLOSE-UP OF SUPPORT PILING

- SUPPORT PILINGS SHOULD BE CUT SLIGHTLY BELOW THE TOP LOG.
- AFTER PLACING LOGS, DRIVE REBAR THROUGH LOGS AND BEND ENDS.
- REBAR MAY BE REPLACED WITH LAG BOLT WITH APPROVAL OF THE ENGINEER.

Axiom Environmental, Inc.

NOTES/REVISIONS

Project:

Cane Creek Restoration Site

Rutherford County North Carolina

Title:

TYPICAL STRUCTURE DETAILS

Scale: NO SCALE

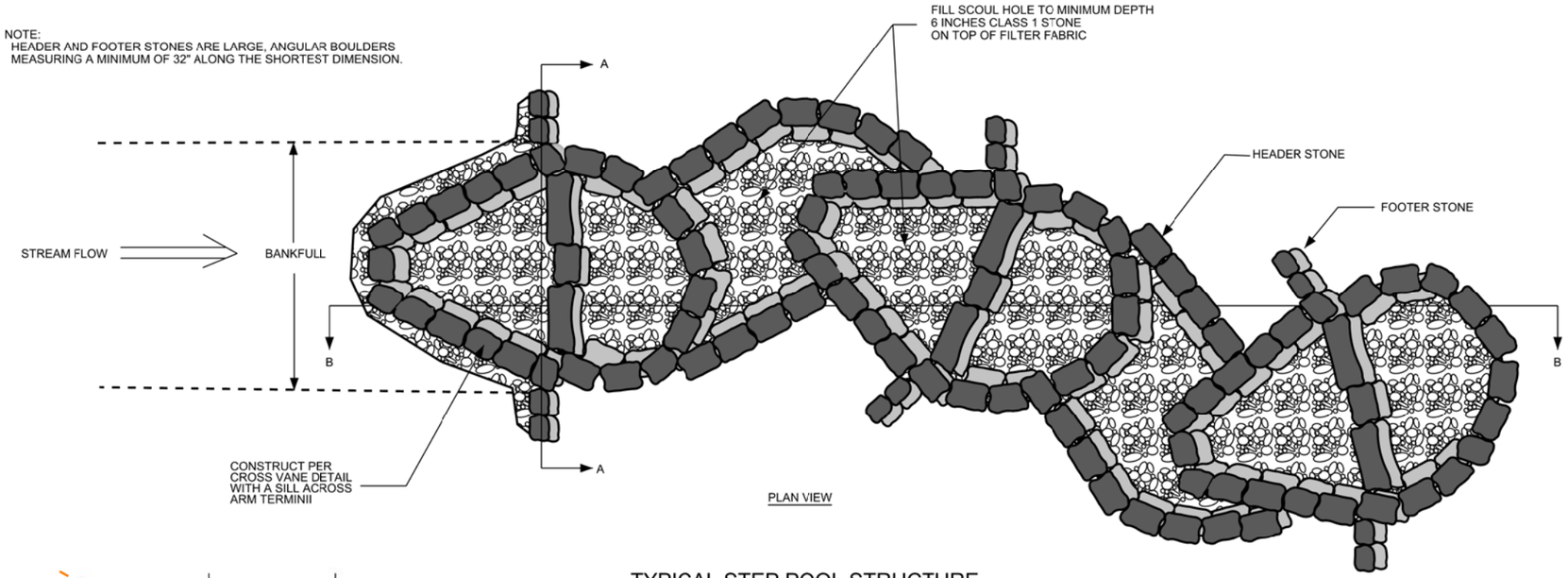
Date: May 2007

Project No.: 06-022

FIGURE NO.

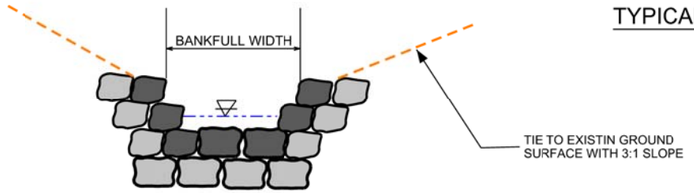
8A

NOTE:
HEADER AND FOOTER STONES ARE LARGE, ANGULAR BOULDERS MEASURING A MINIMUM OF 32" ALONG THE SHORTEST DIMENSION.

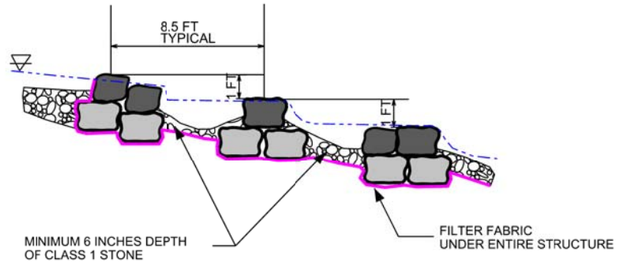


PLAN VIEW

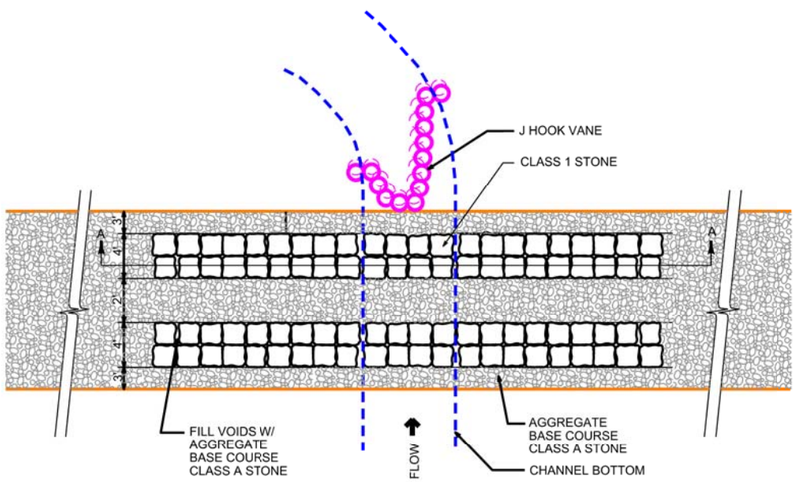
TYPICAL STEP POOL STRUCTURE



CROSS SECTION A-A

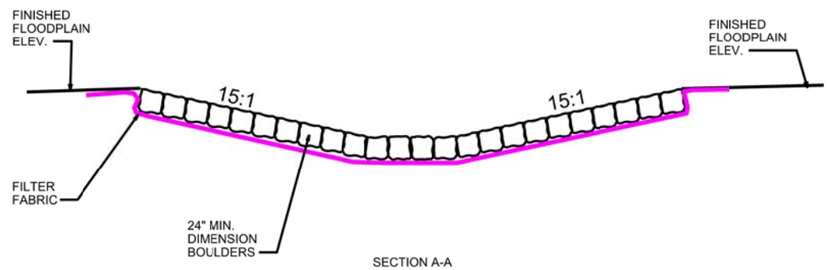


PROFILE B-B



PLAN VIEW

PERMANENT CHANNEL FORD DETAIL



SECTION A-A

PERMANENT CHANNEL FORD DETAIL

NOTES:

1. KEEP FORD CROSS FALL WITHIN 1-2% OF STREAM GRADIENT.
2. FILL VOIDS BETWEEN 24" MININUM DIMENSION BOULDERS W/ AGGREGATE BASE COURSE CLASS A TO CREATE DRIVEABLE SURFACE.

Axiom Environmental, Inc.

NOTES/REVISIONS

Project:

Cane Creek Restoration Site

Rutherford County North Carolina

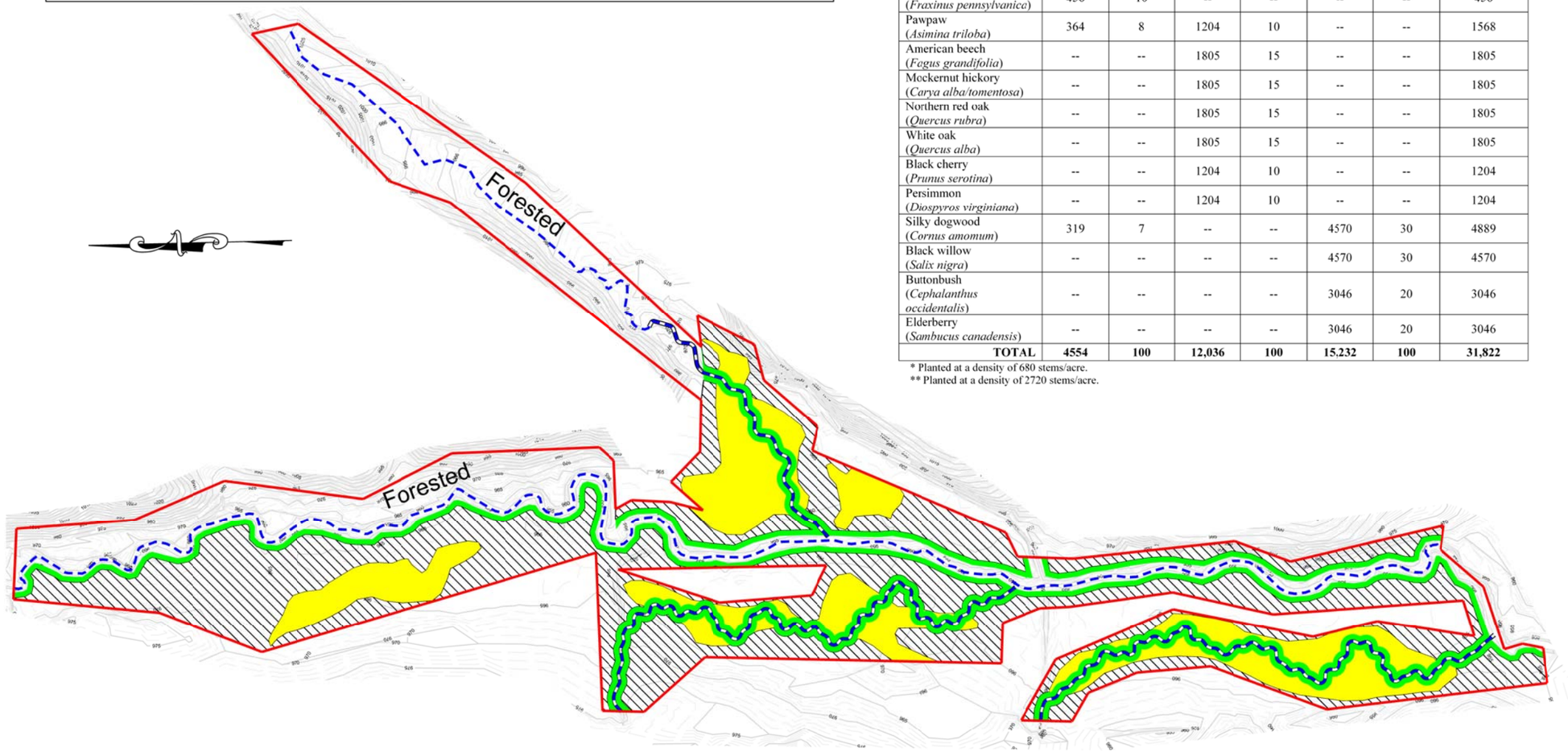
Title:

TYPICAL STRUCTURE DETAILS

Scale:	FIGURE NO.
NO SCALE	8B
Date: May 2007	
Project No.: 06-022	

Planting Plan Legend

	Easement Boundary	38.1 ac
	On-Site Streams	
	Streamside Assemblage	5.6 ac
	Piedmont / Mountain Bottomland Hardwood Forest	6.7 ac
	Piedmont / Low Mountain Alluvial Forest	17.7 ac



Vegetation Association	Bottomland Forest/Nonriverine Wet Hardwoods		Piedmont/Low Mountain Alluvial Forest		Stream-side Assemblage		TOTAL
Area (acres)	6.7		17.7		5.6		23.13
Species	Number planted*	% of total	Number planted*	% of total	Number planted**	% of total	Number planted
Swamp chestnut oak (*Quercus michauxii*)	683	15	--	--	--	--	683
Cherrybark oak (*Quercus pagoda*)	683	15	--	--	--	--	683
Sycamore (*Platanus occidentalis*)	683	15	1204	10	--	--	1887
Hackberry (*Celtis laevigata*)	683	15	--	--	--	--	683
American elm (*Ulmus americana*)	683	15	--	--	--	--	683
Green ash (*Fraxinus pennsylvanica*)	456	10	--	--	--	--	456
Pawpaw (*Asimina triloba*)	364	8	1204	10	--	--	1568
American beech (*Fagus grandifolia*)	--	--	1805	15	--	--	1805
Mockernut hickory (*Carya alba/tomentosa*)	--	--	1805	15	--	--	1805
Northern red oak (*Quercus rubra*)	--	--	1805	15	--	--	1805
White oak (*Quercus alba*)	--	--	1805	15	--	--	1805
Black cherry (*Prunus serotina*)	--	--	1204	10	--	--	1204
Persimmon (*Diospyros virginiana*)	--	--	1204	10	--	--	1204
Silky dogwood (*Cornus amomum*)	319	7	--	--	4570	30	4889
Black willow (*Salix nigra*)	--	--	--	--	4570	30	4570
Buttonbush (*Cephalanthus occidentalis*)	--	--	--	--	3046	20	3046
Elderberry (*Sambucus canadensis*)	--	--	--	--	3046	20	3046
TOTAL	4554	100	12,036	100	15,232	100	31,822

* Planted at a density of 680 stems/acre.
** Planted at a density of 2720 stems/acre.

0 300 600
SCALE IN FEET

Axiom Environmental, Inc.

NOTES/REVISIONS

Project:
Cane Creek Restoration Site

Rutherford County North Carolina

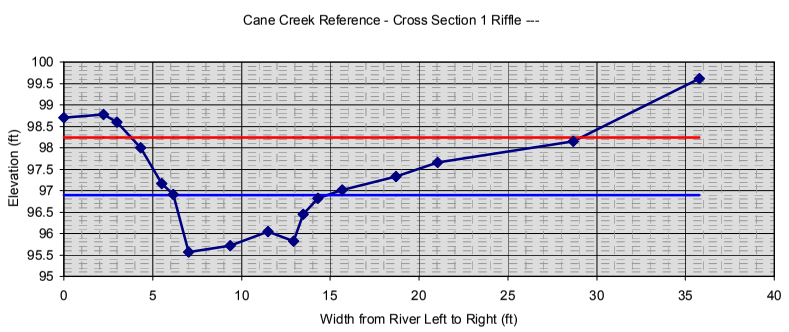
Title:
Planting Plan

Scale: 1 in. = 345 ft.
Date: May 2007
Project No.: 06-022

FIGURE NO.
9

Appendix B. Existing Stream Data

Cross Section



section:	Cane Creek Reference - Cross Section 1
	Riffle

	---
description:	Cane Creek Reference - Cross Section 1
height of instrument (ft):	100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	1.297702	98.7023
	☐	2.234162	1.223113	98.77689
	☐	2.980216	1.406618	98.59338
	☐	4.330339	1.994795	98.00521
	☐	5.508955	2.838305	97.1617
	☐	6.175182	3.091006	96.90899
	☐	7.013601	4.437179	95.56282
	☐	9.364271	4.287589	95.71241
	☐	11.50051	3.952564	96.04744
	☐	12.93113	4.180046	95.81995
	☐	13.46887	3.55764	96.44236
	☐	14.32006	3.173604	96.8264
	☐	15.68666	2.987213	97.01279
	☐	18.70125	2.664887	97.33511
	☐	21.02797	2.350317	97.64968
	☐	28.67074	1.855399	98.1446
	☐	35.78597	0.384428	99.61557
	☐			
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	☐			
	☐			
	☐			
	☐			
	☐			

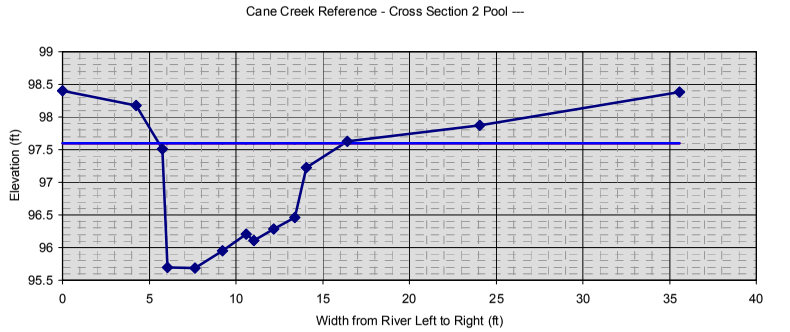
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
3.1	3.1	25.0		
96.9	96.9			

dimensions			
7.7	x-section area	0.9	d mean
8.7	width	9.8	wet P
1.3	d max	0.8	hyd radi
1.3	bank ht	9.7	w/d ratio
25.0	W flood prone area	2.9	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
~~0.0~~	threshold grain size (mm)

check from channel material			
57	measured D84 (mm)		
4.8	relative roughness	6.7	fric. factor
0.000	Manning's n from channel material		

Cross Section



section:	Cane Creek Reference - Cross Section 2
	Pool

	---
description:	Cane Creek Reference - Cross Section 2
height of instrument (ft):	100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	1.593448	98.40655
	☐	4.24347	1.823535	98.17647
	☐	5.749856	2.4925	97.5075
	☐	6.033964	4.30734	95.69266
	☐	7.652938	4.311907	95.68809
	☐	9.230082	4.048873	95.95113
	☐	10.59807	3.797971	96.20203
	☐	11.01975	3.894938	96.10506
	☐	12.17511	3.711708	96.28829
	☐	13.38753	3.543204	96.4568
	☐	14.07149	2.778769	97.22123
	☐	16.40243	2.368001	97.632
	☐	24.06161	2.124414	97.87559
	☐	35.56527	1.619019	98.38098
	☐			
	☐			
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	☐			
	☐			
	☐			
	☐			
	☐			
	☐			

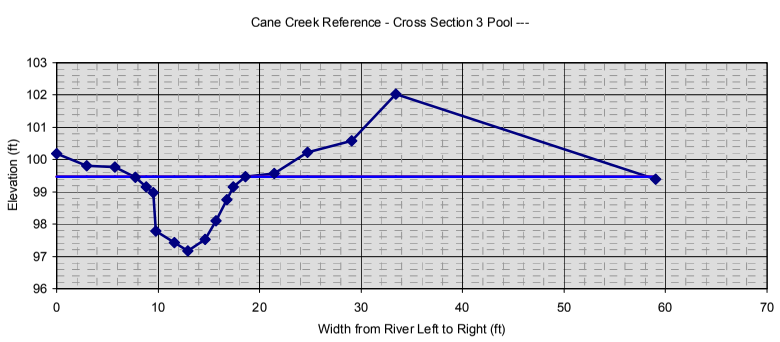
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
2.4	2.4			
97.6	97.6			

dimensions			
12.9	x-section area	1.2	d mean
10.7	width	12.7	wet P
1.9	d max	1.0	hyd radi
1.9	bank ht	~~8.8~~	w/d ratio
~~0.0~~	W flood prone area	~~0.0~~	ent ratio

hydraulics	
~~0.0~~	velocity (ft/sec)
~~0.0~~	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
~~0.000~~	unit stream power (lbs/ft/sec)
~~0.00~~	Froude number
~~0.0~~	friction factor u/u*
~~0.0~~	threshold grain size (mm)

check from channel material			
~~57~~	measured D84 (mm)		
~~6.5~~	relative roughness	~~7.5~~	fric. factor
~~0.000~~	Manning's n from channel material		

Cross Section



section:	Cane Creek Reference - Cross Section 3
	Pool

	---
description:	Cane Creek Reference - Cross Section 3
height of instrument (ft):	100.3926

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	0.20012	100.1924
	☐	2.966768	0.588323	99.80424
	☐	5.734515	0.627177	99.76539
	☐	7.744897	0.940216	99.45235
	☐	8.851431	1.237516	99.15505
	☐	9.526935	1.416467	98.9761
	☐	9.791257	2.609015	97.78355
	☐	11.57662	2.973129	97.41944
	☐	12.92956	3.213746	97.17882
	☐	14.60115	2.865574	97.52699
	☐	15.6867	2.296709	98.09586
	☐	16.76927	1.640064	98.7525
	☐	17.41026	1.244767	99.1478
	☐	18.62547	0.921059	99.47151
	☐	21.4712	0.824304	99.56826
	☐	24.71678	0.165547	100.227
	☐	29.06591	-0.196922	100.5895
	☐	33.44624	-1.645066	102.0376
	☐	58.99664	1.000743	99.39182
	☐			
	☐			
	☐			
	☐			
	☐			
	☐			
	☐			
	☐			
	☐			
	☐			

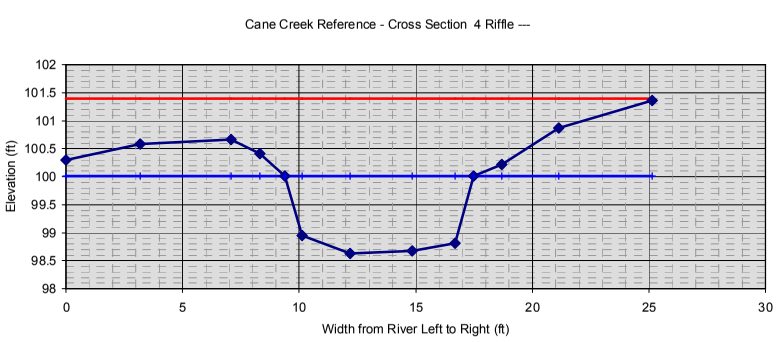
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
0.92	0.92			
99.47257	99.47257			

dimensions			
14.1	x-section area	1.2	d mean
11.8	width	13.4	wet P
2.3	d max	1.0	hyd radi
2.3	bank ht	9.9	w/d ratio
0.0	W flood prone area	0.0	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
0.0	threshold grain size (mm)

check from channel material			
57	measured D84 (mm)		
6.4	relative roughness	7.4	fric. factor
0.000	Manning's n from channel material		

Cross Section



section:	Cane Creek Reference - Cross Section 4
	Riffle

	---
description:	Cane Creek Reference - Cross Section 4
height of instrument (ft):	100.3926

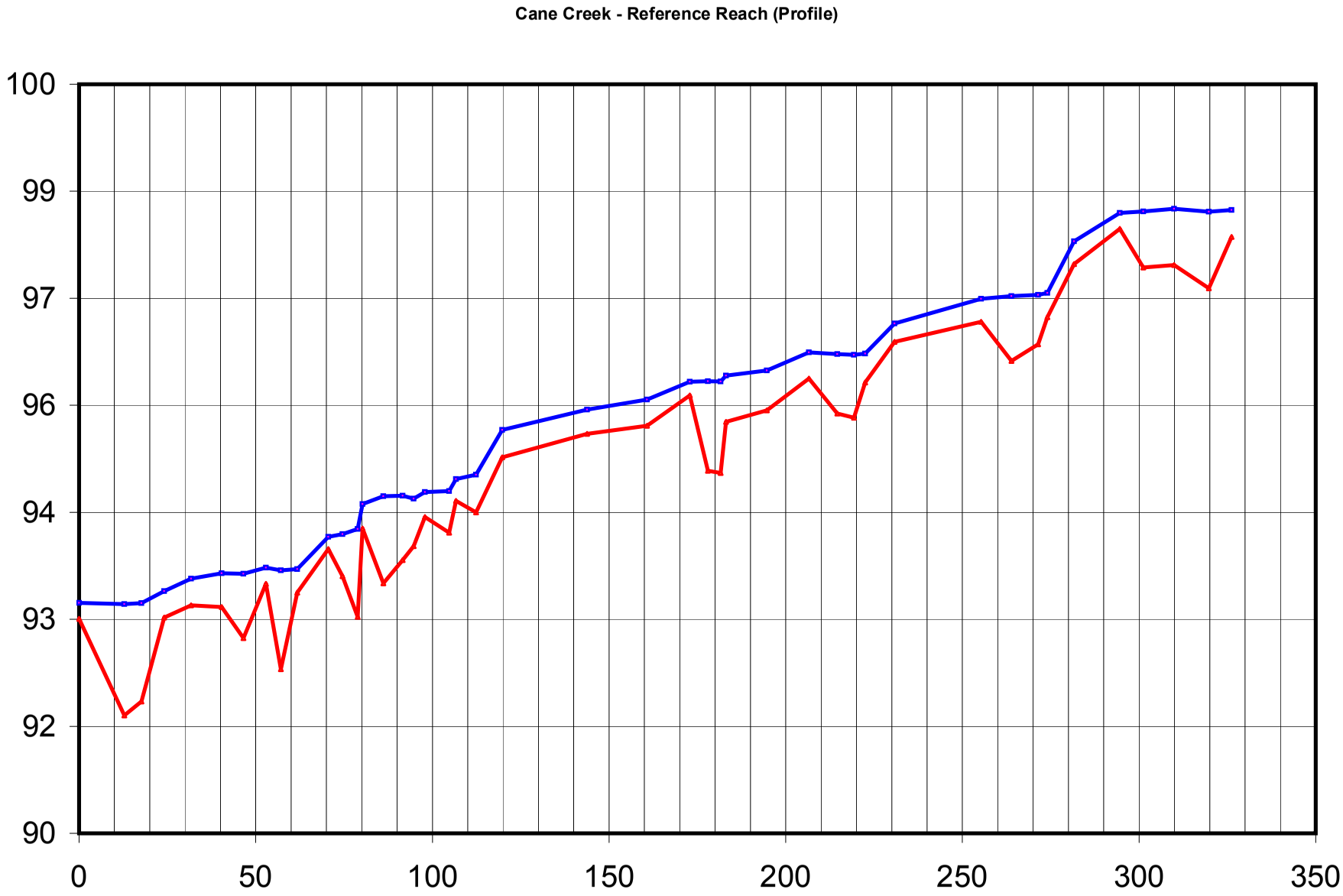
notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	0.099849	100.2927
	☐	3.176913	-0.190633	100.5832
	☐	7.094487	-0.275755	100.6683
	☐	8.307951	-0.020908	100.4135
	☐	9.387936	0.379974	100.0126
	☐	10.12592	1.446862	98.9457
	☐	12.18678	1.760674	98.63189
	☐	14.84989	1.718013	98.67455
	☐	16.68186	1.582736	98.80983
	☐	17.4879	0.383556	100.009
	☐	18.69393	0.171789	100.2208
	☐	21.13667	-0.475033	100.8676
	☐	25.14205	-0.962366	101.3549
	☐			
	☐			
	☐			
	☐			
	☐			
	☐			
	☐			
	☐			
	☐			
	☐			

FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
0.38	0.38	150.0		
100.0126	100.0126			

dimensions			
9.3	x-section area	1.2	d mean
8.1	width	9.3	wet P
1.4	d max	1.0	hyd radi
1.4	bank ht	7.1	w/d ratio
150.0	W flood prone area	18.5	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
0.0	threshold grain size (mm)

check from channel material			
57	measured D84 (mm)		
6.2	relative roughness	7.3	fric. factor
0.000	Manning's n from channel material		

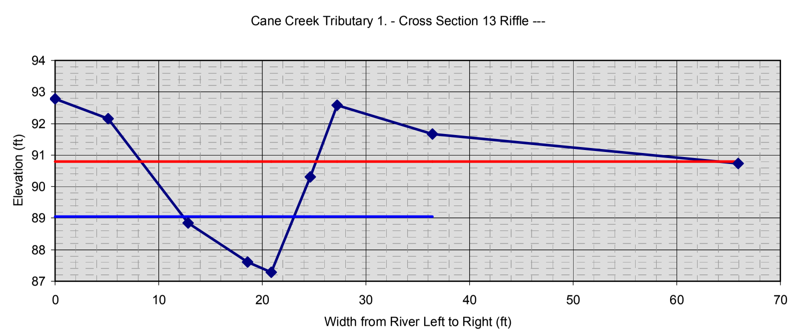

Cane Creek - Reference Reach (Profile)
100
99
97
96
94
93
92
90
0
50
100
150
200
250
300
350

Cane Creek - Reference
Profile (2006)

Average Water Surface Slope
0.0161

Point	Description	Station	Bed Elevation	Water Elevation	Revised Riffle Slope	Revised Pool Slope	Revised Run Slope	Revised Glide Slope
50	tr	0	92.97671	93.19052				
52	g	12.84	91.68531	93.17515		0.0022		0.0000
54	r	17.66	91.87354	93.18554			0.0000	
56	br	24.11	92.99347	93.34667	0.0148			
58	mr	31.72	93.15666	93.51257				
60	tr	40.33	93.13318	93.58679				
62	g	46.55	92.7202	93.58045		0.0040		0.0000
64	debris	52.86	93.44438	93.65932				
66	r	57.12	92.3034	93.62315			0.0039	
68	br	61.73	93.32641	93.64115	0.0492			
70	tr	70.52	93.90926	94.07394				
72	g	74.59	93.54701	94.10908				0.0086
74	p	78.86	93.00419	94.17798			0.2453	
76	log jam	80.22	94.1846	94.5116				
78	g	86.14	93.45015	94.6157		0.0012		
80	r	91.56	93.76099	94.62199			0.0000	
82	br	94.72	93.94999	94.58231	0.0276			
84	tr	97.88	94.33832	94.66986				
86	g	104.72	94.12937	94.68333			0.0819	0.0020
88	debris jam	106.71	94.55189	94.84595				
90	br	112.33	94.3981	94.90442	0.0205			
92	mr	119.74	95.1359	95.50133				
94	mr	143.80	95.44929	95.77341				
96	mr	160.71	95.5557	95.90624				
98	tr	172.85	95.96362	96.14695				
100	g	177.99	94.95578	96.15329		0.0000		0.0012
102	p	181.59	94.92708	96.1487				
104	debris jam	183.10	95.6105	96.22914			0.0534	
106	br	194.67	95.76174	96.29494	0.0204			
108	tr	206.57	96.18684	96.53752				
110	g	214.63	95.72095	96.51377		0.0000		0.0000
112	r	219.31	95.66497	96.50704			0.0045	
114	br	222.48	96.13716	96.52136	0.0224			
116	mr	230.82	96.68002	96.92513				
118	tr	255.28	96.94765	97.2547				
206	g	263.86	96.42483	97.28967		0.0021		0.0041
208	r	271.42	96.64568	97.30527			0.0107	
210	br	274.09	97.00955	97.33368	0.0435			
212	mr	281.63	97.71726	98.02422				
214	tr	294.54	98.18829	98.40274				
216	g	301.22	97.67188	98.42283		0.0000		0.0299
218	p	309.89	97.70516	98.45802				
220	r	319.72	97.39483	98.41991			0.0035	
222	br	326.18	98.08009	98.44258				
				average	0.0284	0.0013	0.0448	0.0057
				median	0.0224	0.0012	0.0045	0.0016
				min	0.0148	0.0000	0.0000	0.0000
				max	0.0492	0.0040	0.2453	0.0299

Cross Section



section: Cane Creek Tributary 1. - Cross Section 13
Riffle

---
description: Cane Creek Tributary 1. - Cross Section 13
height of instrument (ft): 95.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	2.223431	92.77657
	☐	5.14574	2.838487	92.16151
	☐	12.80929	6.163108	88.83689
	☐	18.59383	7.388673	87.61133
	☐	20.84962	7.720691	87.27931
	☐	24.65642	4.6867	90.3133
	☑	27.24565	2.426264	92.57374
	☐	36.44346	3.326073	91.67393
	☑	65.91976	4.274495	90.72551

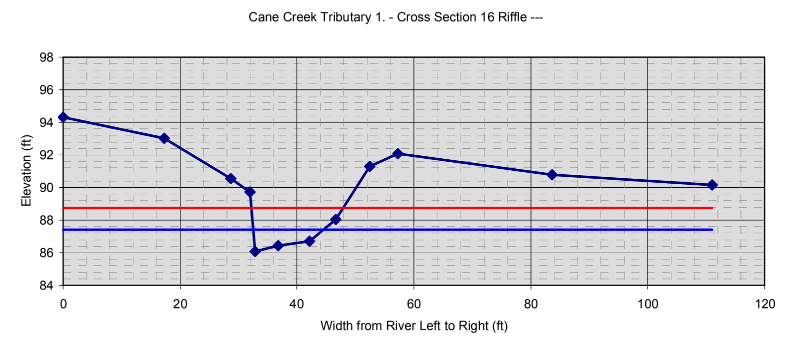
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
5.96	2.42	17.5		
89.04	92.58			

dimensions			
10.3	x-section area	1.0	d mean
10.7	width	11.5	wet P
1.8	d max	0.9	hyd radi
5.3	bank ht	11.1	w/d ratio
17.5	W flood prone area	1.6	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
~~0.0~~	threshold grain size (mm)

check from channel material			
48	measured D84 (mm)		
6.1	relative roughness	7.3	fric. factor
0.000	Manning's n from channel material		

Cross Section



section: Cane Creek Tributary 1. - Cross Section 16
Riffle

---
description: Cane Creek Tributary 1. - Cross Section 16
height of instrument (ft): 95.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	0.694739	94.30526
	☐	17.26783	1.994684	93.00532
	☐	28.68161	4.43146	90.56854
	☐	32.01491	5.265429	89.73457
	☐	32.82734	8.914152	86.08585
	☐	36.82737	8.580525	86.41948
	☐	42.14229	8.301183	86.69882
	☐	46.64566	6.953101	88.0469
	☐	52.46385	3.720886	91.27911
	☐	57.22517	2.90688	92.09312
	☐	83.65068	4.208028	90.79197
	☐	110.9732	4.860849	90.13915

FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
7.58	2.91	18.0		
87.42	92.09			

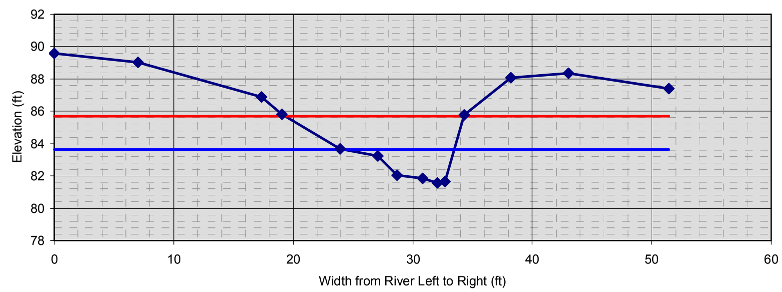
dimensions			
10.3	x-section area	0.9	d mean
12.0	width	13.2	wet P
1.3	d max	0.8	hyd radi
6.0	bank ht	14.0	w/d ratio
18.0	W flood prone area	1.5	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
~~0.0~~	threshold grain size (mm)

check from channel material			
48	measured D84 (mm)		
5.4	relative roughness	7.0	fric. factor
0.000	Manning's n from channel material		

Cross Section

Cane Creek Tributary 1. - Cross Section 18 Riffle ---



section:	Cane Creek Tributary 1. - Cross Section 18
	Riffle --- ---
description:	Cane Creek Tributary 1. - Cross Section 18
height of instrument (ft):	90.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	0.430224	89.56978
	☐	7.001345	0.966213	89.03379
	☐	17.3525	3.133874	86.86613
	☐	19.04318	4.186353	85.81365
	☐	23.92359	6.344179	83.65582
	☐	27.07255	6.763169	83.23683
	☐	28.68959	7.947826	82.05217
	☐	30.8326	8.169932	81.83007
	☐	32.05439	8.423548	81.57645
	☐	32.72209	8.35388	81.64612
	☐	34.29095	4.239545	85.76046
	☐	38.20932	1.913609	88.08639
	☐	43.04685	1.661086	88.33891
	☐	51.42305	2.619766	87.38023

FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
6.36	1.91	15.0		
83.64	88.09			

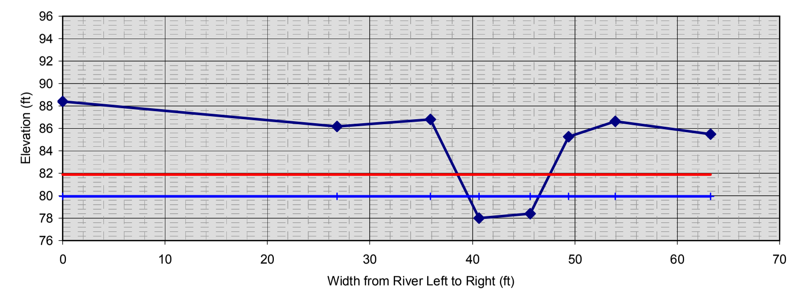
dimensions			
10.3	x-section area	1.1	d mean
9.4	width	11.3	wet P
2.1	d max	0.9	hyd radi
6.5	bank ht	8.6	w/d ratio
15.0	W flood prone area	1.6	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
0.0	threshold grain size (mm)

check from channel material			
48	measured D84 (mm)		
7.0	relative roughness	7.6	fric. factor
0.000	Manning's n from channel material		

Cross Section

Cane Creek Tributary 1. - Cross Section 19 Riffle ---



section:	Cane Creek Tributary 1. - Cross Section 19
	Riffle --- ---
description:	Cane Creek Tributary 1. - Cross Section 19
height of instrument (ft):	90.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	1.621045	88.37896
	☐	26.77818	3.804973	86.19503
	☐	35.88873	3.225219	86.77478
	☐	40.65528	11.98017	78.01983
	☐	45.63107	11.60097	78.39903
	☐	49.37923	4.726234	85.27377
	☐	53.96313	3.372246	86.62775
	☐	63.2659	4.518716	85.48128

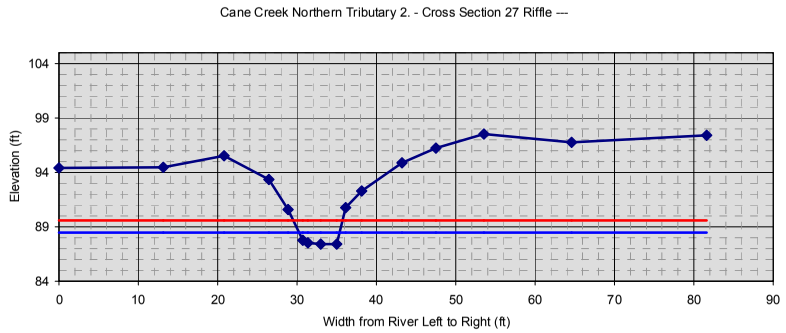
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
10.05	3.37	9.0		
79.95	86.63			

dimensions			
10.3	x-section area	1.5	d mean
6.9	width	9.0	wet P
1.9	d max	1.2	hyd radi
8.6	bank ht	4.6	w/d ratio
9.0	W flood prone area	1.3	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
0.0	threshold grain size (mm)

check from channel material			
48	measured D84 (mm)		
9.5	relative roughness	8.4	fric. factor
0.000	Manning's n from channel material		

Cross Section



section: Cane Creek Northern Tributary 2. - Cross Section 27
Riffle

---
description: Cane Creek Northern Tributary 2. - Cross Section 27
height of instrument (ft): 98.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	3.601635	94.39837
	☐	13.178	3.512759	94.48724
	☐	20.83299	2.495281	95.50472
	☐	26.41812	4.656887	93.34311
	☐	28.88864	7.386866	90.61313
	☐	30.69603	10.26306	87.73694
	☐	31.39743	10.4818	87.5182
	☐	33.00763	10.5923	87.4077
	☐	35.01127	10.59981	87.40019
	☐	36.14865	7.245742	90.75426
	☐	38.1608	5.712798	92.2872
	☐	43.20218	3.112474	94.88753
	☐	47.48436	1.747975	96.25203
	☐	53.52616	0.485715	97.51429
	☐	64.5931	1.228852	96.77115
	☐	81.60846	0.580936	97.41906

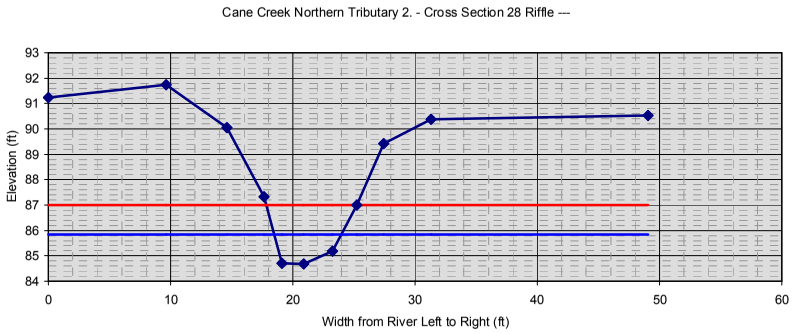
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
9.52	2.5	6.0		
88.48	95.5			

dimensions			
4.8	x-section area	0.9	d mean
5.1	width	6.4	wet P
1.1	d max	0.7	hyd radi
8.1	bank ht	5.6	w/d ratio
6.0	W flood prone area	1.2	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
~~0.0~~	threshold grain size (mm)

check from channel material			
48	measured D84 (mm)		
5.9	relative roughness	7.2	fric. factor
0.000	Manning's n from channel material		

Cross Section



section: Cane Creek Northern Tributary 2. - Cross Section 28
Riffle

---
description: Cane Creek Northern Tributary 2. - Cross Section 28
height of instrument (ft): 92.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	0.755578	91.24442
	☐	9.62971	0.252842	91.74716
	☐	14.60357	1.957563	90.04244
	☐	17.63046	4.680607	87.31939
	☐	19.10248	7.286116	84.71388
	☐	20.90032	7.311055	84.68895
	☐	23.2236	6.813631	85.18637
	☐	25.25267	4.994303	87.0057
	☐	27.44401	2.583993	89.41601
	☐	31.29087	1.63014	90.36986
	☐	49.0385	1.458564	90.54144

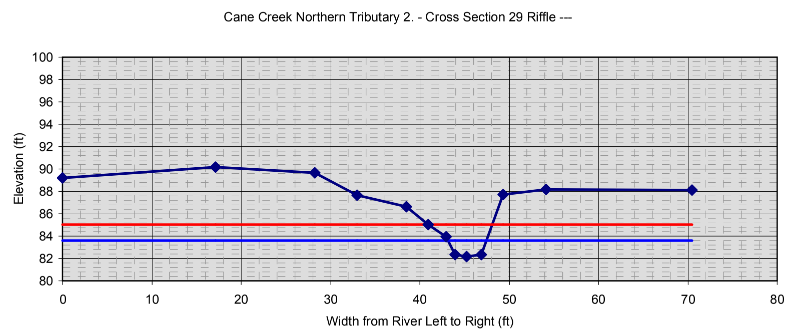
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
6.15	1.63	7.0		
85.85	90.37			

dimensions			
4.8	x-section area	0.9	d mean
5.5	width	6.5	wet P
1.2	d max	0.7	hyd radi
5.7	bank ht	6.3	w/d ratio
7.0	W flood prone area	1.3	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
~~0.0~~	threshold grain size (mm)

check from channel material			
48	measured D84 (mm)		
5.5	relative roughness	7.1	fric. factor
0.000	Manning's n from channel material		

Cross Section



section: Cane Creek Northern Tributary 2. - Cross Section 29
Riffle

---

description: Cane Creek Northern Tributary 2. - Cross Section 29

height of instrument (ft): 92.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	2.822971	89.17703
	☐	17.16426	1.840098	90.1599
	☐	28.24728	2.341039	89.65896
	☐	32.98664	4.340811	87.65919
	☐	38.50509	5.348289	86.65171
	☐	40.95195	6.95565	85.04435
	☐	42.94656	8.055793	83.94421
	☐	43.92574	9.654603	82.3454
	☐	45.22961	9.827637	82.17236
	☐	46.86304	9.681046	82.31895
	☐	49.32878	4.278715	87.72129
	☐	54.10236	3.844008	88.15599
	☐	70.50156	3.888165	88.11184

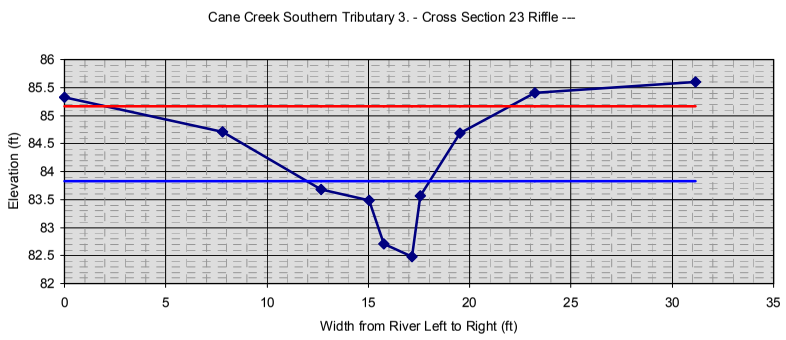
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
8.4	4.3	7.0		
83.6	87.7			

dimensions			
4.8	x-section area	1.1	d mean
4.3	width	5.8	wet P
1.4	d max	0.8	hyd radi
5.5	bank ht	3.8	w/d ratio
7.0	W flood prone area	1.6	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
0.0	threshold grain size (mm)

check from channel material			
48	measured D84 (mm)		
7.1	relative roughness	7.7	fric. factor
0.000	Manning's n from channel material		

Cross Section



section: Cane Creek Southern Tributary 3. - Cross Section 23
Riffle

---
description: Cane Creek Southern Tributary 3. - Cross Section 23
height of instrument (ft): 86.15

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	0.818347	85.32683
	☐	7.81029	1.434594	84.71059
	☐	12.67519	2.466494	83.67869
	☐	15.04958	2.658918	83.48626
	☐	15.74931	3.436221	82.70896
	☐	17.14336	3.66499	82.48019
	☐	17.56926	2.575356	83.56983
	☐	19.51041	1.460441	84.68474
	☐	23.21421	0.738419	85.40676
	☐	31.13298	0.548914	85.59627
	☐			
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	☐			

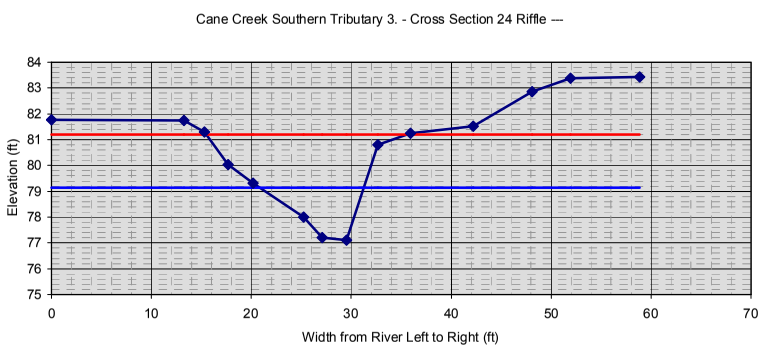
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
2.32	1.4	20.0		
83.82518	84.74518			

dimensions			
3.2	x-section area	0.5	d mean
6.0	width	7.2	wet P
1.3	d max	0.4	hyd radi
2.3	bank ht	11.2	w/d ratio
20.0	W flood prone area	3.3	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
0.0	threshold grain size (mm)

check from channel material			
48	measured D84 (mm)		
3.4	relative roughness	5.9	fric. factor
0.000	Manning's n from channel material		

Cross Section



section: Cane Creek Southern Tributary 3. - Cross Section 24
Riffle

---
description: Cane Creek Southern Tributary 3. - Cross Section 24
height of instrument (ft): 86.15

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	4.382407	81.76277
	☐	13.25809	4.40947	81.73571
	☐	15.3027	4.848872	81.29631
	☐	17.68089	6.123625	80.02156
	☐	20.19259	6.834378	79.3108
	☐	25.24535	8.135104	78.01008
	☐	27.09017	8.940768	77.20441
	☐	29.49339	9.045635	77.09955
	☐	32.66888	5.333731	80.81145
	☐	35.90263	4.906146	81.23904
	☐	42.19743	4.625015	81.52017
	☐	48.11024	3.276346	82.86884
	☐	51.95422	2.754102	83.39108
	☐	58.87617	2.707717	83.43746
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FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
7	4.9	10.0		
79.14518	81.24518			

dimensions			
11.9	x-section area	1.1	d mean
10.4	width	11.7	wet P
2.0	d max	1.0	hyd radi
4.1	bank ht	9.1	w/d ratio
10.0	W flood prone area	1.0	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
0.0	threshold grain size (mm)

check from channel material			
48	measured D84 (mm)		
7.3	relative roughness	7.7	fric. factor
0.000	Manning's n from channel material		

Appendix C. Bankfull Verification

Cleveland County, First Broad River near Casar, North Carolina
Drainage Area = 60.5 square miles
Discharge (Q) = 2275 cfs

Rank (m)	Peak Discharge (cfs)	Exceedance Probability (m/(n+1)) (n=years of record)	Exceedance Probability % 100(m/(n+1))	Return Interval (yrs) (1/Exceedance Probability)
1	12500	0.02	2.17	46.00
2	7790	0.04	4.35	23.00
3	7760	0.07	6.52	15.33
4	6670	0.09	8.70	11.50
5	6580	0.11	10.87	9.20
6	6340	0.13	13.04	7.67
7	6210	0.15	15.22	6.57
8	5600	0.17	17.39	5.75
9	5300	0.20	19.57	5.11
10	5170	0.22	21.74	4.60
11	5120	0.24	23.91	4.18
12	4740	0.26	26.09	3.83
13	4540	0.28	28.26	3.54
14	4500	0.30	30.43	3.29
15	4290	0.33	32.61	3.07
16	3700	0.35	34.78	2.88
17	3670	0.37	36.96	2.71
18	3650	0.39	39.13	2.56
19	3460	0.41	41.30	2.42
20	3380	0.43	43.48	2.30
21	3360	0.46	45.65	2.19
22	3250	0.48	47.83	2.09
23	2960	0.50	50.00	2.00
24	2760	0.52	52.17	1.92
25	2740	0.54	54.35	1.84
26	2500	0.57	56.52	1.77
27	2460	0.59	58.70	1.70
28	2410	0.61	60.87	1.64
29	2400	0.63	63.04	1.59
30	**2260**	**0.65**	**65.22**	**1.53** ⇐
31	**2190**	**0.67**	**67.39**	**1.48**
32	**2080**	**0.70**	**69.57**	**1.44**
33	**1940**	**0.72**	**71.74**	**1.39**
34	**1860**	**0.74**	**73.91**	**1.35**
35	**1860**	**0.76**	**76.09**	**1.31**
36	1830	0.78	78.26	1.28
37	1790	0.80	80.43	1.24
38	1450	0.83	82.61	1.21
39	1400	0.85	84.78	1.18
40	1160	0.87	86.96	1.15
41	944	0.89	89.13	1.12
42	890	0.91	91.30	1.10
43	851	0.93	93.48	1.07
44	620	0.96		
45	519	0.98	97.83	1.02

Note: **Bold** indicates the approximate ranges for the 1.3 to 1.5 year bankfull storm event
⇐ indicates the approximate discharge (Q) calculated from the regional curves

$Q = 100.64x^{0.76}$ where Q = discharge (cubic feet per second) and x = watershed area (square miles)
(Harmen et al. 2001)

Burke County, Jacobs Fork at Ramsey, North Carolina
Drainage Area = 25.7 square miles
Discharge (Q) = 1187 cfs

Rank (m)	Peak Discharge (cfs)	Exceedance Probability (m/(n+1)) (n=years of record)	Exceedance Probability % 100(m/(n+1))	Return Interval (yrs) (1/Exceedance Probability)
1	7220	0.02	2.22	45.00
2	6550	0.04	4.44	22.50
3	5760	0.07	6.67	15.00
4	5360	0.09	8.89	11.25
5	4520	0.11	11.11	9.00
6	3660	0.13	13.33	7.50
7	3490	0.16	15.56	6.43
8	3490	0.18	17.78	5.63
9	3410	0.20	20.00	5.00
10	3180	0.22	22.22	4.50
11	3160	0.24	24.44	4.09
12	3110	0.27	26.67	3.75
13	3060	0.29	28.89	3.46
14	2890	0.31	31.11	3.21
15	2830	0.33	33.33	3.00
16	2700	0.36	35.56	2.81
17	2550	0.38	37.78	2.65
18	2520	0.40	40.00	2.50
19	2480	0.42	42.22	2.37
20	2420	0.44	44.44	2.25
21	2300	0.47	46.67	2.14
22	2300	0.49	48.89	2.05
23	2190	0.51	51.11	1.96
24	1960	0.53	53.33	1.88
25	1840	0.56	55.56	1.80
26	1740	0.58	57.78	1.73
27	1580	0.60	60.00	1.67
28	1560	0.62	62.22	1.61
29	1490	0.64	64.44	1.55
30	**1440**	**0.67**	**66.67**	**1.50**
31	**1430**	**0.69**	**68.89**	**1.45**
32	**1420**	**0.71**	**71.11**	**1.41**
33	**1340**	**0.73**	**73.33**	**1.36**
34	**1320**	**0.76**	**75.56**	**1.32**
35	**1220**	**0.78**	**77.78**	**1.29**
36	1190	0.80	80.00	1.25 ⇐
37	1130	0.82	82.22	1.22
38	1120	0.84	84.44	1.18
39	1100	0.87	86.67	1.15
40	1000	0.89	88.89	1.13
41	885	0.91	91.11	1.10
42	704	0.93	93.33	1.07
43	421	0.96	95.56	1.05
44	329	0.98	97.78	1.02

Note: **Bold** indicates the approximate ranges for the 1.3 to 1.5 year bankfull storm event

⇐ indicates the approximate discharge (Q) calculated from the regional curves

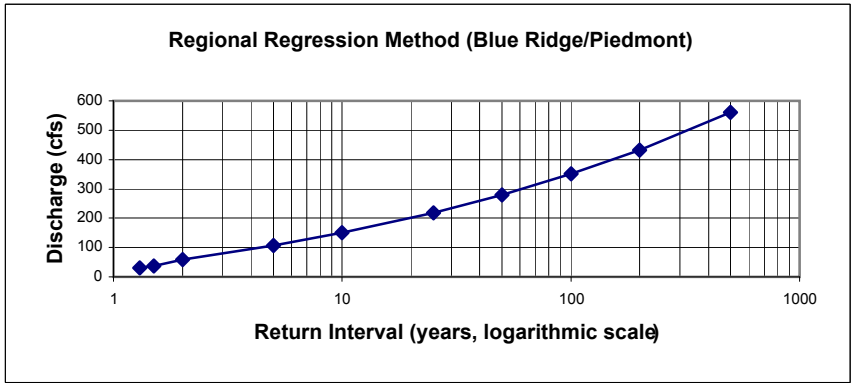
$Q = 100.64x^{0.76}$ where Q = discharge (cubic feet per second) and x = watershed area (square miles)
(Harmen et al. 2001)

Regional Regression Method
Cane Creek Restoration Studies
Reference Reach
(Drainage Area = 0.3 square miles)

Region: Blue Ridge/Piedmont

Return Interval (years)	Discharge (cfs)
1.3	**30**
1.5	**38**
2	58
5	107
10	151
25	219
50	280
100	351
200	433
500	560

Bold indicates interpolated data.



Appendix D. Site Photographs

CANE CREEK

PRECONSTRUCTION PHOTOGRAPHS

Existing Land Use

Tributary 1 Cross-section 16

Tributary 1 Cross-section 12

Tributary 2 Cross-section 27

Tributary 2 Cross-section 28

Cane Creek Preconstruction Photographs (continued)

Tributary 2 Culvert

Tributary 3 Cross-section 23

Tributary 3 Cross-section 25

Tributary 3 Culvert

Reference Cross-section 2

Reference Cross-section 4

Rec. 11/12/2006
Sef

Appendix A

Categorical Exclusion Form for Ecosystem Enhancement Program Projects
Version 1.4

Note: Only Appendix A should to be submitted (along with any supporting documentation) as the environmental document.

Part 1: General Project Information	
Project Name:	Cane Creek Restoration Site
County Name:	Rutherford
EEP Number:	Contract # D06027-E
Project Sponsor:	Restoration Systems, LLC
Project Contact Name:	Worth Creech
Project Contact Address:	1101 Haynes Street, Suite 107, Raleigh, NC 27607
Project Contact E-mail:	worth@restorationsystems.com
EEP Project Manager:	Guy Pearce

Project Description

The Site is located in northern Rutherford County within 14-digit Cataloging Unit 03050105060020 of the Broad River Basin less than 0.2 mile south of the Rutherford/McDowell County line. The Site encompasses approximately 66 acres consisting of 8775 linear feet of existing stream and riparian buffer along Cane Creek and unnamed tributaries and 9.4 acres of hydric soils. Approximately 4470 linear feet of stream restoration, 4860 linear feet of stream enhancement, 1670 linear feet of stream preservation, 4.4 acres of riverine wetland restoration, and 5.0 acres of nonriverine wetland restoration will be constructed.

For Official Use Only

Reviewed By:

Date — EEP Project Manager

Conditional Approved By:

Date — For Division Administrator FHWA

☐ Check this box if there are outstanding issues

Final Approval By:

12-4-06

Date — For Division Administrator FHWA

Part 2: All Projects Regulation/Question	Response
Coastal Zone Management Act (CZMA)	
1. Is the project located in a CAMA county?	☐ Yes ☑ No
2. Does the project involve ground-disturbing activities within a CAMA Area of Environmental Concern (AEC)?	☐ Yes ☐ No ☑ N/A
3. Has a CAMA permit been secured?	☐ Yes ☐ No ☑ N/A
4. Has NCDCM agreed that the project is consistent with the NC Coastal Management Program?	☐ Yes ☐ No ☑ N/A
Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)	
1. Is this a "full-delivery" project?	☑ Yes ☐ No
2. Has the zoning/land use of the subject property and adjacent properties ever been designated as commercial or industrial?	☐ Yes ☑ No ☐ N/A
3. As a result of a limited Phase I Site Assessment, are there known or potential hazardous waste sites within or adjacent to the project area?	☐ Yes ☑ No ☐ N/A
4. As a result of a Phase I Site Assessment, are there known or potential hazardous waste sites within or adjacent to the project area?	☐ Yes ☐ No ☑ N/A
5. As a result of a Phase II Site Assessment, are there known or potential hazardous waste sites within the project area?	☐ Yes ☐ No ☑ N/A
6. Is there an approved hazardous mitigation plan?	☐ Yes ☐ No ☑ N/A
National Historic Preservation Act (Section 106)	
1. Are there properties listed on, or eligible for listing on, the National Register of Historic Places in the project area?	☑ Yes ☐ No
2. Does the project affect such properties and does the SHPO/THPO concur?	☐ Yes ☑ No ☐ N/A
3. If the effects are adverse, have they been resolved?	☑ Yes ☐ No ☑ N/A
Uniform Relocation Assistance and Real Property Acquisition Policies Act (Uniform Act)	
1. Is this a "full-delivery" project?	☑ Yes ☐ No
2. Does the project require the acquisition of real estate?	☑ Yes ☐ No ☐ N/A
3. Was the property acquisition completed prior to the intent to use federal funds?	☐ Yes ☑ No ☐ N/A
4. Has the owner of the property been informed: * prior to making an offer that the agency does not have condemnation authority; and * what the fair market value is believed to be?	☑ Yes ☐ No ☐ N/A

Part 3: Ground-Disturbing Activities Regulation/Question	Response
American Indian Religious Freedom Act (AIRFA)	
1. Is the project located in a county claimed as "territory" by the Eastern Band of Cherokee Indians?	☑ Yes ☐ No
2. Is the site of religious importance to American Indians?	☐ Yes ☑ No ☐ N/A
3. Is the project listed on, or eligible for listing on, the National Register of Historic Places?	☐ Yes ☑ No ☐ N/A
4. Have the effects of the project on this site been considered?	☑ Yes ☐ No ☐ N/A
Antiquities Act (AA)	
1. Is the project located on Federal lands?	☐ Yes ☑ No
2. Will there be loss or destruction of historic or prehistoric ruins, monuments or objects of antiquity?	☐ Yes ☐ No ☑ N/A
3. Will a permit from the appropriate Federal agency be required?	☐ Yes ☐ No ☑ N/A
4. Has a permit been obtained?	☐ Yes ☐ No ☑ N/A
Archaeological Resources Protection Act (ARPA)	
1. Is the project located on federal or Indian lands (reservation)?	☐ Yes ☑ No
2. Will there be a loss or destruction of archaeological resources?	☐ Yes ☐ No ☑ N/A
3. Will a permit from the appropriate Federal agency be required?	☐ Yes ☐ No ☑ N/A
4. Has a permit been obtained?	☐ Yes ☐ No ☑ N/A
Endangered Species Act (ESA)	
1. Are federal Threatened and Endangered species and/or Designated Critical Habitat listed for the county?	☑ Yes ☐ No
2. Is Designated Critical Habitat or suitable habitat present for listed species?	☑ Yes ☐ No ☐ N/A
3. Are T&E species present or is the project being conducted in Designated Critical Habitat?	☐ Yes ☑ No ☐ N/A
4. Is the project "likely to adversely affect" the species and/or "likely to adversely modify" Designated Critical Habitat?	☐ Yes ☑ No ☐ N/A
5. Does the USFWS/NOAA-Fisheries concur in the effects determination?	☐ Yes ☐ No ☑ N/A
6. Has the USFWS/NOAA-Fisheries rendered a "jeopardy" determination?	☐ Yes ☐ No ☑ N/A

Executive Order 13007 (Indian Sacred Sites)	
1. Is the project located on Federal lands that are within a county claimed as "territory" by the EBCI?	☑ Yes ☐ No
2. Has the EBCI indicated that Indian sacred sites may be impacted by the proposed project?	☐ Yes ☑ No ☐ N/A
3. Have accommodations been made for access to and ceremonial use of Indian sacred sites?	☐ Yes ☐ No ☑ N/A
Farmland Protection Policy Act (FPPA)	
1. Will real estate be acquired?	☑ Yes ☐ No
2. Has NRCS determined that the project contains prime, unique, statewide or locally important farmland?	☑ Yes ☐ No ☐ N/A
3. Has the completed Form AD-1006 been submitted to NRCS?	☑ Yes ☐ No ☐ N/A
Fish and Wildlife Coordination Act (FWCA)	
1. Will the project impound, divert, channel deepen, or otherwise control/modify any water body?	☑ Yes ☐ No
2. Have the USFWS and the NCWRC been consulted?	☑ Yes ☐ No ☐ N/A
Land and Water Conservation Fund Act (Section 6(f))	
1. Will the project require the conversion of such property to a use other than public, outdoor recreation?	☐ Yes ☑ No
2. Has the NPS approved of the conversion?	☐ Yes ☐ No ☑ N/A
Magnuson-Stevens Fishery Conservation and Management Act (Essential Fish Habitat)	
1. Is the project located in an estuarine system?	☐ Yes ☑ No
2. Is suitable habitat present for EFH-protected species?	☐ Yes ☐ No ☑ N/A
3. Is sufficient design information available to make a determination of the effect of the project on EFH?	☐ Yes ☐ No ☑ N/A
4. Will the project adversely affect EFH?	☐ Yes ☐ No ☑ N/A
5. Has consultation with NOAA-Fisheries occurred?	☐ Yes ☐ No ☑ N/A
Migratory Bird Treaty Act (MBTA)	
1. Does the USFWS have any recommendations with the project relative to the MBTA?	☐ Yes ☑ No
2. Have the USFWS recommendations been incorporated?	☐ Yes ☐ No ☑ N/A
Wilderness Act	
1. Is the project in a Wilderness area?	☐ Yes ☑ No
2. Has a special use permit and/or easement been obtained from the maintaining federal agency?	☐ Yes ☐ No ☑ N/A

Environmental Documentation
for
Cane Creek Stream and Wetland Restoration Site

EEP Contract Number D06027-E

Categorical Exclusion Form Items

CZMA
Not applicable, as the project is not located in a CAMA county.

CERCLA
See the attached Executive Summary of the limited Phase 1 Site Assessment.

National Historic Preservation Act (Section 106)
See the attached letters to and from the State Historic Preservation Office. SHPO recommended that an archaeological survey of the site be conducted. RS contracted with Legacy Research Associates, Inc. and the survey was conducted. One site was located that is potentially eligible for the National Register of Historic Places. See the attached Management Summary from the report. A GPS survey of the site (area) was submitted to our consultant who has redesigned the nearby stream so that there will be no impact on it and the area will be fenced off to prevent equipment from entering it during construction. Two copies of the archaeological report were submitted to SHPO with the attached cover letter. Their letter of concurrence is included.

Uniform Act
See the attached landowner notification letters.

American Indian Religious Freedom Act
A request for concurrence and a copy of the archaeological report was submitted to Mr. Tyler Howe, Tribal Historic Preservation Officer, EBCI. He concurred with the project as described. See the attached correspondence with Mr. Howe.

Antiquities Act
Not applicable, as the project is not located on Federal lands.

Archaeological Resources Protection Act
Not applicable, as the project is not located on Federal or Indian lands.

Endangered Species Act
There is no suitable habitat on the site for one of the two Federally Endangered species (Indiana Bat) known to occur in Rutherford County. Limited areas of suitable habitat does exist for the other species (White irisette), but surveys for the plant during the flowering period found that it does not exist on the site. See the attached internal memo with the Biological Conclusion of No Effect.

Executive Order 13007

Not applicable, as the project is not located on Federal Lands within a county claimed by the Eastern Band of Cherokee Indians.

Farmland Protection Policy Act

See the attached USDA Form AD-1006

Fish and Wildlife Coordination Act

See the attached letters to the NCWRC and the USFWS. Only the NCWRC provided comment on the project. That was a request to allow the Commission to review the permit application for the project since it is in a "Trout County."

Land and Water Conservation Fund Act

Not applicable. The project will not convert recreation lands.

Magnuson-Stevens Fishery Conservation and Management Act

Not applicable. The project is not located in an estuarine system.

Migratory Bird Treaty Act

See the attached letters to the NCWRC and the USFWS. Neither agency made a comment on the project.

Other Miscellaneous Items

Public Notice

See the attached Affidavit of Publication of a Public Notice in the Waynesville Mountaineer.

EDR® Environmental
Data Resources Inc

The EDR Radius Map
with GeoCheck®

Cane Creek Restoration Site
Rutherford County
Union Mills, NC 28018

Inquiry Number: 01718882.6r

July 19, 2006

The Standard in Environmental Risk Management Information

440 Wheelers Farms Road
Milford, Connecticut 06461

Nationwide Customer Service

Telephone: 1-800-352-0050
Fax: 1-800-231-6802
Internet: www.edrnet.com

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Thank you for your business.
Please contact EDR at 1-800-352-0050
with any questions or comments.

EXECUTIVE SUMMARY

A search of available environmental records was conducted by Environmental Data Resources, Inc (EDR). The report was designed to assist parties seeking to meet the search requirements of EPA's Standards and Practices for All Appropriate Inquiries (40 CFR Part 312), the ASTM Standard Practice for Environmental Site Assessments (E 1527-05) or custom requirements developed for the evaluation of environmental risk associated with a parcel of real estate.

TARGET PROPERTY INFORMATION

ADDRESS

RUTHERFORD COUNTY
UNION MILLS, NC 28018

COORDINATES

Latitude (North):	35.533400 - 35° 32' 0.2"
Longitude (West):	81.853800 - 81° 51' 13.7"
Universal Tranverse Mercator:	Zone 17
UTM X (Meters):	422595.5
UTM Y (Meters):	3932333.8
Elevation:	966 ft. above sea level

USGS TOPOGRAPHIC MAP ASSOCIATED WITH TARGET PROPERTY

Target Property Map:	35081-E7 DYSARTSVILLE, NC
Most Recent Revision:	2003
West Map:	35081-E8 GLENWOOD, NC
Most Recent Revision:	2003

TARGET PROPERTY SEARCH RESULTS

The target property was not listed in any of the databases searched by EDR.

DATABASES WITH NO MAPPED SITES

No mapped sites were found in EDR's search of available ("reasonably ascertainable ") government records either on the target property or within the search radius around the target property for the following databases:

FEDERAL RECORDS

NPL	National Priority List
Proposed NPL	Proposed National Priority List Sites
Delisted NPL	National Priority List Deletions
NPL RECOVERY	Federal Superfund Liens
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
CERC-NFRAP	CERCLIS No Further Remedial Action Planned

EXECUTIVE SUMMARY

CORRACTS	Corrective Action Report
RCRA-TSDF	Resource Conservation and Recovery Act Information
RCRA-LQG	Resource Conservation and Recovery Act Information
RCRA-SQG	Resource Conservation and Recovery Act Information
ERNS	Emergency Response Notification System
HMIRS	Hazardous Materials Information Reporting System
US ENG CONTROLS	Engineering Controls Sites List
US INST CONTROL	Sites with Institutional Controls
DOD	Department of Defense Sites
FUDS	Formerly Used Defense Sites
US BROWNFIELDS	A Listing of Brownfields Sites
CONSENT	Superfund (CERCLA) Consent Decrees
ROD	Records Of Decision
UMTRA	Uranium Mill Tailings Sites
ODI	Open Dump Inventory
TRIS	Toxic Chemical Release Inventory System
TSCA	Toxic Substances Control Act
FTTS	FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)
SSTS	Section 7 Tracking Systems
ICIS	Integrated Compliance Information System
PADS	PCB Activity Database System
MLTS	Material Licensing Tracking System
MINES	Mines Master Index File
FINDS	Facility Index System/Facility Registry System
RAATS	RCRA Administrative Action Tracking System

STATE AND LOCAL RECORDS

SHWS	Inactive Hazardous Sites Inventory
NC HSDS	Hazardous Substance Disposal Site
IMD	Incident Management Database
SWF/LF	List of Solid Waste Facilities
OLI	Old Landfill Inventory
LUST	Regional UST Database
LUST TRUST	State Trust Fund Database
UST	Petroleum Underground Storage Tank Database
AST	AST Database
INST CONTROL	No Further Action Sites With Land Use Restrictions Monitoring
VCP	Responsible Party Voluntary Action Sites
DRYCLEANERS	Drycleaning Sites
BROWNFIELDS	Brownfields Projects Inventory
NPDES	NPDES Facility Location Listing

TRIBAL RECORDS

INDIAN RESERV	Indian Reservations
INDIAN LUST	Leaking Underground Storage Tanks on Indian Land
INDIAN UST	Underground Storage Tanks on Indian Land

EDR PROPRIETARY RECORDS

Manufactured Gas Plants	EDR Proprietary Manufactured Gas Plants
EDR Historical Auto Stations	EDR Proprietary Historic Gas Stations
EDR Historical Cleaners	EDR Proprietary Historic Dry Cleaners

EXECUTIVE SUMMARY

SURROUNDING SITES: SEARCH RESULTS

Surrounding sites were not identified.

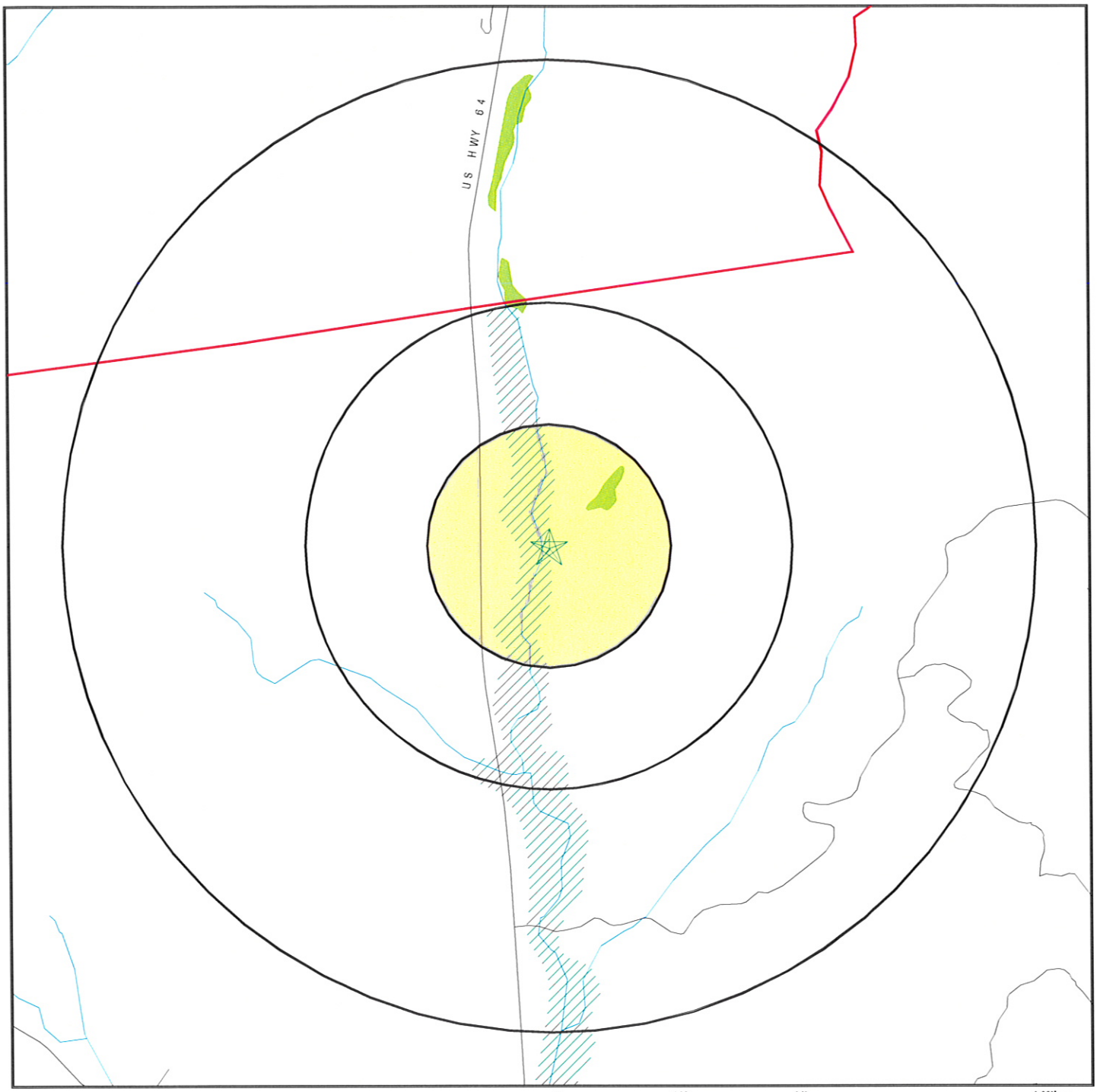
Unmappable (orphan) sites are not considered in the foregoing analysis.

EXECUTIVE SUMMARY

Due to poor or inadequate address information, the following sites were not mapped:

Site Name	Database(s)
JEFF'S PLACE	LUST
UNION MILLS 66	LUST, UST, IMD
HEMLOCK REST HOME	LUST, IMD
HEMLOCK HILLS REST HOME	LUST TRUST
LAIL'S GROCERY	UST
NEEDMORE EXXON 2	UST
WASHBURN'S STORE	UST
GRAY CORNER STOP	UST
DYSARTSVILLE COUNTRY STORE	UST
GOOD OLE BOYS	UST

OVERVIEW MAP - 01718882.6r

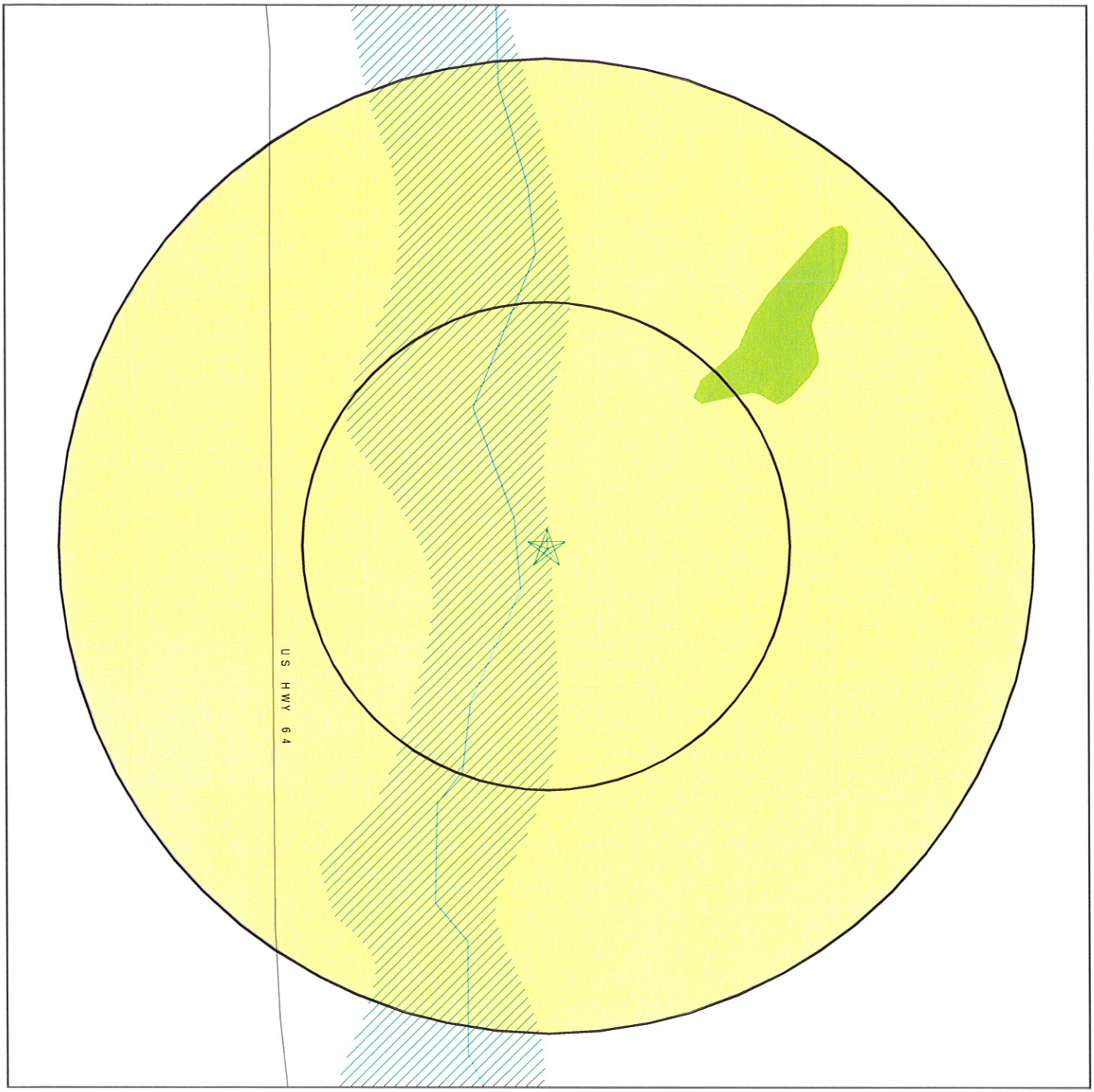


- Target Property
- Sites at elevations higher than or equal to the target property
- Sites at elevations lower than the target property
- Manufactured Gas Plants
- National Priority List Sites
- Landfill Sites
- Dept. Defense Sites
- Indian Reservations BIA
- County Boundary
- Oil & Gas pipelines
- 100-year flood zone
- 500-year flood zone
- National Wetland Inventory
- State Wetlands
- Hazardous Substance Disposal Sites

This report includes Interactive Map Layers to display and/or hide map information. The legend includes only those icons for the default map view.

SITE NAME: Cane Creek Restoration Site ADDRESS: Rutherford County Union Mills NC 28018 LAT/LONG: 35.5334 / 81.8538	CLIENT: Restoration Systems, LLC CONTACT: Dave Schiller INQUIRY #: 01718882.6r DATE: July 19, 2006

DETAIL MAP - 01718882.6r



0 1/16 1/8 1/4 Miles

- Target Property
- Sites at elevations higher than or equal to the target property
- Sites at elevations lower than the target property
- Manufactured Gas Plants
- Sensitive Receptors
- National Priority List Sites
- Landfill Sites
- Dept. Defense Sites
- Indian Reservations BIA
- Oil & Gas pipelines
- 100-year flood zone
- 500-year flood zone
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This report includes Interactive Map Layers to display and/or hide map information. The legend includes only those icons for the default map view.

SITE NAME: Cane Creek Restoration Site	CLIENT: Restoration Systems, LLC
ADDRESS: Rutherford County Union Mills NC 28018	CONTACT: Dave Schiller
LAT/LONG: 35.5334 / 81.8538	INQUIRY #: 01718882.6r DATE: July 19, 2006

MAP FINDINGS SUMMARY

Database	Target Property	Search Distance (Miles)	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
FEDERAL RECORDS								
NPL		1.000	0	0	0	0	NR	0
Proposed NPL		1.000	0	0	0	0	NR	0
Delisted NPL		1.000	0	0	0	0	NR	0
NPL RECOVERY		TP	NR	NR	NR	NR	NR	0
CERCLIS		0.500	0	0	0	NR	NR	0
CERC-NFRAP		0.500	0	0	0	NR	NR	0
CORRACTS		1.000	0	0	0	0	NR	0
RCRA TSD		0.500	0	0	0	NR	NR	0
RCRA Lg. Quan. Gen.		0.250	0	0	NR	NR	NR	0
RCRA Sm. Quan. Gen.		0.250	0	0	NR	NR	NR	0
ERNS		TP	NR	NR	NR	NR	NR	0
HMIRS		TP	NR	NR	NR	NR	NR	0
US ENG CONTROLS		0.500	0	0	0	NR	NR	0
US INST CONTROL		0.500	0	0	0	NR	NR	0
DOD		1.000	0	0	0	0	NR	0
FUDS		1.000	0	0	0	0	NR	0
US BROWNFIELDS		0.500	0	0	0	NR	NR	0
CONSENT		1.000	0	0	0	0	NR	0
ROD		1.000	0	0	0	0	NR	0
UMTRA		0.500	0	0	0	NR	NR	0
ODI		0.500	0	0	0	NR	NR	0
TRIS		TP	NR	NR	NR	NR	NR	0
TSCA		TP	NR	NR	NR	NR	NR	0
FTTS		TP	NR	NR	NR	NR	NR	0
SSTS		TP	NR	NR	NR	NR	NR	0
ICIS		TP	NR	NR	NR	NR	NR	0
PADS		TP	NR	NR	NR	NR	NR	0
MLTS		TP	NR	NR	NR	NR	NR	0
MINES		0.250	0	0	NR	NR	NR	0
FINDS		TP	NR	NR	NR	NR	NR	0
RAATS		TP	NR	NR	NR	NR	NR	0
STATE AND LOCAL RECORDS								
State Haz. Waste		1.000	0	0	0	0	NR	0
NC HSDS		1.000	0	0	0	0	NR	0
IMD		0.500	0	0	0	NR	NR	0
State Landfill		0.500	0	0	0	NR	NR	0
OLI		0.500	0	0	0	NR	NR	0
LUST		0.500	0	0	0	NR	NR	0
LUST TRUST		0.500	0	0	0	NR	NR	0
UST		0.250	0	0	NR	NR	NR	0
AST		0.250	0	0	NR	NR	NR	0
INST CONTROL		0.500	0	0	0	NR	NR	0
VCP		0.500	0	0	0	NR	NR	0
DRYCLEANERS		0.250	0	0	NR	NR	NR	0
BROWNFIELDS		0.500	0	0	0	NR	NR	0
NPDES		TP	NR	NR	NR	NR	NR	0

MAP FINDINGS SUMMARY

Database	Target Property	Search Distance (Miles)	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
TRIBAL RECORDS								
INDIAN RESERV		1.000	0	0	0	0	NR	0
INDIAN LUST		0.500	0	0	0	NR	NR	0
INDIAN UST		0.250	0	0	NR	NR	NR	0
EDR PROPRIETARY RECORDS								
Manufactured Gas Plants		1.000	0	0	0	0	NR	0
EDR Historical Auto Stations		TP	NR	NR	NR	NR	NR	0
EDR Historical Cleaners		TP	NR	NR	NR	NR	NR	0

NOTES:

TP = Target Property

NR = Not Requested at this Search Distance

Sites may be listed in more than one database

RESTORATION SYSTEMS, LLC
Natural Resources
Restoration & Conservation

August 2, 2006

Ms. Renee Gledhill-Earley,
Environmental Review Coordinator
State Historic Preservation Office
4617 Mail Service Center
Raleigh, NC 29699-4617

Subject: Request for Letter of Concurrence on Restoration Project

Dear Ms. Gledhill-Earley:

Restoration Systems (RS) has been awarded a contract by the NC Ecosystem Enhancement Program (EEP) to restore 5 acres of non-riverine wetlands, a 4.4 riverine wetlands, and 6,748 linear feet of stream on a 66 acre parcel in the Broad River Basin. The project is located in Rutherford County, approximately 0.2 miles south of the Rutherford/ McDowell County line adjacent to Highway 64. A map showing the location of the site is attached.

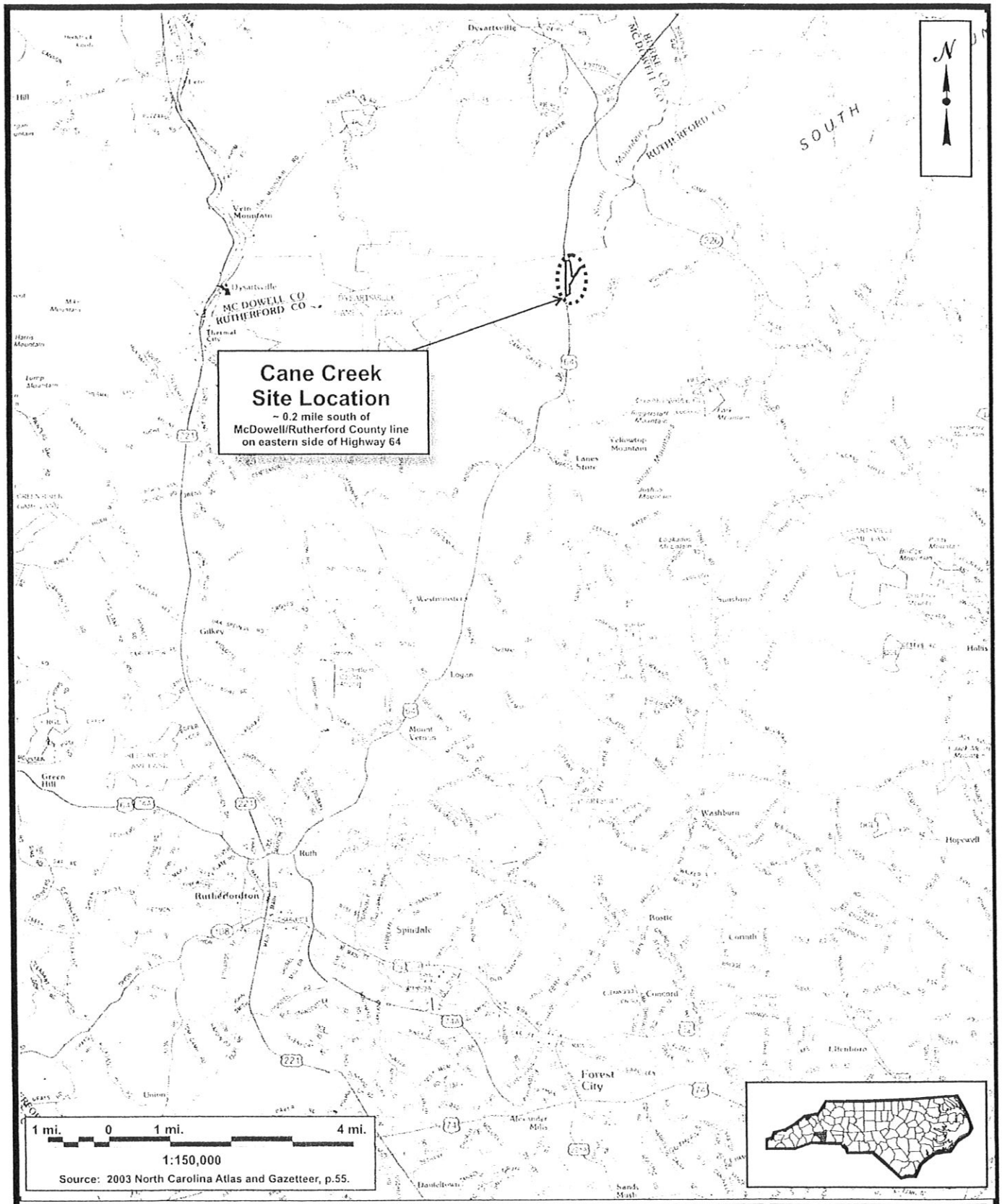
Primary activities are designed to restore the stream and wetland complex include stream restoration, stream preservation, stream enhancement, riverine wetland restoration, non-riverine wetland restoration, and vegetative planting. Stream and wetland restoration activities will include new channel construction on historic floodplains, and light grading on existing banks for enhancement on Cane Creek. Over 1,600 feet of stream will be preserved in its current state and along with the rest of the site, will be placed in a perpetual conservation easement.

There are no structures on or adjacent to the site. RS staff examined the records in your office and determined that there are no listed historic properties or archeological records on or within 0.5 miles of the site. A letter of concurrence from your office is required as part of the Environmental Screening of the project. I would appreciate receiving such a letter for this project at your earliest convenience.

Sincerely,

Worth Creech
Project Manager

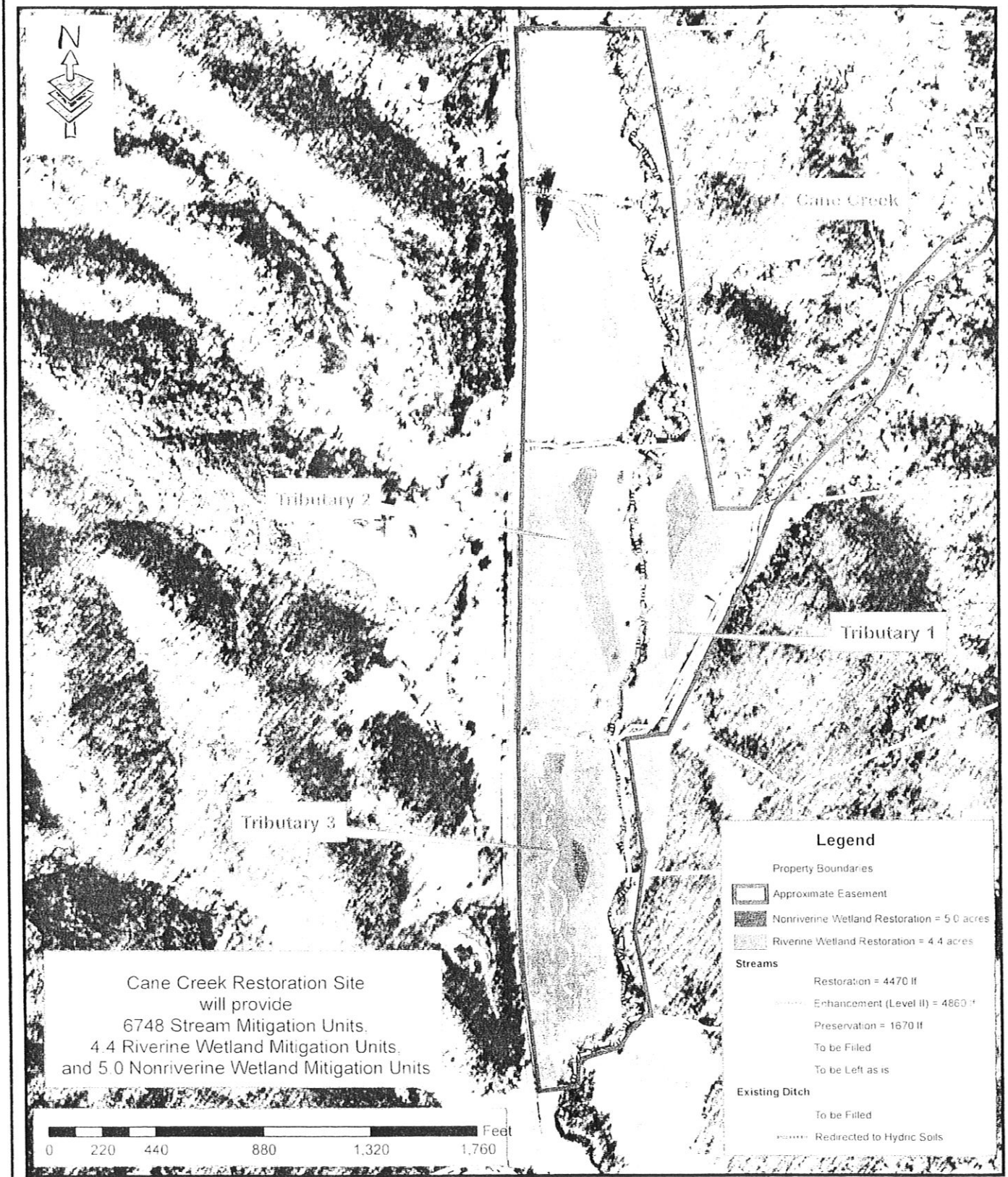
Attachments



Arcadis Environmental, Inc.
2105 Rowland Pond Drive
Willow Spring, NC 27592
(919) 215-1693
(919) 341-3639 fax

SITE LOCATION
CANE CREEK RESTORATION SITE
Rutherford County, North Carolina

Dwn by:	CLF
Date	March 2006
Project	05-002.27
FIGURE	1



Axiom Environmental, Inc
2126 Rowland Pond Drive
Willow Spring, NC 27592
(919) 215-1693
(919) 341-3839 fax

PROPOSED CONDITIONS
CANE CREEK RESTORATION SITE
Rutherford County, North Carolina

Dwn. by: CLF	FIGURE: 5
Date: March 2006	
Project: 05-002.27	

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

August 30, 2006

Worth Creech
Restoration Systems, LLC
1101 Haynes Street, Suite 107
Raleigh, NC 27604

Re: EEP, Wetlands and Stream Restoration, Broad River Basin, Rutherford County, ER 06-2123

Dear Mr. Creech:

Thank you for your letter of August 2, 2006, concerning the above project.

There are no known recorded archaeological sites within the project boundaries. However, the project area has never been systematically surveyed to determine the location or significance of archaeological resources. Based on the topographic and hydrological situation, there is a high probability for the presence of prehistoric or historic archaeological sites.

We recommend that a comprehensive survey be conducted by an experienced archaeologist to identify and evaluate the significance of archaeological remains that may be damaged or destroyed by the proposed project. Potential effects on unknown resources must be assessed prior to the initiation of construction activities.

Two copies of the resulting archaeological survey report, as well as one copy of the appropriate site forms, should be forwarded to us for review and comment as soon as they are available and well in advance of any construction activities.

A list of archaeological consultants who have conducted or expressed an interest in contract work in North Carolina is available at www.arch.dcr.state.nc.us/consults.htm. The archaeologists listed, or any other experienced archaeologist, may be contacted to conduct the recommended survey.

We have determined that the project as proposed will not affect any historic structures.

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 ext. 246. In all future communication concerning this project, please cite the above referenced tracking number.

Sincerely,

Renee Gledhill-Earley

Peter Sandbeck

RESTORATION SYSTEMS, LLC

Natural Resources
Restoration & Conservation

October 10, 2006

Ms. Renee Gledhill-Earley,
Environmental Review Coordinator
State Historic Preservation Office
4617 Mail Service Center
Raleigh, NC 29699-4617

Subject: Archaeological Survey at Cane Creek Restoration Project, ER 06-2123

Dear Ms. Gledhill-Earley:

Restoration Systems (RS) was recently awarded a contract by the NC Ecosystem Enhancement Program (EEP) to restore approximately 10 acres of wetlands and 6,750 feet of stream on a 66 acre parcel in Rutherford County, approximately 0.2 miles south of the Rutherford/ McDowell County line adjacent to Highway 64.

In a letter to you, dated August 2, 2006, we requested your review of and concurrence on the Cane Creek project. Your letter of response dated August 20, 2006 recommended that an archaeological survey of the project be conducted. RS subsequently engaged Legacy Research Associates, Inc. (LRA) and the recommended survey was conducted. Enclosed are two copies of their report and one copy of the Archaeological Site form VI.

The report concluded that one site (31RF176) is "potentially eligible for the NRHP based on land form, abundance of artifacts, and the high probability of subsurface features" and recommended that the site be avoided. LRA provided us with a GIS file of the site that is based on a GPS survey (depicted in Figure 11 of the report). RS instructed our consultant to avoid the site in the design of the project, which they have done. This section of the stream is depicted in Figure 12 of the report.

RS will ensure that the area is clearly identified during the construction phase of the project to prevent any disturbance to the site by equipment. Based on this commitment and redesign of the project, we request your timely concurrence on the project pursuant to Section 106 of the National Historic Preservation Act. If you have any questions, please feel free to contact me at 755-9490.

Sincerely,

Worth Creech
Project Manager

Attachments

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

November 27, 2006

Worth Creech
Restoration Systems, LLC
1101 Haynes St., Suite 107
Raleigh, NC 27604

Re: Cane Creek Restoration Project, Rutherford County, ER 06-2123

Dear Mr. Creech:

Thank you for your letter transmitting the archaeological survey report by Legacy Research Associates, Inc. for the above project. The report meets our guidelines and those of the Secretary of the Interior.

During the course of the survey, one potentially significant archaeological site was located within the project area. Since the project design has been altered to avoid and protect 31RF176, the report author has recommended that no further archaeological investigation be conducted in connection with this project. We concur with this recommendation since the project will not involve significant archaeological resources.

If any design changes are made in the future, please submit the revised plans to our office for review.

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 ext. 246. In all future communication concerning this project, please cite the above referenced tracking number.

Sincerely,

Renee Gledhill-Earley

Peter Sandbeck

cc: Legacy Research Associates, Inc.

RESTORATION SYSTEMS, LLC

Natural Resources
Restoration & Conservation

February 2, 2006

Mr. & Mrs. Whisnant
6871 US Hwy. 64
Union Mills, NC 28167

Dear Mr. & Mrs. Whisnant:

The purpose of this letter is to notify you that Restoration Systems, LLC, in offering to purchase your property in Rutherford County, North Carolina, does not have the power to acquire it by eminent domain. Also, Restoration Systems' offer to purchase your property is based on what we believe to be its fair market.

If you have any questions, please feel free to call me at 919-389-3888.

Sincerely,

Worth Creech
Project Manager

Pilot Mill • 1101 Haynes St., Suite 107 • Raleigh, NC 27604 • www.restorationsystems.com • Phone 919.755.9490 • Fax 919.755.9492

RESTORATION SYSTEMS, LLC

Natural Resources
Restoration & Conservation

February 2, 2006

Mr. & Mrs. Hutchins
1192 Jacktown Road
Marion, NC 28752

Dear Mr. & Mrs. Hutchins:

The purpose of this letter is to notify you that Restoration Systems, LLC, in offering to purchase your property in Rutherford County, North Carolina, does not have the power to acquire it by eminent domain. Also, Restoration Systems' offer to purchase your property is based on what we believe to be its fair market.

If you have any questions, please feel free to call me at 919-389-3888.

Sincerely,

Worth Creech
Project Manager

Pilot Mill • 1101 Haynes St., Suite 107 • Raleigh, NC 27604 • www.restorationsystems.com • Phone 919.755.9490 • Fax 919.755.9492

RESTORATION SYSTEMS, LLC

Natural Resources
Restoration & Conservation

February 2, 2006

Mr. & Mrs. Strassenburg
208 Cane Creek Cove Road
Union Mills, NC 28617-7600

Dear Mr. & Mrs. Strassenburg:

The purpose of this letter is to notify you that Restoration Systems, LLC, in offering to purchase your property in Rutherford County, North Carolina, does not have the power to acquire it by eminent domain. Also, Restoration Systems' offer to purchase your property is based on what we believe to be its fair market.

If you have any questions, please feel free to call me at 919-389-3888.

Sincerely,

Worth Creech
Project Manager

Pilot Mill • 1101 Haynes St., Suite 107 • Raleigh, NC 27604 • www.restorationsystems.com • Phone 919.755.9490 • Fax 919.755.9492

RESTORATION SYSTEMS, LLC

Natural Resources
Restoration & Conservation

February 2, 2006

Mr. and Mrs. Charles Harris
118 Dogwood Drive
Morganton NC 28655

Dear Mr. & Mrs. Harris:

The purpose of this letter is to notify you that Restoration Systems, LLC, in offering to purchase your property in Rutherford County, North Carolina, does not have the power to acquire it by eminent domain. Also, Restoration Systems' offer to purchase your property is based on what we believe to be its fair market.

If you have any questions, please feel free to call me at 919-389-3888.

Sincerely,

Worth Creech
Project Manager

Pilot Mill • 1101 Haynes St., Suite 107 • Raleigh, NC 27604 • www.restorationsystems.com • Phone 919.755.9490 • Fax 919.755.9492

RESTORATION SYSTEMS, LLC

Natural Resources
Restoration & Conservation

February 2, 2006

Mr. & Mrs. Curry
152 Cane Creek Cove Road
Union Mills, NC 28167

Dear Mr. Curry:

The purpose of this letter is to notify you that Restoration Systems, LLC, in offering to purchase your property in Rutherford County, North Carolina, does not have the power to acquire it by eminent domain. Also, Restoration Systems' offer to purchase your property is based on what we believe to be its fair market.

If you have any questions, please feel free to call me at 919-389-3888.

Sincerely,

Worth Creech
Project Manager

Pilot Mill • 1101 Haynes St., Suite 107 • Raleigh, NC 27604 • www.restorationsystems.com • Phone 919.755.9490 • Fax 919.755.9492

David Schiller

From: David Schiller
Sent: Tuesday, October 10, 2006 4:24 PM
To: 'Tyler B. Howe'
Cc: Worth Creech
Subject: CANE CREEK MANAGEMENT SUMMARY.doc

Tyler,

Here is the summary information about the Cane Creek Site that I mentioned. As discussed, the project is located in north-central Rutherford County, just south of the Burke County line and just east of US64. The first figure is from the consultant's report and locates the site boundary by GPS mapping. We submitted the survey to our consultant who redesigned the stream to avoid the site. In addition, we have committed to SHPO to install fencing around the site to prevent disturbance during construction. A CD with the entire report is being sent to you and you should receive it tomorrow. Please review this information and provide me with your comments (hopefully positive).

Thanks for resending the Morgan Creek memo.

Dave Schiller 919-755-9490

MANAGEMENT SUMMARY

Legacy Research Associates Inc. (Legacy), of Durham, North Carolina, has completed the archaeological survey for the Ecosystem Enhancement Program (EEP) Wetlands and Stream Restoration Project along Cane Creek in Rutherford County, North Carolina (ER 06-2123). This work was conducted for Restoration Systems, LLC, of Raleigh, North Carolina.

The Cane Creek project involves the restoration of 3.9 km (2.41 mi) of stream channels (**Error! Reference source not found.**). The purpose of the archaeological survey was to locate, document, and conduct National Register of Historic Places (NRHP)-eligibility evaluation investigations for archaeological resources that may be affected by the stream and wetland restoration project.

This work complies with the National Historic Preservation Act of 1966 (as amended), the Archaeological and Historical Preservation Act of 1974, Executive Order 11593, and 36 CFR Parts 660-66 and 800 (as appropriate). It meets the Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation (Federal Register 48). All information submitted in this report is factual and sufficiently complete to enable the North Carolina State Historic Preservation Officer (SHPO) to perform the necessary reviews.

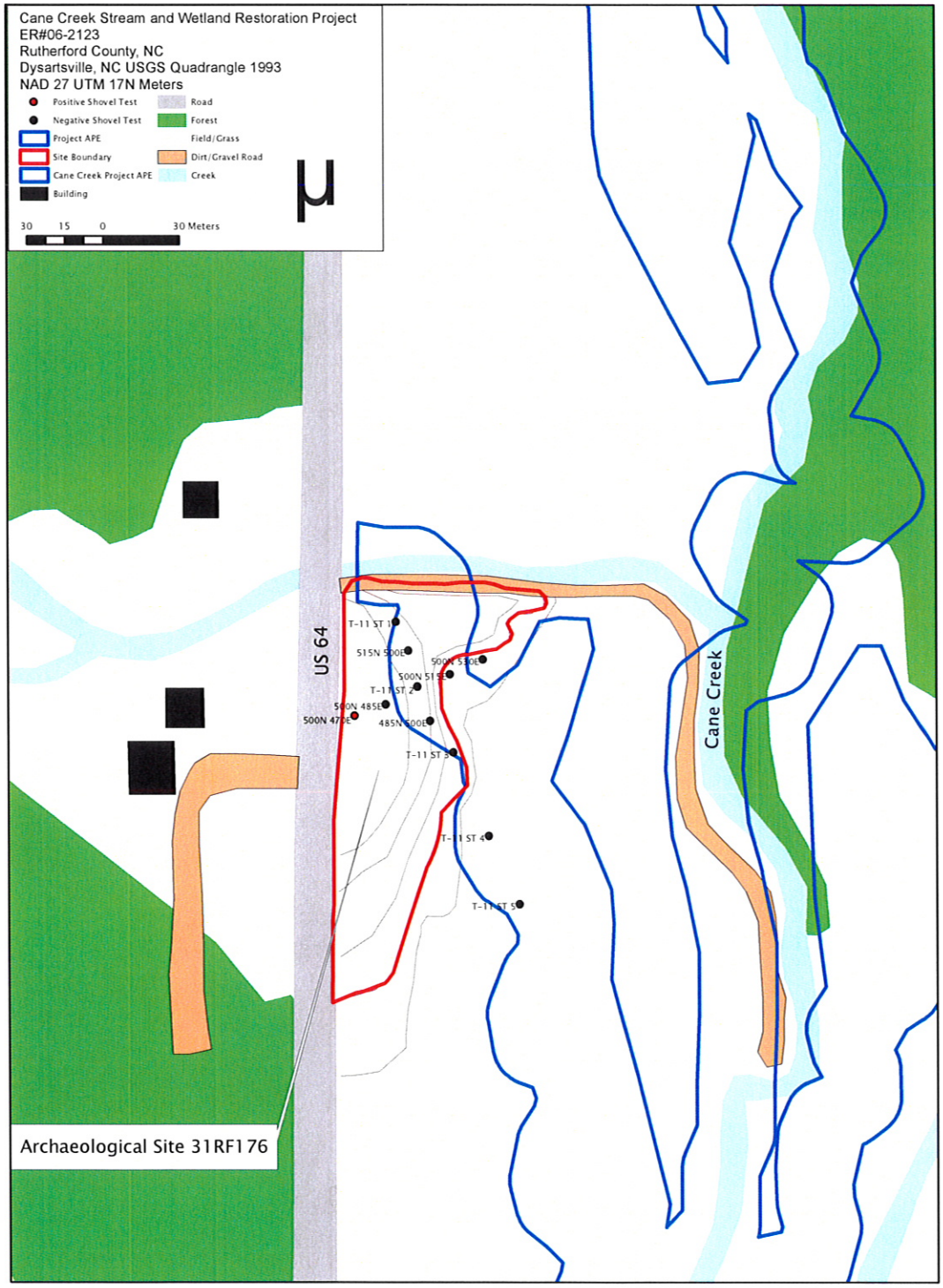
Background Research

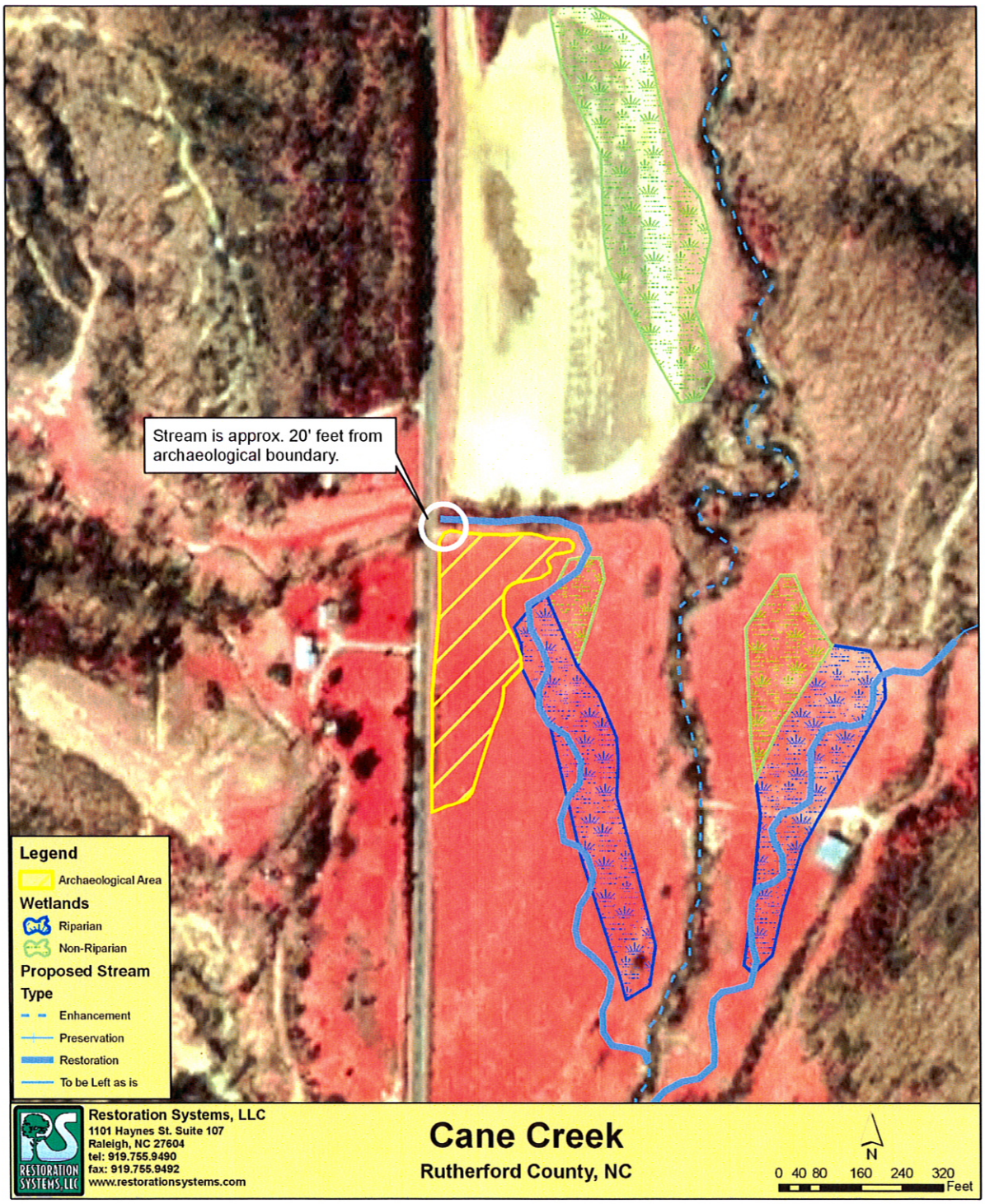
A review of state and local survey data was completed prior to the archaeological survey. This included the files at the North Carolina Office of State Archaeology (OSA) and collections held at the North Carolina State Library in Raleigh. Research identified no previously recorded archaeological sites within 1.6 km (1 mi) of the project. However, based on the topographic and hydrological situation, the North Carolina SHPO determined there to be a high probability for the presence of prehistoric and/or historic archaeological sites within the project boundaries.

Field Investigations Results and Recommendations

Archaeological survey for the project was conducted by Legacy between September 13-15 and 19-22, 2006. Deborah Joy served as project director and Jared Roberts served as field director; Rhonda Cranfill-Moran, Johann Furbacher, Chris Pettyjohn, and Andrea Prentis assisted.

One archaeological site, 31RF176, was recorded within the project Area of Potential Effects (APE) during the survey (**Error! Reference source not found.**). The site consists of a Woodland period lithic and ceramic scatter located on the first terrace above the Cane Creek floodplain east of US Highway 64. The terrace features a cultivated squash field. Site 31RF176 is recommended as being potentially eligible for the NRHP based on the landform, abundance of artifacts, and the high probability of subsurface features. If the site cannot be avoided, further archaeological work will be necessary.


Cane Creek Stream and Wetland Restoration Project
ER#06-2123
Rutherford County, NC
Dysartsville, NC USGS Quadrangle 1993
NAD 27 UTM 17N Meters
Positive Shovel Test
Negative Shovel Test
Project APE
Site Boundary
Cane Creek Project APE
Building
Road
Forest
Field/Grass
Dirt/Gravel Road
Creek
30 15 0 30 Meters
US 64
Cane Creek
T-11 ST 1
515N 500E
500N 515E
T-11 ST 2
500N 485E
500N 479E
485N 500E
T-11 ST 3
T-11 ST 4
T-11 ST 5
Archaeological Site 31RF176


Stream is approx. 20' feet from archaeological boundary.
Legend
Archaeological Area
Wetlands
Riparian
Non-Riparian
Proposed Stream Type
Enhancement
Preservation
Restoration
To be Left as is
Restoration Systems, LLC
1101 Haynes St. Suite 107
Raleigh, NC 27604
tel: 919.755.9490
fax: 919.755.9492
www.restorationsystems.com
Cane Creek
Rutherford County, NC
N
0 40 80 160 240 320
Feet

Eastern Band of Cherokee Indians
Tribal Historic Preservation Office
P.O. Box 455
Cherokee, NC 28719
Ph: 828-488-0237 Fax 828-488-2462

RECEIVED
NOV 0 6 2006
BY: DHS

DATE: 26 - October - 06

TO: FHWA, NC Division
NCEEP
Donnie Brew
1652 Mail Service Center
Raleigh, NC 27699-1652

PROJECT(s): **Comments on phase I archeological testing report of proposed stream bank restoration at Cane Creek, Rutherford County, North Carolina.**

The Tribal Historic Preservation Office of the Eastern Band of Cherokee Indians would like to thank you for the opportunity to comment on this proposed Section 106 activity under 36 C.F.R. 800.

This office agrees with the archeologist's recommendation that site 31RF176 "has the potential to yield significant information about the prehistory of [the] region," and is thus recommended as being potentially eligible for inclusion on the National Register of Historic Places. The EBCI THPO agrees additionally with the archeologist's recommendation that if "the site cannot be avoided, further archeological testing work will be necessary." If further testing is warranted, this office requests all cultural resource data forwarded to the NC SHPO be forwarded to this office as well for comment and recommendation. In the event that human remains or significant cultural resources are inadvertently discovered, all work should cease and immediate Section 106 consultation between the federal government and the sovereign government of the Eastern Band of Cherokee Indians should begin.

If we can be of further service, or if you have any comments or questions, please feel free to contact me at (828) 488-0237 ext 2.

Sincerely,

Tyler B. Howe
Tribal Historical Preservation Specialist
Eastern Band of Cherokee Indians

Cc: Dave Schiller

August 11, 2006

MEMO TO: Dave Schiller
FROM: Worth Creech, Project Manager
SUBJECT: Documentation of Efforts on Behalf of Section 7 of the Endangered Species Act (ESA) for the Cane Creek Restoration Project in Rutherford County.

On October 26, 2005, the North Carolina Ecosystem Enhancement Program (EEP) issued a Request for Proposals for 21,000 stream mitigation units, 20 riverine wetland mitigation units, and 5 non-riverine wetland mitigation units in the Broad River Basin, Cataloging Unit 03050105. Restoration Systems, LLC (RS), of Raleigh, NC was subsequently awarded a contract by the EEP to provide 6,748 stream mitigation units, 4.4 riverine wetland mitigation units, and 5 non-riverine wetland mitigation units at the Cane Creek Restoration Site. Axiom Environmental, Inc. is under contract to RS to provide technical environmental consulting; Appalachian Environmental Services, LLC will provide design services.

One of the earliest tasks to be performed by RS is completion of an environmental screening and preparation/submittal of a Categorical Exclusion (CE) document. This document is specifically required by the Federal Highway Administration (FHWA) to ensure compliance with various federal environmental laws and regulations. The EEP must demonstrate that its projects comply with federal mandates as a precondition to FHWA reimbursement of compensatory mitigation costs borne by the North Carolina Department of Transportation to offset its projects' unavoidable impacts to streams and wetlands.

Since financial support of certain EEP operational budgets derives, in part, from federal authorizations, it is necessary to conduct a Section 7 consultation with the U.S. Fish and Wildlife Service (Service). This letter provides you with certain details about the Cane Creek Restoration Site project, including the project's location, a general description of its physiography, hydrography and existing land uses, as well as the intended modifications to the site proposed by RS. In addition, should the project be located in a geographic area in which federally-listed species may be present (based on element occurrences, as reflected in Service listings), and if scientifically-sound practices have been used to confirm the presence of suitable habitat for any listed species within the project area, the results of appropriate surveys for each listed species and separate biological conclusions for each will be provided for your review and consideration. You

are asked to review the information provided and determine if it is sufficient to enable you to concur with our biological conclusions.

Project Location & Description

The Cane Creek Restoration Site is located in Rutherford County less than 0.2 miles south of the Rutherford/McDowell County line along the eastern edge of Highway 64 (Figure 1). The Site is located at 35.533376 North and -81.853820 West and encompasses approximately 66 acres that is currently being used for livestock grazing and agriculture, land uses that have been employed for many years. Within the Site, 4,470 linear feet of stream will undergo restoration, 4,860 linear feet of stream will undergo level II enhancement, and 1,670 linear feet will be preserved. Wetland restoration would be achieved on 9.4 acres of existing agricultural fields (Figures 4-5).

Restoration Means & Methods

Primary activities are designed to restore the stream and wetland complex include stream restoration, stream preservation, stream enhancement, riverine wetland restoration, non-riverine wetland restoration, and vegetative planting.

Stream restoration on tributaries to Cane Creek is expected to entail: belt-width preparation, changes in pattern, dimension, and profile of these tributaries, channel excavation, spoils stockpiling, channel stabilization, channel diversion, and existing channel backfill.

Stream enhancement (level II) will be achieved through bank stabilization and planting riparian buffers along Cane Creek. Particular attention will be directed toward providing vegetative cover and root growth along the outer bends of the each stream meander. Water quality functions, aquatic, and wildlife habitat associated with stable streams will be greatly improved.

Restoration of wetland hydrology and wetland soil attributes may involve rerouting existing straightened tributaries to Cane Creek, into agricultural fields underlain with hydric soils, channel plug installation, channel backfill, and scarification of soils prior to planting. In addition, the construction of surface water storage depressions (ephemeral pools) also adds an important component to groundwater restoration activities.

Revegetating the floodplain and stream banks will provide stream bank stability, shade, cool surface waters, filter pollutants from adjacent runoff, and provide habitat for area wildlife. The vegetated stream buffer will extend approximately 30 feet or more on both sides of Cane Creek and its tributaries. Scarification of floodplain surfaces may be required prior to planting. Plant community restoration within the Site will include the planting of bare-root seedlings consistent with reference data, on-site observations, and descriptions of the community.

Federally Listed Species

Based on the most recently updated county-by-county database of federally listed species in North Carolina as posted by the United States Fish and Wildlife Service (USFWS) at http://nc-es.fws.gov/es/countyfr.html, four federally protected species are listed in Rutherford County. Table 3 lists the federally protected species for Rutherford County and indicates if suitable habitat exists within the Site (entire easement) for each species.

North Carolina Natural Heritage Program (NCNHP) records were reviewed on March 7, 2006. One Significant Natural Heritage Area, Lone Mountain, occurs immediately northeast of the Site. In addition, one Significant Natural Heritage Area, Biggerstaff Mountain, occurs approximately 1.5 miles southeast of the Site near Yellowtop Mountain. No rare species are documented for the Site.

Table 3. Federally Protected Species for Rutherford County

Common Name	Scientific Name	Status*	Habitat Present Within Site
Indiana bat	*Myotis sodalis*	Endangered	No
Dwarf-flowered heartleaf	*Hexastylis naniflora*	Threatened	Yes
Small-whorled pogonia	*Isotria medeoloides*	Threatened	Yes
White irisette	*Sisyrinchium dichotomum*	Endangered	Yes

"Endangered": A taxon in danger of extinction throughout all or a significant portion of its range; "Threatened": A taxon likely to become endangered within the foreseeable future throughout all or a significant portion of its range.

Indiana Bat

While this bat often overwinters in caves throughout its range, it is known to roost beneath the bark of species such as shagbark hickory and bitternut. These roost sites are often located in close proximity to streams and rivers where it forages for flying insects.

Dwarf-flowered heartleaf

This small herbaceous member of the birthwort family (Aristolochiacea) occurs in a several county area in the western and central piedmont. The species is closely allied with *H. lewisii* and *H. heterophylla*. An interesting soil-plant correlation appears to exist between the species and soils of the Pacolet series (or Madison and Musella), which are sandy-to-gravelly substrates. The habitat where this species occurs is often associated with escarpments into drainages including acidic hardwood embankments. It is often reported in association with *Kalmia latifolia*.

Small-whorled Pogonia

The small-whorled pogonia is a member of the orchid family. It is a perennial with a smooth, hollow stem approximately 4-10 inches tall terminating in a whorl of green, elliptical leaves that are somewhat pointed and measure up to 3 by 1.5 inches. A flower, or occasionally two flowers, is produced at the top of the stem. The hollow stem is an important morphological element when attempting to distinguish the *Isotria medeoloides* from other *Isotria* species and even Indian cucumber-root (*Medeola virginiana*).

Flowering may occur from about mid-May to mid-June, but then the population may lie dormant for an unspecified period of time, which is similar to other members of the orchid family and is thought to be associated with complex soil-fungal relationships. Habitats where this plant has been observed include montane oak-hickory or acidic cove forests, but it has also been found in an apple orchard. Sites currently or historically known to support this species range from 2000 to 4000 feet in elevation.

White Irisette

This herbaceous member of the *Iris* family occurs on rich, basic soils. It grows in clearings and along the edges of upland woods where the canopy is thin and often where down-slope runoff has removed much of the deep litter layer ordinarily present on these sites. The irisette is dependent on some form of disturbance to maintain the open quality of its habitat. Vegetative portions of the plant are dichotomously branched. Small, white flowers occur from May through July.

Summary of Anticipated Effects

The scope of work includes stream enhancement (Level II), stream channel restoration, stream preservation and wetland restoration (riverine and non-riverine). In addition, the contractor will establish haul routes and material storage areas throughout the easement. Earthwork (grubbing, grading, filling) will accompany the stream restoration efforts and, to some extent, the wetland restoration effort. Fortunately, these land-disturbing activities will be concentrated in the agricultural landscape where row crop production of squash is the predominant land-use activity; however, some earthwork will occur immediately adjacent to existing streams within forested communities. To ensure that adequate field investigations were performed to determine if listed species or their habitat were present, natural history and morphological descriptions of each listed species were researched before conducting field investigations. Intensive field investigations throughout the entire easement were conducted on August 2 and August 8, 2006. These surveys included an evaluation of all habitats as well as searches for evidence of listed species. The investigator is Randy Turner, who has more than 35 years direct experience in field survey methodologies. The investigator has found numerous populations of rare species over the years.

Indiana Bat

Parallel transects were walked along the west-facing forested hillside along the entire eastern boundary of the project area including habitats well outside the limits of the project easement. Searches covered a band of forest at least 500 feet deep. The goal of the search was to look for any caves, large bitternut (*Carya cordiformis*), shagbark hickory (*Carya ovata*), or other species with exfoliating bark that could serve as a roosting location for the species.

Biological Conclusion: Since the work to be undertaken will not result in removal of any roosting or hibernacula sites (suitable habitat) and since intensive walking surveys confirmed the absence of suitable roosting sites throughout the Site or within close proximity to Cane Creek, it is reasonable to conclude the project will have **No Effect** on the species.

Dwarf-flowered heartleaf

Although no soils of the Pacolet, Madison or Musella series occur within the site, surveys were conducted at streamside habitats within mixed hardwood forest fragments, because the investigator is not convinced that the soil-plant relationship is absolute. The only members of the birthwort family growing within the construction limits of the project are *Asarum canadense* and *Aristolochia* sp., although an abundance of *Hexastylis arifolia* was observed within the forested hillside community along the eastern boundary of the site outside the Site.

Biological Conclusion: Intensive surveys throughout all suitable habitat within the Site confirms that the species is not present; therefore, it is reasonable to conclude the project will have **No Effect** on the species.

Small-whorled Pogonia

Except for the crane-fly orchid, *Tipularia discolor*, intensive surveys confirmed that no other orchidaceous species occur within the Site.

Biological Conclusion: Intensive surveys of the entire easement confirms that small-whorled pogonia does not occur within the Site. As a consequence of such efforts, it is reasonable to conclude the project will have **No Effect** on the species.

White Irisette

Surveys throughout the Site carefully examined all suitable habitat for individuals of this species.

Biological Conclusion: Based on the results of intensive surveys, it is reasonable to conclude the project will have **No Effect** on the species.

September 28, 2006

Mr. Kent Clary
Resource Soil Scientist
NRCS, PO Box 1109
Waynesville, NC 28786-1109
(828) 456-6341

ATTN: Kent Clary

SUBJECT: Completion of NRCS Form AD-1006 for the Cane Creek Restoration Project in compliance with the Farmland Protection Policy Act.

Mr. Clary,

Attached is the completed AD-1006 form. Please keep this for your records. Thank you for your help in completing this form.

Sincerely,

Worth Creech, Project Manager

Attachments: 1 Form

U.S. Department of Agriculture

FARMLAND CONVERSION IMPACT RATING

PART I *(To be completed by Federal Agency)*	Date Of Land Evaluation Request 8/1/06
Name Of Project Cane Creek Restoration Site	Federal Agency Involved FHWA
Proposed Land Use Stream and Wetland Restoration Site	County And State Rutherford, NC
PART II *(To be completed by NRCS)*	Date Request Received By NRCS

Does the site contain prime, unique, statewide or local important farmland? *(If no, the FPPA does not apply -- do not complete additional parts of this form).*	Yes ☑	No ☐	Acres Irrigated N/A	Average Farm Size 104
Major Crop(s) Hay, Soybeans, Small Grain	Farmable Land In Govt. Jurisdiction Acres: 229,203 % 63		Amount Of Farmland As Defined in FPPA Acres: 135,176 % 37	
Name Of Land Evaluation System Used Rutherford CALES	Name Of Local Site Assessment System		Date Land Evaluation Returned By NRCS 9/28/06	

PART III *(To be completed by Federal Agency)*	Alternative Site Rating Site A	Site B	Site C	Site D
A. Total Acres To Be Converted Directly	66.0			
B. Total Acres To Be Converted Indirectly	0.0			
C. Total Acres In Site	66.0	0.0	0.0	0.0
PART IV *(To be completed by NRCS)* Land Evaluation Information				
A. Total Acres Prime And Unique Farmland	0.6			
B. Total Acres Statewide And Local Important Farmland	0.0			
C. Percentage Of Farmland In County Or Local Govt. Unit To Be Converted	0.0			
D. Percentage Of Farmland In Govt. Jurisdiction With Same Or Higher Relative Value	40.0			
PART V *(To be completed by NRCS)* Land Evaluation Criterion Relative Value Of Farmland To Be Converted *(Scale of 0 to 100 Points)*	65	0	0	0

PART VI *(To be completed by Federal Agency)* Site Assessment Criteria *(These criteria are explained in 7 CFR 658.5(b)*	Maximum Points				
1. Area In Nonurban Use	15	15			
2. Perimeter In Nonurban Use	10	10			
3. Percent Of Site Being Farmed	20	15			
4. Protection Provided By State And Local Government	20	0			
5. Distance From Urban Builtup Area	15	15			
6. Distance To Urban Support Services	15	10			
7. Size Of Present Farm Unit Compared To Average	10	3			
8. Creation Of Nonfarmable Farmland	10	10			
9. Availability Of Farm Support Services	5	3			
10. On-Farm Investments	20	2			
11. Effects Of Conversion On Farm Support Services	10	0			
12. Compatibility With Existing Agricultural Use	10	0			
TOTAL SITE ASSESSMENT POINTS	160	83	0	0	0
PART VII *(To be completed by Federal Agency)*					
Relative Value Of Farmland *(From Part V)*	100	65	0	0	0
Total Site Assessment *(From Part VI above or a local site assessment)*	160	83	0	0	0
TOTAL POINTS *(Total of above 2 lines)*	260	148	0	0	0

Site Selected:	Date Of Selection	Was A Local Site Assessment Used? Yes ☐ No ☐

Reason For Selection:

(See Instructions on reverse side)

Form AD-1006 (10-83)

This form was electronically produced by National Production Services Staff

RESTORATION SYSTEMS, LLC
Natural Resources
Restoration & Conservation

August 18, 2006

U. S. Department of the Interior
Fish and Wildlife Service
Asheville Field Office
160 Zillicoa Street
Asheville, NC 28801

ATTN: Marella Buncick, Fish and Wildlife Biologist

SUBJECT: Coordination with the U.S. Fish and Wildlife Service on Behalf of (1) Fish and Wildlife Coordination Act and (2) Migratory Bird Treaty Act for the Cane Creek Restoration Site.

Mrs. Buncick,

On October 26, 2005, the North Carolina Ecosystem Enhancement Program (EEP) issued a Request for Proposals for 21,000 stream mitigation units, 20 riverine wetland mitigation units, and 5 non-riverine wetland mitigation units in the Broad River Basin, Cataloging Unit 03050105. Restoration Systems, LLC (RS), of Raleigh, NC was subsequently awarded a contract by the EEP to provide 6,748 stream mitigation units, 4.4 riverine wetland mitigation units, and 5 non-riverine wetland mitigation units at the Cane Creek Restoration Site. Axiom Environmental, Inc is under contract to RS to provide technical environmental consulting and Appalachian Environmental Services to provide design services.

One of the earliest tasks to be performed by RS is completion of an environmental screening and preparation/submittal of a Categorical Exclusion (CE) document. This document is specifically required by the Federal Highway Administration (FHWA) to ensure compliance with various federal environmental laws and regulations. The EEP must demonstrate that its projects comply with federal mandates as a precondition to FHWA reimbursement of compensatory mitigation costs borne by the North Carolina Department of Transportation to offset its projects' unavoidable impacts to streams and wetlands.

In order for the project to proceed, RS is obligated to coordinate with your office on behalf of the Fish and Wildlife Coordination Act (FWCA) and the Migratory Bird Treaty Act (MBTA). This letter provides you with certain details of the Cane Creek Restoration Site project, including the project's location, a general description of its physiography, hydrography, and existing land uses, as well as the intended modifications to the site proposed by RS. You are encouraged to determine if the actions proposed by RS may be inimical to any resources embraced by the FWCA, or the MBTA and provide comments to RS based on your evaluation. It is reasonable to assume that the Service will comment if the actions proposed by RS are, in the Service's opinion, likely to result in harm to resources embraced by the FWCA or the MBTA.

Project Location & Description

The Cane Creek Restoration Site is located in Rutherford County less than 0.2 miles south of the Rutherford/McDowell County line along the eastern edge of Highway 64. The Site is located at 35.533376 North and -81.853820 West and encompasses approximately 66 acres that is historically and currently being used for livestock grazing and agriculture, land uses that have been employed for years. Within the Site, 4,470 linear feet of stream will undergo restoration, 4,860 linear feet of stream will undergo level II enhancement, and 1,670 linear feet will be preserved. Wetland restoration would be achieved on 9.4 acres of existing agricultural fields.

Restoration Means & Methods

Primary activities designed to restore, enhance, and preserve stream segments, as well as restoration of riverine and non-riverine wetlands that have been highly modified by historical agricultural practices.

Stream restoration on tributaries to Cane Creek is expected to entail: belt-width preparation, changes in pattern, dimension, and profile of these tributaries, channel excavation, spoils stockpiling, channel stabilization, channel diversion, and backfilling of the existing channel.

Stream enhancement (level II) will be achieved through bank stabilization and planting riparian buffers along Cane Creek. Particular attention will be directed toward providing vegetative cover and root growth along the outer bends of the each stream meander. The stream's overall functionality will experience measurable improvement due to the rehabilitation of selected meander bends and establishment of buffer communities on either side of the stream. These actions will improve aquatic and streamside habitats and will greatly enhance water quality functions.

Restoration of wetland hydrology may involve rerouting existing straightened tributaries to Cane Creek, into agricultural fields underlain with hydric soils, channel plug installation, channel backfill, and scarification of soils prior to planting. In addition, the

construction of surface water storage depressions (ephemeral pools) also adds an important component to groundwater restoration activities.

Revegetating the floodplain and stream banks will provide stream bank stability, shade, cooler surface waters, filter of sediments and pollutants from adjacent runoff, and provide habitat for area wildlife. The vegetated stream buffer will extend approximately 30 feet or more on both sides of Cane Creek and its tributaries. Scarification of floodplain surfaces may be required prior to planting. Plant community restoration within the Site will include the planting of bare-root seedlings consistent with reference data, on-site observations, and descriptions of the community data.

Summary of Anticipated Effects

The proposed stream and wetland restoration project will restore a dysfunctional stream system to a full functionality stream and will restore wetland functions that have been absent for many years. This work will provide the capacity to transport watershed flows and sediment loads, enhance flood storage capacity, provide nutrient abatement, removal and/or neutralization of toxic compounds, and will create a variety and abundance of wildlife habitat. Revegetation of the floodplain will provide stream bank stability, reduce erosion, promote floodwater attenuation, and improve aquatic and terrestrial habitat. The purpose of this project is to greatly benefit aquatic life and wildlife by improving and protecting their habitat in perpetuity.

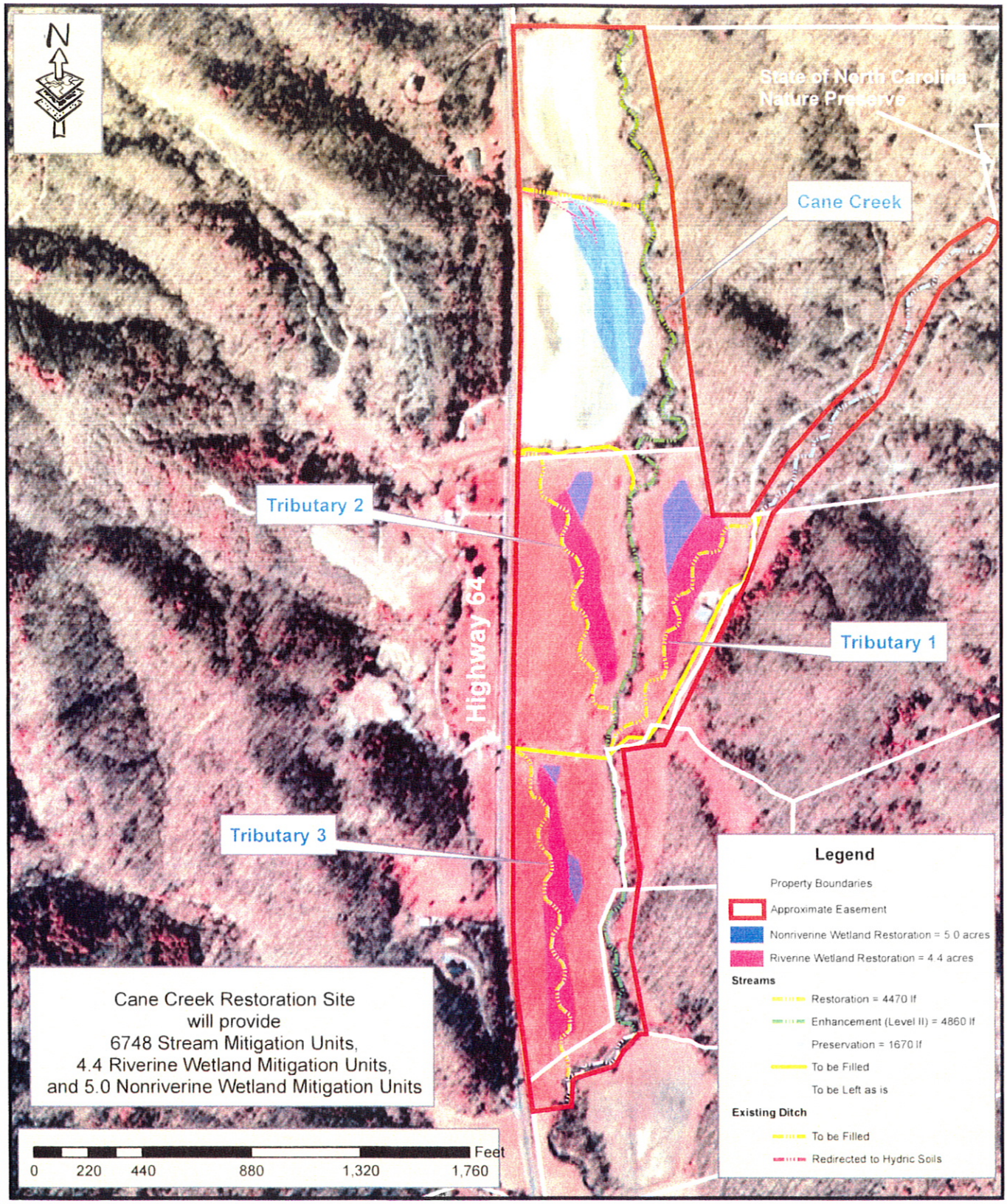
Should you have any questions or if any additional information is needed to complete your review, please feel free to contact me at our office (919) 755-9490.
Your valuable time and cooperation are much appreciated.

Sincerely,

Worth Creech, Project Manager

Attachments

cc: Mr. Dave Schiller, Restoration Systems, LLC

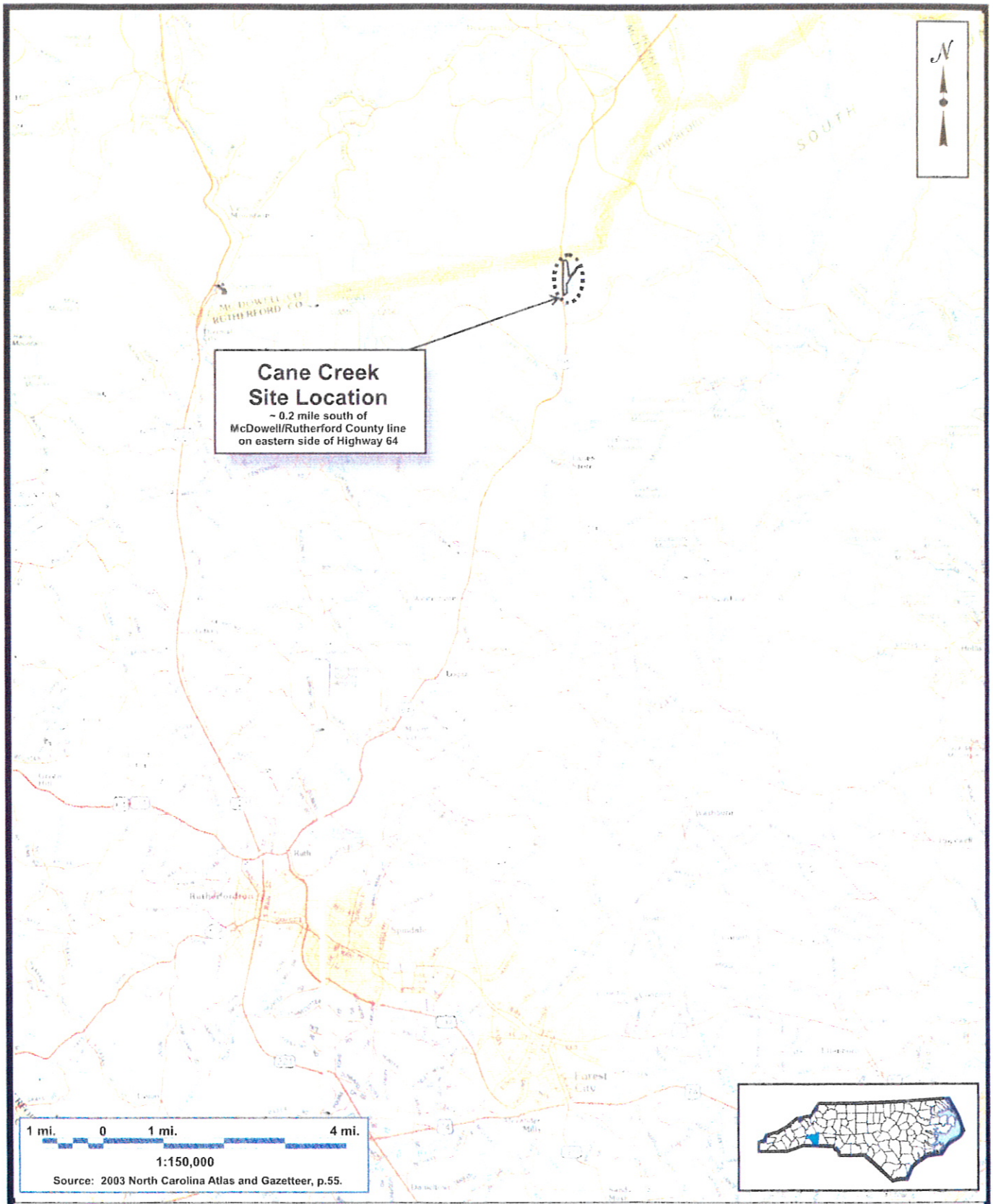


Axiom Environmental, Inc.
2126 Rowland Pond Drive
Willow Spring, NC 27592
(919) 215-1693
(919) 341-3839 fax

Axiom Environmental, Inc.

PROPOSED CONDITIONS
CANE CREEK RESTORATION SITE
Rutherford County, North Carolina

Dwn. by: CLF	FIGURE 5
Date: March 2006	
Project: 05-002.27	



SITE LOCATION
CANE CREEK RESTORATION SITE
Rutherford County, North Carolina

Dwn. by	CLF
Date	March 2006
Project	05-002.27
FIGURE	1

RESTORATION SYSTEMS, LLC

Natural Resources
Restoration & Conservation

August 18, 2006

North Carolina Wildlife Resources Commission
Division of Inland Fisheries
Falls Lake Office
1142 I-85 Service Road
Creedmore, NC 27522

ATTN: David Cox, Technical Guidance Supervisor

SUBJECT: Coordination with the North Carolina Wildlife Resources Commission on Behalf of the Fish and Wildlife Coordination Act for Cane Creek Restoration Site

Mr. Cox:

On October 26, 2005, the North Carolina Ecosystem Enhancement Program (EEP) issued a Request for Proposals for 21,000 stream mitigation units, 20 riverine wetland mitigation units, and 5 non-riverine wetland mitigation units in the Broad River Basin, Cataloging Unit 03050105. Restoration Systems, LLC (RS), of Raleigh, NC was subsequently awarded a contract by the EEP to provide 6,748 stream mitigation units, 4.4 riverine wetland mitigation units, and 5 non-riverine wetland mitigation units at the Cane Creek Restoration Site. Axiom Environmental, Inc is under contract to RS to provide technical environmental consulting and Appalachian Environmental Services to provide design services.

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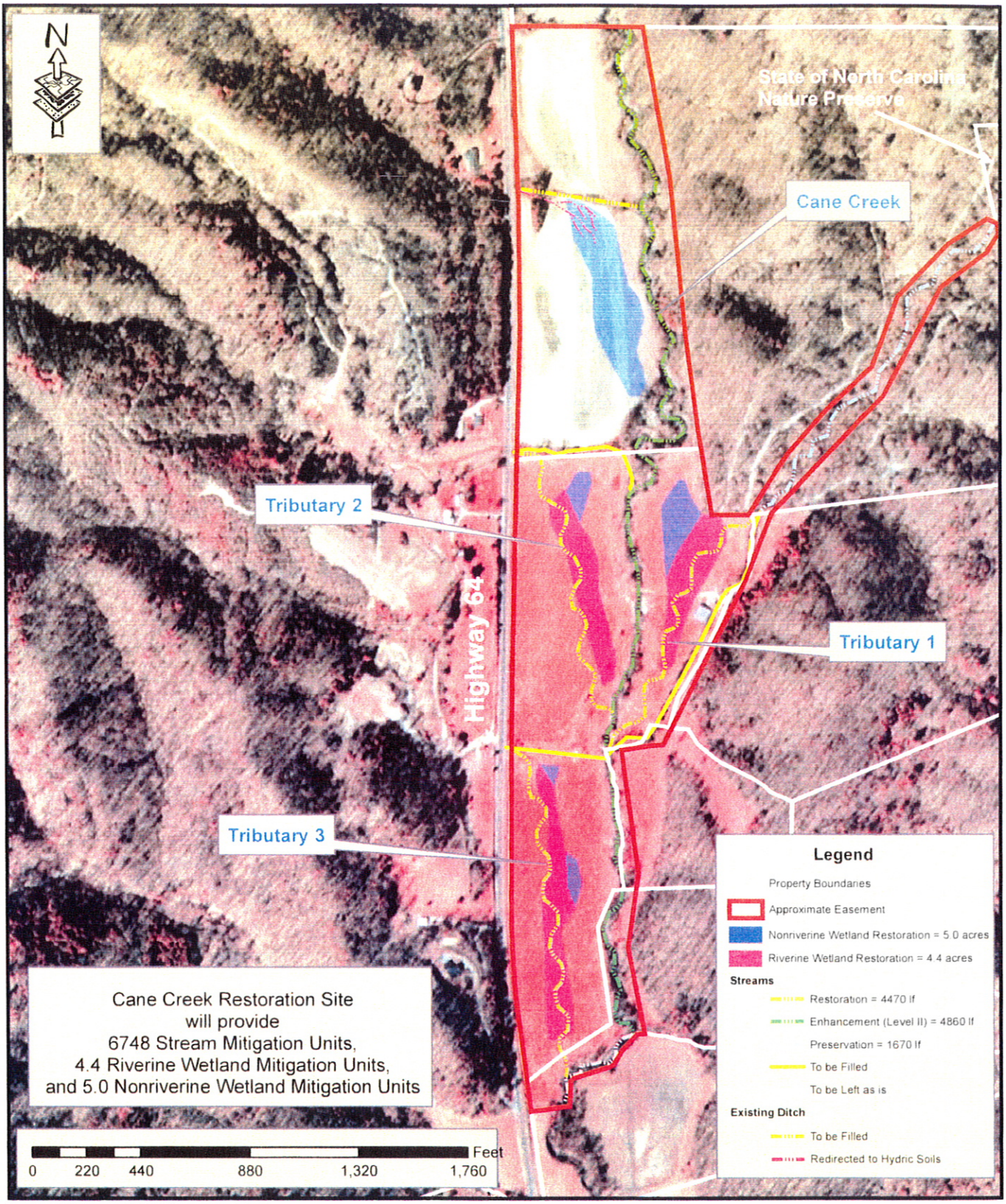
Your valuable time and cooperation are much appreciated.

Sincerely,

Worth Creech, Project Manager

Attachments

cc: Mr. Dave Schiller, Restoration Systems, LLC



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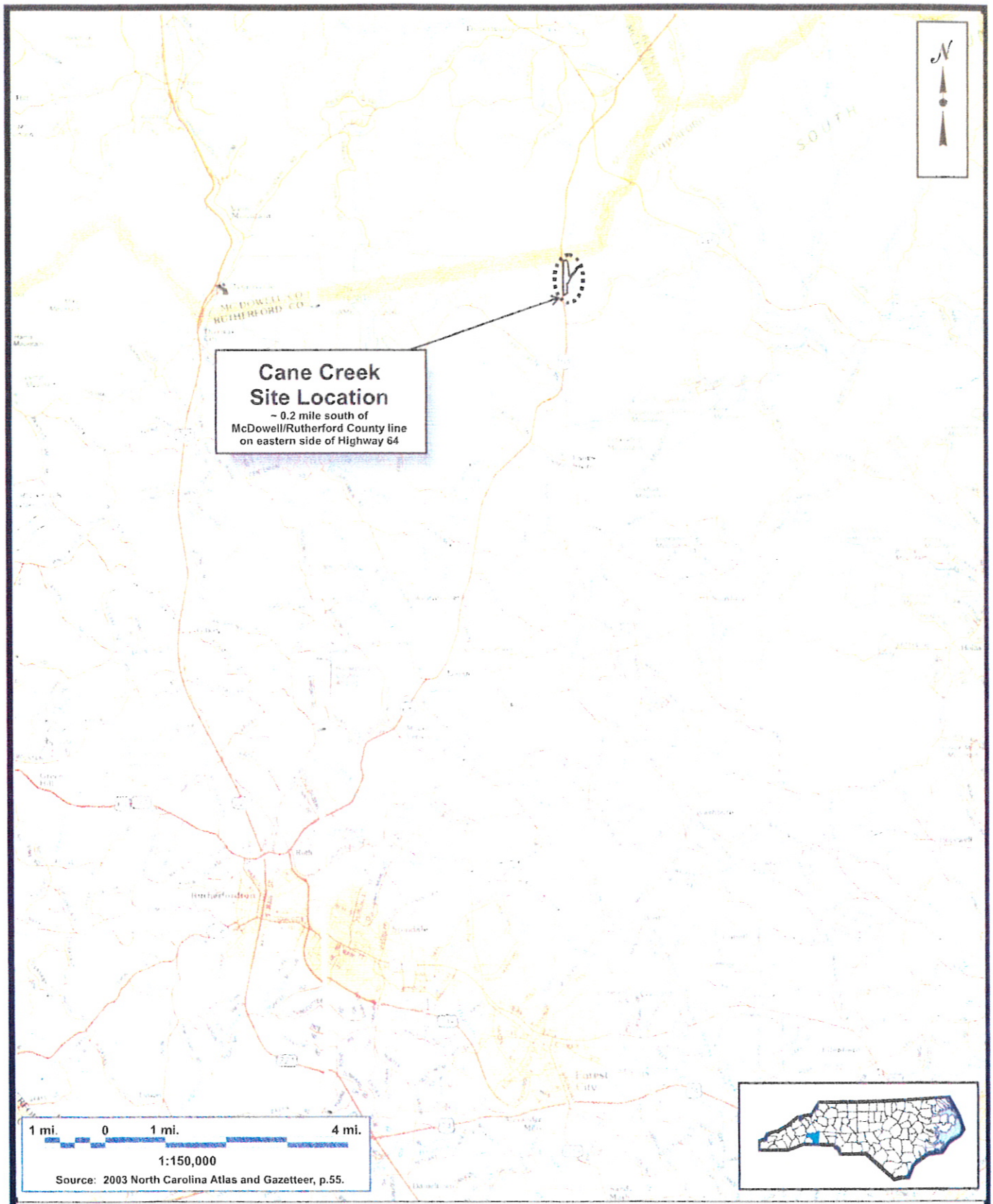
Axiom Environmental, Inc.

PROPOSED CONDITIONS
CANE CREEK RESTORATION SITE
Rutherford County, North Carolina

Dwn. by:	CLF
Date	March 2006
Project	05-002.27
FIGURE	5



Arcadis Environmental, Inc.

SITE LOCATION
CANE CREEK RESTORATION SITE
Rutherford County, North Carolina

Dwn. by: CLF	FIGURE
Date: March 2006	1
Project: 05-002.27	

North Carolina Wildlife Resources Commission

Richard B. Hamilton, Executive Director

September 6, 2006

Worth Creech
Restoration Systems, LLC
1101 Haynes Street, Suite 107
Raleigh, North Carolina 27604

SUBJECT: EEP Wetland and Stream Mitigation Project in Rutherford County
Cane Creek

Dear Mr. Creech:

Biologists with the North Carolina Wildlife Resources Commission (Commission) received your letter dated August 18, 2006 regarding the Ecosystem Enhancement Program project on Cane Creek in Rutherford County. Comments from the Commission are provided under provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.).

Rutherford County is a "trout county" per an agreement between the U.S. Army Corps of Engineers (ACOE) and the Commission. As such, Commission biologists review all Nationwide Permit applications here and make recommendations to minimize the adverse effects associated with some activities, including restoration work. Once a permit application is prepared for this project, a copy must be sent to me in order to solicit Commission concurrence and recommendations for the consideration by the ACOE.

The Commission does not anticipate any major resource concerns with this project provided sedimentation from construction is minimized. The stream channel dimensions, patterns, and profiles should reflect stable, reference conditions. Overly and unnaturally sinuous stream channels should be avoided. The use of balled or container grown trees is recommended in the outside of channel bends to expedite long-term bank stability.

Thank you for the opportunity to review and comment on this project. If there are any questions regarding these comments, please contact me at (828) 452-2546 ext. 24.

Sincerely,

Dave McHenry
Mountain Region Coordinator
Habitat Conservation Program

Mailing Address: Division of Inland Fisheries • 1721 Mail Service Center • Raleigh, NC 27699-1721
Telephone: (919) 707-0220 • **Fax:** (919) 707-0028

NOTICE OF AN OPPORTUNITY FOR AN INFORMATIONAL PUBLIC MEETING ON THE PURCHASE AND OR USE OF PROPERTY FOR THE RESTORATION OF (STREAMS, WETLANDS, BUFFERS)
Rutherford County

Restoration Systems LLC proposes to purchase and/or use a 66 acre tract of land in Rutherford County, North Carolina. The purpose of acquiring and/or using this property is to provide mitigation for impacts to (stream, wetland, buffer) that will result from existing or future development in this area.

Anyone desiring that an informational public meeting be held for this proposed action may make such a request by registered letter to Restoration Systems LLC at 1101 Haynes Street Suite 107, Raleigh, NC 27604. Request must be made by August 21, 2006. If additional information is required, please contact Kristen Poillon at 919-755-9490.

The Ecosystem Enhancement Program reserves the right to determine if a public meeting will be held.

AFFIDAVIT OF PUBLICATION

STATE OF NORTH CAROLINA

RUTHERFORD COUNTY

ersigned, a Notary Public of said County and State, duly qualified, and authorized by law to administer oaths, personally

Brittany Patterson

duly sworn, deposes and says: that they are

Classified Sales Representative

, publisher, or other officer or employee authorlzed to make this ...HE DAILY COURIER, a newspaper published, issued and entered as second class mail In the town of FOREST CITY, In said County and State; that they are authorized to make thls affidavit and sworn statement; that the notice or other legal advertisement, a true copy of which is attached hereto, was published in THE DAILY COURIER on the following dates:

July 23, 2006

and that said newspaper in which such notice, paper, document, or legal advertisement was published was, at the time of each and every such publication, a newspaper meeting all of the requirements and qualifications of Section 1-597 of the General Statutes of North Carolina and was a qualified newspaper within the meaning of Section 1-597 of the General Statutes of North Carolina.

This the 3rd day of August, 2006.

Brittany Patterson

Brittany Patterson, Classified Advertising Representative

Sworn to and subscribed before me this the
3rd day of August, 2006.

Heather D. Rhodes

(Heather D. Rhodes, Notary Public)

My commission expires: August 21, 2008

HEATHER D. RHODES NOTARY PUBLIC RUTHERFORD COUNTY, NC