Cat Creek Stream and Wetland Restoration
Macon County, NC

Restoration Plan

SCO Project Number 050657901

Prepared for:

Ecosystem Enhancement PROGRAM

NCDENR Ecosystem Enhancement Program
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EXECUTIVE SUMMARY

The Cat Creek stream and wetland restoration site in Macon County, North Carolina was identified by the North Carolina Department of Transportation (NCDOT) as a potential stream, riparian buffer, and wetland restoration site. The site consists of reaches on four separate tracts of land referred to as: Swartwout, Waldroop, Parker, and Preserve. The Swartwout, Parker, and Preserve tracts have been purchased by the NCDOT, while the Waldroop tract is in private ownership. Following initial studies of the site by NCDOT beginning in 2002, the site was turned over to the Ecosystem Enhancement Program (EEP) in 2005 for final design, construction, and monitoring.

The proposed restoration area entails about 7,450 linear feet of Cat Creek, and 848 linear feet of three small tributaries in a rural area of Macon County. Cat Creek and the tributaries have been impacted by past land use including use as pastureland and a golf course.

Both stream restoration and enhancement is proposed for various reaches of Cat Creek dependant upon the existing stream conditions and other constraints. Stream restoration will consist of Restoration, Enhancement Level 1, and Enhancement Level 2. Restoration will consist of modifying the streams dimension, pattern and profile to achieve a stable stream channel. Reaches proposed for Enhancement Level 1 activities will have their dimension and profile modified, but pattern will remain the same. Enhancement Level 2 activities will consist of fencing out livestock, spot stabilization, and planting a riparian buffer. The type of restoration by tract is presented in the table below. A Conservation Easement will be obtained for the Waldroop tract

Wetland restoration and enhancement is proposed for the Swartwout, Parker, and Preserve tracts. Restoration activities will restore predisturbance hydrology to the site by removing fill. Following fill removal these areas will be planted with native hardwoods. Areas proposed for enhancement are areas that are still jurisdictional wetlands. These areas, at a minimum, will be planted with hardwoods. In some of the enhancement areas, hydrologic enhancement will also occur with the removal of a small amount of fill.

The following table presents the restoration/enhancement activity by tract and by reach.

Table 1. Project Restoration Structure and Objectives

Reach ID	Restoration Type	Priority Approach	Existing Linear Footage or Acreage	Designed Linear Footage or Acreage	Comment
Swartwout (wetland)	Restoration	NA	0.55 ac	2.27 ac	Small amount of enhancement also included
Swartwout-Upper	Enhancement 2	NA	880	880	Stabilization of eroded areas and planting riparian buffer and fencing
Swartwout- Lower	Restoration	Priority 1	770	882	
Swartwout-UT 1	Restoration	Priority 1	463	581	

Reach ID	Restoration Type	Priority Approach	Existing Linear Footage or Acreage	Designed Linear Footage or Acreage	Comment
Waldroop-Upper	Enhancement 2	NA	1463	1463	Livestock exclusion and Riparian buffer expansion
Waldroop-Lower	Enhancement 1	Priority 2	480	480	Active pastureland with cattle use
Parker (wetland)	Restoration	NA	0 ac	4.4 ac	Former golf course
Parker	Restoration	Priority 1	1750	1879	
Parker-UT 2	Restoration	Priority 1	210	374	
Parker-UT 3	Restoration	Priority 1	165	338	
Preserve (wetland)	Restoration	NA	0.66 ac	1.62 ac	Former golf course
Preserve	Enhancement 1	NA	1765	1852	
Preserve – UT 4	Restoration	Priority 1	110	210	

This project has the following goals:

- Provide a stable stream channel for the main channel and the unnamed tributaries to Cat Creek that neither aggrades nor degrades while maintaining their dimension, pattern, and profile with the capacity to transport their watershed's water and sediment load.
- Improve water quality and reduce erosion by stabilizing the stream banks for all streams by improving riparian vegetation.
- Improve aquatic habitat of the main channel and tributaries with the use of natural material stabilization structures such as root wads, rock vanes, woody debris, and a riparian buffer.
- Provide aesthetic value, wildlife habitat, and bank stability through the creation or enhancement of a riparian zone.
- Create a contiguous wildlife corridor and provide diverse amphibian habitat with added topographic and wetland features.
- Provide shading and biomass input to the stream and mast for wildlife when vegetation is mature.
- Livestock exclusion on Waldroop Tract.
- Enhance wetland biochemical-and geo-chemical processes over an extended area.

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1.0. PROJECT SITE IDENTIFICATION AND LOCATION

The North Carolina Department of Transportation (NCDOT) initialed identified a portion of Cat Creek in Macon County, North Carolina for potential stream, riparian buffer, and wetland restoration and/or enhancement (**Figure 1**). Following initial studies by NCDOT beginning in 2002, the project was turned over to the Ecosystem Enhancement Program (EEP) in 2005 for design, construction and monitoring. The reaches of Cat Creek identified are located on four separate tracts of land: Swartwout, Waldroop, Parker, and Preserve. Three of the tracts, Swartwout, Parker, and Preserve have been purchased by NCDOT.

1.1 Directions to Project Site

The project site is located east of the town of Franklin in Macon County. Cat Creek Road (SR 1513) is located off of US 23/441 between Business 441 and US 64. If proceeding south on US 23 turn left onto Cat Creek Road. Proceed along Cat Creek Road for approximately 1.5 miles and turn left onto Ferguson Road to access the Preserve and the Parker tracts. Cat Creek crosses Ferguson Road about 1,900 feet from the turnoff from Cat Creek. Parking is available on either tract near the creek crossing.

To access the Waldroop Tract continue on Cat Creek Road past Ferguson about 0.5 mile. Bethel Church Road comes in from the right and just before the road there is a driveway on the left with a farmhouse and large barn beyond the farmhouse.

To access the Swartwout Tract continue on Cat Creek Road past Ferguson Road about 0.8 miles. Cat Creek Road takes an abrupt left turn (if you go straight you will be on Jack Cabe Road). Turn left (staying on Cat Creek Road). The Swartwout Tract is immediately on the right. A gate provides access to the field.

1.2 USGS Hydrologic Unit Code and NCDWQ River Basin Designations

Cat Creek is located in the Little Tennessee River Basin in USGS Cataloging Unit 06010202. The NCDWQ Sub-basin is 04-04-01.

2.0 WATERSHED CHARACTERIZATION

2.1 Drainage Area

The watershed to the end of the project site is approximately 3.6 square miles (**Figure 2**). Topography of the area is characterized as hilly with fairly flat floodplains adjacent to the large stream and steep mountains in the headwater region.

Cat Creek is a second to third-order stream. The headwaters originate about 1.5 miles east of the project area. Cat Creek flows from the end of the project area for approximately 0.5 miles before joining Rabbit Creek and then 1 mile before joining Lake Emory along the Little Tennessee River.

The floodplain along Cat Creek on the upper Swartwout Tract is wide to the west and narrow to the east due to the adjacent hillslope to the east. Once the main channel flows past the ridge the floodplain opens up and is relatively wide for a mountain stream. The floodplain for the UT to Cat Creek (UT1) and lower Swartwout is confined along the left bank due to the road slope but the floodplain to the right of the stream is relatively wide. The floodplain through the Waldroop, Parker, and Preserve Tracts is wide and flat until meeting the adjacent hillslopes. The small headwater tributaries that feed into Cat Creek are typically forested with few small cleared areas. However agricultural fields are present along the larger tributaries and Cat Creek.

The main drainage feature at the site is Cat Creek (**Figure 2**), a second to third order stream. The second largest drainage feature at the site is the Unnamed Tributary to Cat Creek (UT1) a second order stream. The stream enters the site from the east and flows approximately 464 feet south, before emptying into Cat Creek on the Swartwout Tract. The watershed for the Unnamed Tributary to Cat Creek (UT1) is approximately 0.86 square miles to the confluence with Cat Creek. The headwaters originate about 1 mile east of the confluence with Cat Creek. Several smaller unnamed tributaries enter Cat Creek on the other tracts. These streams include two small tributaries on the Parker Tract labeled UT2 and UT3. The first tributary UT2 is a second order stream and is shown on the USGS mapping. The second tributary (UT3) is a first order stream and does not appear on the USGS mapping. A fourth unnamed tributary (UT4) flows into Cat Creek on the Preserve Tract. This stream is also a first order stream and does not appear on the USGS mapping. There are also two first order streams that flow into Cat Creek on the Waldroop property. These streams were not "named" as no restoration work is proposed for them.

Table 2. Drainage Areas

Reach	Drainage Area (Square Miles)
Swartwout	2.1
UT-1	0.9
Waldroop	2.5
Parker	3.3
Preserve	3.6

The main land use throughout the watershed is agriculture with about half of the watershed remaining forested. Because the upland areas are not as conducive for farming, the majority of

the large pasture areas are located along the flat floodplains of Cat Creek. All of the parcels of land in the watershed support agriculture and/or single-family housing. From the windshield survey of the watershed, there is a large tract of land on Onion Mountain that is currently being subdivided for large home and land lots.

2.2 Surface Water Classification and Water Quality

Surface waters in North Carolina are assigned a classification by the DWQ that is designed to maintain, protect, and enhance water quality within the state. Cat Creek (NCDWQ Stream Index Number – 03-08-35) is classified as a Class *C* water body (NCDENR, 2001). *Class C* water resources are waters protected for aquatic life propagation and survival, fishing, wildlife, secondary recreation, and agriculture. Secondary recreation includes wading, boating, and other uses involving human body contact with water where such activities take place in an infrequent, unorganized, or incidental manner. There are no restrictions on watershed development activities. The unnamed tributaries that flow into Cat Creek have not been classified and therefore, carry the same Class *C* classification.

2.3 Physiography, Geology, and Soils

The project area in the Mountain Physiographic Province of North Carolina. It is underlain by sedimentary and metamorphic rocks of the Blue Ridge Belt. These include biotite gneiss-migmatic; interlayered and gradational with biotite-garnet gneiss and amphibolate with locally abundant quartz and alumino-silicates.

According to the Macon County Soil Survey (USDA NRCS, 1996) several soil types are present in the project area (**Figure 3**). The predominant soils mapped along the floodplain of Cat Creek are Reddies, Nikwasi, and an Udorthents-Urban Land complex. Only Nikwasi soils are considered to be hydric by the NRCS. Reddies soils may contain hydric inclusions. The surrounding uplands are mapped as Saunook and an Evaard-Cowee complex. Land use and management of these soils may impact the soils in the project area. Soil units mapped by the NRCS along the floodplain at the site are described below.

Reddies fine sandy loam (Re). This unit is a moderately well drained soil formed in recent alluvium and is found on nearly level to gently sloping small stream terraces. Surface runoff is slow. The seasonal high water table is 2.0 to 3.5 feet below the surface. It is frequently flooded for very brief periods. Permeability is moderately rapid within the surface layer and rapid or very rapid in the sub-surface horizon. This soil may have inclusions of Nikwasi and other soils. Flooding is the main limitation of this soil. Runoff from adjacent uplands is also a management concern.

Nikwasi fine sandy loam, frequently flooded (Nk). This unit is a poorly drained soil formed in recent alluvium and is found in depressions on nearly level floodplains along small streams. Surface runoff is very slow or ponded. The seasonal high water table is at the surface to 1 foot below the surface. It is frequently flooded for very brief periods. Permeability is moderately rapid within the surface horizon and the sub-surface horizon is rapidly permeable. Flooding,

wetness, and ponding are the main limitations of this soil. Runoff from adjacent uplands is also a management concern.

Udorthents-Urban Land complex (UFB). This unit includes both Udorthents and Urban Land in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale. The Udorthents map unit consists of borrow areas, landfills, and mines and major revegetated cut and fill areas associated with major highways, commercial sites, and golf courses. These areas are variable in steepness. The land on the Parker and Preserve Tract along Cat Creek are known to have once been a golf course.

2.4 Historical Land Use and Development Trends

The main land use throughout the watershed is agriculture with about half of the watershed remaining forested. Because the upland areas are not as conducive for farming, the majority of the large pasture areas are located along the flat floodplains of Cat Creek. All of the parcels of land in the watershed support agriculture and/or single-family housing. From the windshield survey of the watershed, there is a large tract of land on Onion Mountain that is currently being subdivided for large home and land lots.

2.5 Endangered / Threatened Species

Plants and animals with a federal classification of Endangered (E), Threatened (T), Proposed Endangered (PE), and Proposed Threatened (PT) are protected under provisions of Section 7 and Section 9 of the Endangered Species Act of 1973, as amended. The USFWS lists seven species under federal protection for Macon County (USFWS, 2006). These species are listed in **Table 3**. Critical Habitat for the spotfin chub and Appalachian elktoe are also designated within this county along the main stem of the Little Tennessee River.

Table 3. Species under Federal Protection in Macon County

Common Name	Scientific Name	Federal Status
Vertebrates		
Bog turtle	*Glyptemys muhlenbergii*	T(S/A)
Indiana bat	*Myotis sodalis*	E
Spotfin chub	*Cyprinella monacha*	T
Invertebrates		
Appalachian elktoe	*Alasmidonta raveneliana*	E
Littlewing pearlymussel	*Pegias fibula*	E
Vascular Plants		
Small-whorled pogonia	*Isotria medeoloides*	T
Virginia spiraea	*Spiraea virginiana*	T

E =	Endangered-A species that is threatened with extinction throughout all or a significant portion of its range.
T =	Threatened-A species that is likely to become endangered in the foreseeable future throughout all or a significant portion of its range.
T(S/A) =	Threatened due to similarity of appearance-a species that is threatened due to similarity of appearance with other rare species and is listed for its protection.
**	Obscure record – the date and/or location of observation is uncertain.

Bog turtle (*Glyptemys muhlenbergii*) **Threatened due to Similarity of Appearance**
Federally Listed: 1997

The bog turtle is a small freshwater turtle with a maximum carapace length of 11.4 cm (4.5 in). These turtles have a domed carapace that is weakly keeled and is light brown to ebony in color. The scutes have a lighter–colored starburst pattern. The plastron is brownish-black with contrasting yellow or cream areas along the midline. This species is distinguished by a conspicuous orange, yellow, or red blotch on each side of the head.

The bog turtle is semi-aquatic and is typically found in freshwater wetlands characterized by open fields, meadows, or marshes with slow-moving streams, ditches, and boggy areas. The bog turtle is also found in wetlands in agricultural areas subject to light to moderate livestock grazing, which helps to maintain an intermediate stage of succession. During the winter, this species hibernates just below the upper surface of mud. Mating occurs in May and June, and the female deposits two to six eggs in sphagnum moss or sedge tussocks in May, June, or July. The diet of the bog turtle is varied, consisting of beetles, lepidopteran and caddisfly larvae, snails, millipedes, pondweed and sedge seeds, and carrion.

The southern population of the bog turtle is listed as Threatened due to Similarity of Appearance to the northern population; therefore, the southern population is not afforded protection under Section 7 of the Endangered Species Act. No habitat exists in the project area for the bog turtle. There are freshwater wetlands characterized by open fields, meadows, or marshes with slow moving streams, ditches, or boggy areas. A search of the NHP database revealed no occurrences of the bog turtle within two miles.

Biological Conclusion ***No Effect***

No habitat for the bog turtle exists within the project area. No bogs are located on the site, and the wetland areas are small and isolated. No individuals of this species were observed during the site visit and none are recorded at NHP within two miles of the project site. This project will have no effect on this federally threatened species.

Indiana bat (*Myotis sodalis*) **Endangered**
Federally Listed: 1967

The Indiana bat is a medium-sized myotis, less than two inches long, with a wingspan of nine to eleven inches. They weigh only 0.3 ounces. Fur is brownish to grayish black above and buff to light brown below. The feet are small and delicate and the calcar is strongly keeled.

Though extremely rare this bat is found in 27 states in the eastern United States. Hibernation occurs from October to April primarily in limestone caves or mines with stable temperatures between 38° and 43°F, and a relative humidity averaging 87 percent. The bats form large, dense clusters up to several thousand individuals. During the summer, Indiana bat maternity colonies require dead or dying trees with loose bark, a nearby water source, and areas to hunt for insects.

Males roost nearby, and have the same habitat requirements. The bats roost under the loose bark for warmth and protection from the elements or predators.

Biological Conclusion ***No Effect***

No habitat for the Indiana bat exists within the project area. No caves or mines are nearby, and no dead or dying trees with loose bark were observed. Cat Creek and its tributaries are not sufficiently wide to provide suitable foraging habitat for the bat. No individuals of this species were observed during the site visit and none are recorded at NHP within two miles of the project site. This project will have no effect on this federally endangered species.

Spotfin chub (*Cyprinella monacha*) **Threatened**
Federally Listed: 1977

This small, elongate fish is recognized by the large black spot in the caudal region. The spotfin chub grows to a length of 3.6 in. The mouth is inferior, with a tiny pair of terminal labial barbels. Breeding males are brilliant turquoise on the back and sides and have white-tipped fins. Juveniles and adult females have olive-colored backs, silvery sides, and white undersides. The spotfin chub is believed to spawn in June. It apparently is a sight feeder, and its diet consists mainly of dipterans.

The habitat of the spotfin chub is moderate to large streams with alternating riffles and pools and clear, cool to warm, fast-flowing water. It is restricted to the Tennessee River drainage area. In North Carolina, it is known only from the Little Tennessee River in Macon and Swain counties, and has never been found in streams with significantly silted substrates.

Biological Conclusion ***No Effect***

The USFWS has designated critical habitat for this species within Macon County. The habitat includes the main channel of the Little Tennessee River from Lake Emory Dam at Franklin, downstream to the backwaters of Fontana Reservoir in Swain County. Cat Creek flows into Rabbit Creek, which flows into Lake Emory and the Little Tennessee River upstream from this Critical Habitat area.

Cat Creek is a small stream and is largely consist of long riffles with few pools and does not provide suitable habitat for the spotfin chub. No individuals of this species were observed during the site visit and none are recorded at NHP within two miles of the project site. This project will have no effect on this federally threatened species.

Appalachian elktoe (*Alasmidonta raveneliana*) **Endangered**
Federally Listed: 1994

The Appalachian elktoe is recognized by a thin, kidney-shaped shell about 3.2 inch long, 1.4 inches high, and 1 inch wide. The outer shell surface of juvenile mussels is yellowish-brown whereas the adult shell is dark brown to greenish-black in color. Rays may be prominent to

obscure. The inside shell surface is shiny white to bluish-white, changing to a salmon, pinkish, or brownish color in the central and beak cavity portions of the shell.

Historical records reveal that this species once proliferated throughout the Upper Tennessee River system in western North Carolina and eastern Tennessee. In North Carolina populations were found in the Little Tennessee River system (Talula Creek, Graham County) and the French Broad River system, including the Nolichucky River (county unknown), the Little River (Transylvania County), and Swannanoa River (county unknown), the Pigeon River (Haywood county), and the main stem of the French Broad River (Buncombe County and an unknown county).

The Federal Register lists two known surviving populations of the Appalachian elktoe. One is in the Little Tennessee River between Emory Lake in Macon County and Fontana Reservoir in Swain County. The other is in the Nolichucky River system in Yancey and Mitchell counties. The habitat in these locations can be described as relatively shallow, medium-sized creeks and rivers with cool, well-oxygenated, moderate- to fast-flowing water. Substrates are gravelly mixed with cobble and boulders, or occasionally coarse and sandy.

Biological Conclusion ***No Effect***

The USFWS has designated critical habitat for this species within Macon County. The habitat includes the main channel of the Little Tennessee River from the backwaters of Fontana Lake upstream to the North Carolina-Georgia state line. Cat Creek flows into Rabbit Creek, which flows into the Little Tennessee River within this Critical Habitat area.

Cat Creek was surveyed for freshwater mussels on September 13, 2003. The site is described as poor quality habitat with heavy sediment load and no buffers. The substrate is mainly sand and gravel with few cobbles noted. Within the project area, Cat Creek contains high levels of silt. No mussels were observed during this survey. No occurrences of the Appalachian elktoe are recorded at NHP within two miles of the project site. The survey concluded No Effect for the Appalachian elktoe. A copy of the survey can be found in **Appendix 1**.

Littlewing pearlymussel (*Pegias fibula*) **Endangered**
Federally Listed: 1988

This small freshwater bivalve mollusk attains an average adult size of 0.95 inches in length. The species name is descriptive of its wing-like appearance. The outer shell is usually eroded away in mature individuals, giving the shell a chalky appearance. In younger individuals the shell may appear light green or dark yellowish brown with dark rays of variable width along the shell's anterior surface. The nacre is whitish on the anterior border and salmon or flesh colored in the beak cavity.

This mussel is endemic to the southern Appalachian Mountains and the Cumberland Plateau regions. Historical records place this species in 24 stream reaches in several southeastern states, however the species is presently known from only six stream reaches. In North Carolina it is only known from a small portion of the Little Tennessee River Basin.

The littlewing pearlymussel prefers cool, clear, high-gradient streams. It is commonly found at the head of riffles, but also found in and below riffles on sand and gravel substrates with scattered cobbles. It also inhabits sand pockets between rocks, cobbles and boulders, and underneath large rocks. During spawning, it can be found lying on top or partially buried in sand and fine gravel between cobbles in only 6 to 10 inches of water.

Biological Conclusion ***No Effect***

Cat Creek was surveyed for freshwater mussels on September 13, 2003. The site is described as poor quality habitat with heavy sediment load and no buffers. The substrate is mainly sand and gravel with few cobbles noted. Within the project area, Cat Creek contains high levels of silt. No mussels were observed during this survey. No occurrences of the littlewing pearlymussel are recorded at NHP within two miles of the project site. The survey concluded No Effect for the littlewing pearlymussel. A copy of the survey can be found in **Appendix 1**.

Small whorled pogonia *(Isotria medeoloides)* **Threatened**
Federally Listed: 1982

The specific epithet of the small whorled pogonia comes from the resemblance of this perennial orchid to young plants of Indian cucumber root (*Medeola virginiana*). However, the small whorled pogonia has a stout, hollow stem in contrast to the solid, slender stem of Indian cucumber root. The stem is 3.7 to 9.8 in tall, with a terminal whorl of 5 or 6 light green leaves that are elliptical in shape and measure up to 3 in by 1.5 in. One or two flowers are borne at the top of the stem, appearing from mid-May to mid-June. The flowers lack fragrance and nectar guides, and apparently are self-pollinating.

The small whorled pogonia was formerly scattered in 48 counties in 16 eastern states. Currently, the majority of populations are found in New England at the foothills of the Appalachian Mountains and in northern coastal Massachusetts. The habitat of the small whorled pogonia varies widely throughout its range, although there are a few common characteristics among the majority of sites. These include sparse to moderate ground cover; a relatively open understory; and proximity to features that create extensive, stable breaks in the canopy, such as logging roads or streams. The pogonia has been found in mature forests as well as stands as young as 30 years old. Forest types include mixed-deciduous/ white pine or hemlock in New England, mixed deciduous in Virginia, white pine/mixed-deciduous or white pine/oak-hickory in Georgia, and red maple in Michigan. Understory components in the southern part of the range are most commonly found to be flowering dogwood (*Cornus florida*), sourwood (*Oxydendron arboreum*), mountain laurel (*Kalmia latifolia*), American chestnut (*Castanea dentata*), witch hazel (*Hamamelis virginiana*), and flame azalea (*Rhododendron calendulaceum*). Early descriptions placed the small whorled pogonia on dry sites, but it has since been found on sites with high soil moisture.

Biological Conclusion ***No Effect***

No habitat for the small whorled pogonia exists within the project area. Most of the project area is open pasture or weedy fields and within the limited forested areas, the understory is dense. No occurrences of this species are recorded at NHP within two miles of the project site. This project will have no effect on this federally threatened species.

Virginia spiraea (*Spiraea virginiana*) **Threatened**
Federally Listed: 1990

Virginia spiraea is a perennial shrub with arching, upright stems. Its growth form is described as "plastic" and varies depending upon age and environmental conditions. The roots are a complex system of horizontal rootstock with mats of small fibrous roots. If exposed, the horizontal rootstock gives rise to upright stems. Virginia spiraea typically has a diffuse branching pattern and grows to 3 to 10 ft in height. Leaves are simple, ovate to lanceolate, with an acute base. The leaf margins range from entire to completely serrate. Virginia spiraea flowers from late May to late July, with bright to creamy white flowers forming a corymb.

Virginia spiraea is typically found in disturbed sites along rivers and streams. It forms dense clumps around boulders and in rock crevices, and apparently depends on flood scour to eliminate woody competitors and create suitable early successional habitats. Typical habitat includes scoured banks of high gradient streams, or on meander scrolls, point bars, natural levees and braided features of lower stream reaches. In North Carolina, extant populations are known from Ashe, Macon, Mitchell, and Yancey counties. In Graham County, there is an historic record of an extirpated population.

Biological Conclusion ***No Effect***

The stream banks within the project area provides potential habitat for the Virginia spiraea, although due to continued mowing and past use of the site as pastureland and a golf course the makes it marginal habitat. Earth Tech biologists conducted visual surveys for the Virginia spiraea on July 14, 2003 along the entire project length of Cat Creek. No Virginia spiraea plants were observed and none are recorded at NHP within two miles of the project site. This project will have no effect on this federally threatened species.

Federal Species of Concern (FSC) are not legally protected under the Endangered Species Act and are not subject to any of its provisions, including Section 7, until they are formally proposed or listed as Threatened or Endangered. Organisms that are listed as Endangered (E), Threatened (T), or Special Concern (SC) on the North Carolina Natural Heritage Program list of Rare Plant and Animal Species are afforded state protection under the State Endangered Species Act and the North Carolina Plant Protection and Conservation Act of 1979. However, the level of protection given to state-listed species does not apply to NCDOT activities. **Table 4** contains a complete listing of the federal species of concern in Macon County, their state status, and an indication of habitat presence on the Cat Creek site.

Table 4. Federal Species of Concern in Macon County

Common Name	Scientific Name	State Status	Habitat Present
Vertebrates			
Appalachian Bewick's wren	*Thryomanes bewickii altus*	E	No
Appalachian cottontail	*Sylvilagus transitionalis*	SR	Yes
Appalachian yellow-bellied sapsucker	*Sphyrapicus varius appalachiensis*	SC	Yes
Bachman's sparrow	*Aimophila aestivalis*	SC	No
Cerulean warbler	*Dendroica cerulea*	SR	No
Green salamander	*Aneides aeneus*	E	No
Hellbender	*Cryptobranchus alleganiensis*	SC	No
Olive darter	*Percina squamata*	SC	Yes
Olive-sided flycatcher	*Contopus borealis*	NL	No
Rafinesque's big-eared bat	*Corynorhinus rafinesquii*	T	No
Seepage salamander	*Desmognathus aeneus*	SR	Yes
Sicklefin redhorse	*Moxostoma* sp.	NL	No
Southern Appalachian woodrat	*Neotoma floridana haematoreia*	SC	No
Southern rock vole	*Microtus chrotorrhinus carolinensis*	SC	No
Southern water shrew	*Sorex palustris punctulatus*	SC	Yes
Invertebrates			
Carolina skistodiaptomus	*Skistodiaptomus carolinensis*	SR	No
Diana fritillary butterfly	*Speyeria diana*	SR	No
Lost Nantahala cave spider	*Nesticus cooperia*	SR	No
Margarita River skimmer	*Macromis margarita*	SR **	No
Tawny cresent butterfly	*Phycoides batesii maconensis*	SR	No
Vascular Plants			
Butternut	*Juglans cinerea*	NL	Yes
Carolina saxifrage	*Saxifraga caroliniana*	SR_T	No
Cuthbert's turtlehead	*Chelone cuthbertii*	SR_L *	No
Divided-leaf ragwort	*Senecio millefolium*	T	No
Fraser's loosestrife	*Lysimachia fraseri*	E	Yes
Glade spurge	*Euphorbia purpurea*	SR_T	No
Gorge filmy fern	*Hymenophyllum tayloriae*	NL	No
Granite dome goldenrod	*Solidago simulans*	NL	No
Mountain catchfly	*Silene ovata*	SR_T	No
Piedmont aster	*Aster mirabilis*	SR_T	No
Piratebush	*Buckleya distichophylla*	E	No
Sweet pinesap	*Monotropsis odorata*	SR_T *	No
Torrey's mountain mint	*Pycnanthemum torrei*	NL	No
West Indian dwarf polypody	*Grammitis nimbata*	E	No
Nonvascular plants			
A liverwort	*Cephaloziella obtusilobula*	NL	No
A liverwort	*Chiloscyphus appalchianus*	SR_T	No
A liverwort	*Plagiochila sharpii*	SR_T	No
A liverwort	*Plagiochila sullivantii* var. *sullivantii*	NL	No
A liverwort	*Plagiochila virginica* var. *caroliniana*	SR_T	No
A liverwort	*Porella japonica* var. *appalachiana*	NL	No
A liverwort	*Porella wataugensis*	SR_L	No
Anderson's melon moss	*Brachymenium andersonii*	SR_L	No

NL = Not tracked by NHP
T = Threatened
E = Endangered
SC = Special Concern

SR =	Significantly Rare
_T =	Fewer than 100 populations throughout the species' range
_L =	Fewer than 50 populations throughout the species' range
* =	Historic record; the species was observed over 50 years ago
** =	Obscure record; the date and/or location of observation is uncertain

Sources: Amoroso, ed. 2002; LeGrand and Hall 2001, FWS North Carolina Ecological Services
Common name follows FWS listing when different from NHP.

FWS/NHP January 2006

No FSC species were observed during the site visit, although suitable habitat is present within the project area for several Federal Species of Concern.

Records from the Natural Heritage Program (NHP) were reviewed on July 23, 2003 to determine the presence of protected species. The records did not list any known populations of federal or state protected species occurring at this site or within 2 miles of the site.

2.6 Cultural Resources

The NCDOT Office of Human Environment conducted a survey for cultural resources and an evaluation of Cat Creek restoration area on the Swartwout and Waldroop Tracts in April 2003. During this evaluation, an environmentally sensitive area was found on the Swartwout Tract. The specifics of the sensitivity of this area are withheld from this public document in order to protect it. For further information on the specific sensitivity of the site, please contact Earth Tech, EEP, or the State Historic Preservation Office. Measures have been taken into consideration to avoid the area including the stream and wetland design and access to the site during construction. Coordination with the State Historic Preservation Office will occur throughout the project to insure that the environmentally sensitive area is protected and not disturbed.

Surveys of the Parker and Preserve Tracts were not conducted because both sites have been extensively modified for development of a golf course.

2.7 Potential Constraints

Lower Swartwout has two lateral constraints. One is the environmentally sensitive area. This area will be avoided by moving the stream to the east away from the area and the existing channel. The sinuosity is designed to match the reference condition and account for these lateral constraints. The second lateral constraint is the existing wetland on the east side of the tract. The proposed stream alignment will not impact the wetlands directly, as the alignment and profile is set so that the existing ground is the new flood plain and the limits of construction do not encroach on the wetland. Priority 1 restoration for the stream is important in the area that is adjacent to the wetland in order to limit excavation and improve groundwater hydrology. The resulting increase in base level elevation by approximately 1' and the reconnection of the floodplain will promote a more stable and consistent hydrology for the existing wetlands.

Preserve Tract. The sinuosity of the stream is designed to match the reference conditions for streams of similar stream and valley type while working around the lateral constraints including the road embankments, bedrock outcrops, and existing wetlands.

A review of the EDR report did not reveal any known occurrences of the presence or release of hazardous materials or wastes on the property. During site activities no evidence, such as distressed vegetation, unusual seeps or odors, or the presence of illegally or improperly disposed chemicals or hazardous wastes were observed. There are no records of occurrences for endangered or threatened species within the project area. There are road right-of-way issues along some sections of the project. On the Waldroop Tract, there is a constraint of keeping the stream where it is near the barn and protecting the barn. On the Waldroop tract all work must be done within the fence line. An easement for a septic drainfield for a nearby residence is located on the Parker Tract, but should not limit access or cause a problem during construction. There were no features on site that would restrict equipment access.

2.7.1 Property Ownership and Boundary

Three of the tracts, Swartwout, Parker, and Preserve, have been purchased by NCDOT for the purposes of restoring the streams and wetlands on the tracts. The Waldroop tract is owned by Jim and Sue Waldroop. The Waldroop property will remain in private ownership and a Conservation Easement will be obtained to protect the restored and enhanced stream. A deed restriction will be placed on the Swartwout Tract with regards to the environmentally sensitive area.

Cat Creek Road (SR 1513) lies to the south and parallels most of the project area. Jack Cabe Road (SR 1520) forms the eastern and southern border of the Swartwout Tract, and Cat Creek Road is to the west. Cat Creek Road divides the Swartwout Tract from the Waldroop Tract and continues to run parallel to Cat Creek forming the southern border of the Waldroop Tract. A fence line, approximately 1,000 feet west of the Waldroop barn, divides the Waldroop Tract from the Parker Tract. Cat Creek Road parallels the Parker Tract until the pond and intersection with Ferguson Road (SR 1507). Ferguson Road splits off of Cat Creek Road and divides the Parker and the Preserve Tracts. Ferguson Road then runs parallel to Cat Creek along the eastern boundary of the Preserve Tract. The project ends at the fence line approximately 1,800 linear feet downstream of the culvert under Ferguson Road.

2.7.2 Site Access

Assess to all four tracts will be from the adjacent state roads and should not provide any constraints on the project. Access and work on the lower section of the Waldroop tract will need to be coordinated with Mr. Waldroop.

2.7.3 Utilities

A power line crosses Cat Creek near the divide between the Waldroop and Parker Tracts. The utility lines will need to be flagged and equipment working in the area will only need to work around the pole and watch the overhanging lines. Any utilities within the road right-of-ways will need to be identified, but should not provide any constraints to construction of the project.

2.7.4 FEMA/ Hydrologic Trespass

According to the Macon County Flood Insurance Rate Map (370150 0006 A July 1, 2001), the floodplain along Cat Creek has not been mapped by the Federal Emergency Management Administration (FEMA). It is likely that portions of the site are within the 100-year floodplain; however, no base flood elevations have been determined.

Cat Creek is not regulated by FEMA, and flooding analysis is not required. However, flooding analysis was performed to insure that the floodplain is not raised significantly along the stream to affect non-project areas. The USGS Method for estimating the magnitude and frequency of floods in rural basins was used to estimate the 2, 5, 10, 25, 50, and 100-year peak discharges for the different drainage areas.

The USGS regression equations from USGS Fact Sheet 007-00 were used to estimate flood discharges (USGS 2002). The latitude and longitude and drainage area for each site are inputs that are required.

HEC-RAS, version 3.0, was used to compute a flooding analysis for the existing and proposed conditions. This analysis is used to ensure that the project will not significantly change existing floodwater limits and that shear stresses are not unreasonable. The results of the HEC-RAS analysis are presented in Section 7.

3.0 PROJECT SITE STREAMS

3.1 Methodology

There are several steps in performing a stream restoration design project. The first step is to survey the existing conditions of the stream and analyze that data. Once the existing conditions are analyzed and the existing stream type is known (*i.e.*, B, C, G, etc.) the design process begins by deciding what type of stream channel needs to be built (*i.e.*, C or E). It is important for the newly constructed channel to handle bankfull flows and remain stable. Once it is known what type of channel will be constructed, a stream reference reach needs to be identified and surveyed. Once the reference reach data is compiled, a stable stream can be designed by altering the pattern, profile, and/or dimension of the existing channel and by using in-stream structures.

3.1.1 Stream Survey

The US Forest Service General Technical Report RM-245, Stream Channel Reference Sites: An Illustrated Guide to Field Technique was used as a guide when taking field measurements. Accurate field measurements are critical to determine the present condition of the existing channel, conditions of the floodplain, and watershed drainage patterns. Topographic mapping of the restoration site was provided by NCDOT. This mapping was used to evaluate present conditions, new channel alignment and grading volumes. Mapping also provided the locations of property pins, fence lines, large trees, vegetation lines, culverts, and roads.

Field surveys of the existing stream channels and surrounding floodplains were conducted July 14 through 17, 2003, and July 31, 2003 to determine the potential for stream restoration. The stream measurements are used in the classification and assessment of the existing stream type and provide data to classify the stream using the Rosgen classification method, Levels I and II (Rosgen 1996). While conducting the field survey, visual observations were made regarding the stream condition, seep locations, disturbed wetland areas, stream crossings, fencing layout, bedrock outcrops, and other unique features of the stream and surrounding floodplain.

During the Cat Creek site visits, seventeen (17) cross-sections were taken using standard differential leveling techniques. These cross-sections were used to gather detail on the present dimensions and condition of the channel. Cross-sectional area was calculated using the bankfull features. Twelve (12) cross-sections of the existing Cat Creek channel were surveyed. In addition to the cross-sections along the main channel, two (2) cross-sections along the existing Unnamed Tributary to Cat Creek (UT1) on the Swartwout Tract were surveyed, and three (3) cross-sections were surveyed on the smaller tributaries on Parker and Preserve. Pebble counts, pavement, and subpavement samples were taken along Cat Creek and UT1. A majority of Cat Creek has been altered in the past; therefore, meander length, beltwidth, and radius of curvature were measured in the few areas with sinuosity. An estimation of the bank erosion potential was conducted at the seventeen cross-sections using the Bank Erodibility Hazard Index (BEHI) developed by Rosgen (1996). Field survey data is included as **Appendix 2**, photos of the sites are included as **Appendix 3** and a Morphology Table presenting all the measured and design parameters is included as **Appendix 4**.

3.1.2 Stream Reference Reach Search

The reference reach is a stable stream segment used to develop dimensionless ratios for natural channel design. A reference reach that has the dimensions, pattern, and profile of the desired stream type to be designed should be found within the same physiographic region and if possible within the same River Basin. A stable reference reach has the following: stable banks and bed material; stable bedform sequence; stable pattern; native vegetation along the buffer; similar valley type; and similar land use within the watershed. Potential reference reaches were first identified by reviewing USGS topographic maps for Macon County and the surrounding counties within the Little Tennessee River Basin. Sites were then visited and viewed from the road and other points of public access. The landowners, for the stream reaches that appeared to be suitable were contacted and permission was obtained to evaluate the reaches in greater detail.

3.1.3 Stream Design

The stream restoration design is based upon the dimensionless ratios taken from measurements of the reference reachs in relation to bankfull stage. These ratios are used to derive the proper pattern, profile, and dimension for the channel to ensure sediment is transported effectively and the channel is stable. For this project there are several different reaches each with different problems but with similar characteristics. The reaches were divided based upon the characteristics and location. Overall the site was divided into 9 reaches: Swartwout Upper, Swartwout UT, Swartwout Lower, Waldroop Upper, Waldroop Lower, Parker, and Preserve. The stream restoration designs for each reach were based upon the existing site characteristics and needs for restoration and/or enhancement. The designs used dimensionless ratios from the reference reaches.

3.2 Swartwout Tract

The land uses within the watershed for Swartwout Tract include farms, forested land, secondary roads, and scattered residences. The watershed at the end of the Swartwout Tract covers 2.1 square miles (**Figure 2**).

3.2.1 Streams

Cat Creek flows through the Swartwout Tract for approximately 1,632 feet (**Figure 4**). A geomorphic survey was performed on the Swartwout tract in order to evaluate its current condition and determine a classification for the reach. The longitudinal survey for classification was 180 feet long, which of a sufficient length to identify the poor bedform of the entire reach. The reach was broken into an upper and a lower classification section due to changes in valley type, slope, geometry and cover type. **Table 5** summarizes the existing conditions data found in **Appendix 2** for Cat Creek on the Swartwout Tract. **Appendix 3** contains photographs of the Swartwout Tract.

Table 5. Swartwout Tract Existing Stream Conditions Summary

Tract	Bankfull Width (feet)	Bankfull Cross-Sectional Area	ER	Width to Depth Ratio	Avg. Water Surface Slope	Sinuosity	BHR	BEHI	Stream Type
Upper Reach	17.5	17.1	6.9	17.9	0.015	1.01	1.53	Very High	C4
Lower Reach	19.9	16.7	1.6	23.7	0.014	1.01	1.32	High	NA
UT1 Riffle	16	20.2	3.4	12.7	0.022	1.06	1.41	Very High	C4b
Mt. Regional Curve	20.4 18.0(UT)	24.4 19.5(UT)							

*Additional Survey Data located in **Appendix 2**
*Location of Cross-Sections shown on **Figure 4.**

The cross-sectional areas of Cat Creek, the Unnamed Tributary (UT 1), and the reference reach sites used for this report are plotted on the Mountain Regional Curve of North Carolina developed by the North Carolina State University (NCSU) Water Quality Group, 2000 (**Figure 5**).

Cat Creek Upper Swartwout

For the first 300 feet, the centerline of Cat Creek is the property line for the boundary with the landowner to the east. This reach borders a mature hardwood forest to the east and to the west is an old pasture. This portion of the reach runs through a steep, confining valley where the channel has apparently been moved against the valley wall, though this is likely to have occurred decades if not a century ago. The modification as well as other anthropogenic influences has caused the channel to over widen and incise. This portion of the reach is relatively stable, though still actively widening in several locations. The proposed enhancement/stabilization efforts will not cause any deforestation of this reach.

Cat Creek meanders tightly around a heavily wooded ridge and then makes a drastic bend to the left. The lack of channel bedform, the over-widening, and the lack of riparian vegetation on the outer bank have caused severe erosion on the outside bends near the fence line and an existing access road. Banks here are undercut and mass wasting is causing a significant contribution of sediment to Cat Creek. This section of more than 100 feet of bank has continually eroded during the few years that this project has been in planning. The location of the bank stabilization efforts and proximity to the property boundary fence are shown on **Figure 4**. The fence is beside an access road that belongs to the adjacent property owner. From this meander bend the channel flows over bedrock through a wooded section. The channel remains incised and with short stretches of bank wasting occurring down to an old ford. Here the channel slope changes and property constraints are eliminated allowing for full channel restoration.

Within this reach Cat Creek classifies as a C4 channel under the Rosgen classification method. It has a bankfull width of 17.5 feet. A Bank Height Ratio of 1.53 is indicative of incision. Bank wasting indicated the successional stage of this channel is in a current trend of changing from a "C" to a "G" or "F" as incision or widening continues in future flood events.

Cat Creek Lower Swartwout

The lower reach of Cat Creek flows through a former pasture. The pasture was active up until the time the property was purchased by the NCDOT in 2003 as a stream and wetland restoration site. The stream has been moved from its natural alignment and built as a straight "V-ditch" at some unknown date in the past. Spoil piles line both sides of the channel creating an incised channel. Entrenchment ratios are a poor indicator of channel stability in this case, due the fact that the channel is now a straight reach with no access to the floodplain during relatively large flood events of up to approximately the 5-10 year event. The channel modification has created a channel with little to no bedform and very poor riffle - pool sequencing to provide biological function and channel stability. This reach has intermittent bank wasting along its length. Many channels that are re-aligned and altered by man would have developed a somewhat stable pattern after decades have past. However, in this reach, the confinement by the spoil berms has disabled the ability of the stream to develop any meander pattern or bedform and, therefore, its ability to possess the dimension pattern, profile and biological function of a natural channel. The proposed re-alignment and raising of the channel grade will re-connect this channel to the wide floodplain of the remnant channel and improve the stability and function of Cat Creek.

The channelized reach of Cat Creek does not lend itself to classification under the Rosgen classification system. It has a bankfull width of 19.9 feet. An entrenchment ratio of 1.32 indicates that it is entrenched. Remnants of a spoil bank along the east side and a sinuosity of 1.01 provide evidence of past channelization and disturbance. The average water surface slope is almost equal the valley slope, which in itself indicates the lack of pools and tendency of instability of the reach. Just below the confluence of UT1 the channel has been pushed up against the base of Jack Cabe Road.

UT to Cat Creek (UT1)

This small stream flows onto the site through a culvert beneath Jack Cabe Road (**Figure 4**). The UT runs parallel to Jack Cabe Road before joining Cat Creek just upstream of the bridge on Cat Creek Road. The stream has been channelized from the culvert to its confluence with Cat Creek with a spoil pile on the right bank preventing it from reaching its floodplain on bankfull and larger events. Incision and the confinement of the spoil pile on the right bank and Jack Cabe Road on the left bank has caused bank wasting, bank scour, bed scour and general instability along the entirety of the reach. The reach has poor bedform with few pools for habitat and energy dissipation of higher flow events. Sinuosity of the altered channel is 1.06, also indicating its channelization. The channel is overly wide in some areas and a few side bars along the right bank are present, indicating aggradation. The presence of rip-rap stone in the channel indicated attempts to stabilize sections of the reach in the past. A review of the existing topography indicates that the at one time the stream was likely located to the east where it flowed through a wetland area and into Cat Creek. It is probable that the channel was altered in order to move it to

the edge of the pasture, rather than running through the middle of it. The proposed re-alignment will; reconnect the channel to the floodplain, help reduce near bank stress, provide for a stable channel with greatly reduced sediment contributions to Cat Creek, provide a stable bedform and natural sinuosity for this valley type, and improve the hydrology of the nearby existing wetlands. The proposed channel revision will minimize construction impacts of the adjacent wetlands.

The channelized reach of the UT does not lend itself to classification under the Rosgen classification system. It has a bankfull width of 16.03 feet. An entrenchment ratio of 3.4 indicates that it is moderately entrenched. Remnants of a spoil bank along the right bank and a sinuosity of 1.06 provide evidence of past channelization and alteration. A bank height ratio of 1.41 demonstrates the incision of the altered channel and offers an explanation of the relative instability of the channel. There is no evidence of channel access to the remnant floodplain on the right bank.

3.2.2 Soils and Hydrology

The floodplain along Cat Creek is divided into an upper field and a lower field by a natural narrowing of the floodplain. According to the Macon County Soil Survey, the floodplain adjacent to Cat Creek is mapped as Reddies (**Figure 3**). See Section 5.0 for details on wetland soils and hydrology.

3.2.3 Vegetation

Upper Swartwout

Along the upper section of Cat Creek, a mature hardwood forest is present to the east and to the west is a pasture. Trees, shrubs, and herbaceous plants that are along the left bank shade a majority of the stream in the upper reach. Tree species include red maple (*Acer rubrum*), tulip poplar (*Liriodendron tulipifera*), spicebush (*Lindera benzoin*), and flowering dogwood (*Cornus florida*). Herbaceous vegetation includes switchgrass (*Panicum virgatum*), wingstem (*Verbesina alternifolia*), soft rush (*Juncus effusus*), sedges (*Carex* sp.), jewelweed (*Impatiens capensis*), and goldenrod (*Solidago* sp.). The west side of the channel is similar to the lower pasture portion of the tract described in detail below.

Lower Swartwout

In the lower section, Cat Creek flows through a pasture. The channel is fenced off and heavily vegetated with herbaceous vegetation. The pasture has been mowed annually and consists of grasses and other herbaceous vegetation. The dominant grass is pasture fescue (*Festuca arundinaceum*). Other herbaceous vegetation includes sedges, soft rush, goldenrod (*Solidago* sp.), blackberry vines (*Rubus* sp.), and Joe-pye weed (*Eupatorium maculatum*). Because of infrequent mowing along the channel, scattered woody vegetation is present and includes black willow (*Salix nigra*), tag alder (*Alnus serrulata*), and elderberry (*Sambucus canadensis*).

UT to Cat Creek (UT1)

The vegetation along this stream consists of scattered trees and shrubs with a dense herbaceous layer. The trees are red maple and the dominant shrubs are tag alder and elderberry. The herbaceous vegetation is variable and includes jewelweed, wingstem, blackberry, New York ironweed (*Vernonia noveboracensis*), purplestem aster (*Aster puniceum*), goldenrod, deertongue (*Panicum clandestinum*), and Japanese stilt grass (*Microstegium vimineum*).

Wetlands

The wetland area adjacent to UT1 is dominated by herbaceous vegetation. This vegetation includes blue aster, goldenrod, soft rush, sedges, and ironweed.

3.3 Waldroop Tract

The Waldroop Tract is an active cattle and horse farm owned by Sue and Jim Waldroop (**Figure 6**). Cat Creek flows through the property for approximately 2,160 feet. The tract has been divided into an upper and lower section based upon the proposed design. Photographs of the site are located in **Appendix 3**.

Data obtained from field surveys were used to compute the morphological characteristics of the channel. **Table 6** summarizes the existing conditions data found in **Appendix 2**.

Table 6. Waldroop Tract Existing Stream Conditions Summary

Tract	Bankfull Width (feet)	Bankfull Cross-Sectional Area	ER	Width to Depth Ratio	Ave. Water Surface Slope	Sinuosity	BHR	BEHI
Waldroop Lower	22.9	39.1	3	13.4	0.0077	1.01	1.37	Low
Mt. Regional Curve	27.1	41.4						

* Additional Survey Data located in **Appendix 2**
Locations of Cross-Sections on **Figure6**

3.3.1 Stream

The upper section is fairly stable with a few eroded banks and a narrow buffer. The lower section is unstable due to the highly eroding banks, deep pools, and lack of a good riffle-pool sequence. This section has a narrow mature buffer that is being eroded away and therefore in need of stabilization. The watershed at the end of the Waldroop Tract totals 2.5 square miles.

Upper Waldroop

The upstream portion of Cat Creek on the Waldroop Tract flows alongside Cat Creek Road (**Figure 6**). The upper reach includes approximately 1,463 linear feet. One small road ditch enters the property at the beginning from the north along Cat Creek Road. The creek flows through an equipment/livestock crossing and continues through a narrow buffer. In this section

the stream is fairly stable. However, just below the equipment crossing, there is a boulder outcrop and below the boulder, a large scour pool has formed. A small tributary enters from the left just upstream of a wooden equipment access bridge. Cat Creek then flows under the bridge, which is just upstream of the barn.

Lower Waldroop

Adjacent to and just below the barn is a wide cattle crossing. The crossing is used regularly to move cows from the pasture on the north side of the stream to the "bull pasture" on the south side of the creek. A watering access point for the bull pasture is also found in this area. The cattle have caused erosion and caved in the banks at the crossing. However, rock and other materials have been placed in the crossing, and it appears to be relatively stable.

Below the barn, the creek flows through a narrow (5 feet on both sides) but mature buffer between two fence lines, roughly 35 feet in width. This section of the stream has severe streambank erosion and is overly wide in multiple locations. This has caused aggradation of fines in the channel bed and bar formation which is creating stress on the banks along aggraded sections of the channel. The eroding banks are also causing loss of large trees.

Although the channel is entrenched and has large bank height ratios, the flood-prone area extends into the bull pasture. Due to past channel modifications the stream does not lend itself to classification under the Rosgen classification system. The banks are eroding and scouring, the pools are infrequent, and riffles are shallow and wide with aggradation.

3.3.2 Soils

According to the Macon County Soil Survey, soils adjacent to Cat Creek are mapped as Reddies fine sandy loam. Soil on the Waldroop Tract was not evaluated during field investigations.

3.3.3 Vegetation

Waldroop Upper Section

The vegetation along this section consists of a narrow tree and shrub buffer with pasture on both sides. The woody buffer is approximately 25 feet in total width. The vegetation is maintained in a shorter, shrubby state by the landowner in this area. The woody portion of the buffer consists of mostly tag alder with a few scattered black willows. Herbaceous vegetation consists of blackberry, rushes, wingstem, and deertongue grass.

Waldroop Middle and Lower Section

The vegetation along this reach is also a narrow buffer of trees and shrubs with pasture on both sides. The buffer consists of much larger and older trees and shrubs with maintenance limited to keeping vegetation away from the fence. Several of the larger trees are being undercut by bank erosion. Species include black walnut (*Juglans nigra*), red maple, privet (*Ligustrum sinense*), and scattered black cherry (*Prunus serotina*). Herbaceous vegetation consists of blackberry,

rushes, wingstem, and deertongue grass. The buffer in this section is relatively dense throughout. The adjoining pastures are regularly maintained through mowing and grazing of livestock. Species present include fescues and other pasture grasses.

3.4 Parker Tract

The Parker Tract begins downstream of the Waldroop fence line. This tract was once part of a golf course. The channel has been straightened and the floodplain altered by fill material and drainage modifications to allow for the construction of the golf course. Although the golf course has not been active for a number of years, the tract is still open with the locations of greens and tee boxes still visible. The tract is owned by the NCDOT who purchased it in 2002 for their stream and wetland restoration program. Photographs of the site are located in **Appendix 3**.

Cat Creek flows for approximately 1803 feet through the center of the Parker Tract. Two small unnamed tributaries, UT 2 and UT 3 enter the site from the west.

A geomorphic survey was performed on the Swartwout tract in order to evaluate its current condition and determine a classification for the reach. **Table 7** summarizes the existing conditions data found in **Appendix 2** for Cat Creek on the Parker Tract.

Table 7. Parker Tract Existing Stream Conditions Summary

Tract	Bankfull Width (feet)	Bankfull Cross-Sectional Area	ER	Width to Depth Ratio	Avg. Water Surface Slope	Sinuosity	BHR	BEHI
Parker	18.5	40.3	5.7	8.5	0.0058	1.06	1.38	Low
UT2	8.2	12.9	13.9	5.2	0.013	1	1.33	Low
UT3	6.7	6.9	22.4	6.5	0.013	1	1.5	NA
Mt. Regional Curve	27.13 14.7 (UT2) 11.2 (UT3)	41.4 13.5 (UT2) 8.2 (UT3)						

*Additional Survey Data located in **Appendix 2**
Locations of Cross-Sections on **Figure 7**

3.4.1 Stream

After leaving the Waldroop Tract, Cat Creek flows under an old wooden bridge. From the wooden bridge, the stream turns slightly to the southwest and runs parallel to Cat Creek Road (**Figure 7**). There is bedrock present for approximately 400 feet through this section. The stream flows through the abandoned golf course field and there are no trees along the banks. This reach is extremely straight and has been channelized as evident from spoiled material at the top of the stream banks and from personal accounts from adjacent landowners. The bed material through this section is very unconsolidated, consisting of loose gravel and a significant percentage of fine silt. The lack of consolidation is evidence of the present condition of the actively eroding and aggrading channel. The incision, indicated by a high bank height ratio of 1.38, is causing erosion in multiple locations along the length of the reach. Mid channel bar formation exists throughout the reach, again evidence of the lack of sediment transport capacity of the channel through this

reach. Delta bars exists where the 2 tributaries join this channel which is also an indicator of a lack of sediment carrying capacity and the resulting in-channel stresses that cause bank erosion.

The entrenchment ratio of 5.6 is misleading, as this much floodplain is not available until the flow is high enough to reach approximately 1.7 of the max depth. Until the channel reaches this relatively high flow (approximately greater than the 5-year storm event) there is no useable floodplain. At 2X max depth, the channel has a moderate floodplain width, and thus the misleading nature of the entrenchment ratio. Entrenchment ratio is intended to indicate the width of the floodplain available for floodplain flow (lateral confinement) of the channel and is more useful for stream and valley type determinations than channel stability. The vertical confinement, as indicated by bank height ratio, is a much more consistent indicator of channel stability. This is evident by the highly unstable nature of this reach, even though it has an adequate entrenchment ratio. Approximately 500 feet upstream of where Cat Creek crosses under Ferguson Road, the main stream slightly increases its sinuosity which results in several severely eroded outside meander bends with overhanging, under-cutting banks.

A small tributary (UT2) enters at the midpoint of the straightened and channelized section of Cat Creek from the left. This tributary once had a more sinuous pattern but has been straightened and shortened. The USGS mapping shows this stream flowing into Cat Creek near Ferguson Road, further downstream then where it now enters. Though the fill material of the old golf course covered much of the relic channel, low points in the valley verify the alignment indicated by the USGS topographic mapping. There are two ponds just upstream on UT2. This channel is similar to Cat Creek on this tract in that it is very incised, but has a useable floodplain at 2X max depth, thus having a misleading entrenchment ratio. Again, the channel has to experience a substantially larger than bankfull (approximately 1.5-year storm event) to reach any floodplain. In most flood events, the channel contains the entire flow without reaching a floodplain. The low straight reach has a steep slope that is equal to the valley slope. An alluvial channel is not likely to reach stability without having a channel slope that is less than valley slope. The current slope condition is predictably causing down cutting of the channel bed. UT-2 is highly unstable, lacks bedform, has been straightened (sinuosity of 1.0), and has mass wasting banks intermittently along its length until it joins Cat Creek.

Another tributary, UT3, enters Cat Creek from Ferguson Road downstream of UT2. This small tributary is also very straight from the alteration of the channel during construction of the golf course. This channel has the same problems as UT-2; no sinuosity (1.0), steep channel that is equal to valley slope, incision, and no riffle pools sequence for energy dissipation. The bank height ratio of 1.53 indicates a high degree of incision. As would be expected with this incision, the channel has multiple sections of severe erosion and mass wasting banks.

Just before Cat Creek crosses under Ferguson Road, a ditch enters from the right. The ditch runs parallel to the Parker/Waldroop property line and appears to have been installed to drain groundwater flow and spring seeps at the base of the hillslope along the west side of the valley. The watershed at the end of the Parker Tract is 3.3 square miles.

Within the Parker Tract, due to the past channel modifications, Cat Creek and both unnamed tributaries do not readily lend themselves to classification under the Rosgen classification system.

3.4.2 Soils and Existing Wetland Conditions

According to the Macon County Soil Survey the floodplain adjacent to this section of Cat Creek is mapped as Nikwasi and Reddies soils (**Figure 3**). However, the natural soils have been disturbed and/or buried. Based on numerous soil borings and soil pits it is estimated that some areas have a surface layer up to two feet thick of fill/disturbed material overlaying the natural hydric soil. Beneath the fill/disturbed material is a hydric soil having dark gray and gray colors. The fill appears to be thickest near the channel and old tee/green formations. Typical soil profiles are given in **Appendix 5**.

See Section 5.0 for details on wetland soils and hydrology on this tract.

3.4.3 Vegetation

The Parker Tract has been significantly altered because of its past use as a golf course. Although the site has not been maintained as a golf course, it is mowed regularly, and herbaceous vegetation dominates. The banks along Cat Creek and its tributary consist of annuals and perennials with scattered shrubs and small tree seedlings. The surrounding field supports a similar vegetative composition, although the field was mowed prior to field activities. Woody vegetation consists of elderberry, black willow, black cherry, and tag alder. Herbaceous species include Canada goldenrod (*Solidago canadensis*), Joe-pye-weed, ironweed, blackberry, soft rush, annual ragweed (*Ambrosia artemisiifolia*), switchgrass, and deertongue. According to an adjacent landowner, this floodplain was once part of a large swampy area 30 years ago.

3.5 Preserve Tract

The Preserve Tract is similar to the Parker Tract in that it has been significantly altered from past use as a golf course. The watershed at the end of the Preserve Tract is 3.6 square miles (**Figure 2**). The preserve Tract was purchased by NCDOT in 2004 as a stream and wetland restoration site.

3.5.1 Stream

Cat Creek passes through a culvert at Ferguson Road and flows through the middle of the Preserve Tract. Although once a part of the golf course, Cat Creek through this tract has more sinuosity, terraces (benches) are present, and the bed material is stable compared to the Parker Tract. There are several severely eroded meanders near Ferguson Road. Downstream, the channel appears to be returning to a stable state, though lacking riffle-pool sequencing from past channelization. Access to a small floodplain and wetland has encouraged stability along the majority of this reach. The proposed enhancement will involve minimal disturbance of the channel to install a few structures to restore pools in the channel and provide for improved biological function. What little instability that is present in the lower portion of this reach is

apparently due to a lack of good bedform and a need for energy dissipation at intervals of approximately 150 feet. Bank stabilization is proposed for the upper portion of the reach. There are also several areas of bedrock near Ferguson Road. **Figure 8** shows the locations of cross-sections surveyed and existing conditions at the Preserve Tract.

Several small streams or tributaries flow into Cat Creek on the Preserve Tract. The first (UT 4) is a small tributary that enters from the right (east). Although very small, this tributary is perennial. This tributary is actively incising and widening due to a short and steep average slope to its confluence with Cat Creek. This channel was apparently re-aligned and channelized during the construction of the golf course at the site. The tributary has perpendicular alignment to Cat Creek, and it is assumed that the reminant channel would have run at a more natural angle to converge with Cat Creek. The proposed restoration of the tributary will re-align the tributary to a more natural confluence with Cat Creek, restore dimension, bedform and pattern, and greatly improve sediment contributions from the actively eroding tributary.

Near the midpoint of the site there are two small drainage systems that enter from the left (west). Both of these appear to be fed by small springs or seeps that originate on the Preserve Tract and have very low rates of flow. A fourth small tributary flows through a culvert beneath Ferguson Road and through a second culvert into an old pond bed, before flowing into Cat Creek. None of these small tributaries are shown on the USGS mapping.

Data from field surveys were used to compute the morphological characteristics of Cat Creek. This reach classifies as a C type stream. The cross-sectional areas for Cat Creek on this reach plot along the trend line for the Mountain Regional Curve (**Figure 5**). **Table 8** summarizes the survey data and the cross-section locations are shown on **Figure 8**.

Table 8. Preserve Tract Existing Stream Conditions Summary

Tract	Bankfull Width (feet)	Bankfull Cross-Sectional Area	ER	Width to Depth Ratio	Ave. Water Surface Slope	Sinuosity	BHR	BEHI
Preserve	33	50.2	2.2	21.7	0..0072	1.13	1.52	Low to Very High
UT4	13.2	6.2	7.6	27.9	0.045	1.05	1.3	N/A
Mt. Regional Curve	30.60 9.9 (UT4)	51.8 6.5 (UT4)						

* Additional Survey Data located in **Appendix 2**
Locations of Cross-Sections on **Figure 8**

3.5.2 Soils and Existing Wetland Conditions

The eastern floodplain on the Preserve Tract has extensive fill from the construction of the golf course. According to the Macon County Soil Survey, the floodplain adjacent to this section of Cat Creek is mapped as Udorthents-Urban Land complex (**Figure 3**). Soil borings revealed that up to 4 feet of fill material has been added at some locations. Four shallow pits were excavated to help determine the depth of fill material and nature of the underlying soil. Depth of fill is variable and beneath the fill is a dark gray or light gray hydric soil. Much of the fill material is

rocky which makes determining characteristics of the underlying soil difficult or impossible using hand augers.

See Section 5.0 for details on wetland soils and hydrology on this tract.

3.5.3 Vegetation

The Preserve Tract is dominated by herbaceous vegetation that is maintained by regular mowing. The channel banks are mowed to the edge of the stream, except along the wetlands. The floodplain supports a diverse vegetation of annual and perennials with scattered shrubs and trees. Trees are scattered along the stream and include sycamore (*Platanus occidentalis*), tulip poplar, and black walnut. Shrubs include elderberry, black willow, black cherry, and tag alder. Herbaceous species include Canada goldenrod, Joe-pye-weed, ironweed, blackberry, soft rush, annual ragweed, switchgrass, and deertongue.

4.0 REFERENCE STREAMS

Earth Tech conducted any extensive search for suitable stream and wetland reference sites within the Little Tennessee River basin. Several potential reference reaches were identified. However, upon additional field evaluation of the reaches it was determined that they were not suitable. Because of the long history of utilizing the larger floodplains for agriculture and cattle, few undisturbed, stable streams exist in the Little Tennessee River watershed. Two reference reaches in other watersheds within Mountain Physiographic Province were identified were determined to be suitable based upon similarities in valley type. This reference data was used to develop design parameters for Cat Creek as well as the tributaries.

4.1 Bent Creek

Bent Creek, a fourth order stream, is located in the Bent Creek Experimental Forest south of Asheville, North Carolina in the French Broad watershed (**Figure 9**). The stream is located in a wide alluvial valley within a relatively mature hardwood forest. While logging from the early twentieth-century caused most of the streams within the Bent Creek watershed to become somewhat entrenched, the streams have since stabilized through vegetative-control. Because of the similarity of the Bent Creek valley type, width, drainage area (3.7 square miles), and elevation to the lower reach of Cat Creek, Bent Creek was determined to be a suitable reference reach for this project. Morphological parameters for this reference reach are presented in **Appendix 4**.

4.2 Unnamed Tributary to Meadow Fork

UT to Meadow Fork, a third order stream, is located adjacent to the Blue Ridge Parkway in Allegheny County, North Carolina and is within the New River Watershed (**Figure 10**). The surveyed reach is located in a decades-old fallow pasture and has been relieved of active grazing for four years prior to surveying. Relic benches indicate the original channel was an E channel, which then downcut and widened with grazing pressure and vegetation removal years ago. A stable C channel appears to have existed for several decades and then cessation of grazing allowed the channel to transition to an E in the years prior to being surveyed. The drainage area (1.3 square miles), valley type and valley width of the UT to Meadow Fork is similar to that of the upper reach of Cat Creek and the tributaries to Cat Creek, therefore it was determined to be a suitable reference reach for this project. Morphological parameters for this reference reach are presented in **Appendix 4**.

5.0 PROJECT SITE WETLANDS

5.1 Methodology

Wetland restoration is based upon existing site characteristics, including soil properties, topography, and hydrology. A detailed study of these site characteristics was performed to describe the existing conditions and to develop restoration goals that guide the wetland restoration design.

5.1.1 Soil Evaluation

A detailed investigation of the soils adjacent to Cat Creek was conducted July 28-31, 2003, and October 1-3, 2003. The soil investigation was accomplished through a series of hand auger borings. Features evaluated included horizon depth, moist colors, textures, and other notable features such as mottles and depth to free water. Presence and depth of potential fill materials were also recorded. On December 2, 2003, a number of soil pits were dug to determine buried drainage features, such as drainage pipes, and to verify hand auger borings.

5.1.2 Hydrologic Evaluation

Fourteen groundwater-monitoring gauges were installed on the Parker and Swartwout Tracts to study groundwater conditions and to determine jurisdictional wetland hydrology. A rain gauge is also located at the Swartwout Tract. The gauges were installed and maintained by Fish and Wildlife Associates, and the data were provided to Earth Tech. Recordings for both the groundwater-monitoring gauges and the rain gauge were taken from September 21, 2002 through December 15, 2003. Data for the 2003 growing season, April 30 to October 12, were analyzed (165 days). Areas that are seasonally inundated and/or saturated to the surface for more than 12.5% of the growing season are jurisdictional wetlands. Areas saturated to the surface between 5% (8 days) and 12.5% (21 days) of the growing season may be jurisdictional wetlands if soils and vegetation meet jurisdictional criteria.

5.1.3 Wetland Delineation

Hydric soil areas were identified and delineated in accordance with soil criteria established in the U.S. Army Corps of Engineers Wetlands Delineation Manual (Environmental Laboratory, 1987). The hydric soil boundaries were flagged and surveyed using GPS surveys techniques. A site visit with Steve Lund, with the US Army Corps of Engineers (USACE) was performed on February 24, 2004. During the site visit Mr. Lund confirmed wetland areas and boundaries.

5.2 Swartwout Tract

Upper Swartwout - The floodplain in the upper field is nearly level with the stream flowing along the eastern edge. Hand auger borings within this field indicate that hydric soils are present (**Figure 11**). The hydric soils form a triangle with a shallow drainage swale bordering the east side. The soils narrow to a point where the swale empties into a ditch that flows into Cat Creek. A buried concrete culvert also empties into this ditch. The culvert protects the end of a perforated

drainpipe that drains the wetland area. A soil pit dug in this area revealed that the remaining soils in this field have a non-hydric, sandy, surface layer overlaying a gray hydric layer 19 to 24 inches below the ground surface. This non-hydric surface layer is likely fill material brought in to level the site for a small riding arena.

Two groundwater gauges are located in this upper field (**Figure 11**). Hydrographs for these gauges can be found in **Appendix 6**. Data analysis shows that jurisdictional hydrology may be met for Gauge 10 installed within an area of hydric soils. Groundwater was within 12 inches of the surface for only one 8-day period (5 percent) during the growing season, May 6 to 13. This meets the minimum hydrologic criteria for a wetland despite the drainage modifications. The other gauge (Gauge 9), within a filled area, does not show wetland hydrology during the growing season. Neither of these areas were determined to be jurisdictional wetlands by the USACE.

Lower Swartwout - The lower field is bisected by Cat Creek. Along this reach a small berm is present along the banks of Cat Creek, which helps reduce over bank flooding. To the west, a slightly higher terrace grades into a shallow swale near Cat Creek Road. Hydric soils form a narrow linear shaped unit along the swale. According to the previous landowner a drainpipe was installed in the swale several years ago to drain a spring or seepage located near the head of this swale. This drainpipe was located and found to drain into a ditch along Cat Creek Road. Three groundwater gauges are located in this swale. Data analysis (**Appendix 6**) shows that jurisdictional hydrology is met for Gauges 2 and 3. Groundwater was within 12 inches of the surface for all of the growing season for Gauge 2. This indicates this area meets the criteria for wetlands despite the drainage modifications. The remaining gauge (Gauge 1) does not show wetland hydrology at any time during the growing season. This area was determined not to be a jurisdictional wetland by the USACE.

To the east of Cat Creek the floodplain expands into a wide triangle that connects to UT1. According to the previous landowner, drain tiles were also installed in this field, one along the base of the slope that drains into UT1 and a second more centrally located (**Figure 11**). Soil pits were used to verify the location of these drainpipes. The soils in this area show mottling in the surface layer, indicating extended saturation, but lack the extensive low chroma colors found in hydric soil. An underling layer of gray soil is found, ranging in depth from 12 inches near the drainpipes to 20 inches or deeper. Typical soil profiles are provided in **Appendix 5**.

Five groundwater gauges are located in the eastern portion of the lower field. Hydrographs (**Appendix 6**) show that jurisdictional hydrology is met for all gauges. All gauges had wetland hydrology for at least 19 percent of the growing season (31 days). Groundwater was within 12 inches of the surface throughout the growing season for Gauge 6. This indicates this area meets the criteria for jurisdictional wetlands despite the drainage modifications. Some, but not all of this area was determined to be a jurisdictional wetland by the USACE.

Rainfall measurements were obtained from an on-site rain gauge. Precipitation during the 2003 growing period ranged from normal to below normal. Precipitation data are provided in **Appendix 6**. Recorded onsite precipitation events show a good correlation to groundwater data.

In the corner of the floodplain along UT1 and above the drainpipe, the soils are hydric and were delineated as Jurisdictional Wetlands (**Figure 11**). This wetland area is located between the toe slope and a berm/spoil pile along the UT. This triangular shaped wetland starts as a narrow point near the culvert at Jack Cabe Road and expands into the floodplain. Shallow standing water was observed in portions of the wetland. This wetland appears to originate as seepage along the toe slope.

5.3 Parker Tract

The wide floodplain within this tract has been extensively altered during construction of the golf course. According to the general contractor who built the golf course, soil additions and contour grading were used to increase drainage of the site. Several shallow surface swales are found that drain surface water toward the stream. The contractor does not remember extensive fill in this area and indicated the use of drainpipes was limited. On the north side of the floodplain along the toe slope, a ditch and berm were constructed to drain the seepage water away from the fairway. This ditch flows along the edge of the floodplain and the old fairway next to the fence line along the Waldroop property. The ditch empties into Cat Creek just above Ferguson Road. This ditch ranges from about 1 foot deep and 5 feet wide to 2 feet deep and 10 feet wide. Near Cat Creek the channel is deeper due to a head cut. In the southeast corner of this tract soil pits verified that a drainpipe is present near the road embankment to Cat Creek.

Three hydric soil areas were delineated within the floodplain on the north side of Cat Creek (**Figure 12**). The first is a small, depressional area near the edge of the old fairway. The fill/disturbed soil is absent near the center of the depression and increases in thickness from the center till the hydric indicators are greater than 12 inches. A low berm separates this area from the ditch. The second, slightly larger area of hydric soils is also separated from the ditch by the low berm. The third area is the most extensive, covering approximately one-third of the length of the floodplain, ending near an old tee near Ferguson Road. Most of this area is separated from the ditch by the low berm. Toward the channel these soils grade into a deeper surface layer and borings indicate these soils are disturbed. Soil indicators and depth of fill materials vary.

Four groundwater gauges are located within this tract (**Appendix 6**). The hydrographs show that jurisdictional hydrology is met for all four gauges. All gauges had wetland hydrology for at least 17 percent of the growing season (28 days). Ponding is indicated on the graphs and was observed when data were collected. This area meets the hydrology criteria for jurisdictional wetlands. Three areas that were determined to be jurisdictional wetlands are shown on **Figure 12**.

Although hydrologic conditions meeting jurisdictional criteria are present, it is likely that these wet areas were historically much wetter than they are today. This area was reportedly once part of swamp forest system that occurred along Cat Creek. These systems typically contain low swales and areas of ponded water for extended periods.

5.4 Preserve Tract

Two wetland areas are present on the Preserve Tract (**Figure 13**). The first is a narrow linear wetland adjacent to the channel on the east side. This wetland is situated on a low floodplain bench. It appears that this wetland once extended further to the east. Soils to the east of this wetland have a surface layer of fill 16 to 24 inches thick. Soils beneath this fill are hydric, having a dark gray layer over light gray. The hydric soil layer is silty clay loam over silt loam with sand lenses present (**Appendix 5**).

The second wetland is located in an old pond bed. Soils in the old pond have a thin sandy loam layer that is dark gray with organic matter. This pond most likely was a shallow excavation that was surrounded by the fill/disturbed soils found across the site. Both areas were determined to be jurisdictional wetlands by the USACE.

6.0 REFERENCE WETLANDS

A search for a reference wetland was conducted using NWI maps, USGS Topographic Quadrant maps, windshield surveys, and personal communications. Site suitability was determined based on floodplain topography, source of hydrologic input, site soils, and the vegetative community present.

The Cartoogechaye Creek wetland is located southwest of Franklin and west of Old Murphy Road along Cartoogechaye Creek (**Figure 14**). This wetland is located along a steep toe slope at the edge of the floodplain. The hydrology is seepage with minimal input from over bank flooding and upland runoff. The seepage flows for approximately 500 feet, with a portion adjacent to a maintained residential area. A shallow network of swales with variable depth parallels the slope and collects flows. The network flows parallel to the slope, converging into a deeper wide swale. A small ditch connects the deeper portion of the swale to Cartoogechaye Creek. The ditch did not have flow or show evidence of recent flows, but appears to allow overbank flows to drain rapidly after floodwaters recede.

The vegetative community is forested except near the maintained area. Trees include red maple, river birch and sweet gum. Shrubs include tag alder, and elderberry. Herbaceous vegetation includes sedges, rushes with scattered annuals and perennials. The maintained area is similar to pasture land.

7.0 PROJECT SITE RESTORATION PLAN

Stream and wetland restoration and enhancement is proposed for Cat Creek. General principles regarding the proposed restoration are provided first followed by a detailed discussion for the restoration proposed for each tract.

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

- Form a stable channel with the proper dimension, pattern, and profile;
- Raise the existing streambed elevation where possible;
- Establish a floodplain along the stream channel;
- Place natural material structures in the stream to improve stability and enhance aquatic habitat;
- Stabilize stream banks with herbaceous and woody vegetation; and
- Create or enhance a minimum of a 30-foot riparian zone to provide aesthetic value, wildlife habitat, and bank stability.

In areas where on-site constraints do not allow for full restoration, enhancement is proposed. Stream enhancement requires determining the current condition of a stream and then evaluating the locations where the stream needs stabilizing. The proposed enhancement of Cat Creek will include creating bankfull benches where appropriate, installing grade control structures as needed, stream bank sloping, and establishing a permanent buffer along the stream to insure that the existing stream habitat will remain undisturbed. This enhancement is based on analysis of current watershed hydrologic conditions and evaluation of the project site.

Wetland restoration requires determining the type and extent of degradation at the site and the alteration of hydrologic and vegetative conditions that would be expected under natural conditions. The proposed restoration at Cat Creek will result in a wetland community on the floodplain adjacent to Cat Creek with adequate hydrologic conditions to support appropriate wetland vegetation. The restoration is based on the current conditions at the site and a comparison of this site to other local wetland sites. The following recommendations are included in this restoration plan:

- Remove fill material to elevations of natural soil;
- Plug and fill drainage ditches;
- Remove sub-surface drainage systems;
- Increase surface storage through contouring; and
- Stabilize the site by reforestation and creation of habitat diversity.

7.1 General Principles

7.1.1 Stream Restoration

The design was based upon natural channel design methodology. Morphological characteristics were measured on the existing stream and reference reaches to determine a range of values for the stable dimension, pattern, and profile of the proposed channel. The measured and proposed morphological characteristics are provided in **Appendix 4**.

Sediment Transport

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

Entrainment calculations were completed for each restoration reach and are described in more detail in each proposed restoration tract section below.

Flooding Analysis

Cat Creek is not regulated by FEMA, and flooding analysis is not required. However, flooding analysis was performed to insure that the floodplain is not raised significantly along the stream to affect non-project areas. The USGS Method for estimating the magnitude and frequency of floods in rural basins was used to estimate the 2, 5, 10, 25, 50, and 100-year peak discharges for the different drainage areas.

The USGS regression equations from USGS Fact Sheet 007-00 were used to estimate flood discharges (USGS 2002). The latitude and longitude and drainage area for each site are inputs that are required.

HEC-RAS, version 3.0, was used to compute a flooding analysis for the existing and proposed conditions. This analysis is used to ensure that the project will not significantly change existing floodwater limits and that shear stresses are not unreasonable.

7.1.2 Wetland

Wetland restoration will consist of both restoration and enhancement. Wetland restoration at the Cat Creek site is based on an extensive field evaluation combined with the use of aerial photography, topographic mapping, and interviews with former owners. Data from ground water monitoring gauges were evaluated to determine the existing hydrologic condition. Restoration and enhancement of the wetlands will restore a more natural hydrologic regime and associated

functions. Revegetation of the site will use a landscape approach and integrate the wetland and stream with non-wetland floodplain and upland to create a continuous landscape.

Hydrologic restoration efforts will focus on undoing and eliminating the past drainage alterations and fill material. Wetland hydrology is primarily to be from groundwater and seepage areas located along various toe slopes. The natural drainage has been significantly altered, and the existing wet areas were once wetter than present. Hydrological restoration techniques will consist of filling ditches, removing drainpipes, excavation of fill materials, and restoring the natural contours to restore sheet flow. Adding shallow swales and microtopographic features throughout the floodplain will increase surface water storage and allow greater infiltration. Based on the analysis of the groundwater monitoring gauges, sufficient water is available to restore wetland conditions throughout the proposed restoration area for each tract.

7.1.3 Reforestation

There is no reliable record of the originally occurring communities along Cat Creek. The site will be reforested with vegetative communities suitable for stream bank and well-drained floodplain, and poorly drained floodplain and wetlands. Appropriate species selection and quick establishment of vegetation along the stream banks are needed to protect against potential erosion and damage to structures. Quick establishment of wetland vegetation is less critical, but is necessary before the function of the wetlands will be realized.

7.2 Swartwout Tract

7.2.1 Stream

The upper section of Cat Creek adjacent to the riding ring and bordering the woods will have minimal work performed. Sections of actively eroding banks in this section will be sloped back to create bankfull benches and reduce near bank stresses. The channel through the middle and lower reach of Cat Creek and UT1 will require construction of a new channel and installation of structures (**Design Sheet 1**). The old ford that forms the transition between the upper and lower reach will be removed.

Dimension

Cat Creek (Swartwout - Upper section)

The existing Cat Creek channel averages 17.5 feet across (bankfull width) with cross-sectional area average of 17.5 square feet. The design channel will be constructed to bankfull target dimensions that are based on reference reach data and regional curve information for a C-type channel under the Rosgen Stream Classification System. The channel will border on a E type with a width-to-depth ratio of 11.8.

Cat Creek (Swartwout Lower section)

The existing Cat Creek channel averages 19.9 feet across (bankfull width) with cross-sectional area average of 16.7 square feet. The revised channel will be constructed to bankfull target dimensions that are based on reference reach data and regional curve information for a C-type channel under the Rosgen Stream Classification System. The channel will border on an E type with a width-to-depth ratio of 11.8.

UT to Cat Creek (UT1)

The UT to Cat Creek channel averages 16.02 feet across with cross-sectional area averaging 20.2 square feet. The revised channel will be constructed to bankfull target dimensions for an C-type channel. The channel will border on a E type with a width-to-depth ratio of 11.9. The dimension used will allow vegetation to progressively "tighten" up the channel so that it becomes an E type channel over time.

Cat Creek (Lower Swartwout- Below Confluence)

The Cat Creek channel below the confluence of UT1 will be designed similar to the middle section but bankfull width and cross-sectional area will be increased to handle the increased flows entering from UT1. This section of the revised channel is approximately 110 feet long and does not warrant a separate set of design parameters. The revised channel will follow parameters from the Waldroop tract for this relatively short length to the end of the reach. The revised channel will be constructed to bankfull target dimensions for an C-type channel. The channel will border on a E type with a width-to-depth ratio of 12. The dimension used will allow vegetation to progressively "tighten" up the channel so that it becomes an E type channel over time.

Pattern

Pattern will be introduced into the stream by increasing the sinuosity of the stream through restoration. Meanders will be introduced into the channel with appropriate radius of curvatures and lengths based on the reference reach data and existing site constraints for an C-type stream channel that borders on an E – type channel. The site has two lateral constraints, the environmentally sensitive area and the nearby wetlands. The sinuosity is designed to match the reference condition and account for these lateral constraints. The second lateral constraint is the existing wetland on the east side of the tract. The proposed stream alignment of Cat Creek and UT1 will minimally impact the wetlands directly, as the alignment and profile is set so that the existing ground is the new floodplain and the limits of construction do not encroach on the wetland. Priority 1 restoration for the stream is important in the area that is adjacent to the wetland in order to limit excavation and improve groundwater hydrology. The resulting increase in base level elevation by approximately 1 foot and the reconnection of the floodplain will promote a more stable and consistent hydrology for the existing wetlands (**Design Sheet 1**). Introduction of these meanders will increase stream length, sinuosity, and habitat while lowering slope and shear stress.

Bed form

The design channel will incorporate riffles and pools to provide bed form found in C and E stream types with gravel bottoms. Pools will be located in the outside of meander bends with riffles in the inflection points between meanders. The degree of bed form alterations will relate to the type of valley the existing channel flows through. The proposed riffles will have a thalweg depth of 2.0 feet. Rock sills and j-hook vanes (log and rock) will be utilized, where appropriate, as grade control structures throughout the proposed channel. Modifications to the bed form will provide stability by the dissipation of energy and improve the in-stream habitat of the channel. Where possible, log structures will be used to provide detritus for benthic organisms.

Structures

At this time, no rock structures are planned in the upper section of Cat Creek because the existing bedrock appears sufficient and would preclude the placement of grade control structures. Root wads will be installed in the meander bend near the access road in the upper reach (**Design Sheet 1**). Rock sills will be installed where needed in the main channel through the lower section of Cat Creek and in UT1. Log and rock j- hook vanes (grade control vanes) will be installed where needed along the lower section of Cat Creek and UT1 to help turn the water, reduce near bank stress, and maintain pool definition. Cross-vanes will be installed after the confluence of the main channel and the tributary. The rock sills, rock vanes, and cross-vanes will be constructed from natural materials such as stone and boulders (blasted).

Shear Stress

Shear stress was checked using The Revised Shield's Diagram for a proposed riffle cross-section. The critical shear stress for the proposed channel has to be sufficient to move the D_{84} of the bed material, which for the existing riffles in the main channel of Cat Creek is coarse gravel. Based on the shear stress calculated, the Revised Shield's Diagram predicts that the main channel can move a particle that ranges from 40-400 mm (very coarse gravel to a small boulder). Because the existing bed material is coarse gravel in the riffles, the proposed stream has the competency to move its bed load according to the Revised Shield's Diagram and preliminary design calculations.

The D_{84} of the existing riffles in UT1 classifies as very coarse gravel. Based on the shear stress calculated, the Revised Shield's Diagram predicts that the tributary channel can move a particle that ranges from 50-500 mm (very coarse gravel to large cobble). Because the existing bed material is very coarse gravel in the riffles, the proposed stream has the competency to move its bed load according to the Revised Shield's Diagram and preliminary design calculations. **Appendix 7** contains the sediment transport calculations and data for each reach.

Flooding Analysis

The USGS regression equations from USGS Fact Sheet 007-00 were used to estimate the following peak discharges (USGS 2002). Along with existing and proposed cross-section, these

discharges were input into HEC-RAS to determine floodwater limits in the 2, 5, 10, 25, 50, and 100-year storms. **Table 9** summarizes the peak discharges for the different storm events.

Flooding analysis was performed to insure that the floodplain is not raised significantly along the stream. The USGS Method for estimating the magnitude and frequency of floods in rural basins was used to estimate the 2, 5, 10, 25, 50, and 100-year peak discharges for the different drainage areas.

Table 9. HEC-RAS Analysis for Swartwout Tract

Site	DA	Q_2 (cfs)	Q_5 (cfs)	Q_{10} (cfs)	Q_{25} (cfs)	Q_{50} (cfs)	Q_{100} (cfs)
Cat Creek, just upstream of UT1	769 acres (1.2 sq. mi.)	153	274	377	535	676	835
Cat Creek at Cat Creek Road Bridge	1,356 acres (2.1 sq. mi)	229	402	549	779	970	1192

7.2.2 Wetland

Hydrologic restoration in the upper field will consist of removing the existing drainpipes and filling or contouring the ditch adjacent to the wetland. Excavation of fill material and the creation of a low broad swale will slow surface drainage and increase hydrologic storage. Swales and contours will be constructed and oriented to allow for additional inputs to the restored areas from overbank flood events.

Hydrologic restoration in the lower field will consist of removing the existing drainpipes located along the toe slope and in the lower swale. Filling of shallow ditches and contouring will complete efforts to restore hydrology. Contouring will allow sheet flow to occur and will include shallow swales to slow surface drainage.

7.3 Waldroop Tract

Stream enhancement is proposed for the Waldroop Tract. Minor stabilization work is proposed on the entire reach. A majority of the reach will receive a slightly expanded riparian buffer. No wetland restoration is proposed for the Waldroop Tract.

7.3.1 Stream

Upper Reach

Enhancement in the upper section will involve installing grade control structures below the equipment crossing and below the bedrock feature to help control bank erosion. Only these two structures are planned in the upper reach on the Waldroop Tract. This reach is proposed for Enhancement Level II which will include fencing and an expanded riparian buffer.

Lower Reach

The fence along the lower section downstream of the barn on the bull pasture side will be moved 15 feet south, away from its existing location and into the bull pasture. This will allow the left bank to be sloped back at a 2:1 slope and the creation of a bankfull bench. Through this section, grade control structures will be installed for grade control, habitat improvement, and to create pools. The cross-vanes will be installed based on the design parameters for pool-to-pool spacing, which ranges from 46 to 173 feet. Since the section is fairly straight and available land is limited for increasing sinuosity, the grade control vanes will help to create pools for a stable bed sequence. This reach is proposed for Enhancement Level 1. **Design Sheets 2 and 3** shows the proposed layout for the Waldroop Tract.

Dimension

Within the Waldroop Tract, Cat Creek averages 22.9 feet wide with a cross-sectional area averaging 39.1 square feet. The design channel will be constructed to bankfull target dimensions for C type channels. The channel will border on an E type with a width-to-depth ratio of 12. The dimension used will allow vegetation to progressively "tighten" up the channel so that it becomes an E type channel over time.

Pattern

Because of the relatively narrow easement in this reach, no changes in pattern are proposed for the Waldroop Tract.

Bed form

A series of cross-vanes will provide bed form for this reach. Pools will be located below the cross-vane and riffles will be above. The proposed riffles in Cat Creek will have a thalweg depth of 2.6 feet.

Structures

Several structure types will be installed in the stream channels. These structures include, rock vanes, cross vanes, rock and log j-hook vanes, and root wads. These structures are placed at appropriate locations to reduce near bank stress, provide for bedform definition and maintenance, provide habitat and detritus for benthic organisms, and promote sediment transport. .

Shear Stress

Shear stress was checked using the Revised Shield's Diagram for a proposed riffle cross-section. The critical shear stress for the proposed channel has to be sufficient to move the D_{84} of the bed material, which for the existing riffles is very coarse gravel. Based on the shear stress calculated, the Revised Shield's Diagram predicts that the stream can move a particle that ranges from 20-200 mm (coarse gravel to large cobble). Because the existing bed material is very coarse gravel in the riffles, the proposed stream has the competency to move its bed load according to Revised

Shield's Diagram and preliminary design calculations. **Appendix 7** contains the sediment transport calculations and data.

Flooding Analysis

The reach undergoing Enhancement Level 1 is relatively short and is tied directly into the Parker Tract restoration. Therefore, a separate HEC-RAS analysis was not conducted on this reach. The HEC-RAS analysis conducted on the Parker Tract includes the lower reach of the Waldroop Tract (Section 7.4.1).

7.3.2 Livestock Watering

Cattle and horses will be restricted from accessing Cat Creek by the installation of new fencing in several areas where they are currently accessible. Water for the horses and cattle will be provided by installation of a watering structure. The exact configuration and type of watering structures have not been determined and is being developed in cooperation with the local Natural Resources and Conservation Service (NRCS) office.

7.3.3 Riparian Buffers

The riparian buffers along Cat Creek will be slightly expanded in several locations through the Waldroop Tract. On the upper portion (above the equipment bridge) the buffer will be expanded but fencing will be installed to restrict livestock from the creek. The riparian buffer in this area will average about 15 to 25 feet. The existing equipment crossing (ford) at the upper end of this reach will remain and new 12-foot gates installed to prevent livestock access to the creek.

Along the lower reach the riparian buffer will be planted within the expanded fence line. The buffer in this area will average 20 feet.

7.4 Parker Tract

Both stream and wetland restoration is proposed for the Parker Tract, which has been significantly altered by construction of the golf course. The parker contains the channelized Cat Creek, 2 channelized tributaries and several acres of depleted and filled wetlands.

7.4.1 Stream

The stream restoration work on the Parker Tract will include restoration of the dimension, pattern, and profile of the main channel and its tributaries. **Design Sheet 4** shows the proposed layout for the stream in order to incorporate the proposed wetland areas discussed in section 7.4.2. The reach will be predominately Priority 1 restoration with Priority 2 restoration on the lower portion due to the need to meet grade of the culvert at Ferguson Road. Grade control structures, bank revetment, and proper pool – riffle sequencing will provide channel stability, improved biological function and properly transport the sediment load.

Dimension

Cat Creek

Within the Parker Tract, Cat Creek averages 18.5 feet wide with a cross-sectional area averaging 40.3 square feet. The design channel will be constructed to bankfull target dimensions for C type channels. Raising the channel base so that it re-connects with the floodplain will aid in alleviating near bank stress during bankfull and greater storm events. The channel will border on a E type with a width-to-depth ratio of 11.9. The dimension used will allow vegetation to progressively "tighten" up the channel so that it becomes an E type channel over time.

UT2

The bankfull width of UT2 averages 8.2 feet with a cross-sectional area average of 12.9 square feet. The design channel will be constructed to bankfull target dimensions for C type channels. Raising the channel base so that it re-connects with the floodplain will aid in alleviating near bank stress during bankfull and greater storm events. The channel will have a width-to-depth ratio of 13.25

UT3

UT3 has a bankfull width average of 6.7 feet and a cross-sectional area average of 6.9 square feet. The design channel will be constructed to bankfull target dimensions for C type channels. Raising the channel base so that it reconnects with the floodplain will aid in alleviating near bank stress during bankfull and greater storm events. The channel will have a width-to-depth ratio of 13.24.

Pattern

Cat Creek

Restoring sinuosity to the channel will provide a pool- riffle sequence that is necessary for energy dissipation and biological function. Pattern will be introduced into the stream by restoring the sinuosity that is appropriate for a channel of this size drainage area and valley type (**Design Sheet 4**). Meanders will be introduced into the channel with appropriate radius of curvatures and lengths based on the reference reach data and existing site constraints for an E/C-type stream channel. The proposed alignment utilizes an adequate riffle length to meet the critical design parameter of the ratio of riffle slope to average water surface slope as derived from the reference reach. This is important for the design and self maintenance of relatively flat pools that function well as energy dissipaters and habitat. A short riffle causes steeper riffle slopes and has the possibility of causing pools to steepen over time as the central tendency of the channel shifts to a flatter riffle slope.

UT2

UT2 will be restored to follow the perceived remnant channel location, as indicated by topographic maps and a corresponding depression in the valley. The proposed re-alignment of the tributary to a more natural and sinuous state will help to reduce stress by dissipating energy in pools and loosing elevation in properly designed riffles. The revised channel will meet Cat Creek at a natural angle and reduce the stresses that Cat Creek currently experiences when the two flows converge. Reference reach ratios provide a predictable stable channel pattern. By matching the critical values of the reference reach, such as meander wave length, radius of curvature ratio, and belt width, the proposed channel will be subject to significantly less erosion. Restoring sinuosity also reduces shear stress in the channel by providing an average water surface slope that is flatter than the valley slope.

UT3

The proposed re-alignment of the tributary to a more natural and sinuous state will help to reduce stress by dissipating energy in pools and loosing elevation in properly designed riffles. The revised channel will meet Cat Creek at a natural angle and reduce the stresses that Cat Creek currently experiences when the two flows converge. Reference reach ratios provide a predictable stable channel pattern. By matching the critical values of the reference reach, such as meander wave length, radius of curvature ratio, and belt width, the proposed channel will be subject to significantly less erosion. Restoring sinuosity also reduces shear stress in the channel by providing an average water surface slope that is flatter than the valley slope.

Bed form

The design channels will incorporate riffles and pools to provide bed form found in E stream types with gravel bottoms. Pools will be located in the outside of meander bends with riffles in the inflection points between meanders. The proposed riffles in Cat Creek will have a thalweg depth of 2.6 feet. The proposed riffles in UT2 will have a thalweg depth of 1.5 feet. Cross vanes and rock sills will be used as grade control structures throughout the main channel while rock sills alone will act as grade control structures on UT2. The cross vanes will be constructed out of natural materials such as boulders and stone. Modifications to the bed form will provide stability and habitat to the channel. The proposed riffles on UT3 will have a thalweg max depth of 1.15 feet

Structures

Several structure types will be installed in the stream channels. These structures include, notched rock sills, rock and log vanes, cross vanes, rock and log j-hook vanes, and root wads. These structures are placed at appropriate locations to reduce near bank stress, provide for bedform definition and maintenance, provide habitat and detritus for benthic organisms, and promote sediment transport. Structures can create problems if placed improperly or too often. This design is a "softer" approach that uses more log material and less structures over all.

Shear Stress

Shear stress was checked using the Revised Shield's Diagram for a proposed riffle cross-section. The critical shear stress for the proposed channel has to be sufficient to move the D_{84} of the bed material, which for the existing riffles is very coarse gravel. Based on the shear stress calculated, the Revised Shield's Diagram predicts that the stream can move a particle that ranges from 20-150 mm (coarse gravel to large cobble). Because the existing bed material is very coarse gravel in the riffles, the proposed stream has the competency to move its bed load according to the Revised Shield's Diagram and preliminary design calculations. **Appendix 7** contains the sediment transport calculations and data.

Flooding Analysis

The USGS regression equations from USGS Fact Sheet 007-00 were used to estimate the following peak discharges (USGS 2002). Along with existing and proposed cross-section, these discharges were input into HEC-RAS to determine floodwater limits in the 2, 5, 10, 25, 50, and 100-year storms. **Table 10** summarizes the peak discharges for the different storm events.

Flooding analysis was performed to insure that the floodplain is not raised significantly along the stream. The USGS Method for estimating the magnitude and frequency of floods in rural basins was used to estimate the 2, 5, 10, 25, 50, and 100-year peak discharges for the different drainage areas.

Table 10. HEC-RAS Analysis for Parker Tract

Site	DA	Q_2 (cfs)	Q_5 (cfs)	Q_{10} (cfs)	Q_{25} (cfs)	Q_{50} (cfs)	Q_{100} (cfs)
Just upstream before UT2 enters Cat Creek from the pond	1,650 acres (2.6 sq. mi.)	263	460	626	877	1099	1347
Just upstream before UT3 enters	1,982 acres (3.1 sq. mi.)	299	521	706	987	1235	1571
Upstream of Ferguson Road Culvert	2,139 acres (3.3 sq. mi.)	315	548	742	1036	1295	1583

7.4.2 Wetland

The Parker Tract has been extensively altered from construction of the golf course. Historically the tract once contained an extensive wetland system. The restoration effort will focus on trying to undo the past golf course alterations and will focus on the area on the north and east side of the creek. The shallow ditch along the northern edge of the property will be plugged at its lower end. Using the bottom of the ditch as a reference elevation, fill material will be excavated. This will allow the seepage from the toe slope to remain on-site instead of discharging directly into the creek. Low swales will be formed parallel to the hill slope to catch and hold the seepage. Any drain tiles or pipes encountered will be removed.

Although groundwater gauges indicate that hydric conditions are currently present, this floodplain area has been extensively altered and is not as wet as it once was. Plugging the ditch and removal of the fill will help return the historic hydrology to the site.

7.5 Preserve Tract

The relatively stable reach of Cat Creek that runs through the Preserve tract is proposed as Enhancement 1. This involves a reestablishment of riparian vegetation, bank stabilization on a stretch of less than 150' in length and the establishment of pools at appropriate intervals, as determined from reference reach data. UT4 is proposed as Restoration (Priority 1) in order to reconnect the channel with its floodplain and restore dimension, pattern and profile of a stable, natural channel of this valley type and drainage area.

7.5.1 Stream

Cat Creek

The Cat Creek channel averages 33.0 feet wide with cross-sectional areas average of 50.2 square feet. The design channel will be constructed to bankfull target dimensions for C-type channels. This reach has been altered by the development of the tract as part of a golf course. However, the channel was not particularly incised and has formed a relatively stable bankfull floodplain. Where stabilization is necessary, typical cross section is used that is derived from reference reach conditions. The proposed typical cross-sections for the channel are provided in **Design Sheet 5 and 6**. The typical cross-sections are not different from the Parker Tract because there is not a significant increase in the drainage area from the lower Parker tract and the Preserver tract.

UT4

The UT4 channel averaged 13.2 feet wide and has an average cross sectional area of 6.2 square feet. This small channel will be restored to natural dimensions for a channel of this valley type and similar drainage area as determined from dimensionless ratios from the appropriate reference reach. A width-depth ratio of 10.48 is proposed for this reach. This geometry corresponds with very low w/d C type channels that border on E type channels. The relatively small drainage area of this reach will allow for a lower width-depth ratio channel to be constructed to transport sediment loads from roadways and upstream agricultural activities.

Pattern

Cat Creek

The existence of herbaceous vegetation along the channel banks is likely to be a significant factor in the relative stability of Cat Creek in the Preserve tract. For this reason, the proposed design has no significant alteration the channel pattern. This reach is too far along with stabilizing itself to make it worth the disturbance that would be required to provide Cat Creek with a more typical sinuosity. The existing sinuosity, with enhancement to the vegetation, and

stabilization of the eroding banks where needed, will provide a stable pattern due to the stream's ample floodplain access.

UT4

Pattern will be introduced into the stream by increasing the sinuosity of the stream through restoration (**Design Sheet 5 and 6**). Meanders will be introduced into the channels with appropriate radius of curvatures and lengths based on the reference reach data and existing site constraints for an C/E-type stream channel. Reference reach ratios provide a predictable stable channel pattern. By matching the critical values of the reference reach, such as meander wave length, radius of curvature ratio, and belt width, the proposed channel will be subject to significantly less erosion. Restoring sinuosity also reduces shear stress in the channel by providing an average water surface slope that is flatter than the valley slope.

Bed Form

Cat Creek

Although this reach is fairly stable, it has very little bedform and indications are that what instability the channel presently experiences is probably due to lack of energy dissipation via pools. For this reason, the proposed enhancement to Cat Creek includes the installation of structures at appropriate intervals to create a pool-pool spacing that is indicated in the reference reach. The design will provide pools for energy dissipation and the maintenance of the pool riffle sequence that make up a stable natural channel. Restoring this stable profile to the channel with minimal construction will improve the channel's stability over long periods of time, improve sediment transport and restore needed habitat and biological function.

UT4

The design channel incorporates riffles and pools to provide bed form found in E stream types with gravel bottoms. Pools are located in the outside of meander bends with riffles of adequate length to loose elevation between the meanders. The proposed riffles in the main channel will have a thalweg depth of 1.1 feet.

Structures

The proposed design uses rock and log j-hook vanes and notched sills to reduce near bank stress and provide pool definition where needed for the Cat Creek channel. Structures are to be placed without disturbing the riparian vegetation and channel sections in between the structures. Rather, the design limits the access to install structures to a perpendicular approach to the channel This will minimize the disturbance to Cat Creek while allowing placement of needed structures to primarily improve bedform. No structures are proposed for UT4 due to the small size of the channel. During construction, the designer may choose to a grade control near the confluence with Cat Creek if flow observations dictate that one is needed.

Shear Stress

Shear stress was checked using the Revised Shield's Diagram for a proposed riffle cross-section. The critical shear stress for the proposed channel has to be sufficient to move the D_{84} of the bed material, which for the existing riffles is coarse gravel. Based on the shear stress calculated, the Revised Shield's Diagram predicts that the stream can move a particle that ranges from 18-200 mm (coarse gravel to large cobble). Because the existing bed material is coarse gravel in the riffles, the proposed stream has the competency to move its bed load according to the Revised Shield's Diagram and preliminary design calculations. **Appendix 7** contains the sediment transport calculations and data for each reach.

Flooding Analysis

(Note: HEC-RAS for proposed will be performed during the design phase once Earth Tech has verified data from the topographic survey that may be in error.) The USGS regression equations from USGS Fact Sheet 007-00 were used to estimate the following peak discharges (USGS 2002). Along with existing and proposed cross-section, these discharges were input into HEC-RAS to determine floodwater limits in the 2, 5, 10, 25, 50, and 100-year storms. **Table 11** summarizes the peak discharges for the different storm events.

Flooding analysis was performed to insure that the floodplain is not raised significantly along the stream. The USGS Method for estimating the magnitude and frequency of floods in rural basins was used to estimate the 2, 5, 10, 25, 50, and 100-year peak discharges for the different drainage areas.

Table 11. HEC-RAS Analyses for Preserve Tract

Site	DA	Q_2	Q_5	Q_{10}	Q_{25}	Q_{50}	Q_{100}
Just upstream of UT4	2,147 acres (3.4 sq. mi.)	315	549	744	1038	1297	1586
End of Preserve Tract and end of project site	2,349 acres (3.7 sq. mi.)	336	584	790	1101	1375	1679

7.5.2 Wetland

The Preserve Tract has been extensively altered by past agricultural and golf course activities. Restoration will consist of removal of large amounts of fill that has been placed on the site. Using the existing wetlands as a reference elevation fill material will be removed to expose buried hydric soil layers. Excavation of fill material around the old pond will expand the existing wetland. The culvert for the tributary above the old pond bed will be removed and the water directed into the wetland. The existing wetlands will be enhanced by planting hardwoods and shrubs.

7.6 Natural Plant Community Restoration

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

Along the tops of the channel banks (riparian area), trees and shrubs will be planted. A mixture of live stakes and salvaged transplants will be utilized to stabilize the banks. In the areas where invasive and exotic species are found during construction and monitoring, control by removal or appropriate herbicides will be implemented to prevent competition with the revegetation efforts. The use of material that is genetically adapted to specific site conditions enhances long-term growth and survival and avoids contaminating the gene pool of the surrounding vegetation with non-adapted ecotypes. Plant material should be native species collected or propagated from material within the mountain physiographic province and within 200 miles north or south latitude if possible.

Reforestation plans are provided in **Designed Sheets 18 through 23** and will focus on 3 separate zones having different hydrologic regimes and will include: streambank vegetation; riparian buffer on well-drained floodplain; and wetlands in poorly drained floodplain. Along the streambank, vegetation will be subjected to fluctuating stream flows and stresses. The riparian buffer on the well-drained portions of floodplain will be subjected to occasional flooding, but because of the well-drained nature will be drier much of the year. The wetlands within the floodplain will be saturated much of the year and will be subjected to shallow ponding for long periods. Vegetation planted in each of these areas will need to survive in different hydrologic conditions. The following paragraphs describe the vegetation treatments for the 3 individual zones.

Streambank Vegetation

Areas around structure installations on Cat Creek and the UT's will be revegetated with live stakes. All banks excluding point bars will be reinforced with live stakes. Species that may be proposed for planting in these areas are listed below.

Tag alder	*Alnus serrulata*
Black willow *	*Salix nigra**
Silky willow	*Salix sericea*
Silky dogwood	*Cornus amomum*
Elderberry	*Sambucus canadensis*
Arrow wood	*Viburnum dentatum*

*Use is limited to only in outer meander bends

Woody vegetation will be planted in November or February and March. Care will be taken to make sure that planting occurs in temperatures above freezing to insure maximum seeling survival.

Riparian Buffer - Well-drained Floodplain

The target community to be planted in the riparian buffer and well-drained floodplain zone is a Low Mountain Alluvial Forest as described in Schafale and Weakley (1990). Bare root material will be used. Planting a mixture of the species listed below will best reflect the character of stream bank vegetation typically found along small low mountain streams. Species that may be proposed for planting in these areas are listed below.

Bitternut hickory	*Carya cordiformis*
Black walnut *	*Juglans nigra*
Green ash	*Fraxinus pennsylvanica*
Northern red oak	*Quercus rubra*
River birch	*Betula nigra*
Slippery elm	*Ulmus rubra*
Sugarberry	*Celtis laevigata*
Sycamore	*Platanus occidentalis*
Spicebush	*Lindera benzoin*
Painted buckeye	*Aesculus sylvatica*
Possum-haw	*Viburnum nudum*

*Use is limited

Wetlands

The target community for the wetlands and poorly drained zone of the floodplain is a Swamp Forest-Bog Complex as described in Schafale and Weakley (1990). This community is described as occurring in "poorly drained bottomland, generally with visible microtopography of ridges and sloughs or depressions. It is also noted that in addition to being seasonally or intermittently saturated that seepage is sometimes present. Their planting is dependent upon availability. Species that may be proposed for planting in these areas are listed below.

Bitternut hickory	*Carya cordiformis*	FAC
Black willow	*Salix nigra*	OBL
Green ash	*Fraxinus pennsylvanica*	FACW
Ironwood	*Carpinus caroliniana*	FACW
Red maple	*Acer rubrum*	FAC
River birch	*Betula nigra*	FACU+
Sycamore	*Platanus occidentalis*	FACW-

Areas outside the proposed 30-foot buffer that are currently vegetated with non-invasive trees or shrubs will remain undisturbed where possible and succession allowed to proceed naturally. Woody vegetation will be planted between November and March to allow plants to stabilize during the dormant period and set roots during the spring season. A minimum of 680 stems per

acre will be planted in portions of the buffer that have been disturbed by construction activities. No planting or disturbance is allowed within the environmentally sensitive area on the Swartwout Tract.

On the Waldroop Tract the middle portion of the riparian buffer will consist of alder, elderberry, and black willow. The riparian vegetation will be periodically trimmed to an elevation of 3 to 5 feet to allow visual access to the horse pasture from the Waldroop residence. This is necessary for safety. Additionally, elderberry will be planted throughout the riparian buffer on the Waldroop Tract.

7.7 On-site Invasive Species Management

Fescue is present in old pastureland throughout the site and can hinder the establishment of riparian buffer vegetation. Specifications for fescue eradication will be included in the Special Provisions section of the bid document. Kudzu is also beginning to encroach onto the Preserve Tract along Ferguson Road. With roots that can extend to 9 feet below the soil surface and a potential growth rate of one foot per day, kudzu has the potential to overwhelm a newly planted site if not adequately controlled. Regular, aggressive management of this exotic invasive vine will be required. Management should begin with the site preparation stage and continue through the 5-year monitoring period at a minimum. An additional 5 years of aggressive management may be necessary to completely eradicate the viable propagules. Management techniques will include an initial site preparation burn, painting cut stumps with an appropriate herbicide such as glyphosate, sifting stockpiled soil to remove root fragments, and monitoring the project area monthly April through November to spray sprouts with glyphosate.

8.0 PERFORMANCE CRITERIA

The following section provides both the stream and wetland monitoring for the proposed restoration. The stream will be monitored to insure that it is stable while the wetland will be monitored to determine if it meets the hydrological requirements. Vegetation will also be monitored.

The monitoring report will follow the most recent EEP guidelines at the time monitoring is initiated. The report will discuss the current years' results and a discussion of any changes that have occurred on the restoration site. The relative significance of these changes will be discussed in detail and a maintenance plan will be recommended if applicable. The current data overlaid over the previous data and a photo log showing successive photos will be included

8.1 Streams

Monitoring of the stability of the channel is recommended to occur after the first growing season and should continue annually for a period of 5 years or until two bankfull events have been documented. Bankfull events must be documented during separate monitoring years.

The dimension, pattern, and profile of the stream should show no radical change during the 5-year monitoring period. To determine this, the longitudinal profile and cross-sections will be re-surveyed annually. Cross-sections will be overlaid to verify no significant change in the dimension from year to year. Similarly, the longitudinal profile will be overlaid to confirm a stable bed profile, i.e. riffle pool spacing should remain fairly constant and there should be a general lack of aggradation and degradation.

8.2 Wetlands

Monitoring of the wetland restoration site will be performed for 5 years or until success criteria are met. Monitoring is proposed of both vegetation and hydrology.

Monitoring of vegetation will follow protocols established in the most recent version of the Carolina Vegetative Survey-EEP Protocol. Sample plot distribution will be correlated with the hydrological monitoring locations to help correlate data between vegetation and hydrology parameters.

Success will be determined by survival of target species within the sample plots. A minimum of 260 trees/acre must survive for at least five years after initial planting. At least six different representative tree species should be present on the entire site. If the vegetative success criteria are not met, the cause of failure will be determined and an appropriate corrective action will be taken.

Monitoring gauges will be installed in enhancement/restoration areas to monitor site hydrology. Monitoring gauges will be installed in accordance with USACE guidelines (USACE 1993b). The number and location of the gauges will be determined after final design.

The hydrologic goal is for the soil to be ponded, flooded, or saturated within 12 inches of the surface for at least 8 percent of the growing season under average climatic conditions.

8.3 Riparian Vegetation

Monitoring of the riparian vegetation outside of the wetland restoration areas will be performed. Monitoring protocols and success criteria will be the same as for the wetland areas.

8.4 Photograph Documentation

Photographs will be taken on an annual basis and compared to the as-built photos. The photos will be used to make a qualitative assessment of channel aggradation or degradation, bank erosion, success of riparian vegetation, effectiveness of erosion control measures, and the presence or absence of developing in-stream bars. Any significant changes from the as-built conditions will be discussed and highlighted in the report.

9.0 REFERENCES

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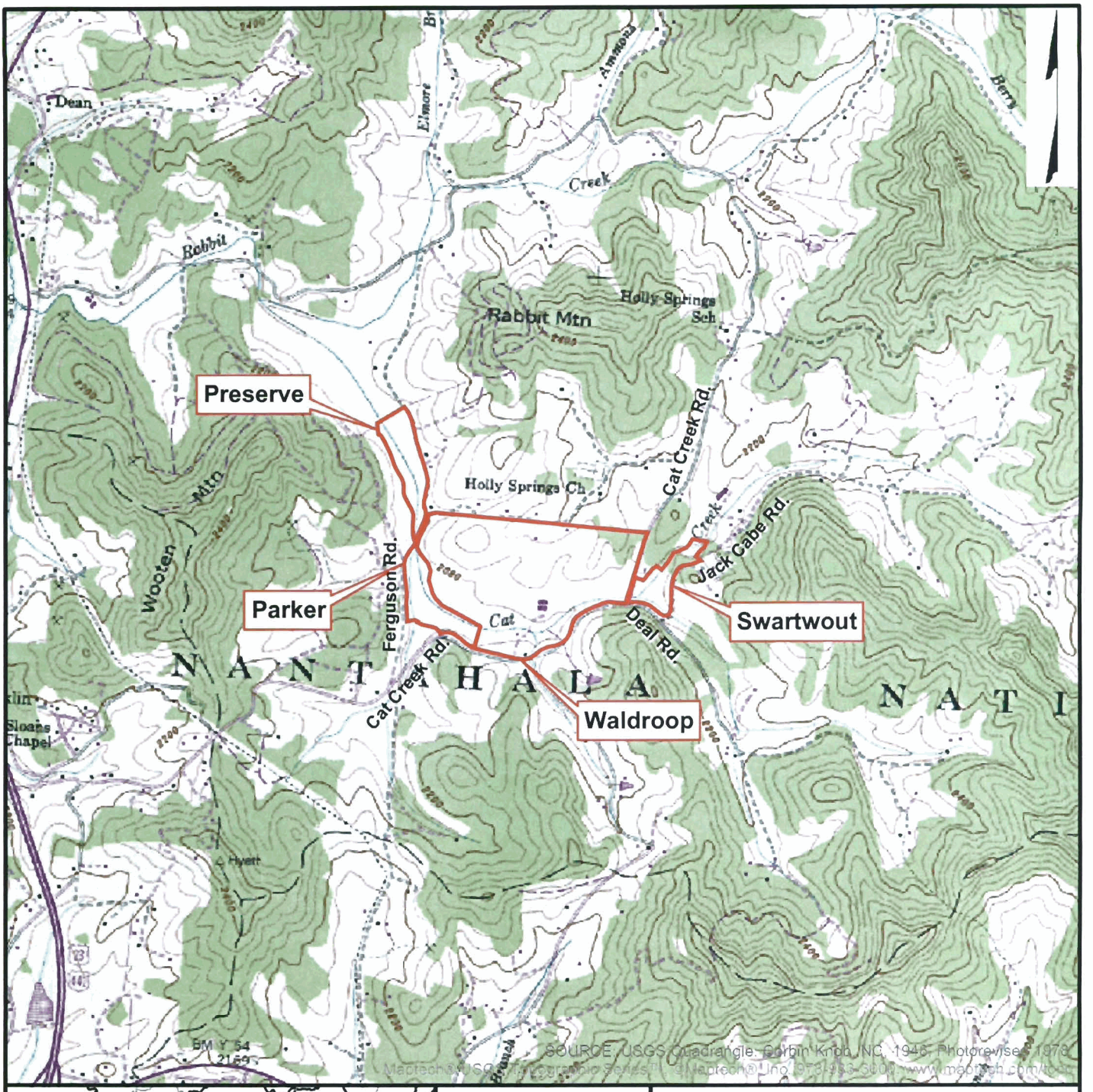
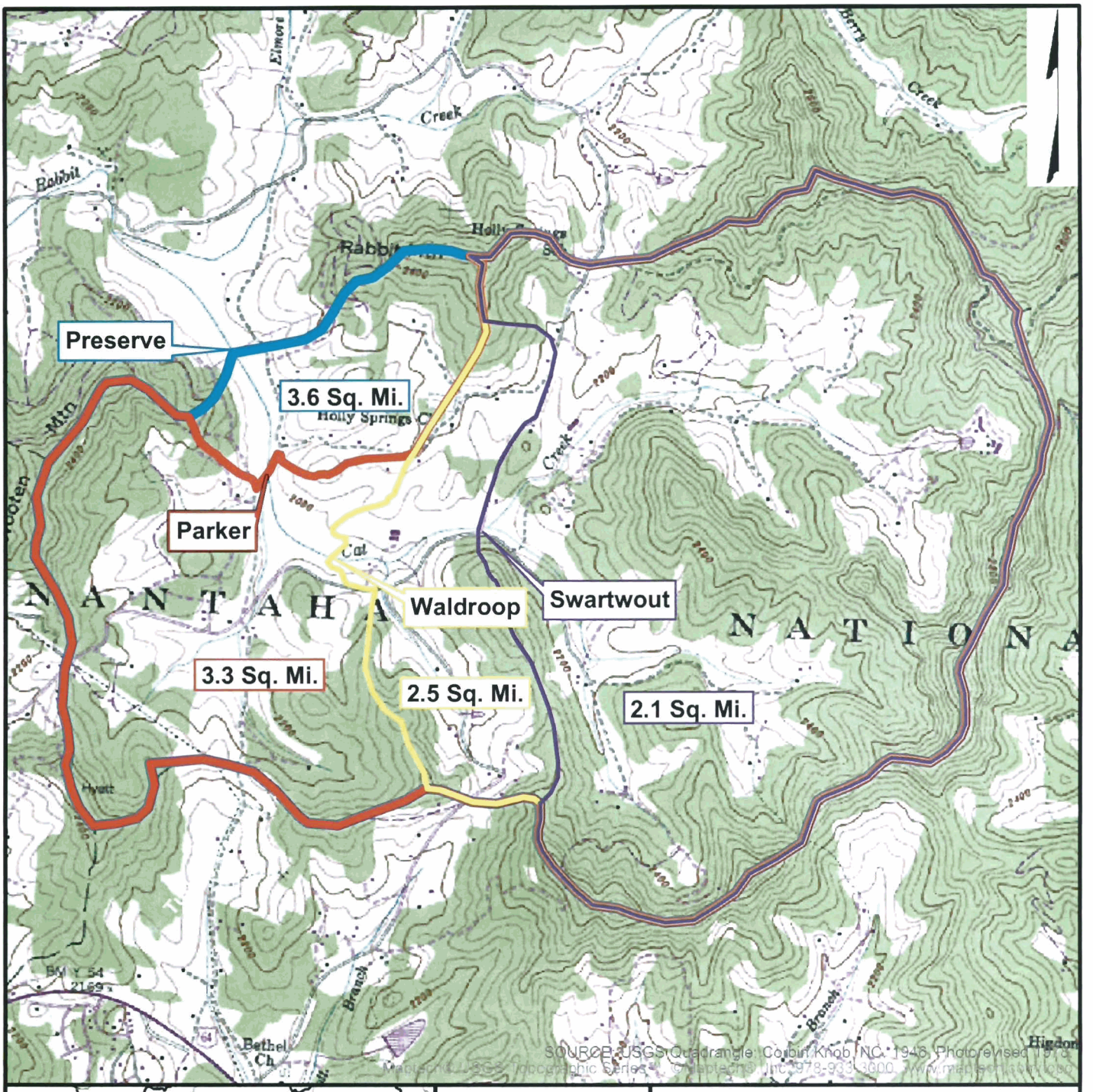


Ecosystem Enhancement PROGRAM

FIGURE 1
VICINITY MAP

Cat Creek Restoration Plan
Macon County, North Carolina

2,000 1,000 0 2,000 4,000 Feet



Ecosystem Enhancement PROGRAM

FIGURE 2
WATERSHED MAP

Cat Creek Restoration Plan
Macon County, North Carolina

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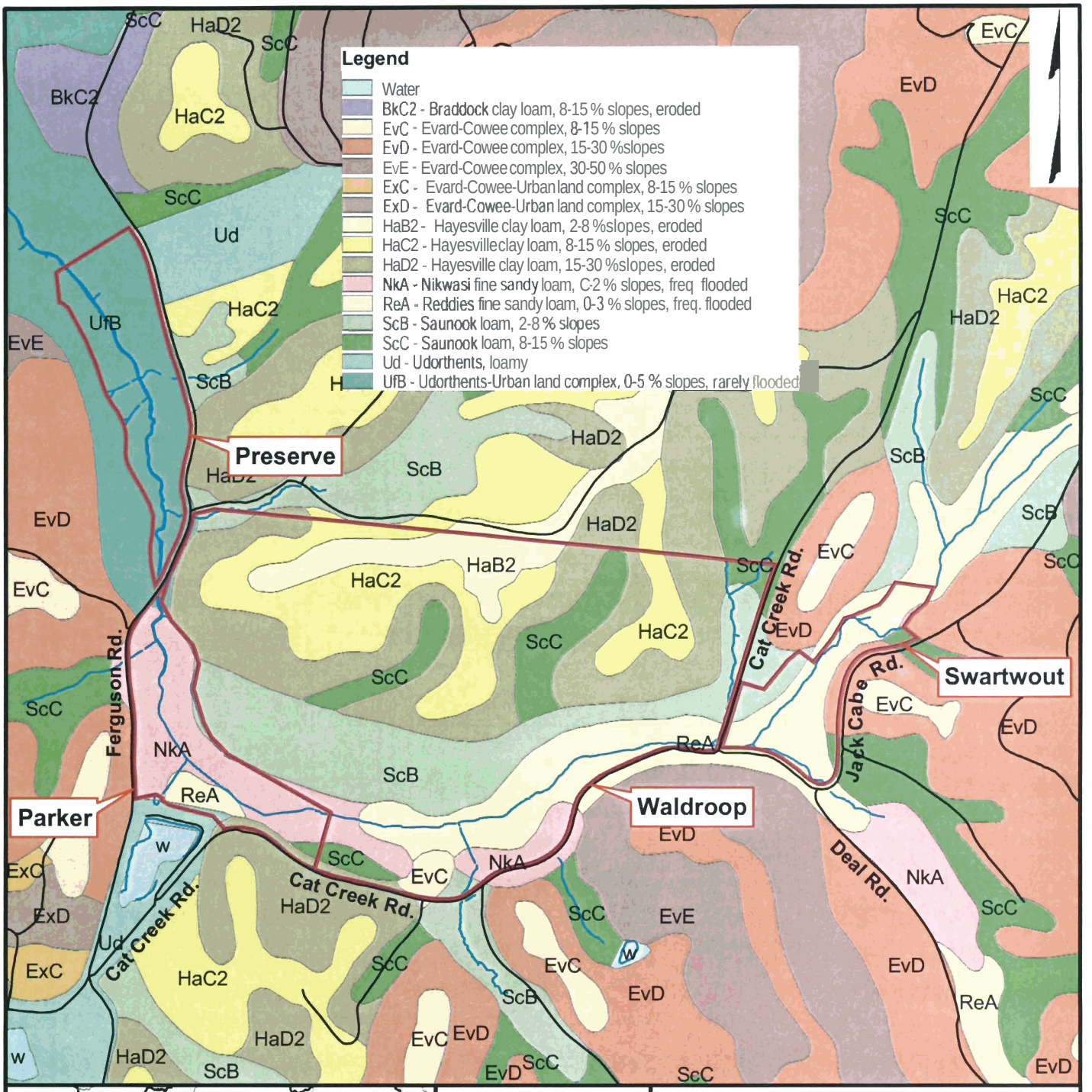
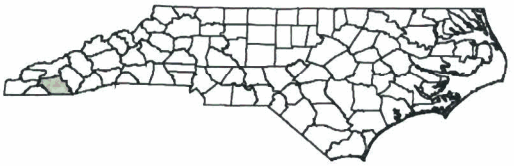




Ecosystem Enhancement Program

FIGURE 3
NRCS SOIL SURVEY MAP

Cat Creek Restoration Plan
Macon County, North Carolina

750 375 0 750 1,500 Feet

K:\16781\GIS\mxd\MitPlan\mxd\05_ExCondSwat.mxd 7/04

BEGIN PROJECT

SWARTWOUT TRACT

END SWARTWOUT

WALDROOP TRACT

Cat Creek Road

Lower

Upper

Jack Cabe Road

Riding Ring

Environmentally Sensitive Area

Main Channel

Cat Creek

UT1

UT

Deal Road

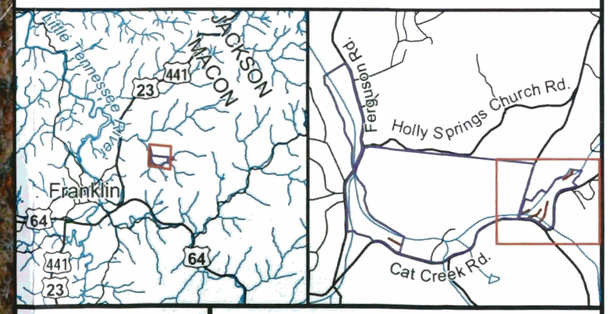
CS 1
CS 2
CS 3
CS 4
CS 5
CS 6
STA. 2+72
STA. 0+77.5

S1
S2
S3
S4
S5
S6
S7
S8
S9
S10

Legend

- Gage
- Existing Fence
- Drain Tiles
- Road
- Bridge
- Culvert
- Stream
- Index Contour (5-Foot Interval)
- Property Line
- Jurisdictional Wetland
- Environmentally Sensitive Area
- Existing Cross Sections
- Existing Long Pro

0 75 150 300 450 Feet

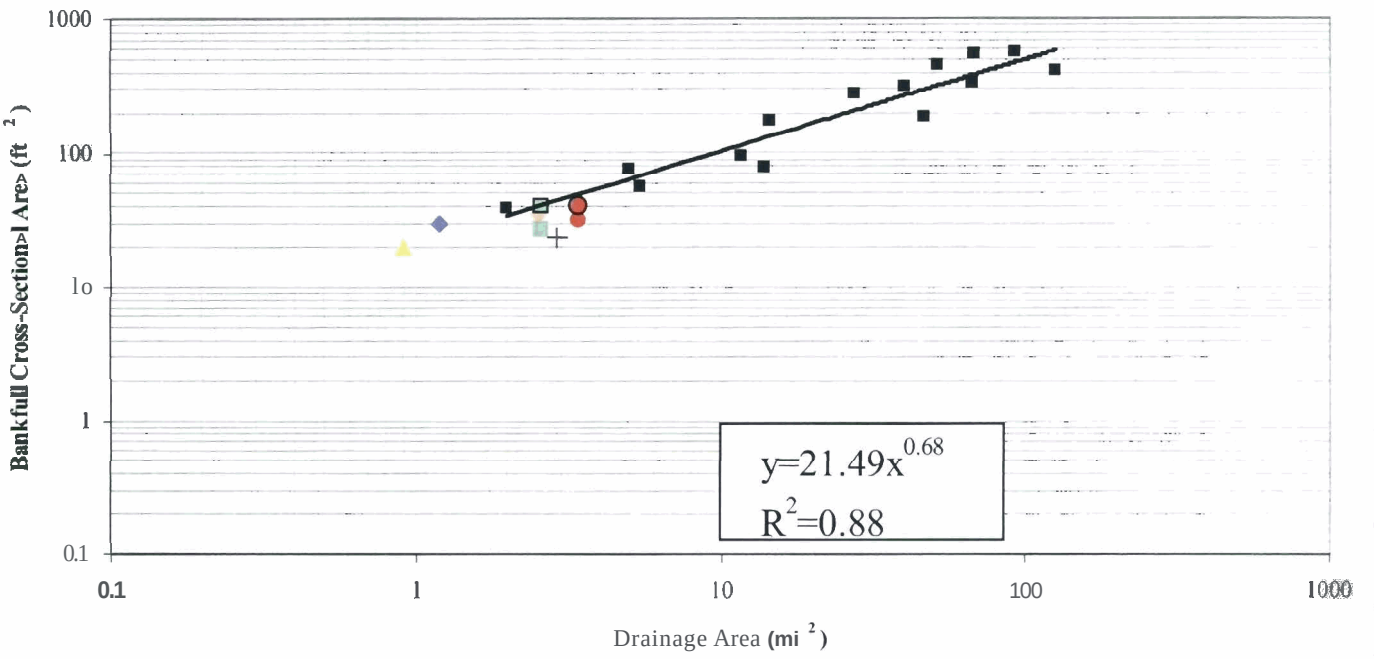


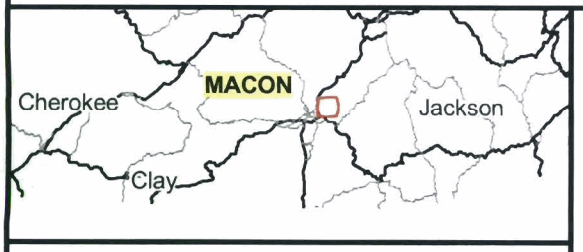
Ecosystem Enhancement PROGRAM

FIGURE 4
SWARTWOUT TRACT
EXISTING CONDITIONS

Cat Creek Restoration Plan
Macon County, North Carolina

North Carolina Rural Mountain Regional Curve





Ecosystem Enhancement PROGRAM

FIGURE 5
NORTH CAROLINA MOUNTAIN REGIONAL CURVE

Cat Creek Restoration Plan
Macon County, North Carolina

BEGIN WALDROOP

Upper

Cattle Pasture

Equipment Crossing

Hay Fields

CS7

Horse Pasture

Cat Creek

Cattle Pasture

Bridge

Cattle Crossing

Lower

Barn

Spring House

Cat Creek Rd.

WALDROOP TRACT

CS8

CS9

Bull Pasture

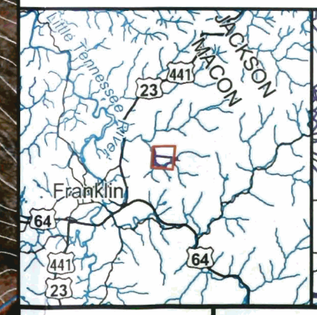
Bethel Church Rd.

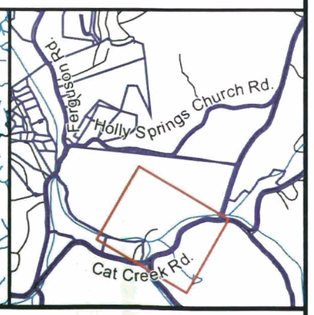
END WALDROOP

Legend

- Road
- Bridge
- Culvert
- Building
- Stream
- Index Contour (5-Foot Interval)
- Property Line
- Jurisdictional Wetland
- Existing Cross Sections
- Existing Long Pro
- Existing Fencing

0 75 150 300 450 Feet





Ecosystem Enhancement PROGRAM

FIGURE 6
WALDROOP TRACT
EXISTING CONDITIONS

Cat Creek Restoration Plan
Macon County, North Carolina

END PARKER

UT3

CS 13

Ditch

1

2

WALDROOP PROPERTY

Main Channel

UT2

3

CS 11

CS 10

CS 12

4

Ferguson Rd.

PARKER TRACT

BEGIN PARKER

Wooden Bridge

CS 8

CS 9

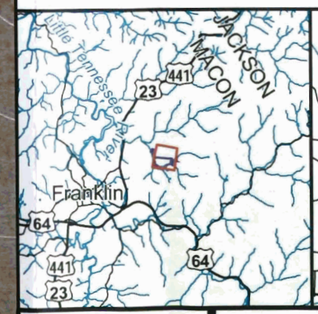
WALDROOP TRACT

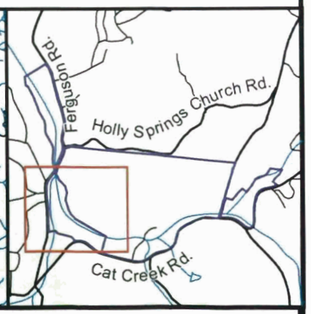
Cat Creek Road

Legend

- Gage
- Road
- Bridge
- Culvert
- Building
- Stream
- Index Contour (5-Foot Interval)
- Property Line
- Jurisdictional Wetland
- Existing Cross Sections
- Existing Long Pro
- Drain Tiles

0 75 150 300 450 Feet





Ecosystem Enhancement Program

FIGURE 7
PARKER TRACT
EXISTING CONDITIONS

Cat Creek Restoration Plan
Macon County, North Carolina

K:\67812\GIS\ArcMap\Plan\Final111_ExCond2reserve.mxd 7/04

END PROJECT

CS 17

Cat Creek

Old Pond Bed

Drainage

Drainage

PRESERVE TRACT

Ferguson Rd

Holly Springs Church Rd.

UT 4

CS 15

CS 16

CS 14

WALDROOP PROPERTY

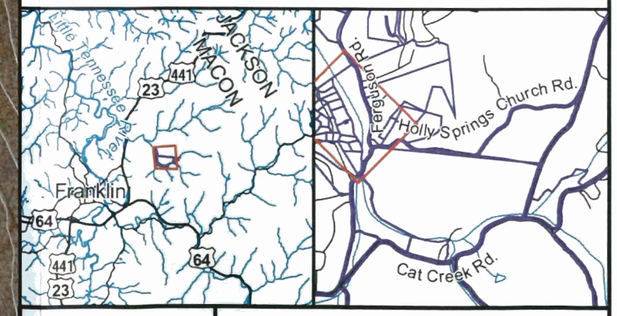
BEGIN PRESERVE

Omega Hills Rd.

Legend

- Road
- Bridge
- Culvert
- Building
- Stream
- Index Contour (5-Foot Interval)
- Property Line
- Jurisdictional Wetland
- Existing Cross Sections
- Existing Long Pro
- Bedrock Locations

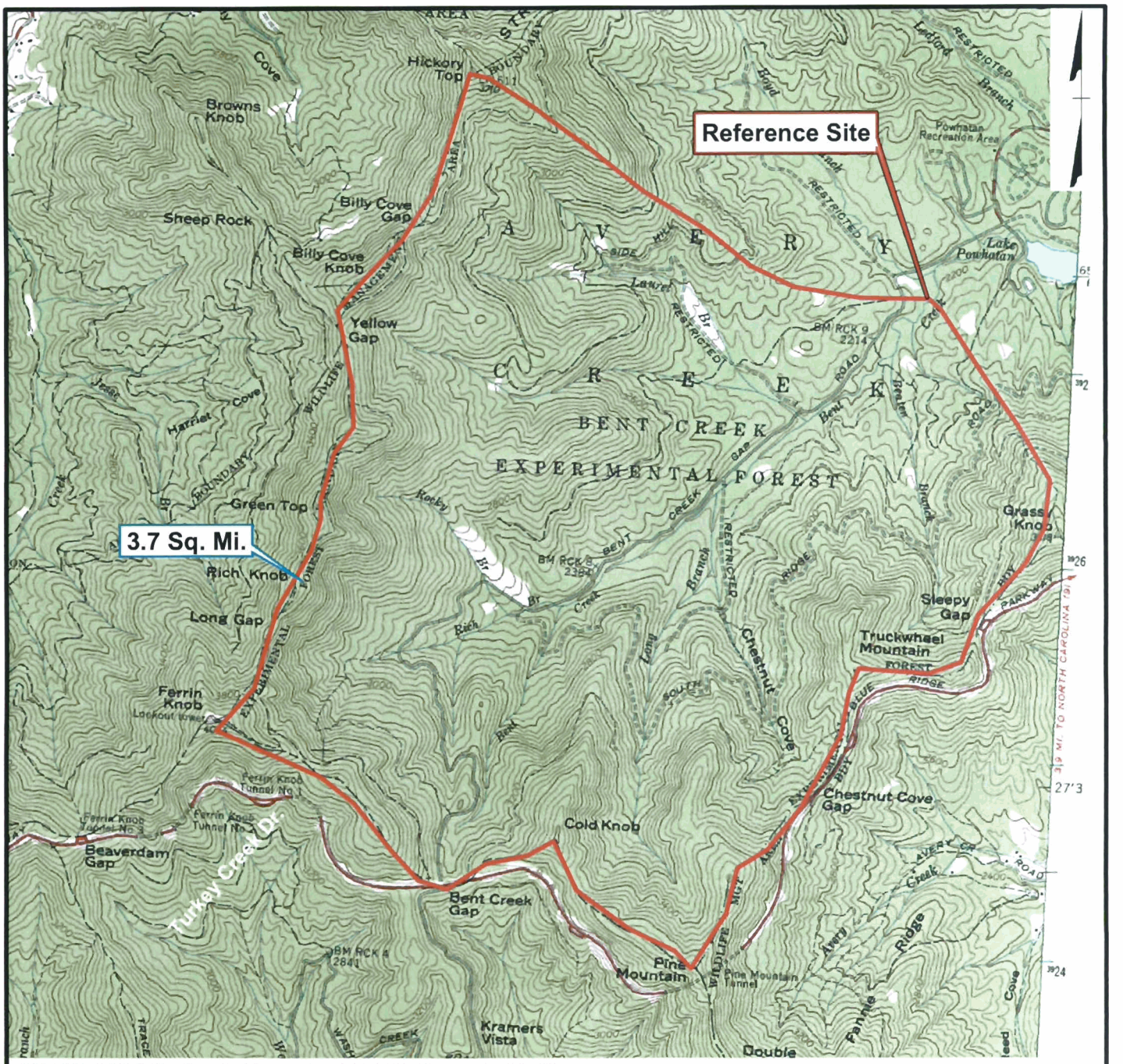
0 75 150 300 450 Feet



Ecosystem Enhancement PROGRAM

FIGURE 8
PRESERVE TRACT
EXISTING CONDITIONS

Cat Creek Restoration Plan
Macon County, North Carolina



SOURCE: USGS Quadrangle: Waynesville, NC, 1941, Photorevised 1979.
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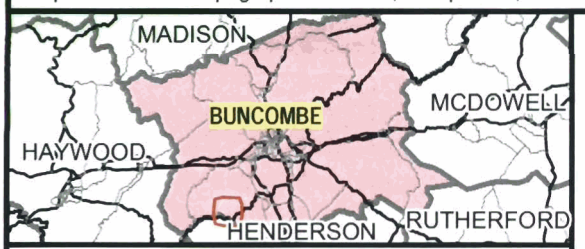
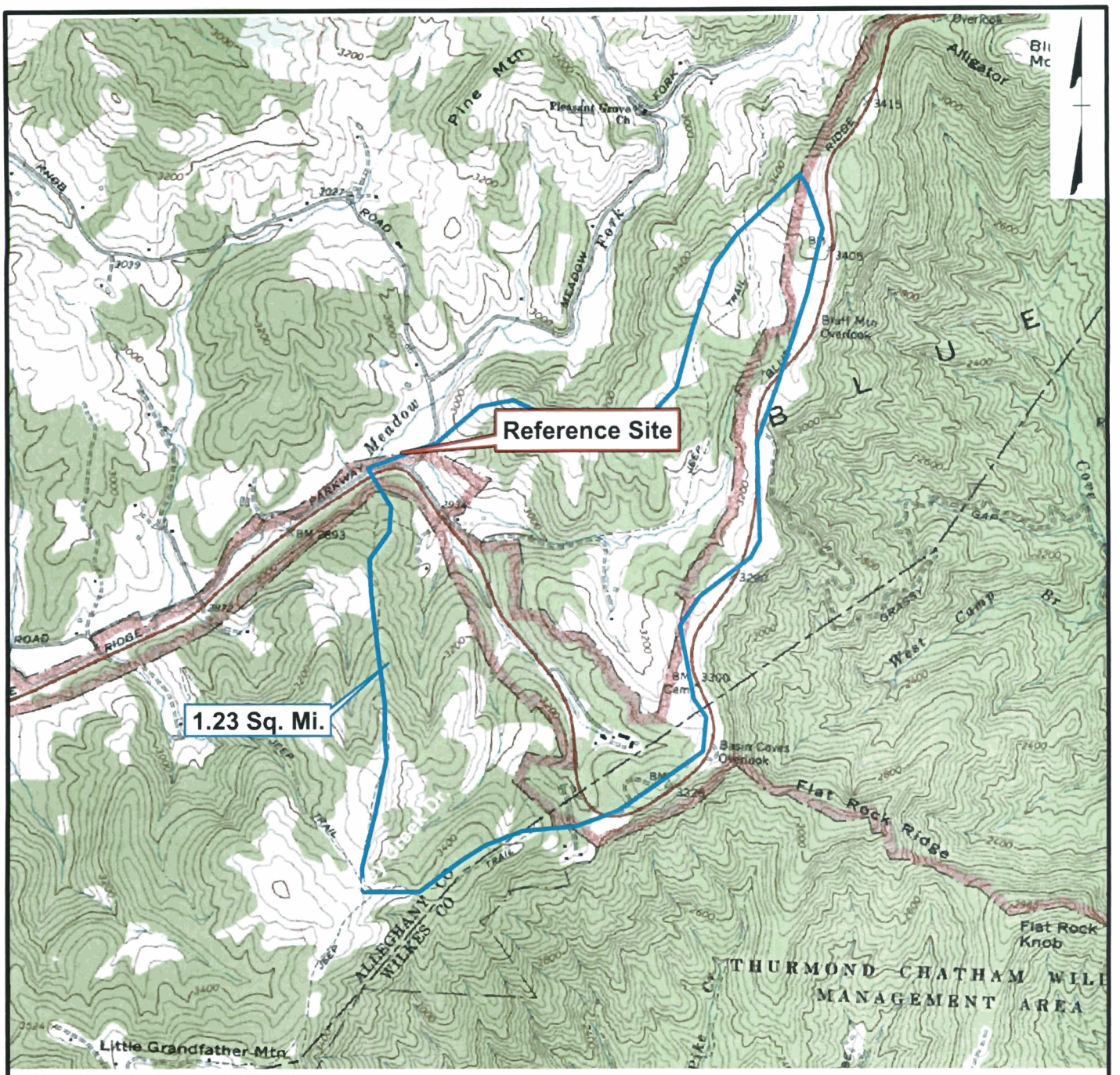


Ecosystem Enhancement PROGRAM

FIGURE 9
REFERENCE REACH
BENT CREEK

Cat Creek Restoration Plan
Macon County, North Carolina

2,000 1,000 0 2,000 4,000 Feet



SOURCE: USGS Quadrangle: Whitehead
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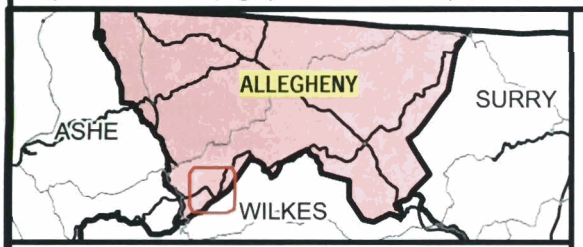
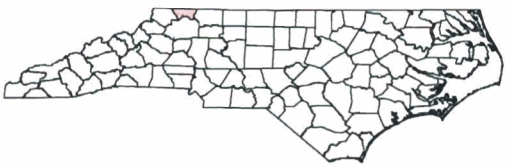




Ecosystem Enhancement PROGRAM

FIGURE 10
REFERENCE REACH
UT TO MEADOW FORK

Cat Creek Restoration Plan
Macon County, North Carolina

2,000 1,000 0 2,000 4,000 Feet

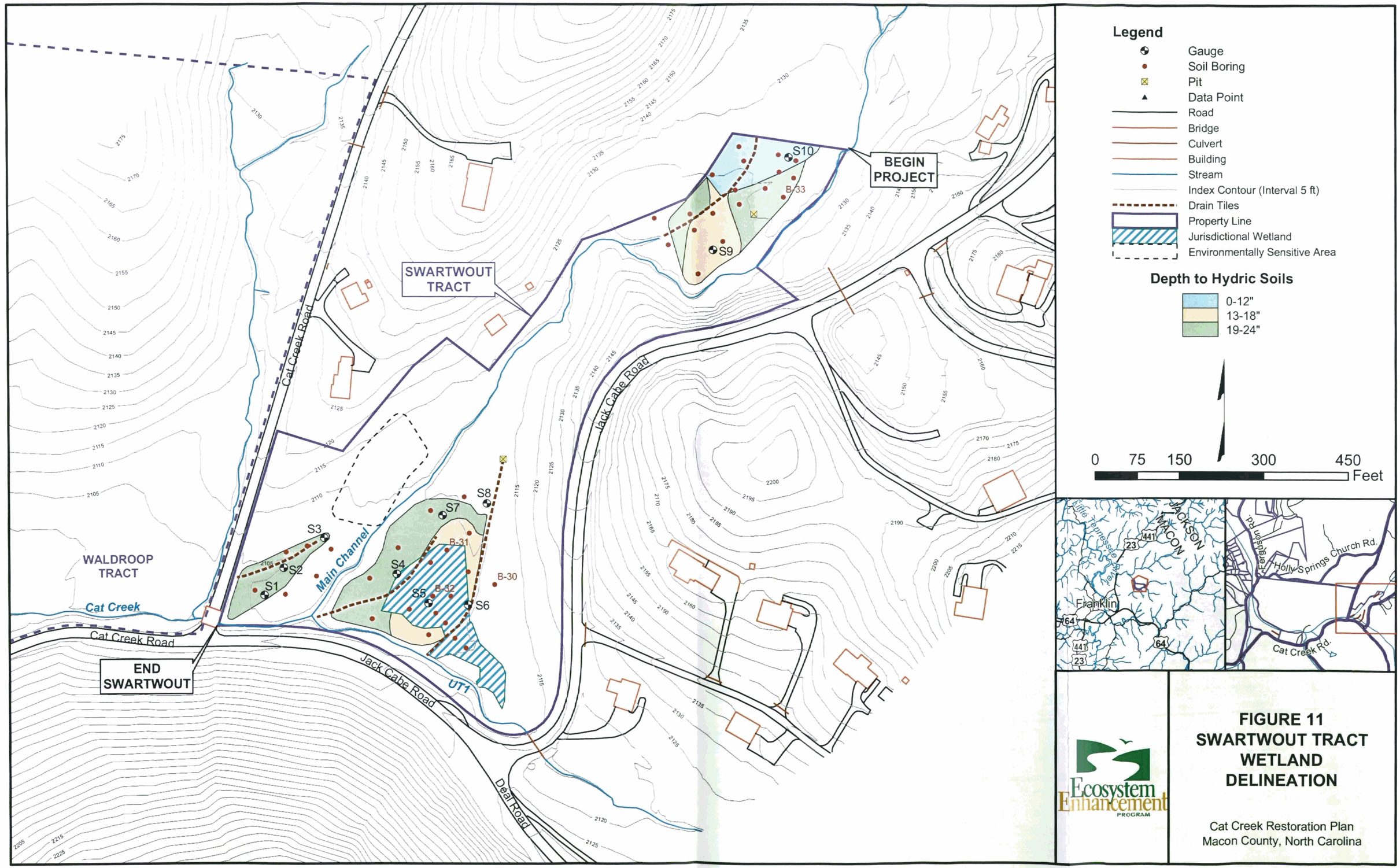


FIGURE 11
SWARTWOUT TRACT
WETLAND
DELINEATION

Cat Creek Restoration Plan
Macon County, North Carolina

END PARKER

Old Tee

UT3

DP2

DP1

1

2

3

4

DP3

Old Green

WALDROOP PROPERTY

Ferguson Rd

UT2

Main Channel

PARKER TRACT

Wooden Bridge

BEGIN PARKER

Old Green

WALDROOP TRACT

Cat Creek Road

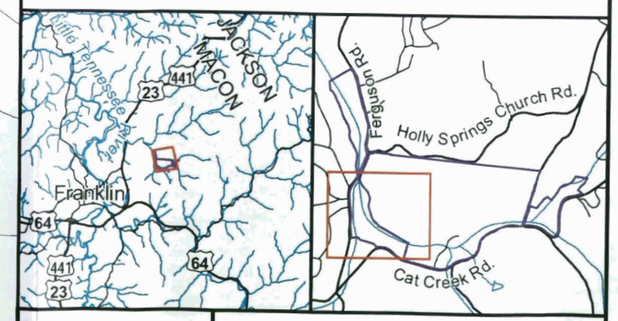
Legend

- Gauge
- Soil Boring
- Soil Pit
- Data Point (DP)
- Road
- Bridge
- Culvert
- Building
- Stream
- Index Contour (Interval 5 ft)
- Drain Pipe
- Property Line
- Jurisdictional Wetland

Depth of Fill over Hydric Soils

- 0-12"
- 13-18"
- 19-24"
- >24"

0 75 150 300 450 Feet



Ecosystem Enhancement PROGRAM

FIGURE 12
PARKER TRACT WETLAND DELINEATION

Cat Creek Restoration Plan
Macon County, North Carolina

END PROJECT

PRESERVE TRACT

BEGIN PRESERVE

Cat Creek

Old Pond Bed

DP4

DP5

UT4

Ferguson Rd.

Holly Springs Church Rd.

Omega Hills Rd.

WALDROOP PROPERTY

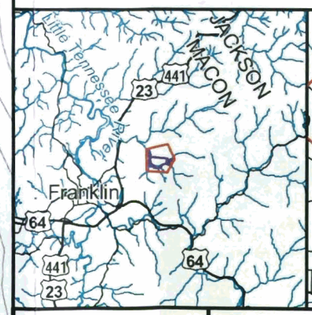
Legend

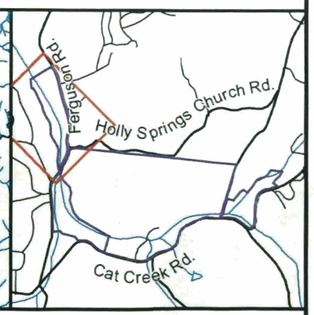
- Soil Boring
- Soil Pit
- Data Point (DP)
- Road
- Bridge
- Culvert
- Building
- Stream
- Index Contour (Interval 5 ft)
- Drain Tiles
- Property Line
- Jurisdictional Wetland

Depth of Fill over Hydric Soils

- 0-12"
- 13-18"
- 19-24"
- >24"

0 75 150 300 450 Feet

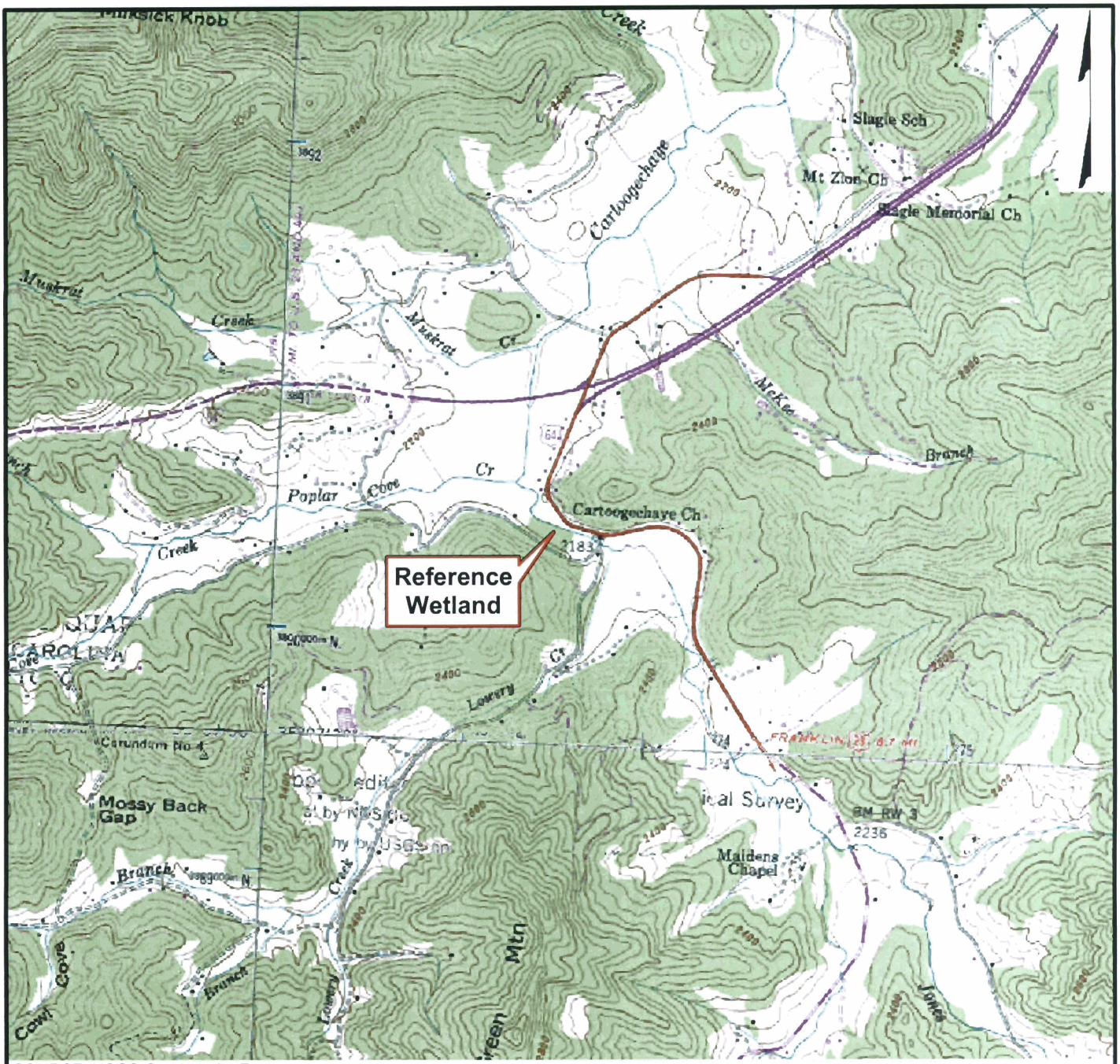




Ecosystem Enhancement PROGRAM

FIGURE 13
PRESERVE TRACT WETLAND DELINEATION

Cat Creek Restoration Plan
Macon County, North Carolina



SOURCE: USGS Quadrangle: Franklin, NC, 1946, PR 1978; Prentiss, NC, 1946, PR 1978; Rainbow Springs, NC, 1957, PR 1978; Wayah Bald, NC, 1957, PR 1978.
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Ecosystem Enhancement PROGRAM

FIGURE 14
REFERENCE WETLAND
CARTOOGECHAYE CREEK

Cat Creek Restoration Plan
Macon County, North Carolina

2,000 1,000 0 2,000 4,000 Feet

SWARTWOUT TRACT

NC GRID NAD 83/93

BEGIN UPPER SWARTWOUT

KEEP THIS FENCE

REMOVE 4S FENCE

WETLAND RESTORATION AREA

REMOVE WOODEN FENCE

RESHAPE BANK AND CHANNEL AT DIRECTION OF DESIGN ENGINEER

REMOVE 15" CMP AND 50 FT DRAIN TILES

INSTALL FENCE

INSTALL BRUSH MATRESS

REMOVE AND REPLACE FENCE AS NECESSARY

ROOT WAD AREA (TYP.)

INSTALL BRUSH MATRESS (TYP.)

KEEP FENCE

STOP FENCE REMOVAL

END UPPER SWARTWOUT
BEGIN LOWER SWARTWOUT

CROSS PIPE DISCHARGES INTO UT SWARTWOUT

COMBO LOG VANE (TYP.)

REMOVE DRAINAGE TILES

NOTCHED SILL (TYP.)

INSTALL BRUSH MATRESS (TYP.)

ROOT WAD AREA (TYP.)

WETLAND RESTORATION AREA

FILL EXISTING CHANNEL

ENVIRONMENTALLY SENSITIVE AREA KEEP OUT

ROOT WAD AREA (TYP.)

FILL EXISTING CHANNEL

CHANNEL PLUG (TYP.)

ROCK CROSS VANE

REMOVE DRAINAGE TILES

MATCHLINE SHEET 2

END LOWER SWARTWOUT

CAT CREEK ROAD SR 1357

LEGEND

- LOG VANE
- COMBO LOG VANE
- ROCK CROSS VANE
- NOTCHED SILL
- ROOT WAD
- JURISDICTIONAL WETLANDS (WLB)
- BRUSH MATTING
- PROPOSED WETLANDS ENHANCEMENT
- PROPOSED WETLAND RESTORATION
- PROPERTY LINE BOUNDARY
- PROPOSED THALWEG
- PROPOSED BANKFULL
- DRAINAGE TILES
- FENCING

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

NO	REVISIONS	DRN	CHK	DATE

HORIZONTAL SCALE
50 0 50 100

EarthTech
A Tyco International Ltd. Company
701 Corporate Center Drive, Suite 475 Raleigh NC 27607
Phone (919) 854-6200 Fax (919) 854-6259

CAT CREEK STREAM & WETLAND RESTORATION
MACON COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

DESIGN SHEET 1

DATE	7/27/2007
PROJECT NO	92531
FILENAME	
SHEET NO	1
DRAWN BY	
CHKD BY	

USER: larry.lewell
DGN: q:\92531\coad\restoration plan\92531_design_sheet1.dgn
DATE: 7/27/2007

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WALDROOP TRACT

MATCHLINE SHEET 1

MATCHLINE SHEET 3

BRUSH MATTRESS (TYP)

ROOT WAD AREA (TYP)

FILL EXISTING CHANNEL

CHANNEL PLUG (TYP)

ROCK CROSS VANE

REMOVE DRAINAGE TILES

RESTORATION AREA

CAT CREEK ROAD SR 1603

MOVE FENCE AS NEEDED FOR CONSERVATION EASEMENT

INSTALL 6 STRAND BARBED WIRE FENCE

12' GATE

INSTALL PERMANENT EQUIPMENT CROSSING

INSTALL VANES AT DIRECTION OF DESIGN ENGINEER

CAT CREEK

LEGEND

- LOG VANE
- COMBO LOG VANE
- ROCK CROSS VANE
- NOTCHED SILL
- ROOT WAD
- JURISDICTIONAL WETLANDS
- BRUSH MATTING
- PROPOSED WETLANDS ENHANCEMENT
- PROPOSED WETLAND RESTORATION
- PROPERTY LINE BOUNDARY
- PROPOSED THALWEG
- PROPOSED BANKFULL
- DRAINAGE TILES
- CONSERVATION EASEMENT
- FENCING

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

NO	REVISIONS	DRN	CHK	DATE

HORIZONTAL SCALE
50 0 50 100

EarthTech
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Phone: (919) 854-6200 Fax: (919) 854-6259

CAT CREEK STREAM & WETLAND RESTORATION
MACON COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

DESIGN SHEET 2

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DATE: 7/27/2007

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WALDROOP TRACT

NC GRID NAD 83/95

CAT CREEK ROAD SR 1513

SR 1513

CAT CREEK RD

MATCHLINE SHEET 2

MATCHLINE SHEET 4

REMOVE AND REPLACE FENCE AS NECESSARY FOR ACCESS

INSTALL 6 STRAND BARBED WIRE FENCE ALONG CONSERVATION EASEMENT BOUNDARY

COMBO LOG VANE (TYP.)

REMOVE FENCE

REMOVE DRAIN TILES

FILL EXISTING CHANNEL

CAT CREEK

INSTALL 12' GATE

INSTALL 6 STRAND BARBED WIRE FENCE

INSTALL 12' GATE

INSTALL 6 STRAND BARBED WIRE FENCE AS NECESSARY

COMBO LOG VANE (TYP.)

LOG VANE

INSTALL 6 STRAND BARBED WIRE FENCE

INSTALL VANES AT DIRECTION OF DESIGN ENGINEER

LEGEND

- LOG VANE
- COMBO LOG VANE
- ROCK CROSS VANE
- NOTCHED SILL
- ROOT WAD
- JURISDICTIONAL WETLANDS
- BRUSH MATTING
- PROPOSED WETLANDS ENHANCEMENT
- PROPOSED WETLAND RESTORATION
- PROPERTY LINE BOUNDARY
- PROPOSED THALWEG
- PROPOSED BANKFULL
- DRAINAGE TILES
- CONSERVATION EASEMENT
- FENCING

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

NO	REVISIONS	DRN	CHK	DATE

HORIZONTAL SCALE
100 50 0 50

EarthTech
A Tyco International Ltd. Company
701 Corporate Center Drive, Suite 475 Raleigh, NC 27607
Phone (919) 854-6200 Fax (919) 854-6259

CAT CREEK STREAM & WETLAND RESTORATION
MACON COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

DESIGN SHEET 3

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DATE: 7/27/2007

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PARKER TRACT

INSTALL BRUSH MATTRESS (TYP.)

NOTCHED SILL (TYP.)

ROOT WAD (TYP.)

FILL EXISTING CHANNEL

COMBO LOG VANE (TYP.)

INSTALL BRUSH MATTRESS (TYP.)

WETLAND RESTORATION AREA

WETLAND SWALE EL 2070

WETLAND SWALE 1 EL 2070.5

WETLAND SWALE 2 EL 2069

CHANNEL PLUG (TYP.)

REMOVE DRAIN TILES

LOG VANE (TYP.)

ROCK CROSS VANE (TYP.)

END WALDROOP
BEGIN PARKER

END PARKER

MATCHLINE SHEET 3

MATCHLINE SHEET 5

CAT CREEK

AERIAL POWER LINES

FERGUSON ROAD SR 1001

SR 1510

LEGEND

- LOG VANE
- COMBO LOG VANE
- ROCK CROSS VANE
- NOTCHED SILL
- ROOT WAD
- JURISDICTIONAL WETLANDS
- BRUSH MATTING
- PROPOSED WETLANDS ENHANCEMENT
- PROPOSED WETLAND RESTORATION
- PROPERTY LINE BOUNDARY
- PROPOSED THALWEG
- PROPOSED BANKFULL
- DRAINAGE TILES
- CONSERVATION EASEMENT
- FENCING

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

NO	REVISIONS	DRN	CHK	DATE

HORIZONTAL SCALE
50 0 50 100

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CAT CREEK STREAM & WETLAND RESTORATION
MACON COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

DESIGN SHEET 4

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DRAWN BY	
CHKD BY	

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DATE: 7/27/2007

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PRESERVE TRACT

NC GRID
NAD 83/95

MATCHLINE SHEET 4

MATCHLINE SHEET 6

PRESERVE DRIVE

FERGUSON ROAD SR 1507

RESHAPE BANK AT CHANNEL

EXISTING BEDROCK AREAS

NOTCHED SILL (TYP.)

ROOT WAD AREA (TYP.)

WETLAND RESTORATION AREA

EDGE OF WETLAND EL 2060.00'

STRUCTURES ARE TO BE BUILT IN EXISTING CHANNEL

REMOVE PIPE

STEP POOL

COMBO LOG VANE (TYP.)

AERIAL POWER LINES

INV=2069.08

INV=2065.32

INV=2065.57

LEGEND

- LOG VANE
- COMBO LOG VANE
- ROCK CROSS VANE
- NOTCHED SILL
- ROOT WAD
- JURISDICTIONAL WETLANDS
- BRUSH MATTING
- PROPOSED WETLANDS ENHANCEMENT
- PROPOSED WETLAND RESTORATION
- PROPERTY LINE BOUNDARY
- PROPOSED THALWEG
- PROPOSED BANKFULL
- DRAINAGE TILES
- CONSERVATION EASEMENT
- BEDROCK AREAS

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

NO	REVISIONS	DRN	CHK	DATE

HORIZONTAL SCALE
50 0 50 100

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ECOSYSTEM ENHANCEMENT PROGRAM

DESIGN SHEET 5

DATE	7/27/2007
PROJECT NO	92531
FILENAME	
SHEET NO	5
DRAWN BY	CHKD BY

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DATE: 7/27/2007

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PRESERVE TRACT

LEGEND

- LOG VANE
- COMBO LOG VANE
- ROCK CROSS VANE
- NOTCHED SILL
- ROOT WAD
- JURISDICTIONAL WETLANDS
- BRUSH MATTING
- PROPOSED WETLANDS ENHANCEMENT
- PROPOSED WETLAND RESTORATION
- PROPERTY LINE BOUNDARY
- PROPOSED THALWEG
- PROPOSED BANKFULL
- DRAINAGE TILES
- CONSERVATION EASEMENT
- FENCING

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

NO	REVISIONS	DRN	CHK	DATE

HORIZONTAL SCALE
50 0 50 100

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ECOSYSTEM ENHANCEMENT PROGRAM

DESIGN SHEET 6

DATE	7/27/2007
PROJECT NO	92531
FILENAME	
SHEET NO	6
DRAWN BY	
CHKD BY	

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DATE: 7/27/2007

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5/28/99

PROJECT REFERENCE NO.	SHEET NO.
92531	7

ROADWAY DESIGN ENGINEER

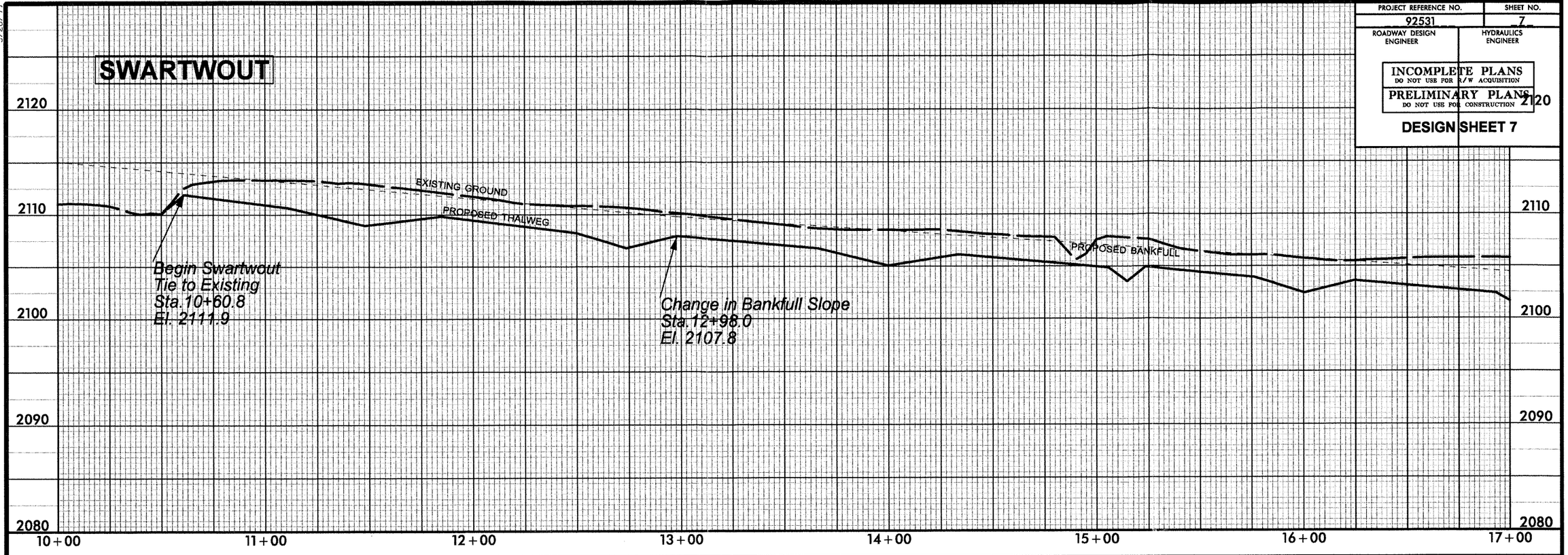
HYDRAULICS ENGINEER

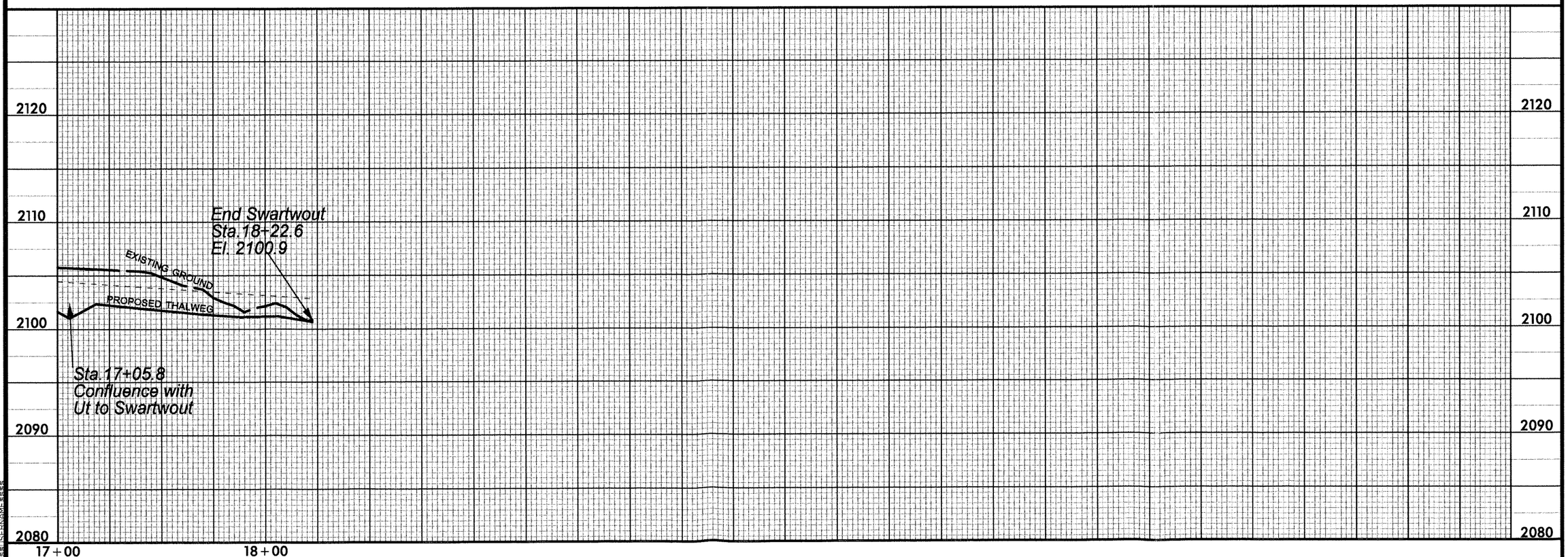
INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

DESIGN SHEET 7

SWARTWOUT





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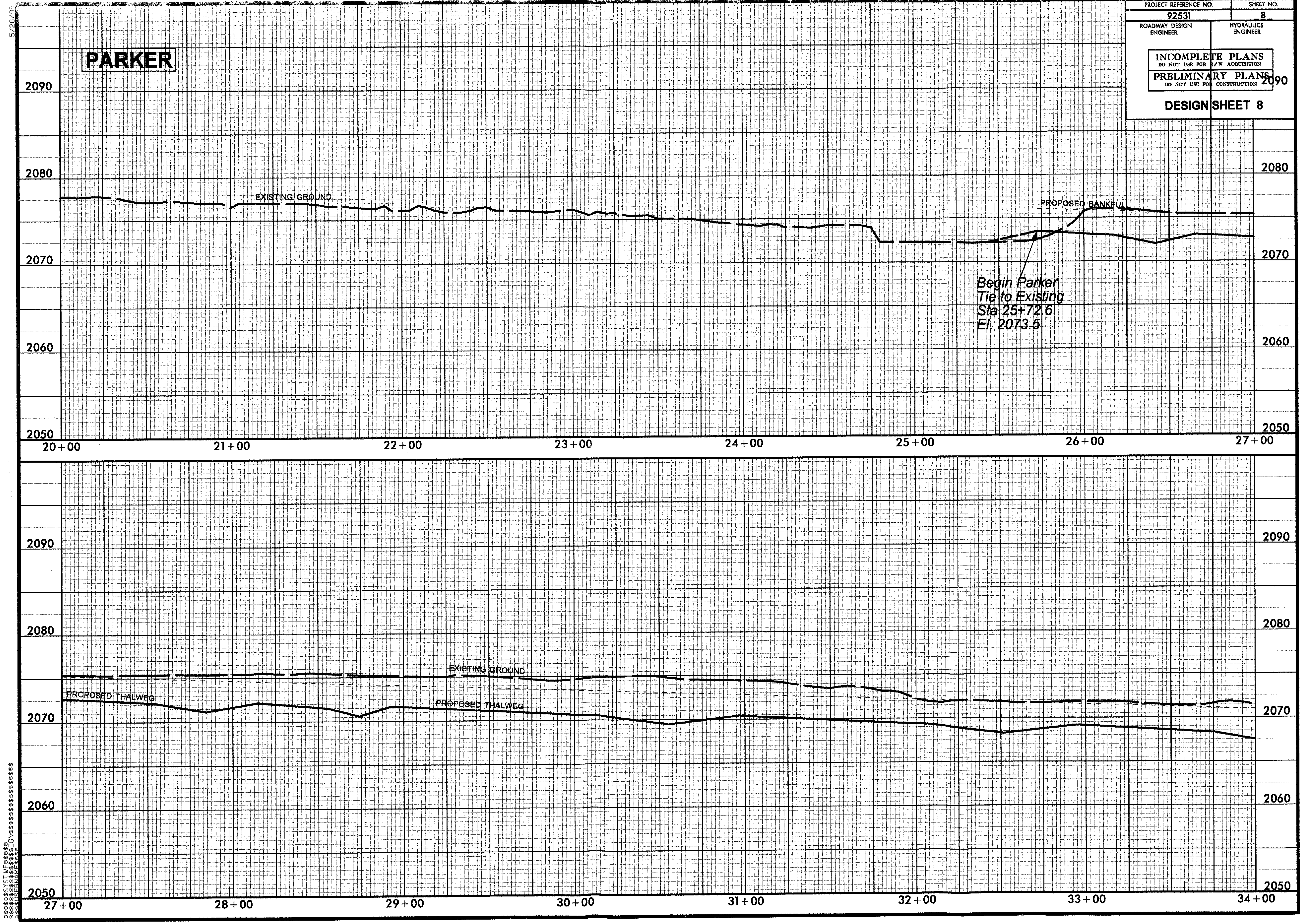
$$$$$$$USERNAME$$$$$$$



PROJECT REFERENCE NO.
92531
SHEET NO.
8
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION
PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION
DESIGN SHEET 8
PARKER
5/28/99
EXISTING GROUND
PROPOSED BANKFULL
Begin Parker
Tie to Existing
Sta 25+72.6
El. 2073.5
2090
2080
2070
2060
2050
20+00
21+00
22+00
23+00
24+00
25+00
26+00
27+00
EXISTING GROUND
PROPOSED THALWEG
PROPOSED THALWEG
28+00
29+00
30+00
31+00
32+00
33+00
34+00

5/28/99

PARKER

PROJECT REFERENCE NO.	SHEET NO.
92531	9

ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

DESIGN SHEET 9

2080
2070
2060
2050
2040

Sta.35+58.0
Confluence with
Ut 2

EXISTING GROUND
PROPOSED THALWEG
PROPOSED BANKFULL

Change in Bankfull Slope
Sta.39+92.3
El. 2064.9

34+00 35+00 36+00 37+00 38+00 39+00 40+00 41+00

2080
2070
2060
2050
2040

EXISTING GROUND
PROPOSED THALWEG

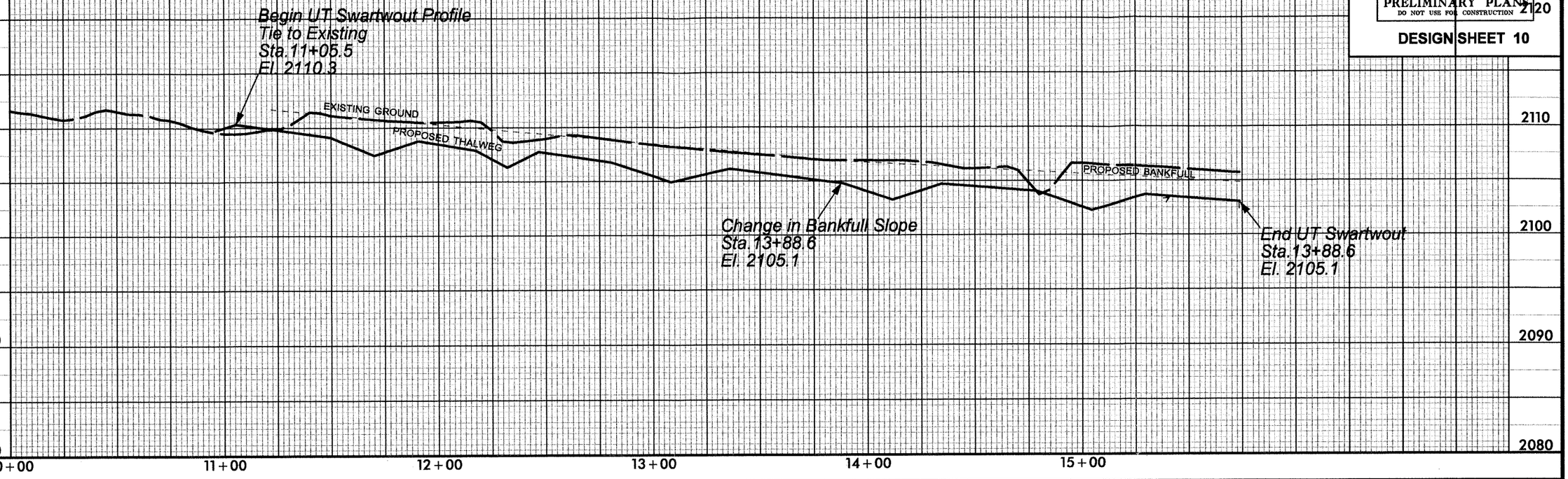
Sta.43+15.5
Confluence with
UT3

End Parker Profile
Tie to Existing
Sta.42+41.9
El. 2062.0

41+00 42+00 43+00

$$$$$SYSTEM$$$$$
$$$$$$$$$$$DGN$$$$$$$$$$$
$$$$$USERNAME$$$$$

UT SWARTWOUT



92531	10
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

DESIGN SHEET 10

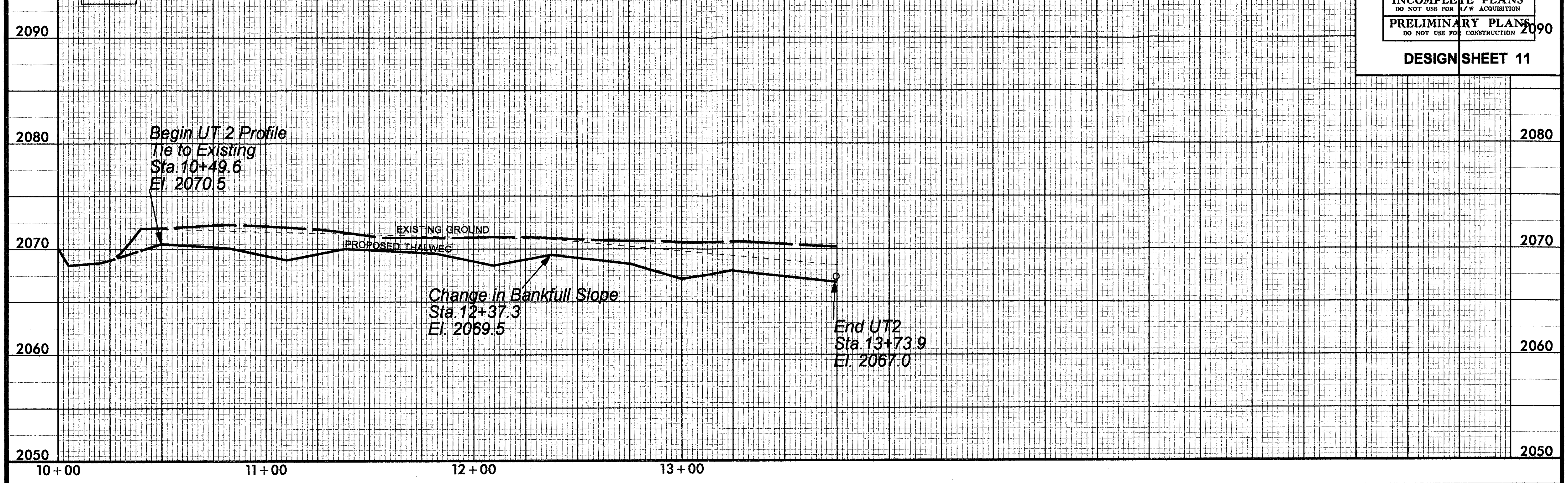
PROJECT REFERENCE NO.	SHEET NO.
92531	11
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

DESIGN SHEET 11

UT2



5/28/99

$$$$$$SYSTIME$$$$$
$$$$$$$$$$$$$$$DGN$$$$$$$$$$$$$$$$$$$$$$$
$$$$$$USERNAME$$$$

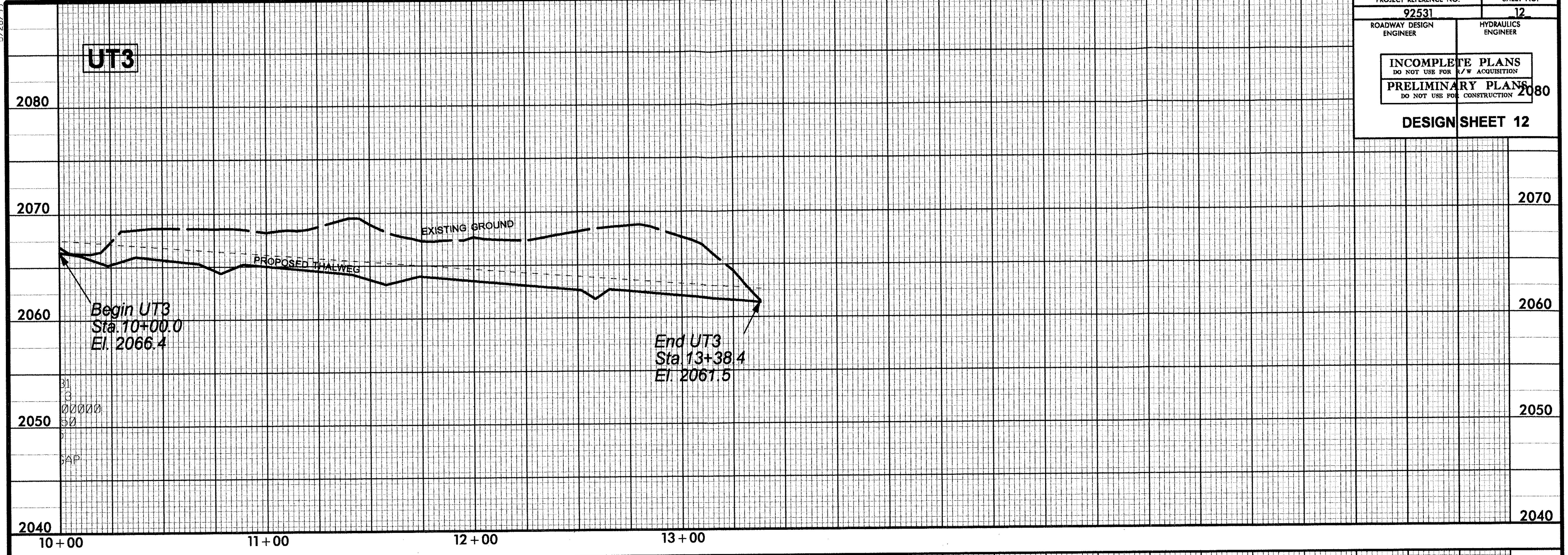
PROJECT REFERENCE NO.	SHEET NO.
92531	12
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

DESIGN SHEET 12

5/28/99



5/28/99

PROJECT REFERENCE NO.	SHEET NO.
92531	13

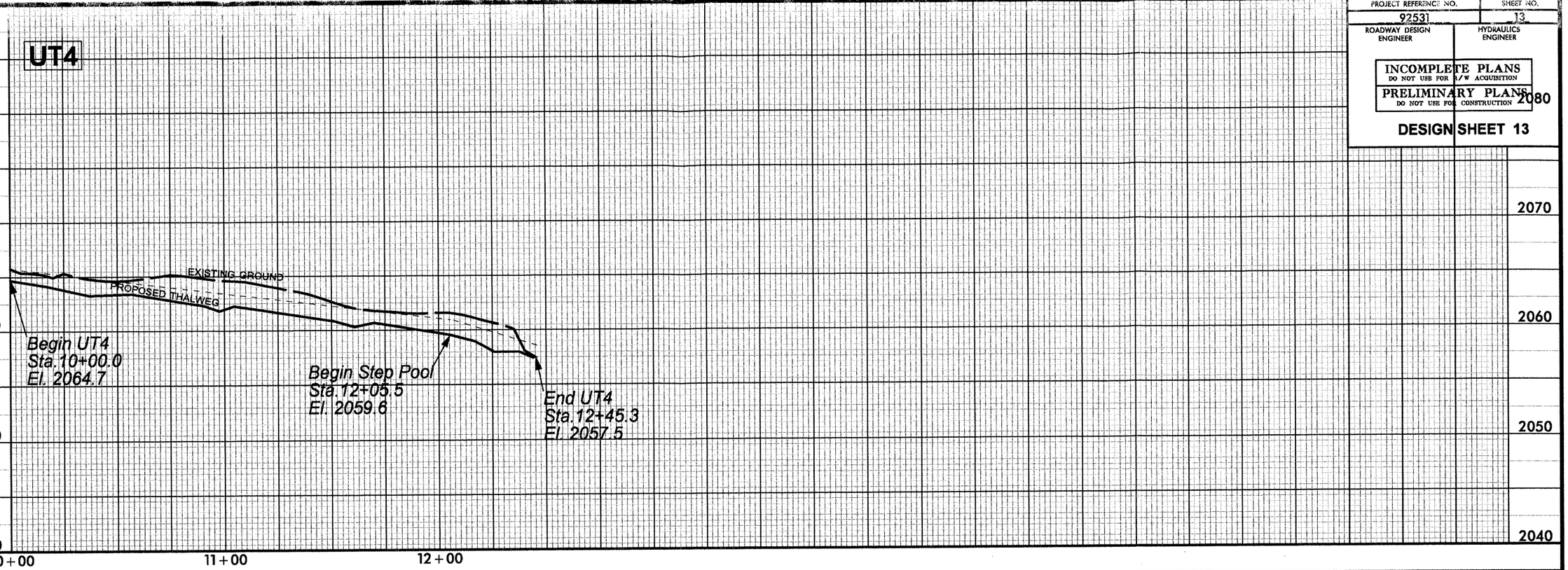
ROADWAY DESIGN ENGINEER | HYDRAULICS ENGINEER

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

DESIGN SHEET 13

UT4



$$$$STIME$$$$
$$$$DESIGN$$$$

5/26/99

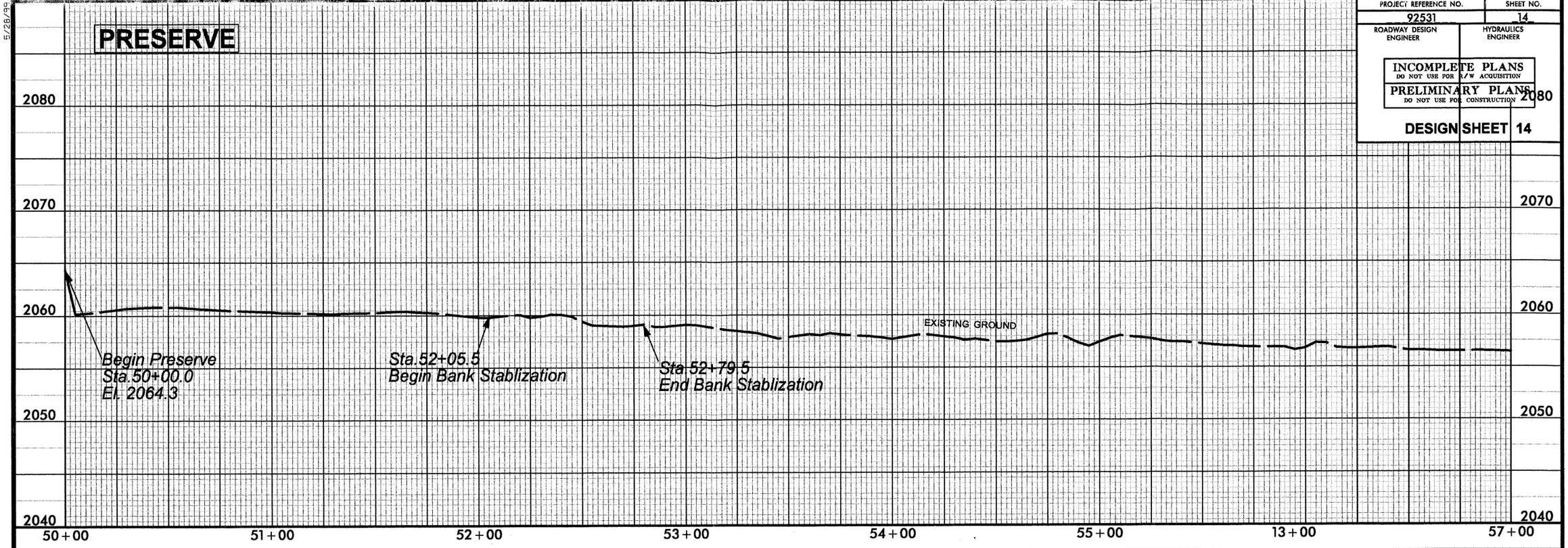
PROJECT REFERENCE NO.	SHEET NO.
92531	14
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

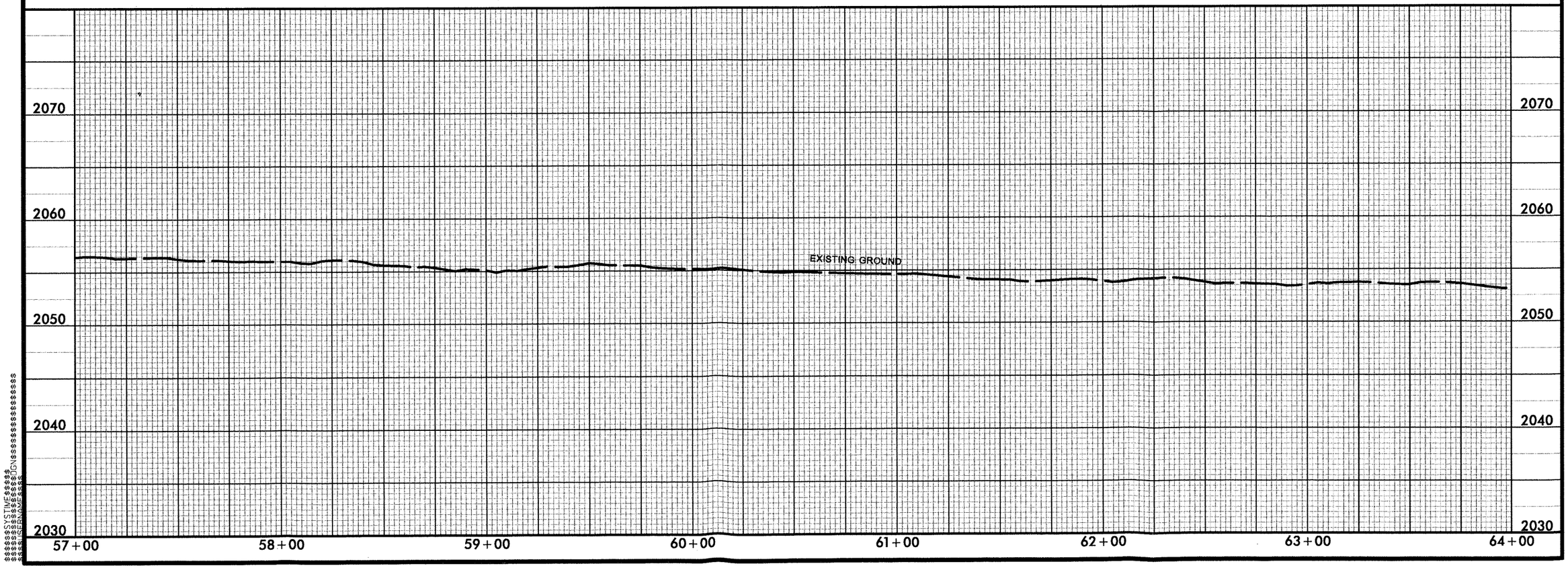
INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

DESIGN SHEET 14

PRESERVE





ACTIVE ENGINEERING

5/26/99

PROJECT REFERENCE NO.	SHEET NO.
92531	15

ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

DESIGN SHEET 15

2070
2060
2050
2040
2030

EXISTING GROUND

End Preserve
Sta.68+62.1
El. 2052.2

64+00

$$$$$$SYSTIM=$$$$
$$$$$$JCN=$$$$$$$$$$$$$$$$$$$$
$$$$$$USERNAME=$$$$

SWARTWOUT TRACT

BEGIN UPPER SWARTWOUT

END UPPER SWARTWOUT
BEGIN LOWER SWARTWOUT

END LOWER SWARTWOUT

ENVIRONMENTALLY SENSITIVE AREA KEEP OUT

MATCHLINE SHEET 2

CAT CREEK ROAD SR 1353

NC GRID 83/95 NAD

LEGEND

- JURISDICTIONAL WETLANDS
- PROPOSED WETLANDS ENHANCEMENT
- PROPOSED WETLAND RESTORATION
- PROPERTY LINE BOUNDARY
- DRAINAGE TILES
- ZONE 1 WELL-DRAINED FLOODPLAIN
- ZONE 2 WETLAND
- ZONE 3 STREAM BANK

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

NO	REVISIONS	DRN	Chk	DATE

HORIZONTAL SCALE
50 0 50 100

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MACON COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

DESIGN SHEET 16
REFORESTATION PLAN

DATE	7/27/2007
PROJECT NO	92531
FILENAME	
SHEET NO	16
DRAWN BY	CHKD BY

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DATE: 7/27/2007

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WALDROOP TRACT

NC GRID
NAD 83/95

MATCHLINE SHEET 1

MATCHLINE SHEET 3

SPAUD JACK CABE RD (SR 1001)

CAT CREEK ROAD (SR 1004)

CAT CREEK

LEGEND

- JURISDICTIONAL WETLANDS
- PROPOSED WETLANDS ENHANCEMENT
- PROPOSED WETLAND RESTORATION
- PROPERTY LINE BOUNDARY
- DRAINAGE TILES
- ZONE 1 WELL-DRAINED FLOODPLAIN
- ZONE 2 WETLAND
- ZONE 3 STREAM BANK

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

NO	REVISIONS	DRN	CHK	DATE

HORIZONTAL SCALE
100 50 0 50

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CAT CREEK STREAM & WETLAND RESTORATION
MACON COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

DESIGN SHEET 17
REFORESTATION PLAN

DATE	7/27/2007
PROJECT NO	92531
FILENAME	
SHEET NO	17
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WALDROOP TRACT

NC GRID
NAD 83/95

CAT CREEK ROAD SR 1513

MATCHLINE SHEET 2

MATCHLINE SHEET 1

CAT CREEK

GRAVEL

EXISTING R/W

AERIAL POWER LINES

WLB

LEGEND

- JURISDICTIONAL WETLANDS
- PROPOSED WETLANDS ENHANCEMENT
- PROPOSED WETLAND RESTORATION
- PROPERTY LINE BOUNDARY
- DRAINAGE TILES
- ZONE 1 WELL-DRAINED FLOODPLAIN
- ZONE 2 WETLAND
- ZONE 3 STREAM BANK

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

REVISIONS | NO | DATE | DRN | CHK

HORIZONTAL SCALE
100 50 0 50

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CAT CREEK STREAM & WETLAND RESTORATION
MACON COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

DESIGN SHEET 18
REFORESTATION PLAN

DATE	7/27/2007
PROJECT NO	92531
FILENAME	
SHEET NO	18
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PARKER TRACT

NC GRID
NAD 83/95

END WALDROOP
BEGIN PARKER

END PARKER

MATCHLINE SHEET 3

MATCHLINE SHEET 5

CAT CREEK

FERGUSON ROAD SR 1502

SR 1501

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
R/W PROJECT
P.O. BOX 25201
RALEIGH, N.C. 27611-5201

WV:2012.5

WV:2017.3

WV:2069.08

WV:2060.5

LEGEND

- JURISDICTIONAL WETLANDS
- PROPOSED WETLANDS ENHANCEMENT
- PROPOSED WETLAND RESTORATION
- PROPERTY LINE BOUNDARY
- DRAINAGE TILES
- ZONE 1 WELL-DRAINED FLOODPLAIN
- ZONE 2 WETLAND
- ZONE 3 STREAM BANK

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

HORIZONTAL SCALE
50 0 50 100

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CAT CREEK STREAM & WETLAND RESTORATION
MACON COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

DESIGN SHEET 19
REFORESTATION PLAN

DATE	7/27/2007
PROJECT NO	92531
FILENAME	
SHEET NO	19
DRAWN BY	
CHKD BY	

USER: ian.jewell
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DATE: 7/27/2007

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PRESERVE TRACT

NC GRID
NAD 83/95

MATCHLINE SHEET 4

MATCHLINE SHEET 6

PRESERVE DRIVE

FERGUSON ROAD SR 1507

CAT CREEK

W.L.B.

POWER LINES

INV=2069.08

INV=2060.57

LEGEND

- JURISDICTIONAL WETLANDS
- PROPOSED WETLANDS ENHANCEMENT
- PROPOSED WETLAND RESTORATION
- PROPERTY LINE BOUNDARY
- DRAINAGE TILES
- ZONE 1 WELL-DRAINED FLOODPLAIN
- ZONE 2 WETLAND
- ZONE 3 STREAM BANK

USER: larylewell
DGN: q:\9253\cad\vegetation plan\92531_veg_sheet5.dgn

DATE: 7/27/2007

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

NO	REVISIONS	DRN	CHK	DATE

HORIZONTAL SCALE
100 50 0 50

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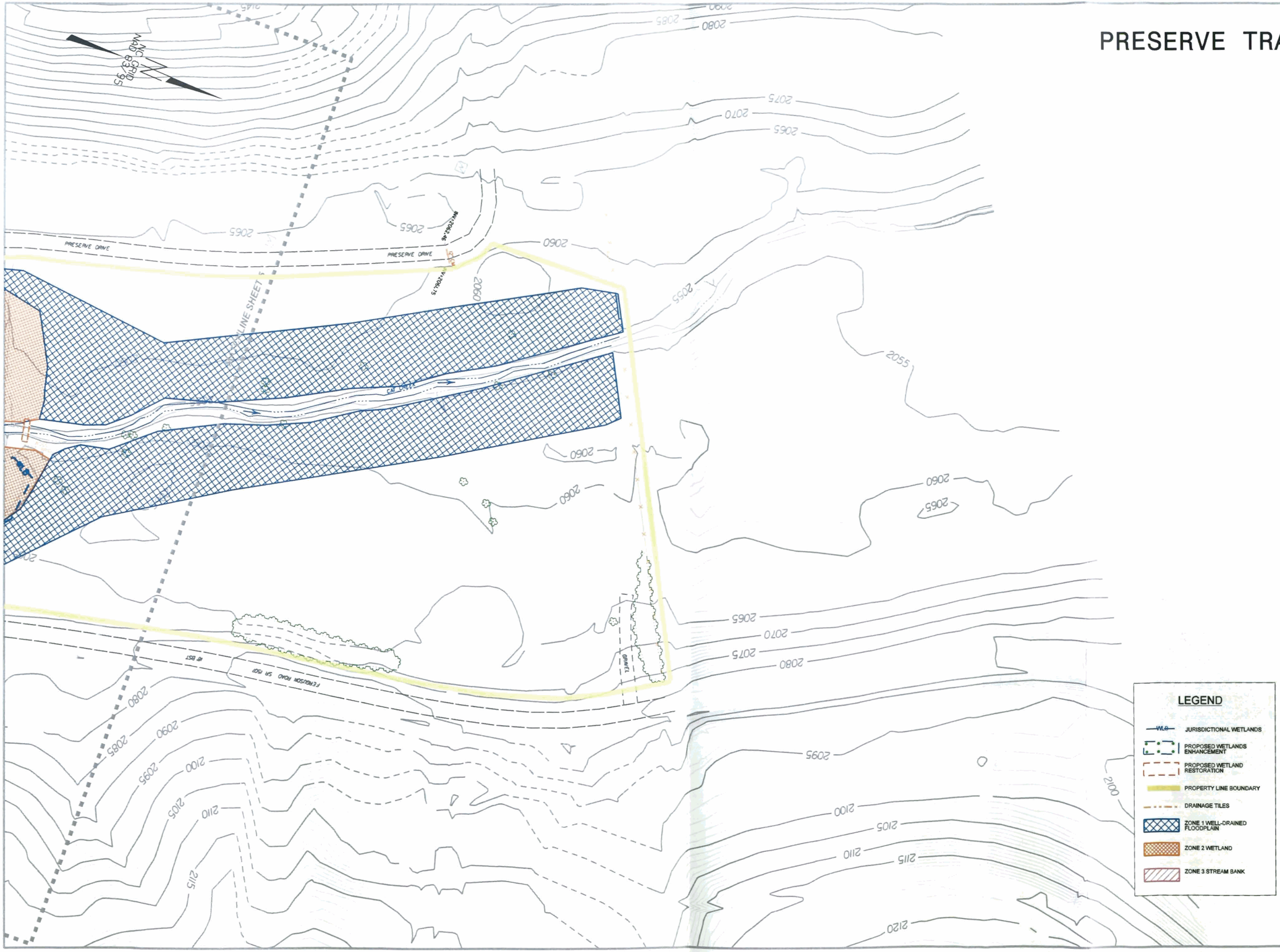
CAT CREEK STREAM & WETLAND RESTORATION
MACON COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

DESIGN SHEET 20
REFORESTATION PLAN

DATE	7/27/2007
PROJECT NO	92531
FILENAME	
SHEET NO	20
DRAWN BY	CHKD BY

PRESERVE TRACT



PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

REVISIONS | DRN | CHK | DATE

HORIZONTAL SCALE
100 50 0 50

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CAT CREEK STREAM & WETLAND RESTORATION
MACON COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

DESIGN SHEET 21
REFORESTATION PLAN

DATE 7/27/2007
PROJECT NO 92531
FILNAME
SHEET NO
DRN BY | CHKD BY

USER: Ian_Iswell
DGN: q:\92531\cadd\restoration plan\92531_veg_sheet6.dgn
DATE: 7/27/2007

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APPENDIX 1

AQUATIC SURVEY REPORT

Alderman Environmental Services, Inc.

September 13, 2003

PROJECT: Freshwater mussel survey for A-9 WM, survey of Cat Creek

Target Species: Federally listed endangered Appalachian elktoe (*Alasmidonta raveneliana*)

BIOLOGIST: John M. Alderman

ASSISTANT: Joseph D. Alderman

N.C. WILDLIFE RESOURCES COMMISSION ES PERMIT: NC – 2003 ES 21

U.S. FISH AND WILDLIFE SERVICE ES PERMIT: TE065756-0

STATION 20030906.2jma

LOCATION: Cat Creek, Little Tennessee River Basin, Macon County, North Carolina; downstream and upstream from the Ferguson Road (SR 1148) bridge crossing within the mitigation project footprint; bridge location: 35.19812 N, 83.34120 W; **see associated map at end of report.**

SURVEY DATE: September 6, 2003

SITE COMMENTS: Poor quality habitat, heavy sediment load, no buffers.

HABITAT:

WATERBODY TYPE:	Stream
FLOW:	Run, slack
RELATIVE DEPTH:	Very shallow
DEPTH (%<2 FEET):	98
SUBSTRATE:	Silt, sand, gravel, cobble, boulder, bedrock
COMPACTNESS:	Normal
SAND/GRAVEL BARS:	Present

HABITAT (CONT.):

WOODY DEBRIS:	Low
BEAVER ACTIVITY:	None
WINDTHROW:	None
TEMPORARY POOLS:	None
CHANNEL WIDTH:	3 – 5+ meters
BANK HEIGHT:	~ 1.5+ meter
BANK STABILITY:	Very stable to some erosion and undercutting
BUFFER WIDTH:	None
RIPARIAN VEGETATION:	Wooded (very little), shrub-brush, grass
LAND USE:	Natural, timber, rural, active pasture
PERCENT COVER:	5
WOODLAND EXTENT:	Not extensive
NATURAL LEVEES:	None
VISIBILITY:	Clear
WATER LEVEL:	Normal
WEATHER:	Sun-cloud, warm

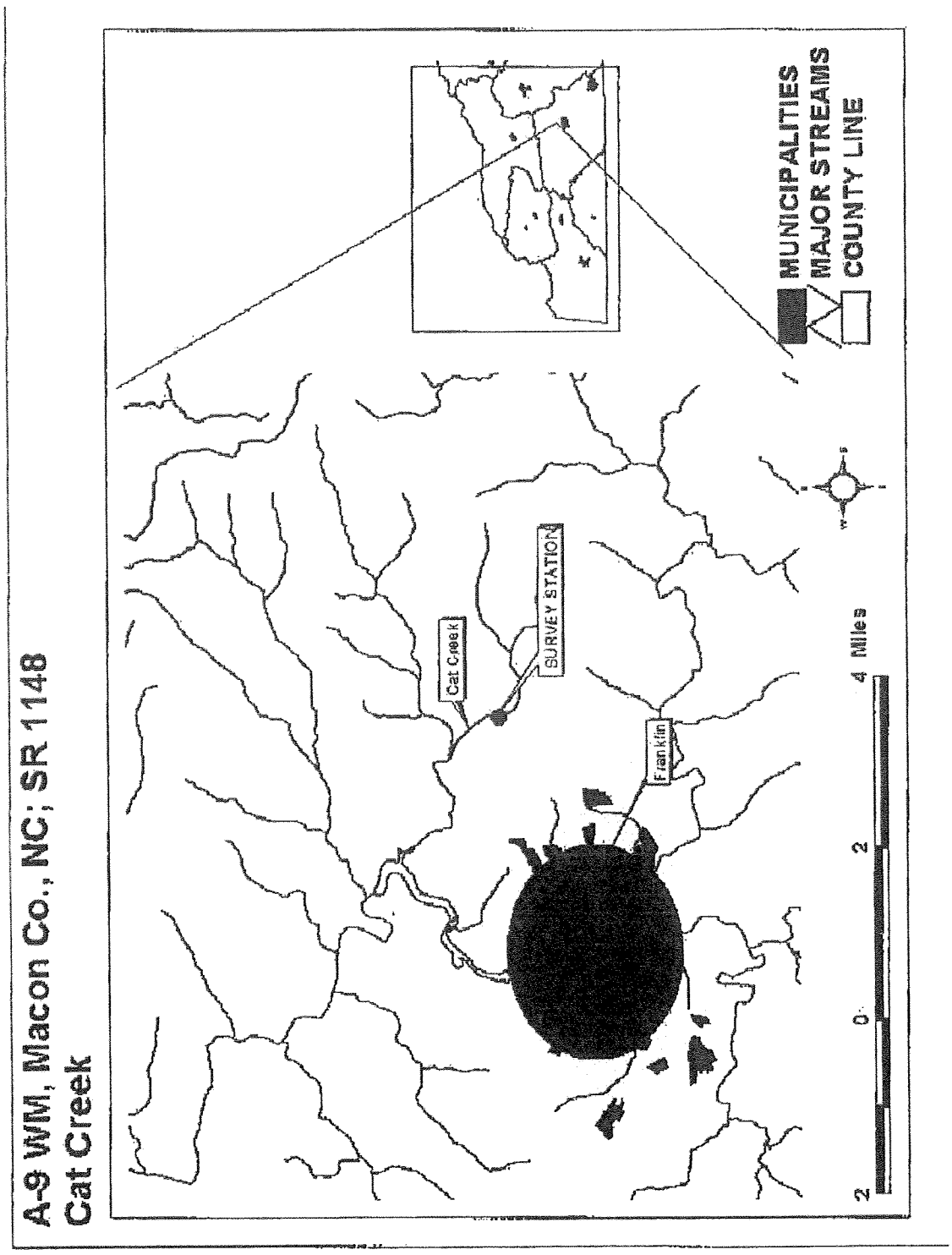
TECHNIQUES AND SURVEY TIME:

TECHNIQUES:	Visual and tactile
SURVEY TIME:	1.1 person-hours

FRESHWATER MUSSELS:

None

BIOLOGICAL DETERMINATION: No Effect for federally listed species.


A-9 WM, Macon Co., NC; SR 1148
Cat Creek
Cat Creek
SURVEY STATION
Franklin
MUNICIPALITIES
MAJOR STREAMS
COUNTY LINE
2
0
2
4 Miles

APPENDIX 2

EXISTING CONDITIONS DATA

Cat Creek
Swartwout Property
Macon County

Field Crew:	Amanda Todd, George Lankford
River Basin:	Little Tennessee
Stream Reach:	Cat Creek-Middle Swartwout Tract
Drainage Area:	1.26
Date:	7/21/2003
Description:	LONGITUDINAL PROFILE

STA	BS	HI	FS	ELEV	NOTE
TBM #1	4.73	104.73		100.00	Fence post-east of stream post marked at 4.0'

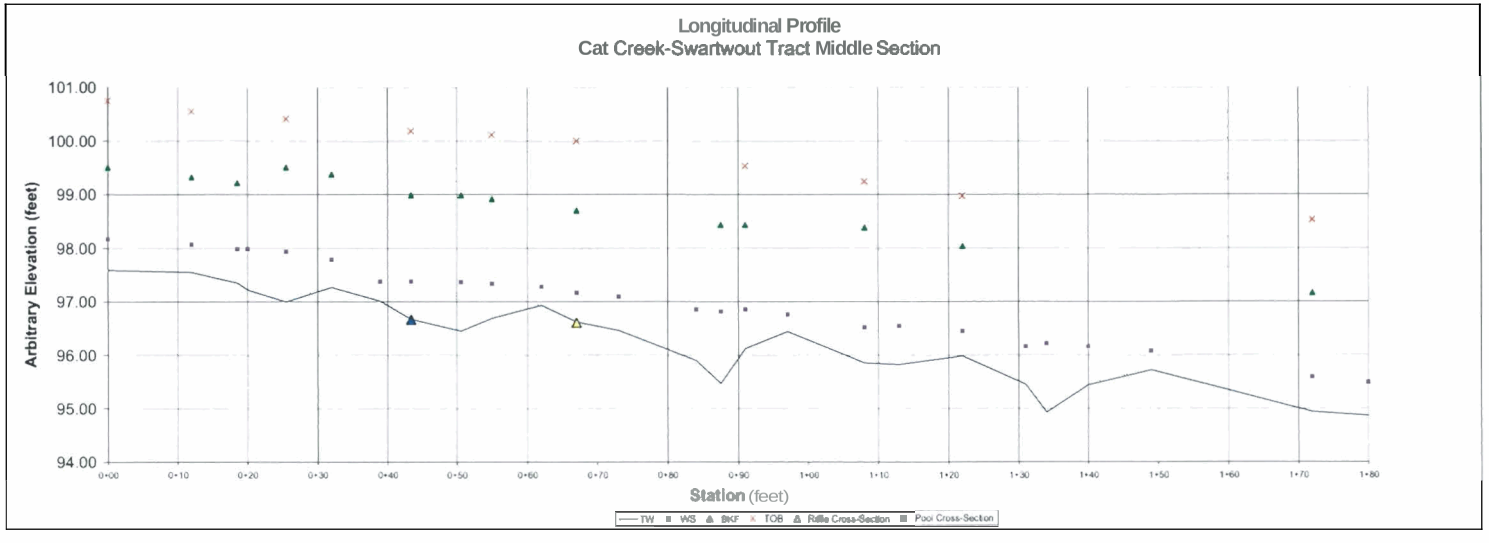
Station	TW (FS)	TW	WS (FS)	WS	BKF (FS)	BKF	TOB (FS)	TOB	Notes	HI	Bk Ht/ Bkf Ht.	P-P	Pool Length	Max Pool Depth	Pool Slope	Riffle Length	Riffle Slope	Glide Length	Glide Slope	Run Length	Run Slope
0+00.0	7.15	97.58	6.57	98.16	5.23	99.50	3.98	100.75	Top Riffle	104.73	1.65					12	0.0083				
0+12.0	7.19	97.54	6.67	98.06	5.41	99.32	4.18	100.55	Run	104.73	1.69									7	0.0123
0+18.5	7.39	97.34	6.75	97.98	5.52	99.21			Top Pool	104.73		25	14		0.0148						
0+20.0	7.52	97.21	6.75	97.98					Pool	104.73											
0+25.5	7.74	96.99	6.80	97.93	5.23	99.50	4.32	100.41	Max Pool	104.73	1.36			2.51							
0+32.0	7.47	97.26	6.95	97.78	5.36	99.37			Top Riffle	104.73						7	0.0586				
0+39.0	7.73	97.00	7.36	97.37					Run	104.73										4	0.0000
0+43.4	8.07	96.66	7.36	97.37	5.75	98.98	4.55	100.18	Pool CS	104.73	1.52	41	12		0.0034						
0+50.6	8.29	96.44	7.37	97.36	5.75	98.98			Max Pool	104.73				2.54							
0+55.0	8.05	96.68	7.40	97.33	5.83	98.90	4.62	100.11	Top Glide	104.73	1.55							7	0.0086		
0+62.0	7.81	96.92	7.46	97.27					Top Riffle	104.73						11	0.0164				
0+67.0	8.12	96.61	7.57	97.16	6.04	98.69	4.74	99.99	Riffle CS	104.73	1.63										
0+73.0	8.28	96.45	7.64	97.09					Run	104.73										11	0.0218
0+84.0	8.84	95.89	7.90	96.85					Top Pool	104.73		47	7		0.0000						
0+87.5	9.27	95.46	7.92	96.81	6.31	98.42			W P M	104.73				2.96							
0+91.0	8.62	96.11	7.88	96.85	6.31	98.42	5.21	99.52	Glide	104.73	1.48							6	0.0167		
0+97.0	8.30	96.43	7.98	96.75					Top Riffle	104.73						25	0.0124				
1+08.0	8.89	95.84	8.22	96.51	6.36	98.37	5.50	99.23	Riffle	104.73	1.34										
1+13.0	8.92	95.81	8.20	96.53					Riffle	104.73											
1+22.0	8.76	95.97	8.29	96.44	6.70	98.03	5.77	98.96	Run	104.73	1.45									9	0.0322
1+31.0	9.34	95.45	8.60	96.15					Top Pool	104.73			9		0.0000						
1+34.0	9.81	94.92	8.52	96.21					Max Pool	104.73											
1+40.0	9.30	95.43	8.58	96.15					Glide	104.73								9	0.0089		
1+49.0	9.02	95.71	8.66	96.07					Run	104.73										23	0.0209
1+72.0	9.80	94.93	9.14	95.59	7.57	97.16	6.21	98.52	Top Riffle	104.73	1.61										
1+80.0	9.87	94.86	9.24	95.49					Riffle	104.73											

tw slope 0.0151 ws slope 0.0148 bkf slope 0.0136

BKF W (ft)= 17.5
BKF D (ft)= 1.0
BKF Max D (ft)= 2.7

	Bk Ht/ Bkf Ht.	P-P	Pool Length	Max Pool Depth	Pool Slope	Riffle Length	Riffle Slope	Glide Length	Glide Slope	Run Length	Run Slope
min	1.34	25	7	2.51	0.0000	7	0.0060	6	0.0000	4	0.0200
max	1.69	47	14	2.96	0.0099	25	0.0300	9	0.0100	23	0.0540
avg	1.53	38	10	2.67	0.0043	14	0.0040	7	0.0050	11	0.0350
Min ratio	NA	1.4		2.51	0.0000		0.0500		0.0000		1.5300
Max ratio	NA	2.7		2.96	0.7300		2.2100		0.7600		3.9000
avg ratio	NA	2.1		2.67	0.3200		1.3500		0.3800		2.5800
			41			55		22		54	

172
180



Cat Creek
Swartwout Property
Macon County

Field Crew:	Amanda Todd and George Lankford
River Basin:	Little Tennessee River
Watershed:	Cat Creek
Stream Reach:	Swartwout
Drainage Area:	1.2 sq. miles (765.19 acres)
Date:	12/9/2003
Station:	
Feature:	CS#1 Riffle (beside riding ring)

STATION (Feet)	HI (Feet)	FS (Feet)	ELEVATION (Feet)	NOTES Notes		BANKFULL (BKF) Hydraulic Geometry Width (Feet)	Depth (Feet)	Area (Sq. Ft.)	TOP OF BANK (TOB) Hydraulic Geometry Width (Feet)	Depth (Feet)	Area (Sq. Ft.)
0+00.0	100	4.74	95.26	RIGHT		0.0	0.0	0.0	0.0	0.0	0
0+09.0	100	4.9	95.10			0.1	0.3	0.0	1.0	0.4	0.2
0+16.0	100	4.91	95.09			0.8	0.7	0.4	0.1	2.0	0.1
0+22.0	100	5.00	95.00			1.0	2.0	1.3	0.1	2.3	0.2
0+25.0	100	4.91	95.09	FENCE		1.0	2.0	2.0	0.8	2.7	2.0
0+30.0	100	4.96	95.04			0.7	2.0	1.4	1.0	4.0	3.4
0+34.0	100	4.90	95.10			1.3	1.9	2.5	1.0	4.0	4.0
0+35.0	100	4.97	95.03	RTOB		1.0	1.6	1.8	0.7	4.0	2.8
0+36.0	100	5.37	94.63			0.6	1.5	0.9	1.3	3.9	5.2
0+36.1	100	6.99	93.01	RBKF		0.6	0.8	0.7	1.0	3.6	3.8
0+36.2	100	7.32	92.68			1.8	0.5	1.2	0.6	3.5	2.2
0+37.0	100	7.69	92.31			1.0	0.4	0.5	0.6	2.8	1.9
0+38.0	100	8.95	91.05	REOW		2.0	0.3	0.6	1.8	2.5	4.9
0+39.0	100	8.96	91.04			3.5	0.3	0.9	1.0	2.4	2.5
0+39.7	100	8.99	91.01	TW	ws=8.33	1.2	0.7	0.6	2.0	2.3	4.7
0+41.0	100	8.88	91.12			2.1	0.7	1.5	3.5	2.3	8.0
0+42.0	100	8.61	91.39			1.2	0.0	0.4	1.2	2.7	3.0
0+42.6	100	8.50	91.50	LEOW		TOTALS 19.9		16.7	2.1	2.7	5.7
0+43.2	100	7.82	92.18						1.2	2.0	2.9
0+45.0	100	7.51	92.49						1.5	1.3	2.5
0+46.0	100	7.38	92.62						0.8	0.9	0.9
0+48.0	100	7.24	92.76						1.7	0.8	1.5
0+51.5	100	7.27	92.73						2.0	0.6	1.4
0+52.7	100	7.67	92.33						TOTALS 23.3		60.6
0+54.8	100	7.70	92.30								
0+56.0	100	6.99	93.01	LBKF							
0+57.5	100	6.26	93.74								
0+58.3	100	5.90	94.10	LTOB							
0+60.0	100	5.79	94.21								
0+62.0	100	5.55	94.45								
0+68.0	100	4.45	95.55	LEFT							

SUMMARY DATA (BANKFULL)

A(BKF)	16.7	W(FPA)	120
W(BKF)	19.9	Slope	0.000
Max d	2.0	Sinuosity	1.01
Mean d	0.8	Area=	A
W/D	23.7	Width=	W
Entrenchment	6.0	Depth=	D
Stream Type	C	Bankfull=	BKF
Area from Rural Regional Curve			24.5

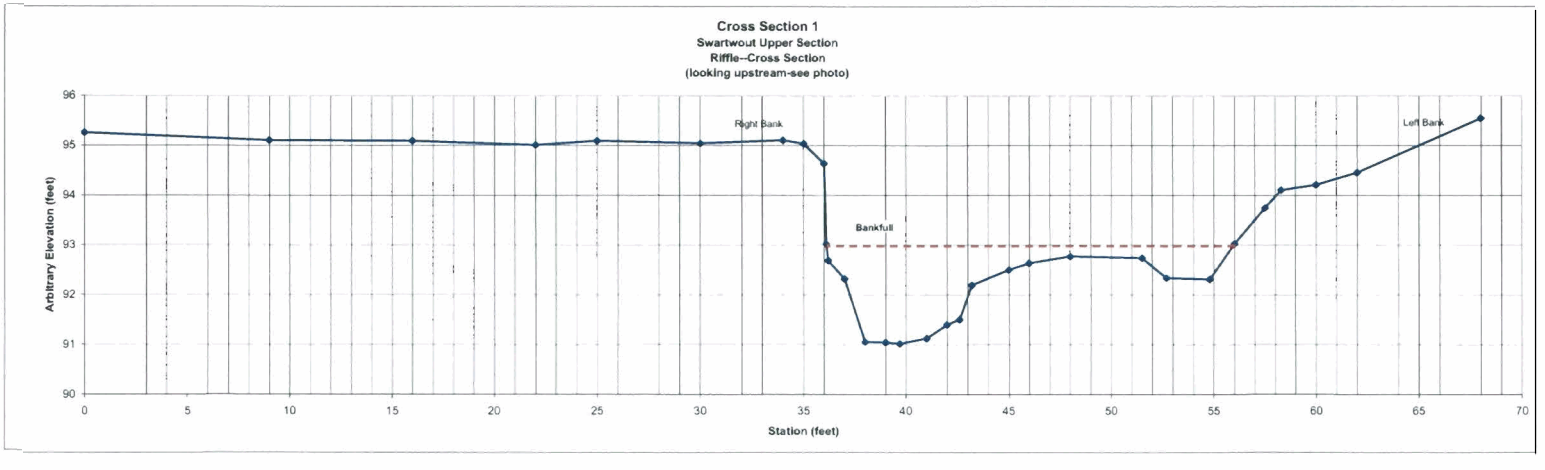
SUMMARY DATA (TOB)

A(BKF)	60.6
W(BKF)	23.3
Max d	4.0
Mean d	2.6

Bank Erosion Hazard Index (BEHI)

Criteria	Value	Index	Bank Erosion Potential
Bank Ht/Bkf Ht	2	7.9	high
Root Depth/Bank Ht	0.25	6.5	high
Root Density (%)	10	7.5	high
Bank Angle (Degrees)	88	7.5	high
Surface Protection (%)	5	10	extreme
Bank Materials	Silt/Clay	0	
Stratification		5	
		44.4	very high

Looking Upstream



Cat Creek
Swartwout Property
Macon County

Field Crew:	Amanda Todd and George Lankford
River Basin:	Little Tennessee River
Watershed:	**Cat Creek**
Stream Reach:	Swartwout
Drainage Area:	1.2 sq. miles (765.19 acres)
Date:	7/15/2003
Station:	
Feature:	Riffle (Eroding Bend)

STATION (Feet)	HI (Feet)	FS (Feet)	ELEVATION (Feet)	NOTES Notes	
0+00.0	100	5.54	94.46		
0+03.0	100	5.68	94.32		
0+05.0	100	5.70	94.30	WFPA	
0+06.0	100	6.00	94.00		
0+07.0	100	6.21	93.79		
0+08.0	100	6.39	93.61	LTOB	
0+08.5	100	6.81	93.19		
0+09.5	100	7.01	92.99		
0+10.3	100	7.23	92.77		
0+11.0	100	7.80	92.20	LBKF	
0+12.0	100	8.16	91.84		
0+14.0	100	8.37	91.63		
0+16.0	100	8.42	91.58		
0+17.4	100	8.47	91.53		
0+18.5	100	8.41	91.59		
0+20.0	100	8.38	91.62		
0+21.0	100	8.42	91.58		
0+22.0	100	8.47	91.53		
0+23.3	100	8.69	91.31		
0+24.0	100	9.19	90.81		
0+24.7	100	9.48	90.52	LEOW	
0+26.0	100	9.65	90.35		
0+27.5	100	9.85	90.15		
0+28.2	100	9.87	90.13	TW	ws= 9.43
0+29.2	100	9.81	90.19		
0+30.0	100	9.47	90.53	REOW/SLUMP	
0+30.7	100	9.33	90.67		
0+31.0	100	9.20	90.80		
0+31.4	100	7.80	92.20	RBKF	
0+31.6	100	6.67	93.33		
0+33.0	100	6.39	93.61	RTOB	
0+34.2	100	6.31	93.69	FENCE	
0+36.6	100	6.28	93.72		
0+40.0	100	6.16	93.84		
0+44.0	100	6.07	93.93		
0+47.4	100	6	94.00		
0+49.0	100	5.83	94.17		
0+50.0	100	5.73	94.27	WFPA	

BANKFULL (BKF)
Hydraulic Geometry

Width (Feet)	Depth (Feet)	Area (Sq. Ft.)
0.0	0.0	0
1.0	0.4	0.2
2.0	0.6	0.9
2.0	0.6	1.2
1.4	0.7	0.9
1.1	0.6	0.7
1.5	0.6	0.9
1.0	0.6	0.6
1.0	0.7	0.6
1.3	0.9	1.0
0.7	1.4	0.8
0.7	1.7	1.1
1.3	1.9	2.3
1.5	2.1	2.9
0.7	2.1	1.4
1.0	2.0	2.0
0.8	1.7	1.5
0.7	1.5	1.1
0.3	1.4	0.4
0.4	0.0	0.3
TOTALS 20.4		20.9

SUMMARY DATA (BANKFULL)

A(BKF)	20.9	W(FPA)	140
W(BKF)	20.4	Slope	0.012
Max d	2.1	Sinuosity	1.01
Mean d	1.0	Area= A	
W/D	19.9	Width= W	
Entrenchment	6.9	Depth= D	
Stream Type	C	Bankfull= BKF	
Area from Rural Regional Curve			24.5

TOP OF BANK (TOB)
Hydraulic Geometry

Width (Feet)	Depth (Feet)	Area (Sq. Ft.)
0.0	0.0	0.0
0.5	0.4	0.1
1.0	0.6	0.5
0.8	0.8	0.6
0.7	1.4	0.8
1.0	1.8	1.6
2.0	2.0	3.8
2.0	2.0	4.0
1.4	2.1	2.9
1.1	2.0	2.3
1.5	2.0	3.0
1.0	2.0	2.0
1.0	2.1	2.1
1.3	2.3	2.8
0.7	2.8	1.8
0.7	3.1	2.1
1.3	3.3	4.1
1.5	3.5	5.0
0.7	3.5	2.4
1.0	3.4	3.5
0.8	3.1	2.6
0.7	2.9	2.1
0.3	2.8	0.9
0.4	1.4	0.8
0.2	0.3	0.2
1.4	0.0	0.2
TOTALS 25.0		52.1

SUMMARY DATA (TOB)

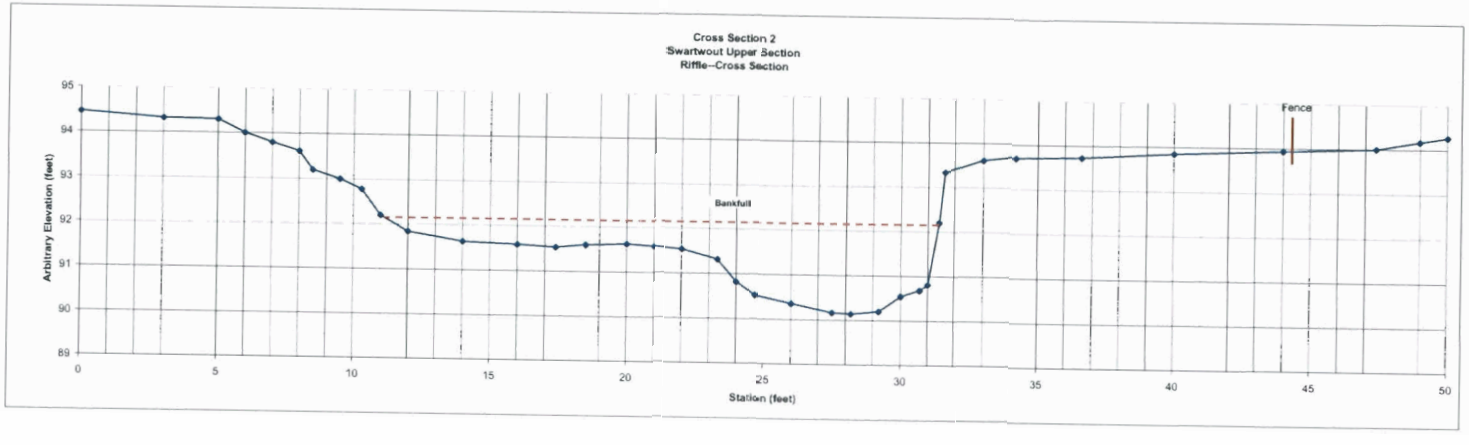
A(BKF)	52.1
W(BKF)	25.0
Max d	3.5
Mean d	2.1

Bank Erosion Hazard Index (BEHI)

Criteria	Value	Index	Bank Erosion Potential
Bank Ht/Bkf Ht	1.1	1.9	moderate
Root Depth/Bank Ht	0.81	2.4	low
Root Density (%)	55	3.9	low
Bank Angle (Degrees)	80	5.9	moderate
Surface Protection (%)	55	3.9	low
Bank Materials	Silt/Clay	4	
		22	moderate

STATION	SLOPE TW	WS
0	9.32	8.64
90.0	10.4	9.43
90.0	1.1	0.79
	0.012	0.009

Looking Downstream



Cat Creek
Swartwout Property
Macon County

Field Crew:	Amanda Todd and George Lankford
River Basin:	Little Tennessee
Watershed:	**Cat Creek**
Stream Reach:	Swartwout
Drainage Area:	1.2 sq. miles (765.14 acres)
Date:	7/15/2003
Station:	0+43.4
Feature:	POOL

STATION (FEET)	HI (FEET)	FS (FEET)	ELEVATION (FEET)	NOTES
0+00.0	104.73	5.21	99.52	
0+10.0	104.73	5.31	99.42	
0+20.0	104.73	5.13	99.60	
0+30.0	104.73	4.79	99.94	
0+36.0	104.73	4.55	100.18	LTOB AT FENCE
0+38.0	104.73	4.69	100.04	
0+39.0	104.73	4.70	100.03	
0+40.3	104.73	5.08	99.65	
0+42.0	104.73	5.38	99.35	
0+43.0	104.73	5.75	98.98	LBKF
0+44.0	104.73	6.09	98.64	
0+44.4	104.73	6.46	98.27	
0+44.8	104.73	6.80	97.93	
0+45.7	104.73	8.07	96.66	LEOW/TW
0+46.7	104.73	8.01	96.72	
0+47.9	104.73	7.70	97.03	REOW
0+49.1	104.73	6.99	97.74	
0+50.4	104.73	6.64	98.09	
0+51.8	104.73	6.62	98.11	
0+53.0	104.73	6.46	98.27	
0+53.5	104.73	6.16	98.57	
0+54.1	104.73	5.75	98.98	RBKF
0+55.0	104.73	5.18	99.55	
0+59.0	104.73	5.08	99.65	
0+64.0	104.73	4.57	100.16	RTOB
0+68.0	104.73	4.56	100.17	
0+70.0	104.73	4.53	100.20	
0+76.0	104.73	4.66	100.07	
0+86.0	104.73	4.62	100.11	
0+95.0	104.73	4.43	100.30	
1+00.0	104.73	4.21	100.52	

BANKFULL (BKF) Hydraulic Geometry

Width (Feet)	Depth (Feet)	Area (Sq. Ft.)
0.0	0.0	0.0
1.0	0.3	0.2
0.4	0.7	0.2
0.4	1.1	0.4
0.9	2.3	1.5
1.0	2.3	2.3
1.2	2.0	2.5
1.2	1.2	1.9
1.3	0.9	1.4
1.4	0.9	1.2
1.2	0.7	0.9
0.5	0.4	0.3
0.6	0.0	0.1
TOTALS 11.1		12.9

SUMMARY DATA (BANKFULL)

A(BKF)	12.9
W(BKF)	11.1
Max d	2.3
Mean d	1.2

TOP OF BANK (TOB) Hydraulic Geometry

Width (Feet)	Depth (Feet)	Area (Sq. Ft.)
0.0	0.0	0.0
2.0	0.1	0.1
1.0	0.2	0.1
1.3	0.5	0.4
1.7	0.8	1.2
1.0	1.2	1.0
1.0	1.5	1.4
0.4	1.9	0.7
0.4	2.3	0.8
0.9	3.5	2.6
1.0	3.5	3.5
1.2	3.2	4.0
1.2	2.4	3.4
1.3	2.1	2.9
1.4	2.1	2.9
1.2	1.9	2.4
0.5	1.6	0.9
1.5	0.6	1.7
4.0	0.5	2.3
5.0	0.0	1.4
TOTALS 28.0		33.7

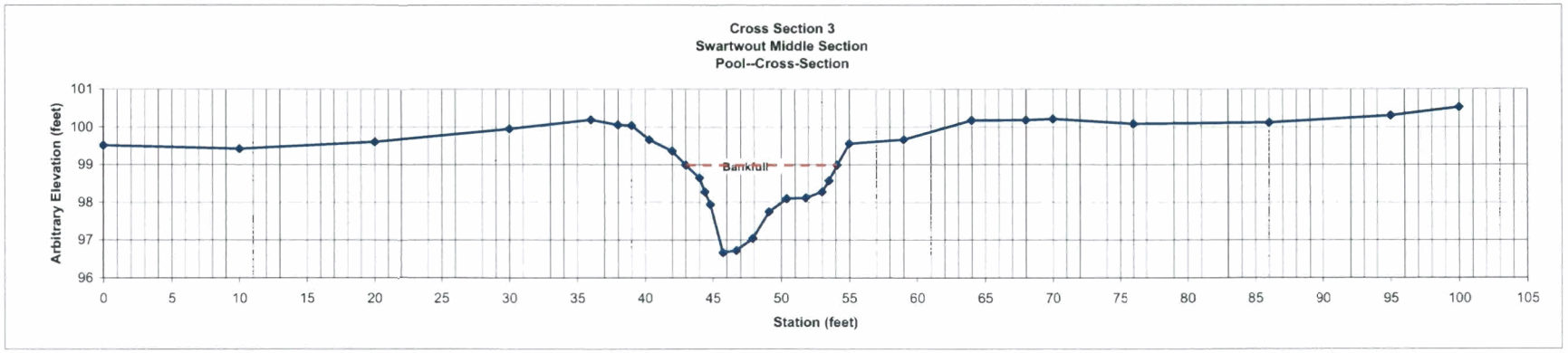
SUMMARY DATA (TOB)

A(BKF)	33.7
W(BKF)	28.0
Max d	3.5
Mean d	1.2

Bank Erosion Hazard Index (BEHI)

Criteria	Value	Index	Bank Erosion Potential
Bank Ht/Bkf Ht	2.2	8.16	very high
Root Depth/Bank Ht	1	1	very low
Root Density (%)	95	1.23	very low
Bank Angle (Degrees)	60	3.9	low
Surface Protection (%)	95	1.2	very low
Bank Materials	silt/clay	5	
		20.49	moderate

Pool Cross-Section Looking Downstream



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Cat Crnk
Swartwout Property
Macon County

Field Crew:	Amanda Todd and George Lankford
River Basin:	Little Tennessee River
Watershed:	**Cat Creek**
Stream Reach:	Swartwout
Drainage Area:	1.2 sq. miles (765.19 acres)
Date:	7/15/2003
Station:	0+67
Feature:	RIFFLE

STATION (Feet)	HI (Feet)	FS (Feet)	ELEVATION (Feet)	NOTES Notes
0+00.0	104.73	4.02	100.71	FPA
0+12.0	104.73	5.46	99.27	
0+22.0	104.73	5.46	99.27	
0+32.0	104.73	5.33	99.40	
0+42.0	104.73	5.01	99.72	
0+45.0	104.73	4.82	99.81	
0+51.0	104.73	4.74	99.99	FENCE LINE/LTOB
0+54.0	104.73	5.16	99.57	
0+55.0	104.73	5.45	win	
0+55.5	104.73	5.62	99.11	LBKFCIF
0560	104.73	5.80	98.93	
0+56.5	104.73	5.89	98.84	
0+57.0	104.73	6.04	98.69	
0+58.0	104.73	6.52	98.21	
0+58.7	104.73	7.06	97.67	
0+60.4	104.73	7.57	97.16	LEOW/WS
0+61.3	104.73	8.05	96.68	
0+62.0	104.73	8.12	96.61	
0+63.3	104.73	7.59	97.14	REOW
0+65.0	104.73	6.82	97.91	
0+66.0	104.73	6.59	98.14	
0+66.5	104.73	6.52	98.21	
0+67.3	104.73	6.07	98.66	
0+68.6	104.73	5.89	98.84	
0+73.0	104.73	5.62	99.11	RBKFCIF
0+78.0	104.73	5.11	99.62	
0+83.0	104.73	4.75	99.98	RTOB
0+88.0	104.73	4.85	99.88	FENCE LINE
0+97.0	104.73	4.91	99.82	
1+07.0	104.73	4.96	99.77	
1+12.0	104.73	4.73	100.00	
1+20.0	104.73	4.02	100.71	FPA

BANKFULL (BKF) Hydraulic Geometry

Width (Feet)	Depth (Feet)	Area (Sq. Ft.)
0.0	0.0	0
0.5	0.2	0.0
0.5	0.3	0.1
0.5	0.4	0.2
1.0	0.9	0.7
0.7	1.4	0.8
1.7	2.0	2.9
0.9	2.4	2.0
0.7	2.5	1.7
1.3	2.0	2.9
1.7	1.2	2.7
1.0	1.0	1.1
0.5	0.8	0.5
0.8	0.5	0.5
1.3	0.3	0.5
4.4	0.0	0.6
TOTALS 17.5		17.1

SUMMARY DATA (BANKFULL)

A(BKF)	17.1	W(FPA)	140
W(BKF)	17.5	Slope	0.015
Max d	2.7	Sinuosity	1.01
Mean d	1.0	Area=	A
W/D	17.9	Width=	W
Entrenchment	8.0	Depth=	D
Stream Type	C4	Bankfull=	BKF
Area from Rural Regional Curve			24

channel has been modified

TOP OF BANK (TOB) Hydraulic Geometry

Width (Feet)	Depth (Feet)	Area (Sq. Ft.)
0.00	0.0	0.0
3.00	0.4	0.6
1.00	0.7	0.6
0.48	0.9	0.4
0.52	1.1	0.5
0.50	1.2	0.6
0.50	1.3	0.6
1.00	1.8	1.5
0.70	2.3	1.4
1.70	2.8	4.4
0.90	3.3	2.8
0.70	3.4	2.3
1.30	2.8	4.0
1.70	2.1	4.2
1.00	1.9	2.0
0.50	1.8	0.9
0.80	1.3	1.2
1.30	1.2	1.6
4.40	0.9	4.5
5.00	0.4	3.1
5.00	0.0	1.0
TOTALS 32.0		38.2

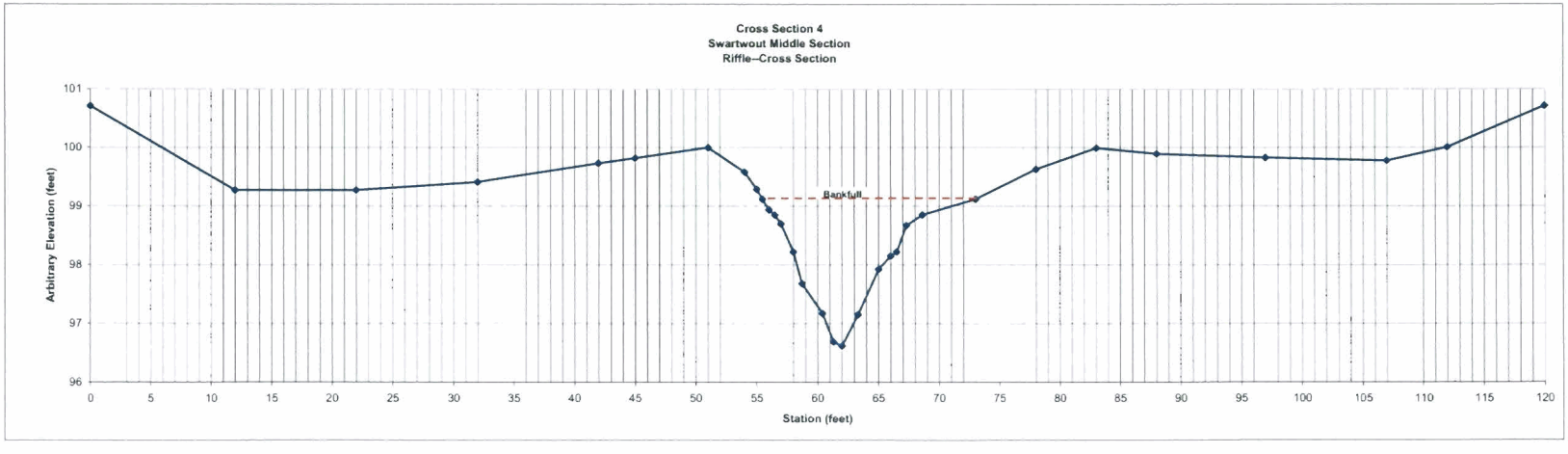
SUMMARY DATA (TOB)

A(BKF)	38.2
W(BKF)	32.0
Max d	3.4
Mean d	1.2

Bank Erosion Hazard Index (BEHI)

Criteria	Value	Index	Bank Erosion Potential
Bank Ht/Bkf Ht	1.6	6	high
Root Depth/Bank Ht	1	1	very low
Root Density (%)	95	1.2	very low
Bank Angle (Degrees)	62	4.1	moderate
Surface Protection (%)	90	1.45	very low
Bank Materials	Silt/Clay	5	
		18.75	low

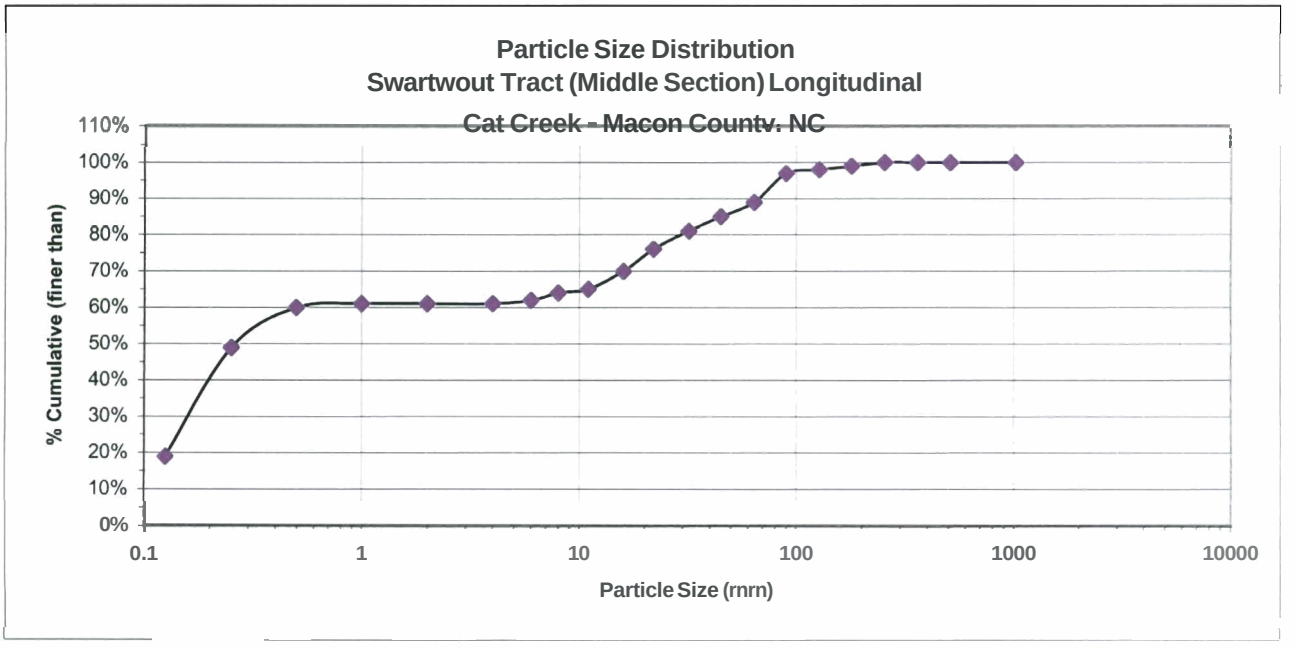
Riffle Cross-Section Looking Upstream



Swartwout Property
Cat Creek
Macon County, NC

PEBBLE COUNT

Site: Cat Creek							7/15/2003		
Party: Amanda Todd and George Lankford							Swartwout Tract Longitudinal		
Particle Count									
Inches	Particle	Millimeter		Riffle	Run/Pool		Total No.	Item %	% Cumulativ
	Silt/Clay	< 0.062	S/C	8	4		12	12%	12%
	Very Fine	.062 - .125	S	5	2		7	7%	19%
	Fine	.125 - .25	A	22	8		30	30%	49%
	Medium	.25 - .50	N	7	4		11	11%	60%
	Coarse	.50 - 1.0	D	1	0		1	1%	61%
.04 -.08	Very Coars	1.0 - 2.0	S	0	0		0	0%	61%
.08 - .16	Very Fine	2.0 - 4.0		0	0		0	0%	61%
.16 - .22	Fine	4.0 - 5.7	G	1	0		1	1%	62%
.22 - .31	Fine	5.7 - 8.0	R	2	0		2	2%	64%
.31 - .44	Medium	8.0 - 11.3	A	0	1		1	1%	65%
.44 - .63	Medium	11.3 - 16.0	V	3	2		5	5%	70%
.63 - .89	Coarse	16.0 - 22.6	E	3	3		6	6%	76%
.89 - 1.26	Coarse	22.6 - 32.0	L	4	1		5	5%	81%
1.26 - 1.77	Very Coars	32.0 - 45.0	S	4	0		4	4%	85%
1.77 - 2.5	Very Coars	45.0 - 64.0		3	1		4	4%	89%
2.5 - 3.5	Small	64 - 90	C	6	2		8	8%	97%
3.5 - 5.0	Small	90 - 128	O	0	1		1	1%	98%
5.0 - 7.1	Large	128 - 180	B	1	0		1	1%	99%
7.1 - 10.1	Large	180 - 256	L	0	1		1	1%	100%
10.1 - 14.3	Small	256 - 362	B	0	0		0	0%	100%
14.3 - 20	Small	362 - 512	L	0	0		0	0%	100%
20 - 40	Medium	512 - 1024	D	0	0		0	0%	100%
40 - 80	Lrg- Very Lr	1024 - 2048	R	0	0		0	0%	100%
	Bedrock		BDRK	0	0		0	0%	100%
			Totals	70	30		100	100%	100%



UT1 Cat Creek
Swartwout Property
Macon County

Field Crew:	Amanda Todd, George Lankford
River Basin:	Little Tenessee
Stream Reach:	UT Cat Creek (UT1)
Drainage Area:	0.86
Date:	7/21/2003
Description:	LONGITUDINAL PROFILE

STA	BS	HI	FS	ELEV	NOTE
TBM #1	0.00	100		100.00	
TP #1	2.56	95.64	6.92	93.08	cane
TP #2		94.72	0.92	94.72	fence post

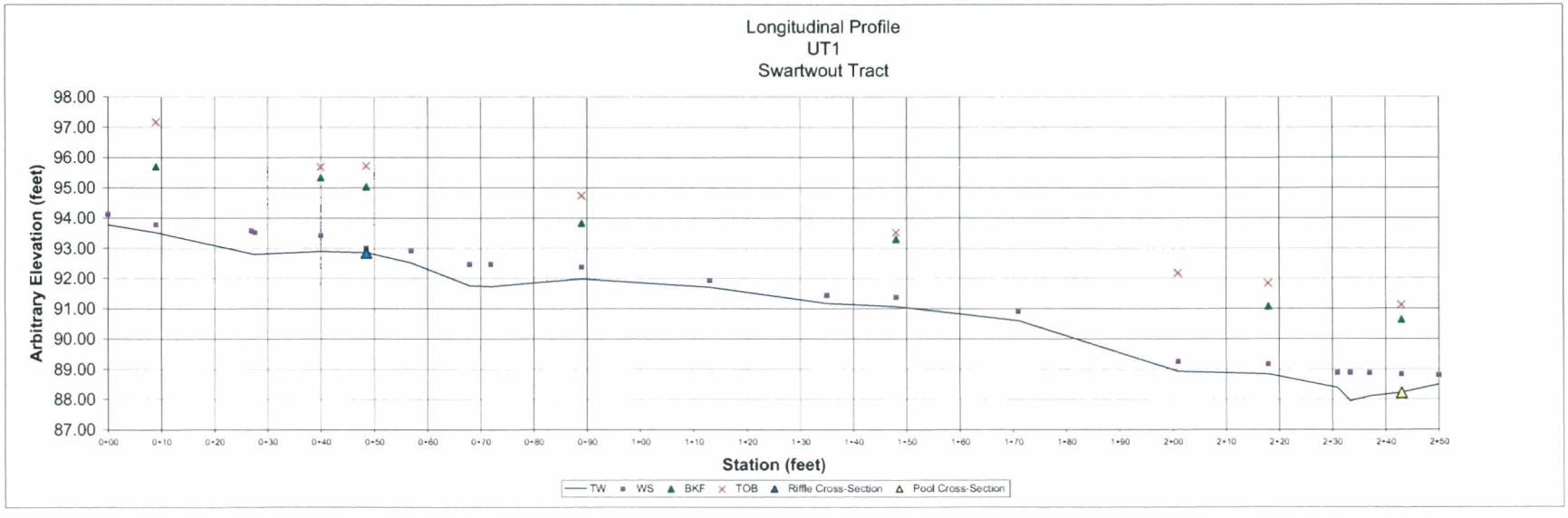
Station	TW (FS)	TW	WS (FS)	WS	BKF (FS)	BKF	TOB (FS)	TOB	Notes	HI	Bk Ht/Bkf Ht.	P-P	Pool Length	Max Pool Depth	Pool Slope	Riffle Length	Riffle Slope	Run Length	Run Slope	Step Length	Step Slope
0+00.0	6.23	93.77	5.87	94.13					Top Riffle	100.00						9	0.0389				
0+09.0	6.49	93.51	6.22	93.78	4.30	95.70	2.82	97.18	run	100.00	1.68							18	0.0111		
0+27.0	7.19	92.81	6.42	93.58					riffle	100.00						1	0.1000				
0+27.6	7.21	92.79	6.48	93.52					run	100.00								12	0.0081		
0+40.0	7.12	92.88	6.58	93.42	4.66	95.34	4.31	95.69	riffle	100.00	1.14					17	0.0300				
0+48.5	7.15	92.85	7.00	93.00	4.96	95.04	4.28	95.72	riffle CS	100.00	1.31										
0+57.0	7.50	92.50	7.09	92.91					run	100.00								11	0.0409		
0+68.0	8.26	91.74	7.54	92.46					top pool	100.00			21		0.0043						
0+72.0	8.29	91.71	7.54	92.46					max pool	100.00											
0+89.0	8.03	91.97	7.63	92.37	6.18	93.82	5.26	94.74	top riffle/run	100.00	1.50					24	0.0183				
1+13.0	8.31	91.69	8.07	91.93					run	100.00								22	0.0227		
1+35.0	8.85	91.15	8.57	91.43					riffle	100.00						13	0.0046				
1+48.0	8.95	91.05	8.63	91.37	6.71	93.29	6.49	93.51	run	100.00	1.10							23	0.0204		
1+71.0	9.41	90.59	9.10	90.90					step	100.00										30.0	0.055
2+01.0	6.73	88.91	6.39	89.25			3.47	92.17	riffle	95.64						17	0.0053				
2+18.0	6.81	88.83	6.48	89.16	4.56	91.08	3.80	91.84	run	95.64	1.34							13	0.0215		
2+31.0	7.26	88.38	6.76	88.88					top pool	95.64			19		0.0042						
2+33.4	7.70	87.94	6.76	88.88					max pool	95.64				1.90							
2+37.0	7.54	88.10	6.77	88.87					pool/glide	95.64											
2+43.0	7.42	88.22	6.80	88.84	5.00	90.64	4.52	91.12	pool CS	95.64	1.20										
2+50.0	7.15	88.49	6.84	88.80					top riffle	95.64											

tw slope 0.0211 ws slope 0.0213 bkf slope 0.02211

BKF W (ft)= 16.0
BKF D (ft)= 1.3
BKF Max D (ft)= 2.2

	Bk Ht/Bkf Ht.	P-P	Pool Length	Max Pool Depth	Pool Slope	Riffle Length	Riffle Slope	Run Length	Run Slope
min	1.10	43	19	1.90	0.0070	1	0.0090	11	0.0110
max	1.68	91	21	1.90	0.0110	24	0.1000	23	0.0440
avg	1.35	68	20	1.90	0.0080	13	0.0400	17	0.0240
Min ratio	NA	2.7		1.52	0.3283		0.4221		0.5159
Max ratio	NA	5.7		1.52	0.5159		4.6904		2.0638
avg ratio	NA	4.3		1.52	0.3752		1.8762		1.1257
			40			81		99	

Step Length	Step Slope
30	250



UT1 Cat Creek
Swartwout Property
Macon County

Field Crew:	Amanda Todd and George Lankford
River Basin:	Little Tennessee
Watershed:	UT Cat Creek
Stream Reach:	Swartwout UT1
Drainage Area:	0.86 sq mi (551.15 acres)
Date:	7/15/2003
Station:	0+77.5
Feature:	Riffle

STATION (FEET)	HI (FEET)	FS (FEET)	ELEVATION (FEET)	NOTES
0+00.0	100.00	3.75	96.25	below road
0+00.5	imm	3.93	96.07	
0+02.0	100.00	4.13	95.87	
0+04.2	100.00	4.28	95.72	LTOB
0+06.0	imm	4.96	95.04	LBKF
0+07.5	100.00	5.49	94.51	
0+09.0	100.00	5.85	94.15	
0+10.5	100.00	5.89	94.11	
0+11.3	100.00	6.31	93.69	
0+12.3	100.00	6.88	93.12	LEOW/ws
0+14.4	100.00	7.15	92.85	TW
0+16.0	100.00	6.97	93.03	
0+17.4	100.00	6.78	93.22	REOW
0+18.9	100.00	6.10	93.90	
0+20.0	100.00	5.87	94.13	
0+21.0	100.00	5.49	94.51	
0+22.0	100.00	4	95.05	RBKF
0+24.0	Imm	4.55	95.45	
0+29.0	100.00	4.27	95.73	RTOB
0+34.0	Imm	4.50	95.50	
0+39.0	Imm	4.64	95.36	
0+55.0	imm	3.93	96.07	
0.27	5.10	1.38		

BANKFULL (BKF) Hydraulic Geometry

Width (Feet)	Depth (Feet)	Area (Sq. Ft.)
0.0	0.0	0.0
1.5	0.5	0.4
1.5	0.9	1.1
1.5	0.9	1.4
0.8	1.4	0.9
1.0	1.9	1.6
2.1	2.2	4.3
1.6	2.0	3.4
1.4	1.8	2.7
1.5	1.1	2.2
1.1	0.9	1.1
1.0	0.5	0.7
1.0	0.0	0.3
Totals 16.0		20.1

SUMMARY DATA (BANKFULL)

A(BKF)	20.1	W(FPA)	
W(BKF)	16.0	Slope	0.02
Max d	2.2	Sinuosity	1.06
Mean d	1.25	Area= A	
W/D	12.8	Width= W	
Entrenchment	3.4	Depth= D	
Stream Type	Cb	Bankfull= BKF	
Area from Rural Regional Curve			19

TOP OF BANK (TOB) Hydraulic Geometry

Width (Feet)	Depth (Feet)	Area (Sq. Ft.)
0.0	0.0	0.0
1.8	0.7	0.6
1.5	1.2	1.4
1.5	1.6	2.1
1.5	1.6	2.4
0.8	2.0	1.5
1.0	2.6	2.3
2.1	2.9	5.7
1.6	2.7	4.4
1.4	2.5	3.6
1.5	1.8	3.2
1.1	1.6	1.9
1.0	1.2	1.4
1.0	0.7	0.9
2.0	0.3	0.9
5.0	0.0	0.6
Totals 24.8		33.1

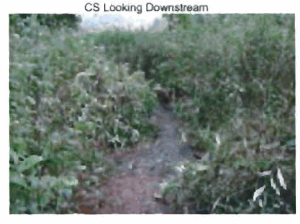
SUMMARY DATA (TOB)

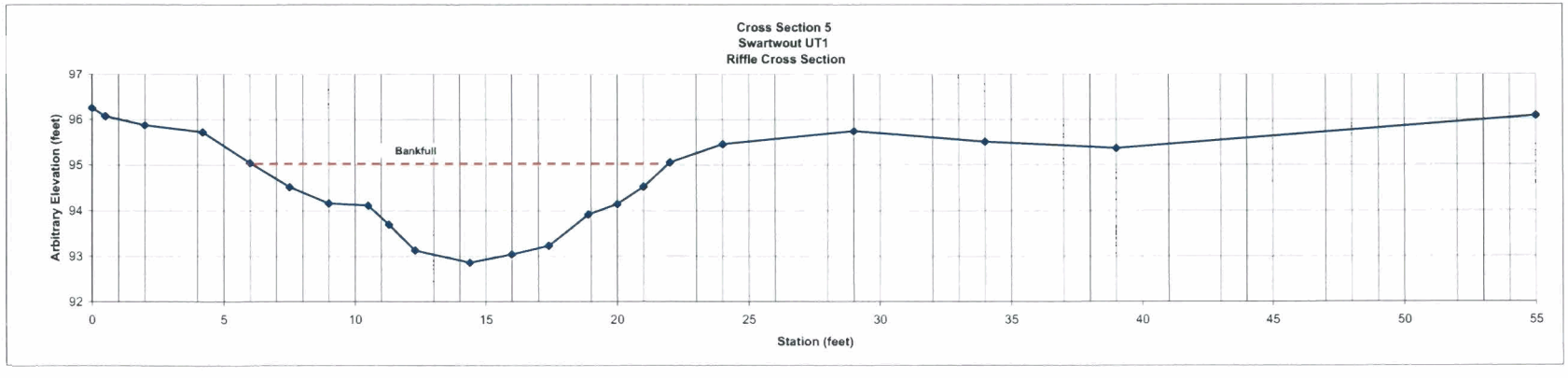
A(BKF)	33.1
W(BKF)	24.8
Max d	2.9
Mean d	1.3

Bank Erosion Hazard Index (BEHI)

Criteria	Value	Index	Bank Erosion Potential
Bank Ht/Bkf Ht	1.72	6.5	high
Root Depth/Bank Ht	1	1	very low
Root Density (%)	90	1.45	very low
Bank Angle (Degrees)	70	5.8	moderate
Surface Protection (%)	95	1.2	very low
Bank Materials	silt/clay	10	
		25.95	moderate

CS Looking Downstream





UT1 Cat Creek
Swartwout Property
Macon County

Field Crew:	Amanda Todd and George Lankford
River Basin:	Little Tennessee
Watershed:	**UT Cat Creek**
Stream Reach:	Swartwout UT1
Drainage Area:	0.86 sq mi (551.15 acres)
Date:	7/15/2003
Station:	2+72
Feature:	POOL

STATION (Feet)	HI (Feet)	FS (Feet)	ELEVATION (Feet)	NOTES	
0+00.0	95.60	3.85	91.95		
0+10.0	95.60	4.06	91.54		
0+12.0	95.60	4.29	91.31	LTOB	
0+14.0	95.60	5.00	90.60	LBKF	
0+15.0	95.60	5.55	90.05		
0+16.8	95.60	5.96	89.64		
0+17.5	95.60	6.48	89.12		
0+19.0	95.60	6.92	88.68	LEW	
0+19.3	95.60	7.41	88.19		
0+20.3	95.60	7.42	88.18	TW	ws= 6.77
0+21.7	95.60	7.29	88.31		
0+23.0	95.60	6.89	88.71	REW	
0+23.6	95.60	6.13	89.47		
0+24.3	95.60	5.87	89.73		
0+24.7	95.60	5.57	90.03		
0+25.3	95.60	5.22	90.38		
0+25.8	95.60	5.00	90.60	RBKF	
0+27.0	95.60	4.52	91.08	RTOB	
0+33.0	95.60	4.41	91.19		
0+36.5	95.60	4.47	91.13		
0+40.0	95.60	4.95	90.65		
0+47.0	95.60	5.25	90.35		
0+55.0	95.60	5.21	90.39		
0+58.0	95.60	4.78	90.82		
0+68.0	95.60	3.68	91.92		

Width Fpa=68

BANKFULL (BKF) Hydraulic Geometry

Width (Feet)	Depth (Feet)	Area (Sq. Ft.)
0	0	0
1.0	0.5	0.3
1.8	1.0	1.4
0.7	1.5	0.9
1.5	1.9	2.6
0.3	2.4	0.6
1.0	2.4	2.4
1.4	2.3	3.3
1.3	1.9	2.7
0.6	1.1	0.9
0.7	0.9	0.7
0.4	0.6	0.3
0.6	0.2	0.2
0.5	0.0	0.1
11.8		16.3

SUMMARY DATA (Bankfull)

A(BKF)	16.3
W(BKF)	11.8
Max d	2.4
Mean d	1.4

TOP OF BANK (TOB) Hydraulic Geometry

Width (Feet)	Depth (Feet)	Area (Sq. Ft.)
2.0	0.0	0.0
1.0	0.7	0.4
1.8	1.3	1.8
0.7	1.7	1.0
1.5	2.2	2.9
0.3	2.6	0.7
1.0	3.1	2.9
1.4	3.1	4.4
1.3	3.0	4.0
0.6	2.6	1.7
0.7	1.8	1.6
0.4	1.6	0.7
0.6	1.3	0.9
0.5	0.9	0.6
1.2	0.7	1.0
TOTALS 15.0		24.3

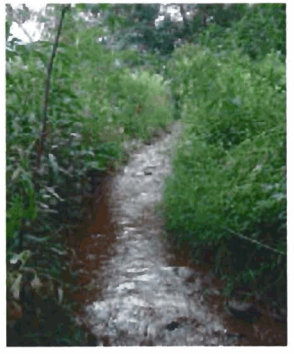
SUMMARY DATA (TOB)

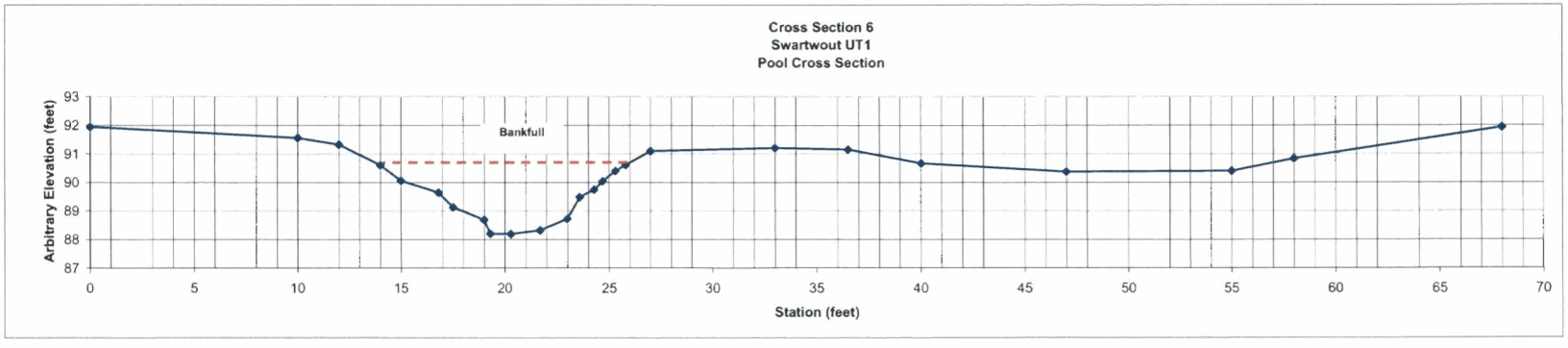
A(BKF)	24.3
W(BKF)	15.0
Max d	3.1
Mean d	1.6

Bank Erosion Hazard Index (BEHI)

Criteria	Value	Index	Bank
Bank Ht/Bkf Ht	1.7	6.4	high
Root Depth/Bank Ht	1	1	very low
Root Density (%)	92	1.4	very low
Bank Angle (Degrees)	56	3.7	low
Surface Protection (%)	95	1.2	very low
Bank Materials	Silt/Clay	5	
		19	low

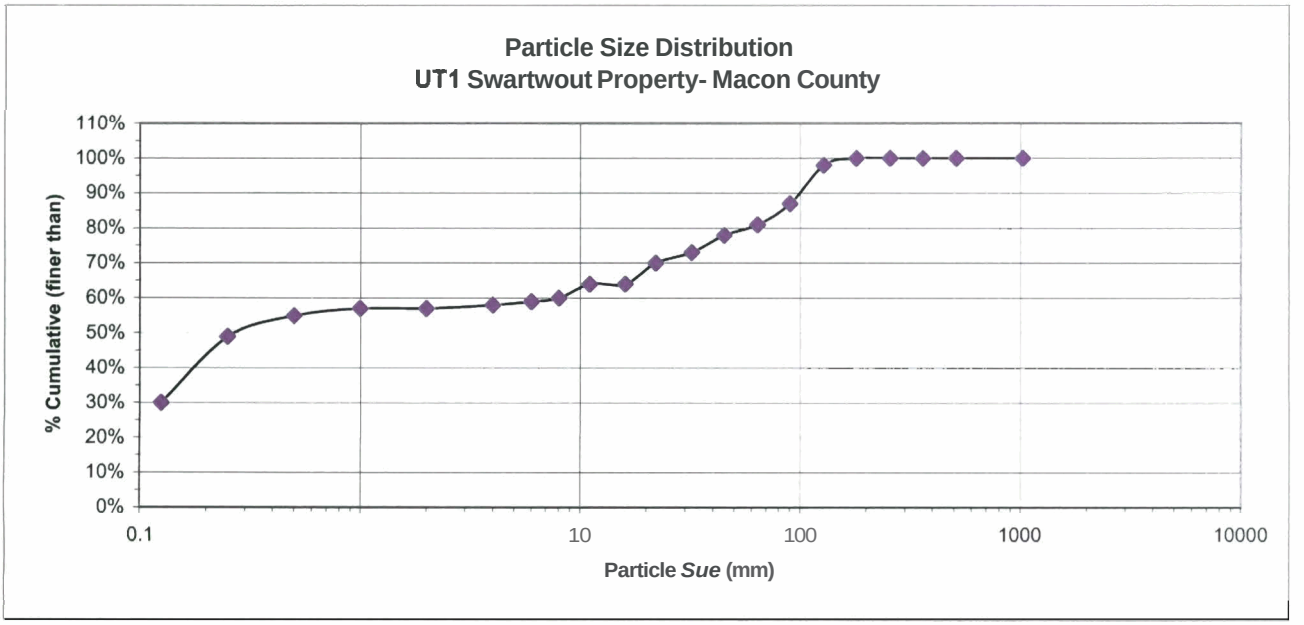
CS Looking Upstream





UT1 Cat Creek
Swartwout Property
Macon County

PEBBLE COUNT									
Site: Cat Creek							7/21/2003		
Party: Amanda Todd and George Lankford							Swartwout Tract UT1 Longitudinal		
			Particle Count						
Inches	Particle	Millimeter		Riffle	Run/Pool		Total No.	Item %	% Cumulative
	Silt/Clay	< 0.062	S/C	12	9		21	21%	21%
	Very Fine	.062 - .125	S	5	4		9	9%	30%
	Fine	.125 - .25	A	10	9		19	19%	49%
	Medium	.25 - .50	N	4	2		6	6%	55%
	Coarse	.50 - 1.0	D	0	2		2	2%	57%
.04 -.08	Very Coarse	1.0 - 2.0	S	0	0		0	0%	57%
.08 - .16	Very Fine	2.0 - 4.0		1	0		1	1%	58%
.16 - .22	Fine	4.0 - 5.7	G	0	1		1	1%	59%
.22 - .31	Fine	5.7 - 8.0	R	1	0		1	1%	60%
.31 - .44	Medium	8.0 - 11.3	A	2	2		4	4%	64%
.44 - .63	Medium	11.3 - 16.0	V	0	0		0	0%	64%
.63 - .89	Coarse	16.0 - 22.6	E	4	2		6	6%	70%
.89 - 1.26	Coarse	22.6 - 32.0	L	1	2		3	3%	73%
1.26 - 1.77	Very Coarse	32.0 - 45.0	S	4	1		5	5%	78%
1.77 - 2.5	Very Coarse	45.0 - 64.0		2	1		3	3%	81%
2.5 - 3.5	Small	64 - 90	C	5	1		6	6%	87%
3.5 - 5.0	Small	90 - 128	O	8	3		11	11%	98%
5.0 - 7.1	Large	128 - 180	B	1	1		2	2%	100%
7.1 - 10.1	Large	180 - 256	L	0	0		0	0%	100%
10.1 - 14.3	Small	256 - 362	B	0	0		0	0%	100%
14.3 - 20	Small	362 - 512	L	0	0		0	0%	100%
20 - 40	Medium	512 - 1024	D	0	0		0	0%	100%
40 - 80	Lrg- Very Lr	1024 - 2048	R	0	0		0	0%	100%
	Bedrock		BDRK	0	0		0	0%	100%
			Totals	60	40		100	100%	100%



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Cat Creek
Waldroop Property
Macon County

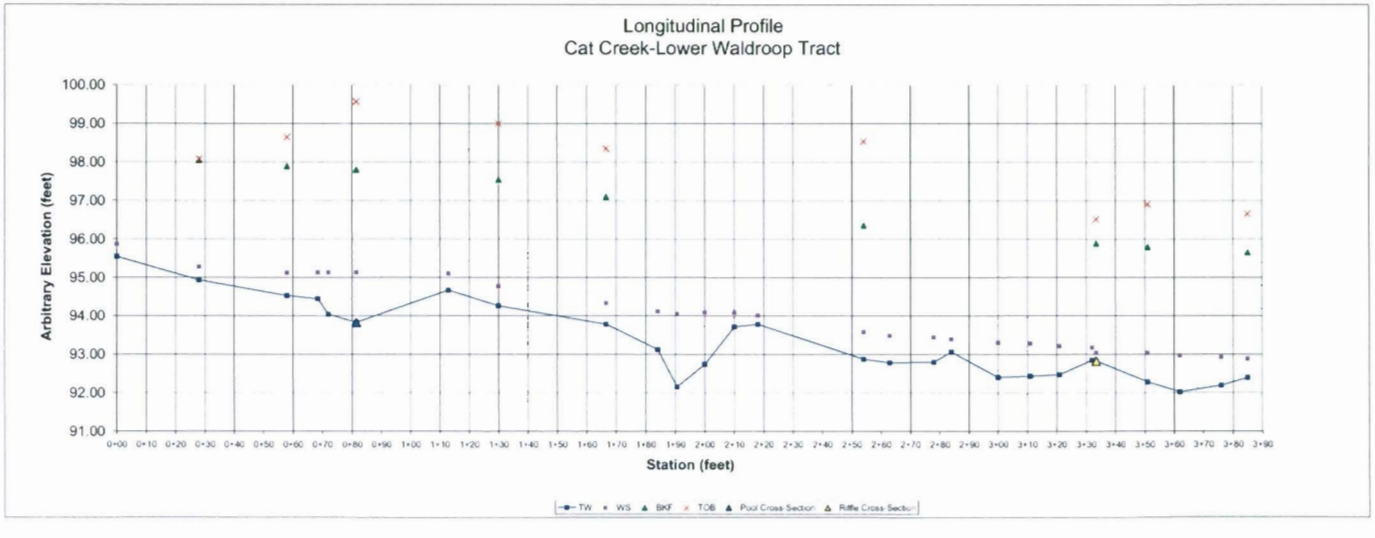
Field Crew:	Amanda Todd, George Lankford
River Basin:	Little Tennesse
Stream Reach:	Lower Cat Creek Waldroop Tract
Drainage Area:	2.53
Date:	7/21/2003
Description:	LONGITUDINAL PROFILE

	STA	BS	HI	FS	ELEV	NOTE
TBM #1	3.74		103.74		100.00	
TP #1	3.09		102.03	4.8	98.94	
TP #2	4.76		103.7	3.09	98.94	
TBM #1			100	3.7	100	

Station	TW (FS)	TW	WS (FS)	WS	BKF (FS)	BKF	TOB (FS)	TOB	Notes	HI	Bk Ht./ Bkf Ht.	P-P	Pool Length	Max Pool Depth	Pool Slope	Riffle Length	Riffle Slope	Run Length	Run Slope	Glide Length	Glide Slope
0+00.0	8.20	95.54	7.88	95.86					Top Riffle	103.74						68.5	0.0085				
0+28.0	8.81	94.93	8.46	95.28	5.70	98.04	5.67	98.07	Flow Gate	103.74	1.01										
0+58.0	9.22	94.52	8.62	95.12	5.86	97.88	5.10	98.64	intermediate	103.74	1.23										
0+68.5	9.30	94.44	8.61	95.13					Top Pool	103.74		98	45		0.0007						
0+72.0	9.71	94.03	8.61	95.13					Drain Tile	103.74											
0+81.5	9.92	93.82	8.61	95.13	5.95	97.79	4.18	99.56	Max Pool CS	103.74	1.45			4.6							
1+13.0	9.08	94.66	8.64	95.10					Top Riffle	103.74						17	0.0194				
1+30.0	9.49	94.25	8.97	94.77	6.21	97.53	4.75	98.99	Run	103.74	1.45							37	0.0121		
1+66.5	9.97	93.77	9.41	94.33	6.65	97.09	5.39	98.35	Top Pool	103.74	1.38	88	44		0.0057						
1+84.0	10.63	93.11	9.63	94.11					Pool	103.74											
1+90.5	11.59	92.15	9.69	94.05					Max Pool	103.74											
2+00.0	11.01	92.73	9.65	94.09					Pool	103.74											
2+10.0	10.03	93.71	9.66	94.08					Glide	103.74										8	0.0088
2+18.0	9.97	93.77	9.73	94.01					Top Riffle	103.74						36	0.0119				
2+54.0	10.88	92.86	10.16	93.58	7.40	96.34	5.21	98.53	Top Pool	103.74	1.63	46	24		0.0058						
2+63.0	9.26	92.77	8.55	93.48					Pool	102.03											
2+78.0	9.24	92.79	8.59	93.44					Top Glide	102.03										6	0.0083
2+84.0	8.98	93.05	8.64	93.39					Top Riffle	102.03						16	0.0062				
3+00.0	9.64	92.39	8.74	93.29					Max Pool	102.03		33	21		0.0038						
3+11.0	10.70	92.43	8.75	93.28					Pool	102.03											
3+21.0	9.57	92.46	8.82	93.21					Top Glide	102.03										11	0.0036
3+32.0	9.19	92.84	8.86	93.17					Top Riffle	102.03						19	0.0074				
3+33.4	9.21	92.82	9.00	93.03	6.15	95.88	5.52	96.51	Riffle CS	102.03	1.21										
3+51.0	9.75	92.28	9.00	93.03	6.24	95.79	5.13	96.90	Top Pool	102.03	1.32		25		0.0040						
3+62.0	10.01	92.02	9.06	92.97					intermediate	102.03											
3+76.0	9.84	92.19	9.10	92.93					Top Glide	102.03										9	0.0044
3+85.0	9.64	92.39	9.14	92.89	6.38	95.65	5.37	96.66	Riffle	102.03	1.31										

tw slope	0.0082	ws slope	0.0077
BKF W (ft)=	22.9		
BKF D (ft)=	1.7		
BKF Max D (ft)=	2.9		

	Bk Ht./ Bkf Ht.	P-P	Pool Length	Max Pool Depth	Pool Slope	Riffle Length	Riffle Slope	Run Length	Run Slope	Glide Length	Glide Slope
min	1.01	43	21	4.60	0.0000	16	0.0070	37	0.0060	6	0.0010
max	1.63	108	45	4.60	0.0040	69	0.0110	37	0.0170	11	0.0050
avg	1.37	70	32	4.60	0.0020	31	0.0140	37	0.0120	9	0.0030
Min ratio	NA	1.9		2.69	0.0000		0.9074		0.7400		0.1296
Max ratio	NA	4.7		2.69	0.4700		1.9500		2.2600		0.6481
avg ratio	NA	3.1		2.69	0.2200		1.5000		1.6100		0.4600
			158			156.5		37		34.0	385



Cat Creek
Waldroop Property (upper)
Macon County

Field Crew:	Amanda Todd, George Lankford
River Basin:	Little Tenessee
Stream Reach:	Cat Creek
Drainage Area:	2.20
Date:	7/21/2003
Station:	N/A
Feature:	Upper Reach below Ford crossing and bedrock feature

STATION (FEET)	HI (FEET)	FS (FEET)	ELEVATION (FEET)	NOTES
0+00.0	103.74	5.59	98.15	
0+21.0	103.74	5.64	98.10	
0+26.0	103.74	5.76	97.98	
0+29.0	103.74	5.87	97.87	
0+33.0	103.74	6.09	97.65	
0+37.0	103.74	5.98	97.76	
0+42.0	103.74	5.93	97.81	
0+47.0	103.74	5.86	97.88	
0+51.0	103.74	5.79	97.95	
0+55.0	103.74	5.97	97.77	LTOB
0+57.0	103.74	6.18	97.56	
0+60.0	103.74	6.63	97.11	EDGE OF HORSE PASTURE
0+61.0	103.74	6.89	96.85	
0+62.0	103.74	7.08	96.66	
0+63.0	103.74	7.31	96.43	Wfpa = 102.5
0+64.0	103.74	7.56	96.18	
0+66.0	103.74	7.67	96.07	LBKF
0+66.8	103.74	7.89	95.85	
0+68.0	103.74	8.06	95.68	
0+69.0	103.74	8.20	95.54	
0+70.0	103.74	8.33	95.41	
0+70.9	103.74	8.42	95.32	
0+72.0	103.74	8.73	95.01	
0+73.0	103.74	8.89	94.85	
0+74.2	103.74	9.13	94.61	LIB
0+75.5	103.74	9.26	94.48	
0+76.3	103.74	9.59	94.15	
0+77.0	103.74	9.95	93.79	LEOW
0+77.8	103.74	10.40	93.34	TW ws=9.91
0+79.0	103.74	10.36	93.38	
0+80.0	103.74	10.28	93.46	
0+81.3	103.74	10.32	93.42	
0+81.7	103.74	9.91	93.83	REOW
0+82.7	103.74	9.48	94.26	
0+83.4	103.74	9.12	94.62	
0+83.8	103.74	8.52	95.22	
0+84.3	103.74	8.04	95.70	
0+85.0	103.74	7.65	96.09	RBKF
0+85.3	103.74	7.56	96.18	
0+86.0	103.74	7.31	96.43	
0+87.0	103.74	7.12	96.62	
0+89.3	103.74	6.77	96.97	
0+90.5	103.74	6.46	97.28	
0+92.3	103.74	6.04	97.70	FENCE/RTOB
0+93.0	103.74	5.97	97.77	
0+96.0	103.74	5.79	97.95	
0+99.0	103.74	5.57	98.17	
1+02.0	103.74	5.38	98.36	

BANKFULL Hydraulic Geometry

Width (Feet)	Depth (Feet)	Area (Sq. Ft.)
0.0	0.0	0.0
0.8	0.2	0.1
1.2	0.4	0.4
1.0	0.5	0.5
1.0	0.7	0.6
0.9	0.8	0.6
1.1	1.1	1.0
1.0	1.2	1.1
1.2	1.5	1.6
1.3	1.6	2.0
0.8	1.9	1.4
0.7	2.3	1.5
0.8	2.7	2.0
1.2	2.7	3.3
1.0	2.6	2.7
1.3	2.7	3.4
0.4	2.2	1.0
1.0	1.8	2.0
0.7	1.5	1.1
0.4	0.8	0.5
0.5	0.4	0.3
0.7	0.0	0.1
TOTALS 19.0		27.1

TOB Hydraulic Geometry

Width (Feet)	Depth (Feet)	Area (Sq. Ft.)
0.0	0.0	0.0
2.0	0.3	0.3
3.0	0.5	1.1
1.0	0.7	0.6
1.0	0.9	0.8
1.0	1.0	1.0
1.0	1.3	1.2
2.0	1.4	2.7
0.8	1.6	1.2
1.2	1.7	2.0
1.0	1.8	1.7
1.0	2.1	1.9
0.9	2.3	2.0
1.1	2.5	2.6
1.0	2.6	2.6
1.2	3.0	3.4
1.3	3.3	4.1
0.8	3.8	2.8
0.7	3.7	2.6
0.8	3.7	3.0
1.2	3.7	4.4
1.0	3.3	3.5
1.3	2.9	4.0
0.4	2.5	1.1
1.0	1.9	2.2
0.7	1.4	1.2
0.4	1.0	0.5
0.5	0.7	0.4
0.7	0.5	0.4
1.0	0.1	0.3
TOTALS 31.0		55.3

Bank Erosion Hazard Index (BEHI)

Criteria	Value	Index	Bank Erosion
Bank Ht/Bkf Ht	1.3	4.63	moderate
Root Depth/Bank Ht	1	1	very low
Root Density (%)	80	1.9	moderate
Bank Angle (Degrees)	85	6.85	high
Surface Protection (%)	80	1.9	very low
Bank Materials	silt/clay	3	
		19.28	low

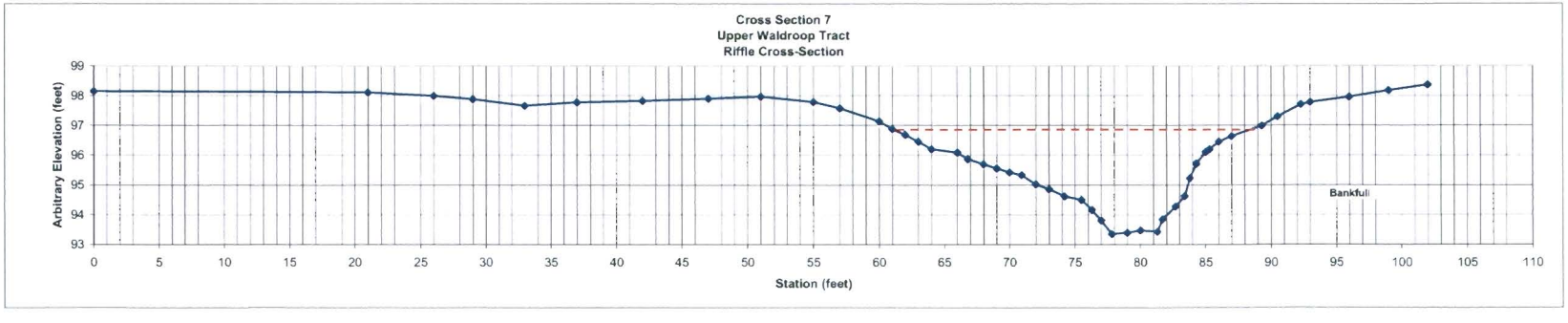
Looking at Right Bank

SUMMARY DATA (BANKFULL)

A(BKF)	27.1	W(FPA)	150
W(BKF)	19.0	Slope	0.8
Max d	2.7	Sinuosity	1.01
Mean d	1.4	Area= A	
W/D	13.3	Width= W	
Entrenchment	>5.5	Depth= D	
Stream Type	C	Bankfull= BKF	
Area from Rural Regional Curve			36.94

SUMMARY DATA (TOB)

A(BKF)	55.3
W(BKF)	31.0
Max d	3.8
Mean d	1.8



Cat Creek
Waldroop Property
Macon County

Field Crew:	Amanda Todd and George Lankford
River Basin:	Little Tennessee
Watershed:	**Cat Creek**
Stream Reach:	Waldroop Property
Drainage Area:	2.5 sq mi
Date:	7/18/2003
Station:	0+81.5
Feature:	POOL

STATION (Feet)	HI (Feet)	FS (Feet)	ELEVATION (Feet)	NOTES	
0+00.0	103.74	4.87	98.87		
0+07.0	103.74	4.77	98.97		
0+14.0	103.74	4.59	99.15		
0+22.0	103.74	4.43	99.31		
0+27.0	103.74	4.58	99.16		
0+29.2	103.74	4.93	98.81		
0+30.9	103.74	5.41	98.33		
0+33.7	103.74	5.21	98.53	FENCE	
0+35.0	103.74	5.24	98.50	LTOB	
0+36.0	103.74	5.57	98.17		
0+37.7	103.74	5.95	97.79	LBKF	
0+38.4	103.74	6.47	97.27		
0+39.2	103.74	6.93	96.81		
0+39.7	103.74	7.35	96.39		
0+40.5	103.74	7.80	95.94		
0+41.2	103.74	9.10	94.64		
0+43.2	103.74	9.42	94.32	LEOW	
0+44.2	103.74	9.88	93.86	TW	ws=8.61
0+45.2	103.74	9.82	93.92		
0+47.5	103.74	9.46	94.28		
0+49.0	103.74	9.46	94.28		
0+50.1	103.74	8.63	95.11	REOW	
0+52.0	103.74	8.1	95.64		
0+53.0	103.74	7.88	95.86		
0+53.2	103.74	7.29	96.45		
0+54.2	103.74	6.55	97.19		
0+55.0	103.74	5.95	97.79	RKBF	
0+56.0	103.74	5.27	98.47	RTOB	
0+57.0	103.74	4.93	98.81		
0+59.0	103.74	4.79	98.95		
0+61.7	103.74	4.57	99.17		
0+63.0	103.74	4.14	99.60		
0+64.5	103.74	4.18	99.56	FENCE	
					0+30.8

BANKFULL (BKF) Hydraulic Geometry

Width (Feet)	Depth (Feet)	Area (Sq. Ft.)
0	0	0
0.7	0.5	0.2
0.8	1.0	0.6
0.5	1.4	0.6
0.8	1.8	1.3
0.7	3.1	1.8
2.0	3.5	6.6
1.0	3.9	3.7
1.0	3.9	3.9
2.3	3.5	8.5
1.5	3.5	5.3
1.1	2.7	3.4
1.9	2.1	4.6
1.0	1.9	2.0
0.2	1.3	0.3
1.0	0.6	1.0
0.8	0.0	0.2
TOTALS 17.3		44.0

SUMMARY DATA (BANKFULL)

A(BKF)	44.0
W(BKF)	17.3
Max d	3.9
Mean d	2.5

TOP OF BANK (TOB) Hydraulic Geometry

Width (Feet)	Depth (Feet)	Area (Sq. Ft.)
0.0	0.0	0.0
1.0	0.3	0.2
1.7	0.7	0.9
0.7	1.2	0.7
0.8	1.7	1.2
0.5	2.1	0.9
0.8	2.6	1.9
0.7	3.9	2.2
2.0	4.2	8.0
1.0	4.6	4.4
1.0	4.6	4.6
2.3	4.2	10.1
1.5	4.2	6.3
1.1	3.4	4.2
1.9	2.9	5.9
1.0	2.6	2.8
0.2	2.1	0.5
1.0	1.3	1.7
0.8	0.7	0.8
1.0	0.0	0.4
TOTALS 21.0		57.7

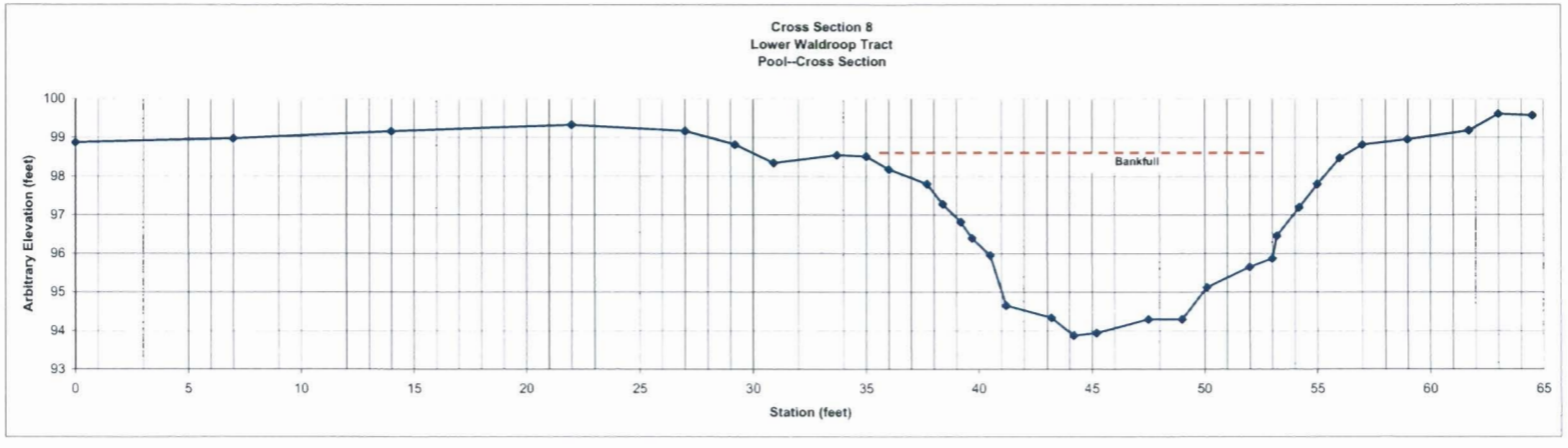
SUMMARY DATA (TOB)

A(BKF)	57.7
W(BKF)	21.0
Max d	4.6
Mean d	2.7

Bank Erosion Hazard Index (BEHI)

Criteria	Value	Index	Bank Erosion Potential
Bank Ht/Bkf Ht	1.8	6.95	high
Root Depth/Bank Ht	1	1	very low
Root Density (%)	75	2.3	low
Bank Angle (Degrees)	85	6.9	high
Surface Protection (%)	80	1.9	very low
Bank Materials	Silt/Clay	10	
Stratificaiton		0	
		29.05	moderate

CS Looking Upstream



Cat Creek
Waldroop Property
Macon County

Field Crew:	Amanda Todd and George Lankford
River Basin:	Little Tennessee
Watershed:	**Cat Creek**
Stream Reach:	Waldroop Property
Drainage Area:	2.5 sq mi (1,619 acres)
Date:	7/18/2003
Station:	N/A
Feature:	Riffle (Staion 3+33.4)

STATION (Feet)	HI (Feet)	FS (Feet)	ELEVATION (Feet)	NOTES		BANKFULL (BKF) Hydraulic Geometry Width (Feet)	Depth (Feet)	Area (Sq. Ft.)
0+00.0	102.03	5.11	96.92			0.0	0.0	0.0
0+10.0	102.03	5.23	96.80					
0+22.0	102.03	5.36	96.67					
0+30.0	102.03	5.42	96.61					
0+35.4	102.03	5.52	96.51	LTOB	FENCE	2.0	0.1	0.1
0+38.0	102.03	5.89	96.14			2.0	0.1	0.2
0+40.0	102.03	6.15	95.88			0.8	0.2	0.1
0+44.0	102.03	6.28	95.75	LBKF LINTP		1.2	0.7	0.6
0+46.0	102.03	6.35	95.68			1.3	1.2	1.2
0+48.0	102.03	6.39	95.64			1.2	1.7	1.8
0+48.8	102.03	6.50	95.53			0.1	2.2	0.2
0+50.0	102.03	6.98	95.05			0.1	2.8	0.3
0+51.3	102.03	7.48	94.55			2.3	2.9	6.6
0+52.5	102.03	8.01	94.02			3.0	2.9	8.7
0+52.6	102.03	8.46	93.57		2.71	2.0	2.9	5.9
0+52.7	102.03	9.10	92.93	LEW	**3.79**	3.4	2.7	9.6
0+55.0	102.03	9.16	92.87			0.0	2.6	0.0
0+58.0	102.03	9.21	92.82	TW	ws=8.88	0.9	2.2	2.2
0+60.0	102.03	9.20	92.83			0.5	1.2	0.9
0+63.4	102.03	9.00	93.03	REW		0.2	0.9	0.2
0+63.4	102.03	8.88	93.15			1.0	0.4	0.6
0+64.3	102.03	8.51	93.52			0.3	0.2	0.1
0+64.8	102.03	7.48	94.55			0.5	0.0	0.1
0+65.0	102.03	7.17	94.86			0.1	0.0	0.0
0+66.0	102.03	6.68	95.35		TOTALS	22.9		39.1
0+66.3	102.03	6.50	95.53					
0+66.8	102.03	6.31	95.72					
0+66.9	102.03	6.28	95.75	RBKF				
0+67.3	102.03	6.15	95.88					
0+68.0	102.03	5.62	96.41	RTOB				
0+69.5	102.03	4.63	97.40	FENCE				

SUMMARY DATA (BANKFULL)

A(BKF)	39.1	W(FPA)	100
W(BKF)	22.9	Slope	0.008
Max d	2.9	Sinuosity	1.01
Mean d	1.7	Area= A	
W/D	13.4	Width= W	
Entrenchment	>5.0	Depth= D	
Stream Type	C4	Bankfull= BKF	
Area from Rural Regional Curve			40

	Top of Bank (TOB) Hydraulic Geometry Width (Feet)	Depth (Feet)	Area (Sq. Ft.)
	0	0	0
	2.6	0.4	0.5
	2.0	0.6	1.0
	4.0	0.8	2.8
	2.0	0.8	1.6
	2.0	0.9	1.7
	0.8	1.0	0.7
	1.2	1.5	1.5
	1.3	2.0	2.2
	1.2	2.5	2.7
	0.1	2.9	0.3
	0.1	3.6	0.3
	2.3	3.6	8.3
	3.0	3.7	11.0
	2.0	3.7	7.4
	3.4	3.5	12.2
	0.0	3.4	0.0
	0.9	3.0	2.9
	0.5	2.0	1.2
	0.2	1.7	0.4
	1.0	1.2	1.4
	0.3	1.0	0.3
	0.5	0.8	0.4
	0.5	0.6	0.4
	0.7	0.1	0.3
TOTALS	32.6		61.3

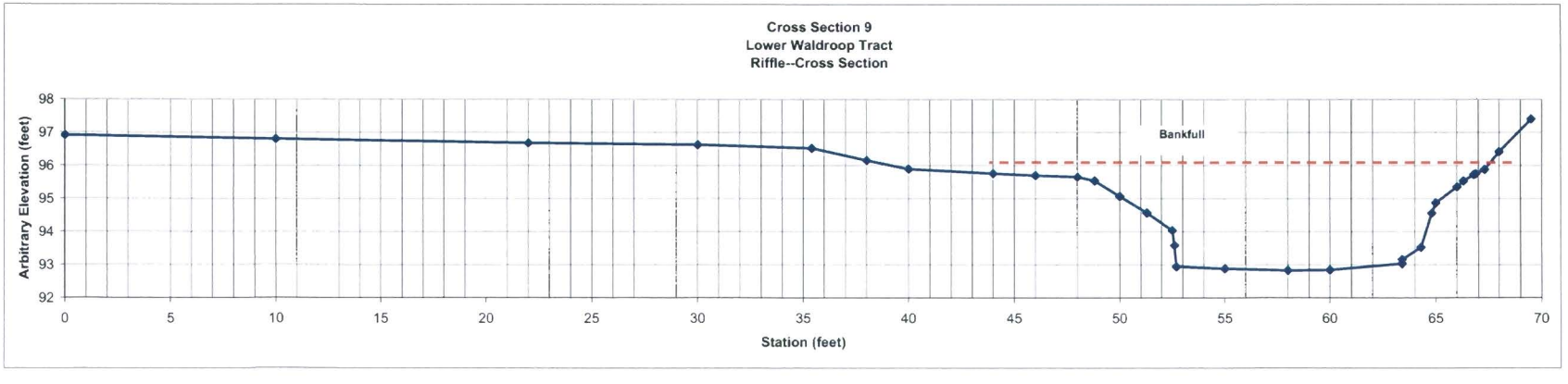
SUMMARY DATA (TOB)

A(BKF)	61.3
W(BKF)	32.6
Max d	3.7
Mean d	1.9

Bank Erosion Hazard Index (BEHI)

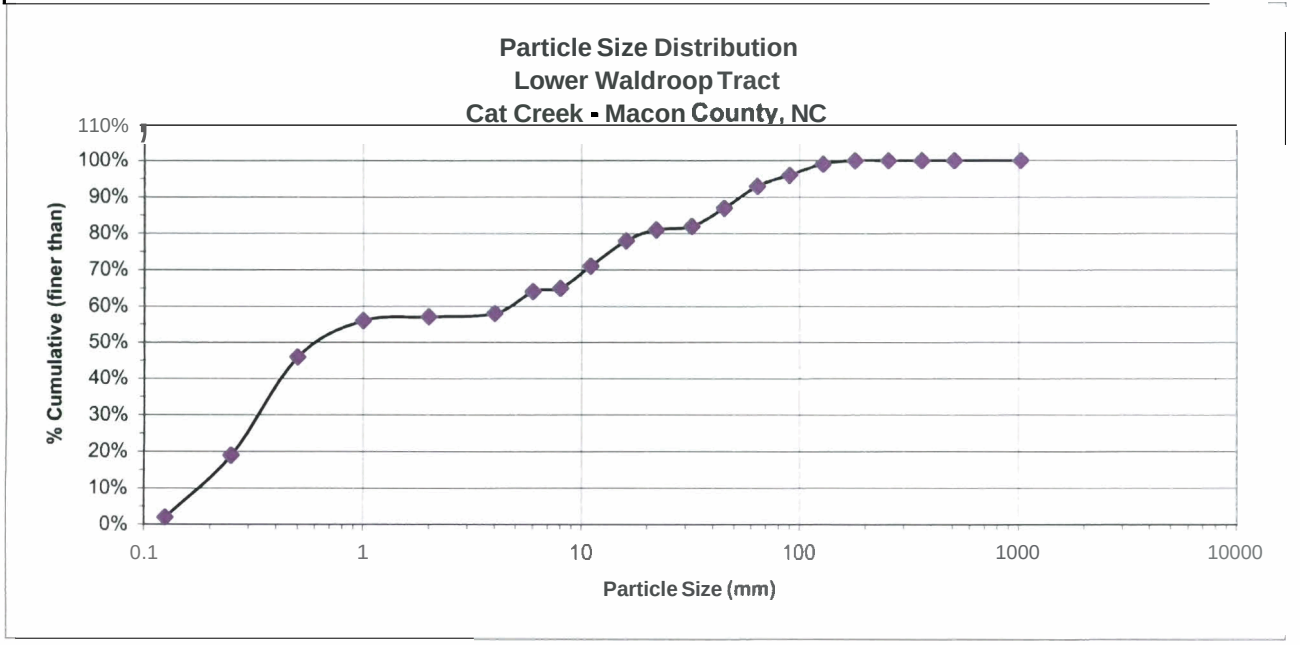
Criteria	Value	Index	Bank Erosion Potential
Bank Ht/Bkf Ht	2.6	8.7	very high
Root Depth/Bank Ht	0.5	3.9	low
Root Density (%)	40	5.1	high
Bank Angle (Degrees)	50	3.4	low
Surface Protection (%)	30	5.9	moderate
Bank Materials	Silt/Clay	7	
Stratificaiton		5	
		39	high

CS Looking Downstream



Cat Creek
Lower Waldroop Property
Macon County

PEBBLE COUNT									
Site: Cat Creek							7/18/2003		
Party: Amanda Todd and George Lankford							Lower Waldroop Tract Longitudinal		
				Particle Count					
Inches	Particle	Millimeter		Riffle	Run/Pool		Total No.	Item %	Cumulativ
	Silt/Clay	< 0.062	SIC	1	1		2	2%	2%
	Very Fine	.062 - .125	S	0	0		0	0%	2%
	Fine	.125 - .25	A	11	6		17	17%	19%
	Medium	.25 - .50	N	11	16		27	27%	46%
	Coarse	.50 - 1.0	D	2	8		10	10%	56%
.04 - .08	Very Coars	1.0 - 2.0	S	0	1		1	1%	57%
.08 - .16	Very Fine	2.0 - 4.0		1	0		1	1%	58%
.16 - .22	Fine	4.0 - 5.7	G	5	1		6	6%	64%
.22 - .31	Fine	5.7 - 8.0	R	1	0		1	1%	65%
.31 - .44	Medium	8.0 - 11.3	A	6	0		6	6%	71%
.44 - .63	Medium	11.3 - 16.0	V	6	1		7	7%	78%
.63 - .89	Coarse	16.0 - 22.6	E	2	1		3	3%	81%
.89 - 1.26	Coarse	22.6 - 32.0	L	1	0		1	1%	82%
1.26 - 1.77	Very Coars	32.0 - 45.0	S	2	3		5	5%	87%
1.77 - 2.5	Very Coars	45.0 - 64.0		4	2		6	6%	93%
2.5 - 3.5	Small	64 - 90	C	3	0		3	3%	96%
3.5 - 5.0	Small	90 - 128	O	3	0		3	3%	99%
5.0-7.1	Large	128-180	B	1	0		1	1%	100%
7.1 - 10.1	Large	180 - 256	L	0	0		0	0%	100%
10.1 - 14.3	Small	256 - 362	B	0	0		0	0%	100%
14.3 - 20	Small	362 - 512	L	0	0		0	0%	100%
20 - 40	Medium	512 - 1024	D	0	0		0	0%	100%
40 - 80	rg- Very Lr	1024 - 2048	R	0	0		0	0%	100%
	Bedrock		BDRK	0	0		0	0%	100%
			Totals	60	40		100	100%	100%



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Cat Creek
Parker Tract
Macon County

Field Crew:	Amanda Todd, George Lankford
River Basin:	Little Tenessee
Stream Reach:	Cat Creek-Parker Tract
Drainage Area:	3.35
Date:	7/22/2003
Description:	LONGITUDINAL PROFILE

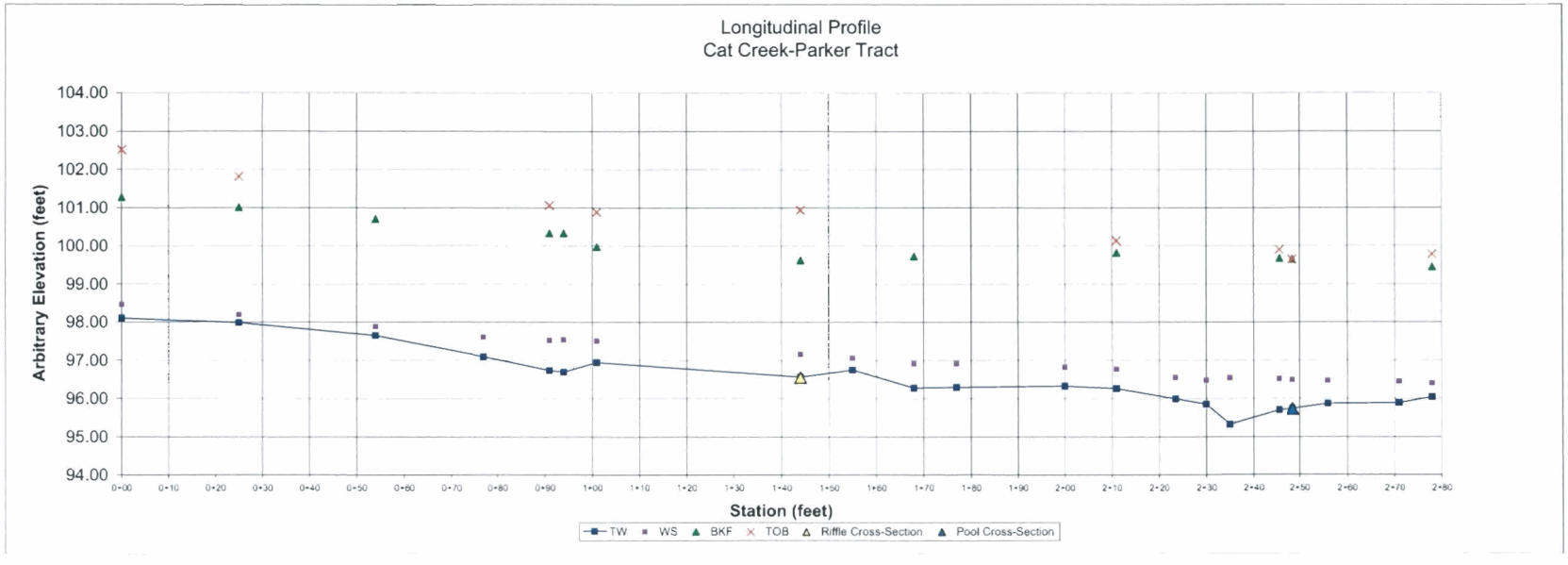
	STA	BS	HI	FS	ELEV	NOTE
TBM #1		6.15	106.15		100.00	groundwatergauge
TP #1			100	6.15	100	

Station	TW (FS)	TW	WS (FS)	WS	BKF (FS)	BKF	TOB (FS)	TOB	Notes	HI	Bk Ht/Bkf Ht.	P-P	Pool Length	Max Pool Depth	Pool Slope	Riffle Length	Riffle Slope
0+00.0	8.05	98.10	7.69	98.46	4.88	101.27	3.64	102.51	top riffle	106.15	1.39					77	0.0110
0+25.0	8.17	97.98	7.98	98.19	5.15	101.00	4.34	101.81	run	106.15	1.27						
0+54.0	8.51	97.64	8.27	97.88	5.48	100.69			run	106.15			17				
0+77.0	9.07	97.08	8.54	97.61					top pool	106.15			24		0.0046		
0+91.0	9.43	96.72	8.64	97.51	5.83	100.32	5.10	101.05	mini pool	106.15	1.20	153					
0+94.0	9.47	96.68	8.62	97.53	5.83	100.32			max of mini pool	106.15				2.79			
1+01.0	9.22	96.93	8.65	97.50	6.19	99.96	5.26	100.87	Top Riffle	106.15	1.30					67	0.0090
1+44.0	9.60	96.55	9.00	97.15	6.54	99.61	5.22	100.93	riffle cs	106.15							
1+55.0	9.42	96.73	9.10	97.05					run	106.15							
1+68.0	9.89	96.26	9.25	96.90	6.44	99.71		106.15	riffle	106.15	2.87						
1+77.0	9.87	96.28	9.25	96.90					riffle	106.15						53	0.0083
2+00.0	9.84	96.31	9.34	96.81					riffle	106.15							
2+11.0	9.90	96.25	9.39	96.76	8.34	99.81	6.03	100.12	run	106.15	1.09						
2+23.5	10.17	95.98	9.61	96.54					run	106.15							
2+30.0	10.31	95.84	9.69	96.46					mini pool	106.15			41		0.0017		
2+35.0	10.84	95.31	9.62	96.53					max of mini pool	106.15				3.79			
2+45.5	10.46	95.69	9.64	96.51	6.48	99.67	6.26	99.89	intermediate	106.15	1.06						
2+48.5	10.42	95.73	9.67	96.48	6.51	99.64	6.51	99.64	pool cs	106.15							
2+56.0	10.29	95.86	9.69	96.46					glide	106.15							
2+71.0	10.27	95.88	9.71	96.44					intermediate	106.15							
2+78.0	10.12	96.03	9.76	96.39	8.71	99.44	6.38	99.77	top riffle	106.15	1.10						

tw slope 0.0074 ws slope 0.0058 bkf slope 0.0066

BKF W (ft)= 19.1
BKF D (ft)= 2.5
BKF Max D (ft)= 4.3

	Bk Ht/Bkf Ht.	P-P	Pool Length	Max Pool Depth	Pool Slope	Riffle Length	Riffle Slope
min	1.06	54	17	2.79	0.0000	53	0.0090
max	2.87	90	40	3.79	0.0030	77	0.0160
avg	1.41	72	29	3.29	0.0020	66	0.0120
Min ratio	NA	2.8		1.13	0.0000		1.6400
Max ratio	NA	4.7		1.53	0.5172		2.7586
avg ratio	NA	3.8		1.33	0.2600		2.0800



Cat Creek
Parker Tract
Macon County

Field Crew:	Amanda Todd and George Lankford
River Basin:	Little Tenessee
Watershed:	**Cat Creek-Parker Tract**
Stream Reach:	Parker Tract
Drainage Area:	2.60
Date:	7/22/2003
Station:	1+44
Feature:	Riffle

STATION (FEET)	HI (FEET)	FS (FEET)	ELEVATION (FEET)	NOTES	
0+00.0	106.15	4.46	101.69		
0+08.0	106.15	4.53	101.62		
0+16.0	106.15	4.48	101.67		
0+26.0	106.15	4.60	101.55		
0+35.0	106.15	4.85	101.30		
0+36.0	106.15	4.94	101.21	LTOB	
0+37.5	106.15	5.22	100.93	LTOB lint	
0+38.0	106.15	5.34	100.81	LBKF lint	
0+39.0	106.15	5.79	100.36		
0+40.0	106.15	6.28	99.87		
0+40.5	106.15	6.54	99.61		
0+40.9	106.15	6.86	99.29		
0+42.0	106.15	7.74	98.41		
0+43.3	106.15	8.28	97.87	IB	
0+44.0	106.15	8.58	97.57		
0+44.5	106.15	9.48	96.67	WS/LEOW	
0+45.4	106.15	9.52	96.63		
0+46.4	106.15	9.60	96.55	TW	ws=9.48
0+47.3	106.15	9.55	96.60		
0+48.5	106.15	9.49	96.66		
0+48.8	106.15	9.08	97.07	REOW	
0+50.7	106.15	8.70	97.45		
0+51.0	106.15	8.30	97.85		
0+51.9	106.15	8.28	97.87	IB	
0+53.0	106.15	7.57	98.58		
0+54.1	106.15	6.93	99.22		
0+55.0	106.15	6.54	99.61		
0+56.0	106.15	5.69	100.46		
0+57.1	106.15	5.34	100.81	RBKF	
0+57.5	106.15	5.22	100.93	RTOB	
0+61.0	106.15	5.07	101.08		
0+66.0	106.15	4.98	101.17		
0+72.0	106.15	4.70	101.45		
0+80.0	106.15	4.48	101.67		
0+90.0	106.15	4.47	101.68		
1+00.0	106.15	4.64	101.51		
1+10.0	106.15	4.33	101.82		
1+20.0	106.15	4.57	101.58		
1+30.0	106.15	4.28	101.87		
1+35.0	106.15	4.65	101.50		

BANKFULL (BKF) Hydraulic Geometry

Width (Feet)	Depth (Feet)	Area (Sq. Ft.)
0.0	0.0	0.0
1.0	0.5	0.2
1.0	0.9	0.7
0.5	1.2	0.5
0.4	1.5	0.5
1.1	2.4	2.2
1.3	2.9	3.5
0.7	3.2	2.2
0.5	4.1	1.8
0.9	4.2	3.7
1.0	4.3	4.2
0.9	4.2	3.8
1.2	4.1	5.0
0.3	3.7	1.2
1.9	3.4	6.7
0.3	3.0	0.9
0.9	2.9	2.7
1.1	2.2	2.8
1.1	1.6	2.1
0.9	1.2	1.3
1.0	0.3	0.8
1.1	0.0	0.2
TOTALS 19.1		47.1

TOP OF BANK (TOB) Hydraulic Geometry

Width (Feet)	Depth (Feet)	Area (Sq. Ft.)
0.0	0.0	0.0
0.5	0.1	0.0
1.0	0.6	0.3
1.0	1.1	0.8
0.5	1.3	0.6
0.4	1.6	0.6
1.1	2.5	2.3
1.3	3.1	3.6
0.7	3.4	2.2
0.5	4.3	1.9
0.9	4.3	3.9
1.0	4.4	4.3
0.9	4.3	3.9
1.2	4.3	5.2
0.3	3.9	1.2
1.9	3.5	7.0
0.3	3.1	1.0
0.9	3.1	2.8
1.1	2.3	3.0
1.1	1.7	2.2
0.9	1.3	1.4
1.0	0.5	0.9
1.5	0.0	0.4
TOTALS 20.0		49.5

SUMMARY DATA (BANKFULL)

A(BKF)	47.1	W(FPA)	150
W(BKF)	19.1	Slope	0.006
Max d	4.3	Sinuosity	1
Mean d	2.5	Area=	A
W/D	7.7	Width=	W
Entrenchment	7.1	Depth=	D
Stream Type	NA/G4	Bankfull=	BKF
Area from Rural Regional Curve			41

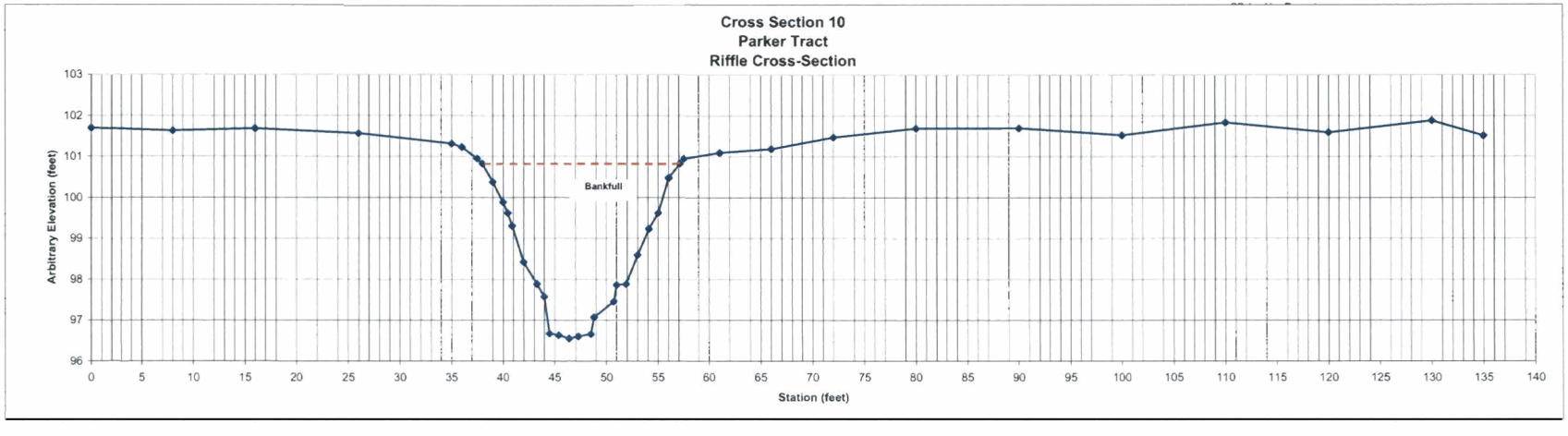
*LACK OF INDICATORS/RECENT CHANNELIZATION

SUMMARY DATA (TOB)

A(BKF)	49.5
W(BKF)	20.0
Max d	4.4
Mean d	2.5

Bank Erosion Hazard Index (BEHI)

Criteria	Value	Index	Bank Erosion Potential
Bank Ht/Bkf Ht	1.5	5.9	moderate
Root Depth/Bank Ht	1	1	very low
Root Density (%)	95	1.2	very low
Bank Angle (Degrees)	60	3.9	low
Surface Protection (%)	95	1.2	very low
Bank Materials	silt/clay	3	
		16.2	low



Cat Creek
Parker Tract
Macon *County*

Field Crew:	Amanda Todd and George Lankford
River Basin:	Little Tenessee
Watershed:	**Cat Creek-Parker Tract**
Stream Reach:	Parker Tract
Drainage Area:	2.60
Date:	7/22/2003
Station:	2+48.5
Feature:	Pool

STATION (Feet)	HI (Feet)	FS (Feet)	ELEVATION (Feet)	NOTES	
0+00.0	102.26	5.6	96.66		
0+08.0	102.26	5.72	96.54		
0+16.0	102.26	6.00	96.26		
0+26.0	102.26	5.88	96.38		
0+33.0	102.26	5.98	96.28		
0+38.0	102.26	6.51	95.75	LTOB	
0+39.0	102.26	6.63	95.63	LBKF lint	
0+41.0	102.26	7.01	95.25		
0+41.8	102.26	7.39	94.87		
0+42.6	102.26	7.86	94.40		
0+44.0	102.26	8.51	93.75		
0+45.3	102.26	9.49	92.77		
0+45.5	102.26	9.76	92.50	LEOW	
0+46.0	102.26	10.16	92.10		
0+47.8	102.26	10.23	92.03		
0+49.0	102.26	10.42	91.84	TW	ws=9.71
0+50.3	102.26	10.30	91.96		
0+51.5	102.26	10.22	92.04		
0+52.4	102.26	9.91	92.35	REOW	
0+54.0	102.26	8.90	93.36		
0+55.4	102.26	7.90	94.36		
0+56.0	102.26	7.39	94.87		
0+57.2	102.26	6.63	95.63	RBKF	
0+60.0	102.26	6.02	96.24	RTOB	
0+69.0	102.26	5.86	96.40		
0+75.0	102.26	5.45	96.81		
0+82.0	102.26	5.18	97.08		
0+89.0	102.26	5.18	97.08		
0+95.0	102.26	5.57	96.69		
1+00.0	102.26	5.34	96.92		
1+05.0	102.26	5.09	97.17		

BANKFULL (*BKF*) Hydraulic Geometry

	Width (Feet)	Depth (Feet)	Area (Sq. Ft.)
	0.0	0.0	0.0
	2.0	0.4	0.4
	0.8	0.8	0.5
	0.8	1.2	0.8
	1.4	1.9	2.2
	1.3	2.9	3.1
	0.2	3.1	0.6
	0.5	3.5	1.7
	1.8	3.6	6.4
	1.2	3.8	4.4
	1.3	3.7	4.8
	1.2	3.6	4.4
	0.9	3.3	3.1
	1.6	2.3	4.4
	1.4	1.3	2.5
	0.6	0.8	0.6
	1.2	0.0	0.5
TOTALS	18.2		40.3

SUMMARY DATA (BKF)

A(BKF)	40.3
W(BKF)	18.2
Max d	3.8
Mean d	2.2

TOP OF BANK (TOB) Hydraulic Geometry

	Width (Feet)	Depth (Feet)	Area (Sq. Ft.)
	0.0	0.0	0.0
	3.0	0.5	0.8
	1.6	0.9	1.1
	1.4	1.3	1.6
	1.3	2.0	2.2
	0.2	3.0	0.5
	0.5	3.3	1.6
	1.8	3.6	6.2
	1.2	3.7	4.4
	1.3	3.9	5.0
	1.2	3.8	4.6
	0.9	3.7	3.4
	1.6	3.4	5.7
	1.4	2.4	4.1
	0.6	1.4	1.1
	1.2	0.9	1.4
	2.8	0.1	1.4
TOTALS	22.0		44.9

SUMMARY DATA (TOB)

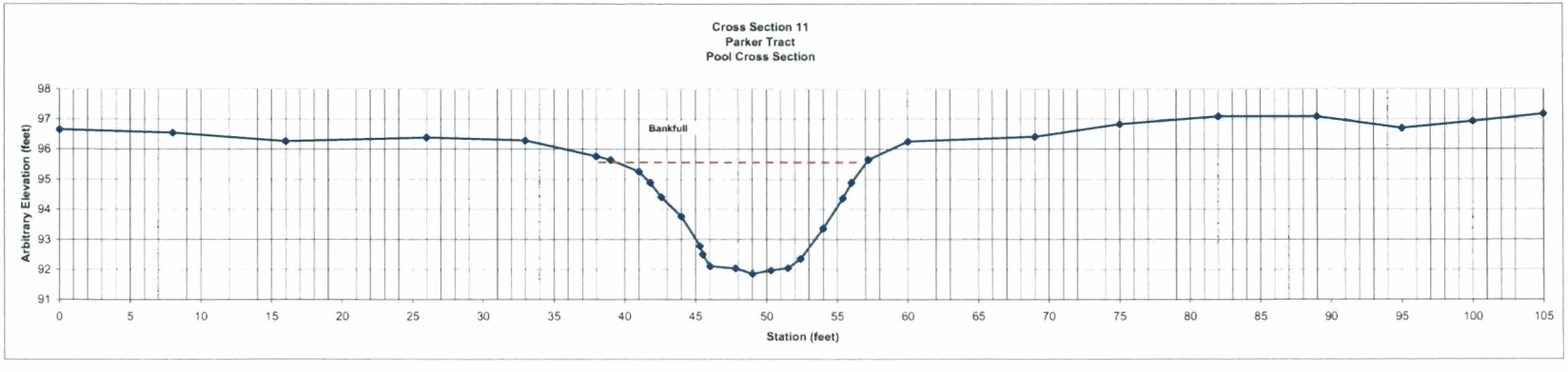
A(BKF)	44.9
W(BKF)	22.0
Max d	3.9
Mean d	2.0

*LACK OF INDICATORS/RECENT CHANNELIZATION

Bank Erosion Hazard Index (BEHI)

Criteria	Value	Index	Bank Erosion Potential
Bank Ht/Bkf Ht	1.5	5.9	moderate
Root Depth/Bank Ht	1	1	very low
Root Density (%)	95	1.2	very low
Bank Angle (Degrees)	60	3.9	low
Surface Protection (%)	95	1.2	very low
Bank Materials	Silt/Clay	5	
		18.2	low

CS LOOKING DOWNSTREAM



Cat Creek
Parker Tract
Macon County

Field Crew:	Amanda Todd and George Lankford
River Basin:	Little Tenessee
Watershed:	**Cat Creek-Parker Tract**
Stream Reach:	UT2
Drainage Area:	0.47
Date:	7/31/2003
Station:	N/A
Feature:	TRIB FROM POND

STATION (Feet)	HI (Feet)	FS (Feet)	ELEVATION (Feet)	NOTES	
0+00.0	100.00	5.25	94.75		
0+08.0	100.00	5.42	94.58		
0+18.0	100.00	5.57	94.43		
0+27.0	100.00	5.47	94.53		
W35.0	IW.W	522	04.78		
0+42.5	100.00	4.98	95.02		
0+47.0	100.00	4.88	95.02	LTOB	
0+52.0	IW.W	5.13	94.87		
0+61.0	100.00	5.14	94.86		
0+64.0	100.00	5.14	94.86		
W86.0	IW.W	5.49	94.51		
0+67.0	IW.W	5.90	94.10		
0+67.2	100.00	6.09	93.91	LBKF lint	
0+67.7	IW.W	6.52	93.48		
0+68.0	1W.W	8.77	93.23		
0+69.1	1M.M	7.62	92.38		
OW.7	IW.W	7.95	92.05		
OW.9	IW.W	8.16	91.84	IB	
0+70.4	100.00	8.50	81.50	LEOW	
0+70.6	100.00	9.21	90.79	TW	WS=8.50
0+71.0	IM.W	9.15	90.85		
0+71.5	IW.W	8.62	91.38	REOW	
0+72.3	100.00	8.45	91.55		
0+73.0	IW.W	8.16	81.U	IB	
0+74.0	IW.W	7.08	92.92		
0+74.7	IW.W	6.56	93.44		
0+75.4	IW.W	6.09	83.91	RBKF	
0+76.2	IW.W	5.55	94.45		
0+77.5	IW.W	5.12	94.88		
0+79.0	100.00	4.93	85.07	RTOB	
0+82.0	IW.W	5.05	04.85		
0+85.0	100.00	51	9490		
0+88.0	IW.W	4.88	95.12		
0+92.0	IW.W	4.81	95 19		
0+97.0	IW.W	4.62	85.38		
1+00.0	100.00	4.51	85 49		
1+08.0	IW.W	3.77	96.23		
1+16.0	100.00	2.74	97.26		

BANKFULL Hydraulic Geometry

Width (Feet)	Depth (Feet)	Area (Sq. Ft.)
0.0	0.0	0.0
0.5	0.4	0.1
0.3	0.7	0.2
1.1	1.5	1.2
0.6	1.9	1.0
0.2	2.1	0.4
0.5	2.4	1.1
0.2	3.1	0.6
0.4	3.1	1.2
0.5	2.5	1.4
0.8	2.4	2.0
0.7	2.1	1.6
1.0	1.0	1.5
0.7	0.5	0.5
0.7	0.0	0.2
TOTALS 8.2		12.9

TOP OF BANK (TOB) Hydraulic Geometry

Width (Feet)	Depth (Feet)	Area (Sq. Ft.)
0.0	0.0	0.0
5.0	0.1	0.4
9.0	0.2	1.4
3.0	0.2	0.5
2.0	0.5	0.7
1.0	0.9	0.7
0.2	1.1	0.2
0.5	1.5	0.7
0.3	1.8	0.5
1.1	2.6	2.4
0.6	3.0	1.7
0.2	3.2	0.6
0.5	3.5	1.7
0.2	4.2	0.8
0.4	4.2	1.7
0.5	3.6	2.0
0.8	3.5	2.8
0.7	3.2	2.3
1.0	2.1	2.6
0.7	1.6	1.3
0.7	1.1	0.9
0.8	0.6	0.7
1.3	0.1	0.5
1.5	0.0	0.1
TOTALS 32.0		27.1

Bank Erosion Hazard Index (BEHI)

Criteria	Value	Index	Bank Erosion Potential
Bank Ht/Bkf Ht	1.4	5.2	moderate
Root Depth/Bank Ht	1	1	very low
Root Density (%)	50	4.3	moderate
Bank Angle (Degrees)	55	3.6	low
Surface Protection (%)	60	3.5	low
Bank Materials	Silt/Clay	0	
		17.6	low

Looking across UT2 at right bank

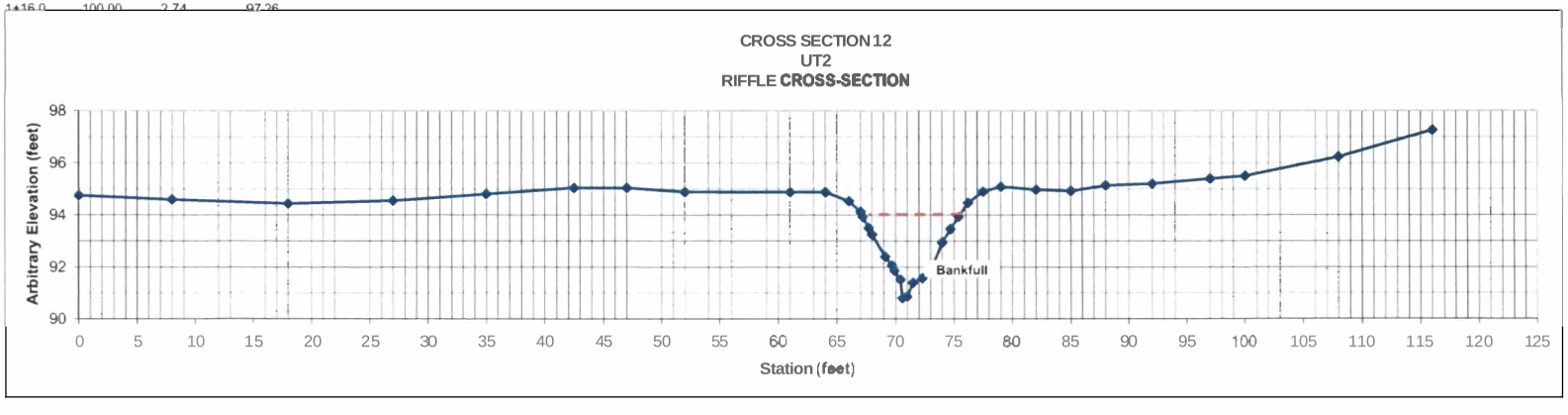
SUMMARY DATA (BANKFULL)

A(BKF)	12.9	W(FPA)	150
W(BKF)	8.2	Slope	0.01
Max d	3.1	Sinuosity	
Mean d	1.6	Area=	A
W/D	5.2	Width=	W
Entrenchment	>18.3	Depth=	D
Stream Type	NA	Bankfull=	BKF
Area from Rural Regional Curve			13

SUMMARY DATA (TOB)

A(BKF)	27.1
W(BKF)	32.0
M u d	4.2
Mean d	0.8

'LACK OF INDICATORS/RECENT CHANNELIZATION



Cat Creek
Parker Tract
Macon County

Field Crew:	Amanda Todd and George Lankford
River Basin:	Little Tenessee
Watershed:	Cat Creek-Parker Tract
Stream Reach:	UT3
Drainage Area:	0.24
Date:	7/31/2003
Station:	N/A
Feature:	UT3

STATION (Feet)	HI (Feet)	FS (Feet)	ELEVATION (Feet)	NOTES	
0+00.0	100.00	5.77	94.23		
0+05.0	10000	611	93.89		
0+10.0	100.00	6.19	93.81		
0+15.0	100.00	6.33	93.67		
0+18.0	100.00	6.65	93.35	LTOB	
0+18.7	100.00	6.88	93.12		
0+19.7	100.00	7.33	92.67	LBKF	
0+20.6	100.00	7.66	92.34		
0+21.4	100.00	8.22	91.78		
0+22.0	100.00	8.30	91.70		
0+22.7	100.00	8.60	91.40		
0+23.0	100.00	9.30	90.70	LEOW	
0+23.7	100.00	9.40	90.60	TW	WS=9.05
0+24.3	100.00	9.29	90.71	REOW	
0+24.4	100.00	9.00	91.00		
0+24.9	100.00	8.92	91.08		
0+25.6	100.00	7.65	92.35		
0+26.4	100.00	7.33	92.67	RBKF	
0+27.0	100.00	6.78	93.22		
0+28.0	100.00	6.24	93.76		
0+29.4	100.00	5.68	94.32		
0+31.0	100.00	5.60	94.40		
0+35.0	100.00	5.47	94.53		
0+40.0	100.00	5.43	94.57		
0+45.0	100.00	5.45	94.55		
0+50.0	100.00	5.44	94.56		

BANKFULL Hydraulic Geometry

Width (Feet)	Depth (Feet)	Area (Sq. Ft.)
0.0	0.0	0.0
0.9	0.3	0.1
0.8	0.9	0.5
0.6	1.0	0.6
0.7	1.3	0.8
0.3	2.0	0.5
0.7	2.1	1.4
0.6	2.0	1.2
0.1	1.7	0.2
0.5	1.6	0.8
0.7	0.3	0.7
0.8	0.0	0.1
TOTALS 6.7		6.9

SUMMARY DATA (BANKFULL)

A(BKF)	6.9	W(FPA)	150
W(BKF)	6.7	Slope	0.01
Max d	2.1	Sinuosity	
Mean d	1.0	Area= A	
WID	6.5	Width= W	
Entrenchment	22.4	Depth= D	
Stream Type	NA	Bankfull= BKF	
Area from Rural Regional Curve		a	

TOP OF BANK (TOB) Hydraulic Geometry

Width (Feet)	Depth (Feet)	Area (Sq. Ft.)
0.0	0.0	0.0
0.7	0.2	0.1
1.0	0.7	0.5
0.9	1.0	0.8
0.8	1.6	1.0
0.6	1.6	1.0
0.7	1.9	1.3
0.3	2.6	0.7
0.7	2.8	1.9
0.6	2.6	1.6
0.1	2.3	0.2
0.5	2.3	1.2
0.7	1.0	1.1
0.8	0.7	0.7
0.6	0.1	0.2
TOTALS 9.0		12.2

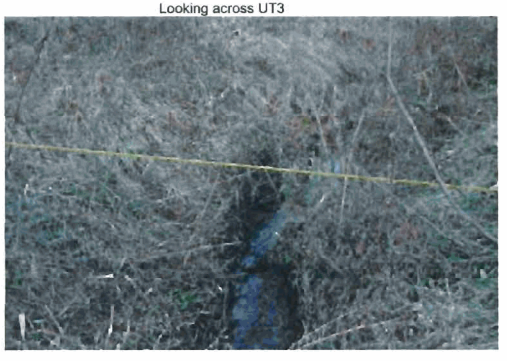
SUMMARY DATA (TOB)

A(BKF)	12.2
W(BKF)	9.0
Max d	2.8
Mean d	1.4

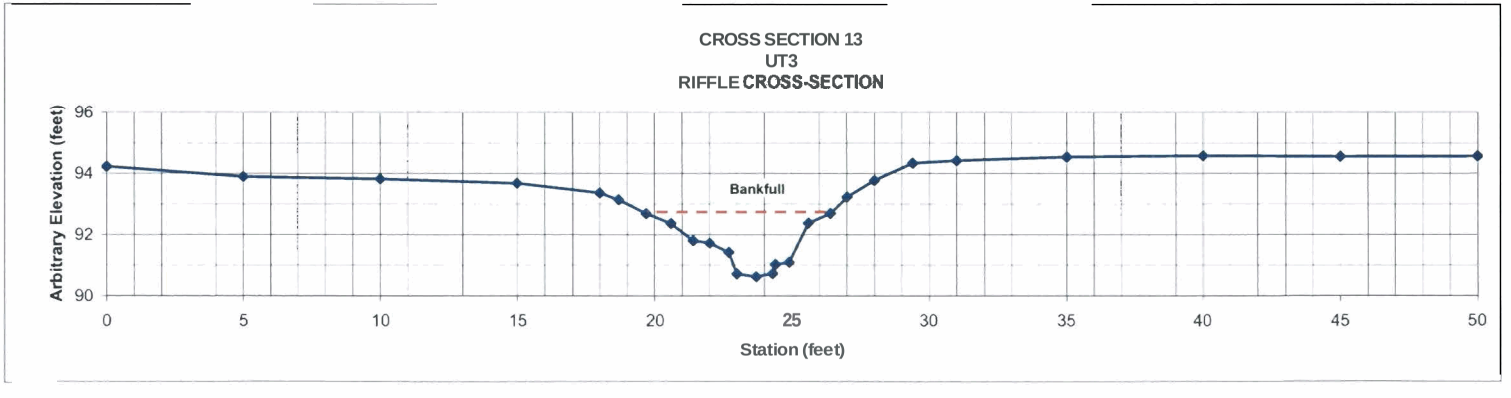
Bank Erosion Hazard Index (BEHI)

Criteria	Value	Index	Bank Erosion Potential
Bank Ht/Bkf Ht			moderate
Root Depth/Bank Ht			very low
Root Density (%)	Not Done		moderate
Bank Angle (Degrees)			low
Surface Protection (%)			low
Bank Materials	Silt/Clay	0	
		0	low

Looking across UT3

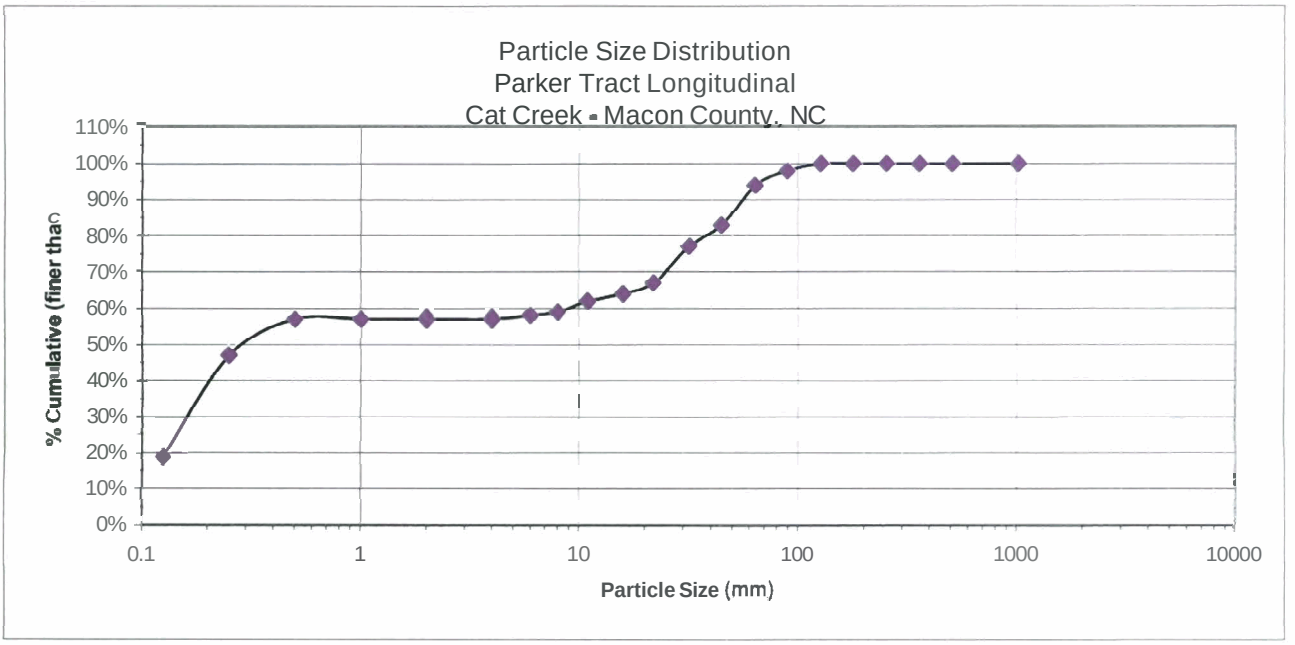


'LACK OF INDICATORS/RECENT CHANNELIZATION



Cat Creek
Parker Tract
Macon County

PEBBLE COUNT									
Site: Cat Creek							7/22/2003		
Party: Amanda Todd and George Lankford							Parker Tract Longitudinal		
				Particle Count					
Inches	Particle	Millimeter		Riffle	Run/Pool		Total No.	Item %	% Cumulativ
	Silt/Clay	< 0.062	SIC	4	3		7	7%	7%
	Very Fine	.062 - .125	S	6	6		12	12%	19%
	Fine	.125 - .25	A	17	11		28	28%	47%
	Medium	.25 - .50	N	6	4		10	10%	57%
	Coarse	.50 - 1.0	D	0	0		0	0%	57%
.04 -.08	Very Coars	1.0 - 2.0	S	0	0		0	0%	57%
.08 - .16	Very Fine	2.0 - 4.0		0	0		0	0%	57%
.16 - .22	Fine	4.0 - 5.7	G	0	1		1	1%	58%
.22 - .31	Fine	5.7 - 8.0	R	1	0		1	1%	59%
.31 - .44	Medium	8.0 - 11.3	A	0	3		3	3%	62%
.44 - .63	Medium	11.3 - 16.0	V	1	1		2	2%	64%
.63 - .89	Coarse	16.0 - 22.6	E	1	2		3	3%	67%
.89 - 1.26	Coarse	22.6 - 32.0	L	6	4		10	10%	77%
1.26 - 1.77	Very Coars	32.0 - 45.C	S	4	2		6	6%	83%
1.77 - 2.5	Very Coars	45.0 - 64.0		8	3		11	11%	94%
2.5 - 3.5	Small	64 - 90	C	4	0		4	4%	98%
3.5 - 5.0	Small	90 - 128	O	2	0		2	2%	100%
5.0 - 7.1	Large	128 - 180	B	0	0		0	0%	100%
7.1 - 10.1	Large	180-256	L	0	0		0	0%	100%
10.1 - 14.3	Small	256 - 362	B	0	0		0	0%	100%
14.3-20	Small	362 -512	L	0	0		0	0%	100%
20 - 40	Medium	512 - 1024	D	0	0		0	0%	100%
40 - 80	rg- Very Lr	1024 - 2048	R	0	0		0	0%	100%
	Bedrock		BDRK	0	0		0	0%	100%
			Totals	**60**	**40**		**100**	**100%**	**100%**



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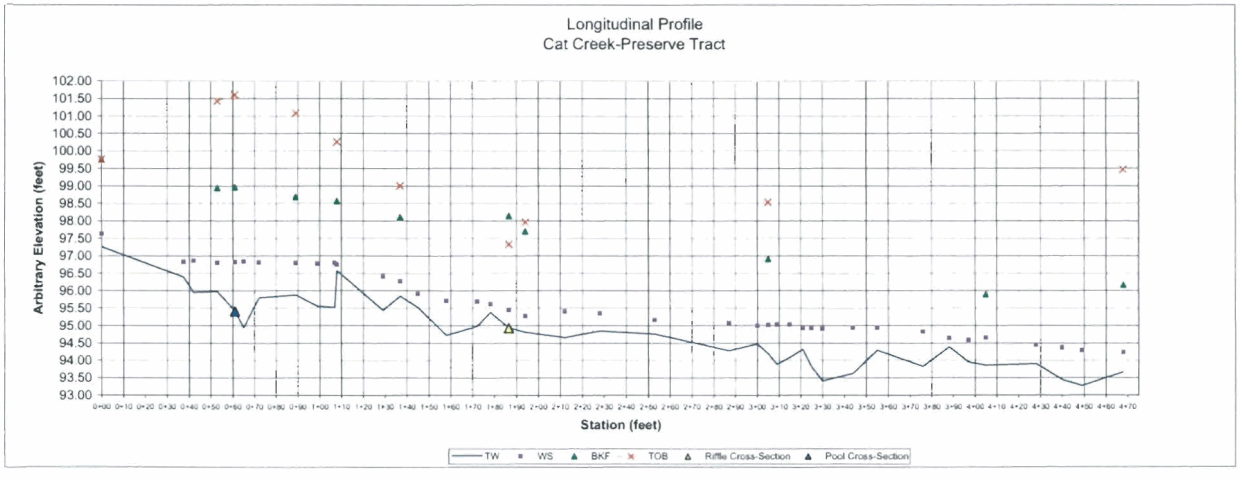
Cat Creek
Preserve Tract
Macon County

Field Crew:	Amanda Todd, George Lankford
River Basin:	Little Tenessee
Stream Reach:	Cat Creek-Preserve Tract
Drainage Area:	3.63
Date:	7/21/2003
Description:	LONGITUDINAL PROFILE

	STA	BS	HI	FS	ELEV	NOTE
TBM #1		6.34	106.34		100.00	wooden stake
TP #1			100	6.34	100	

Station	TW (FS)	TW	WS (FS)	WS	BKF (FS)	BKF	TOB (FS)	TOB	Notes	HI	Bk Ht./ Bkf Ht.	P-P	Pool Length	Max Pool Depth	Pool Slope	Riffle Length	Riffle Slope	Run Length	Run Slope	Glide Length	Glide Slope
0+00.0	9.08	97.26	8.71	97.63	9.58	99.76	7.39	99.76	head riffle	106.34	1.00					42.0	0.0183				
0+37.5	9.95	96.39	9.51	96.83					intermediate	106.34											
0+42.0	10.39	95.95	9.48	96.86					head run	106.34								11	0.0055		
0+53.0	10.37	95.97	9.54	96.80	7.41	98.93	4.92	101.42	head pool	106.34	1.84	46	19		0.0000						
0+61.0	10.93	95.41	9.52	96.82	7.39	98.95	4.74	101.60	pool cs	106.34											
0+65.0	11.40	94.94	9.50	96.84					max pool	106.34				3.10							
0+72.0	10.55	95.79	9.53	96.81					head of glide	106.34										17	0.0012
0+89.0	10.47	95.87	9.55	96.79	7.67	98.67	5.26	101.08	riffle bedrock starts	106.34	1.86					10	0.0020				
0+99.0	10.79	95.55	9.57	96.77					head small pool	106.34		30	9		0.0022						
1+07.0	10.83	95.51	9.54	96.80					max pool/br vane	106.34											
1+08.0	9.77	96.57	9.59	96.75	7.78	98.56	6.09	100.25	riffle top of br	106.34	1.85					21	0.0162				
1+29.0	10.91	95.43	9.93	96.41					head pool	106.34		16	8		0.0175						
1+37.0	10.51	95.83	10.07	96.27	8.24	98.10	7.34	99.00	head of br riffle	106.34	1.40					8	0.0463				
1+45.0	10.83	95.51	10.44	95.90					head of pool	106.34		49	27		0.0078						
1+58.0	11.63	94.71	10.63	95.71					max pool	106.34											
1+72.0	11.37	94.97	10.65	95.69					head of glide	106.34										6	0.0117
1+78.0	10.97	95.37	10.72	95.62					head riffle	106.34						16	0.0213				
1+86.5	11.41	94.93	10.89	95.45	8.20	98.14	9.01	97.33	riffle cs	106.34											
1+94.0	11.54	94.80	11.06	95.28	8.64	97.70	8.37	97.97	trib. head of pool	106.34	1.09	93	34		0.0000						
2+12.0	11.69	94.65	10.94	95.40					max pool	106.34											
2+28.0	11.50	94.84	10.99	95.35					head riffle	106.34						59	0.0047				
2+53.0	11.59	94.75	11.18	95.16					intermediate	106.34											
2+87.0	12.07	94.27	11.27	95.07					head small pool	106.34		18	13		0.0062						
3+00.0	11.88	94.46	11.35	94.99					intermediate	106.34											
3+05.0	12.16	94.18	11.32	95.02	9.44	96.90	7.81	98.53	head pool	106.34	1.60	20	10		0.0090						
3+09.0	12.46	93.88	11.31	95.03					max pool	106.34											
3+15.0	12.26	94.08	11.31	95.03					head of glide	106.34										6	0.0167
3+21.0	12.03	94.31	11.41	94.93					head riffle	106.34						4	0.0000				
3+25.0	12.53	93.81	11.41	94.93					head pool	106.34		51	19		0.0000						
3+30.0	12.94	93.40	11.43	94.91					max pool	106.34											
3+44.0	12.72	93.62	11.40	94.94					head of glide	106.34										11	0.0000
3+55.0	12.06	94.28	11.40	94.94					head riffle	106.34						21	0.0057				
3+76.0	12.52	93.82	11.52	94.82					head pool	106.34		21	12		0.0150						
3+88.0	11.98	94.38	11.70	94.64					head riffle	106.34						9	0.0056				
3+97.0	12.40	93.94	11.75	94.59					head pool	106.34		43	31		0.0048						
4+05.0	12.49	93.85	11.69	94.65	10.45	95.89			max pool	106.34				2.04							
4+28.0	12.44	93.90	11.90	94.44					head riffle	106.34						12	0.0067				
4+42.0	12.80	93.44	11.98	94.36					head pool	106.34			28								
4+49.0	13.07	93.27	12.05	94.29					max pool	106.34											
4+68.0	12.68	93.66	12.10	94.24	10.18	96.16	6.88	99.46	head riffle	106.34	2.32						#DIV/0!				

						Bk Ht./ Bkf Ht.	P-P	Pool Length	Max Pool Depth	Pool Slope	Riffle Length	Riffle Slope	Run Length	Run Slope	Glide Length	Glide Slope
tw slope	0.0077	ws slope	0.0072		min	1.00	23	22	2.04	0.0000	4	0.0050	11	0.0200	6	0.0020
					max	2.32	98	77	3.10	0.0340	59	0.0160	11	0.0420	17	0.0070
BKF W (ft)=	32.9				avg	1.62	56	54	2.57	0.0020	20	0.0100	11	0.0290	10	0.0050
BKF D (ft)=	1.5				Min ratio	NA	0.7		1.34	0.0000		0.6903		2.7611		0.2761
BKF Max D (ft)=	2.9				Max ratio	NA	3.0		2.04	0.5522		2.2088		5.7982		0.9664
					avg ratio	NA	1.7		1.69	0.2761		1.3805		4.0035		0.6903
								210			202.0		11		40.0	463.0



Cat Creek
Preserve Tract
Macon County

Field Crew:	Amanda Todd and George Lankford
River Basin:	Little Tennessee
Watershed:	Cat Creek
Stream Reach:	Preserve Tract-upper
Drainage Area:	3.40
Date:	7/21/2003
Station:	0+61
Feature:	Pool

STATION (FEET)	HI (FEET)	FS (FEET)	ELEVATION (FEET)	NOTES	
0+00.0	106.34	3.77	102.57		
0+05.0	106.34	3.98	102.36	FPA	
0+15.0	106.34	4.56	101.78		
0+20.0	106.34	4.56	101.78		
0+23.0	106.34	4.74	101.60	LTOB	
0+24.0	106.34	5.22	101.12		
0+24.3	106.34	7.39	98.95	LBKF (lint)	
0+24.6	106.34	9.40	96.94		
0+25.5	106.34	9.52	96.82	LEOW	
0+25.8	106.34	9.62	96.72		
0+27.0	106.34	10.19	96.15		
0+28.0	106.34	10.47	95.87		
0+29.0	106.34	10.76	95.58		
0+30.0	106.34	10.93	95.41	TW	ws=9.54
0+31.0	106.34	10.75	95.59		
0+32.2	106.34	10.51	95.83	REOW	
0+34.0	106.34	8.89	97.45		
0+38.0	106.34	9.00	97.34		
0+38.8	106.34	8.89	97.45		
0+42.2	106.34	8.18	98.16		
0+44.0	106.34	8.04	98.30		
0+47.7	106.34	7.88	98.46		
0+49.5	106.34	7.38	98.96		
0+53.0	106.34	7.39	98.95	RBKF office	
0+55.3	106.34	6.98	99.36		
0+58.3	106.34	6.90	99.44		
0+63.0	106.34	6.81	99.53		
0+66.3	106.34	7.08	99.26		
0+69.8	106.34	7.05	99.29		
0+73.9	106.34	6.52	99.82		
0+77.4	106.34	5.93	100.41		
0+82.0	106.34	5.22	101.12		
0+84.4	106.34	5.15	101.19		
0+88.0	106.34	4.47	101.87		
0+93.4	106.34	3.48	102.86	FPA	
0+98.0	106.34	2.70	103.64		

*better match to regional curv

	BANKFULLoffice* Hydraulic Geometry		
	Width (Feet)	Depth (Feet)	Area (Sq. Ft.)
	0.0	0.0	0.0
	0.3	2.0	0.3
	0.9	2.1	1.9
	0.3	2.2	0.7
	1.2	2.8	3.0
	1.0	3.1	2.9
	1.0	3.4	3.2
	1.0	3.5	3.5
	1.0	3.4	3.5
	1.2	3.1	3.9
	1.8	1.5	4.2
	4.0	1.6	6.2
	0.8	1.5	1.2
	3.4	0.8	3.9
	1.8	0.6	1.3
	3.7	0.5	2.1
	1.8	0.0	0.4
	3.5	0.0	0.0
TOTALS	28.7		42.1

SUMMARY DATA (TOB)	
A(BKF)	42.1
W(BKF)	28.7
Max d	3.5
Mean d	1.5

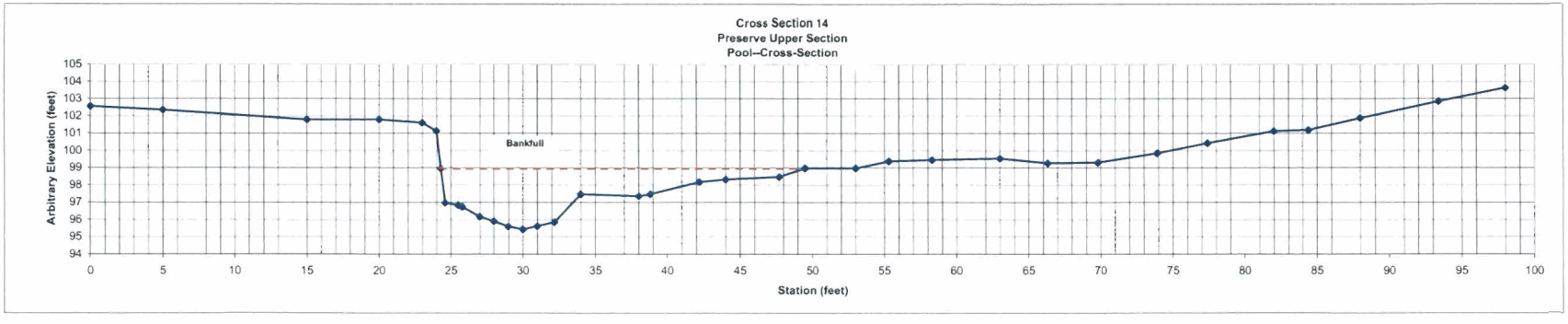
	TOB Hydraulic Geometry		
	Width (Feet)	Depth (Feet)	Area (Sq. Ft.)
	0.0	0.0	0.0
	1.0	0.5	0.2
	0.3	2.7	0.5
	0.3	4.7	1.1
	0.9	4.8	4.2
	0.3	4.9	1.4
	1.2	5.5	6.2
	1.0	5.7	5.6
	1.0	6.0	5.9
	1.0	6.2	6.1
	1.0	6.0	6.1
	1.2	5.8	7.1
	1.8	4.2	8.9
	4.0	4.3	16.8
	0.8	4.2	3.4
	3.4	3.4	12.9
	1.8	3.3	6.1
	3.7	3.1	11.9
	1.8	2.6	5.2
	3.5	2.7	9.3
	2.3	2.2	5.6
	3.0	2.2	6.6
	4.7	2.1	9.9
	3.3	2.3	7.3
	3.5	2.3	8.1
	4.1	1.8	8.4
	3.5	1.2	5.2
	4.6	0.5	3.8
	2.4	0.4	1.1
TOTALS	61.4		175.0

SUMMARY DATA (TOB)	
A(BKF)	175.0
W(BKF)	61.4
Max d	6.2
Mean d	2.8

Bank Erosion Hazard Index (BEHI)

Criteria	Value	Index	Bank Erosion
Bank Ht/Bkf Ht	1.5	5.9	moderate
Root Depth/Bank Ht	0.11	8.33	very high
Root Density (%)	47.7	4.55	moderate
Bank Angle (Degrees)	100	8.3	very high
Surface Protection (%)	0	10	extreme
Stratification		5	
Bank Materials	silt/clay	0	
		42.08	very high

CS Left Bank Looking Downstream



Cat Creek
Preserve Tract
Macon County

Field Crew:	Amanda Todd and George Lankford
River Basin:	Little Tennessee
Watershed:	Cat Creek
Stream Reach:	Preserve Tract
Drainage Area:	3.40
Date:	7/21/2003
Station:	1+86.5
Feature:	Riffle

STATION (Feet)	HI (Feet)	FS (Feet)	ELEVATION (Feet)	NOTES	
0+00.0	106.34	4.05	102.29		
0+07.0	106.34	4.72	101.62		
0+21.0	106.34	5.68	100.66		
0+27.0	106.34	5.99	100.35		
0+33.0	106.34	6.43	99.91		
0+37.0	106.34	7.11	99.23	LTOB	
0+42.0	106.34	8.33	98.01		
0+47.0	106.34	8.77	97.57		
0+52.0	106.34	8.75	97.59		
0+57.0	106.34	8.18	98.16		
0+60.0	106.34	8.52	97.82		
0+62.0	106.34	8.20	98.14	LBKF	
0+63.4	106.34	8.34	98.00		
0+65.0	106.34	8.76	97.58		
0+68.0	106.34	9.26	97.08		
0+69.7	106.34	9.70	96.64		
0+71.6	106.34	10.05	96.29		
0+72.7	106.34	11.00	95.34	LEOW	
0+73.5	106.34	11.12	95.22		
0+75.0	106.34	11.19	95.15		
0+76.3	106.34	11.41	94.93	TW	ws=10.94
0+76.8	106.34	10.95	95.39	REOW	
0+77.8	106.34	10.41	95.93		
0+78.7	106.34	11.27	95.07		
0+80.0	106.34	9.01	97.33	RTOB	
0+81.0	106.34	8.58	97.76		
0+84.0	106.34	8.25	98.09	RBKF	
0+85.0	106.34	8.34	98.00		
1+06.0	106.34	7.65	98.69		
1+15.0	106.34	6.76	99.58		
1+20.0	106.34	5.99	100.35		
1+25.0	106.34	5.99	100.35		
1+27.0	106.34	5.37	100.97		
1+32.0	106.34	4.68	101.66		
1+37.0	106.34	4.48	101.86		
1+47.0	106.34	4.27	102.07		
1+57.0	106.34	4.06	102.28		

BANKFULL (BKF) Hydraulic Geometry

Width (Feet)	Depth (Feet)	Area (Sq. Ft.)
0.0	0.0	0.0
1.4	0.1	0.1
1.6	0.6	0.6
3.0	1.1	2.4
1.7	1.5	2.2
1.9	1.8	3.2
1.1	2.8	2.6
0.8	2.9	2.3
1.5	3.0	4.4
1.3	3.2	4.0
0.5	2.8	1.5
1.0	2.2	2.5
0.9	3.1	2.4
1.3	0.8	2.5
1.0	0.4	0.6
3.0	0.0	0.6
TOTALS 22.0		31.9

SUMMARY DATA (BANKFULL)

A(BKF)	31.9	W(FPA)	120
W(BKF)	22.0	Slope	0.01
Max d	3.2	Sinuosity	1.13
Mean d	1.4	Area= A	
W/D	15.2	Width= W	
Entrenchment	5.5	Depth= D	
Stream Type	C	Bankfull= BKF	
Area from Rural Regional Curve			49

TOP OF BANK Hydraulic Geometry

Width (Feet)	Depth (Feet)	Area (Sq. Ft.)
0.0	0.0	0.0
5.0	1.2	3.1
5.0	1.7	7.2
5.0	1.6	8.2
5.0	1.1	6.8
3.0	1.4	3.7
2.0	1.1	2.5
1.4	1.2	1.6
1.6	1.7	2.3
3.0	2.2	5.7
1.7	2.6	4.0
1.9	2.9	5.3
1.1	3.9	3.8
0.8	4.0	3.2
1.5	4.1	6.1
1.3	4.3	5.4
0.5	3.8	2.0
1.0	3.3	3.6
0.9	4.2	3.4
1.3	1.9	3.9
1.0	1.5	1.7
3.0	1.1	3.9
1.0	1.2	1.2
21.0	0.5	18.6
TOTALS 69.0		107.1

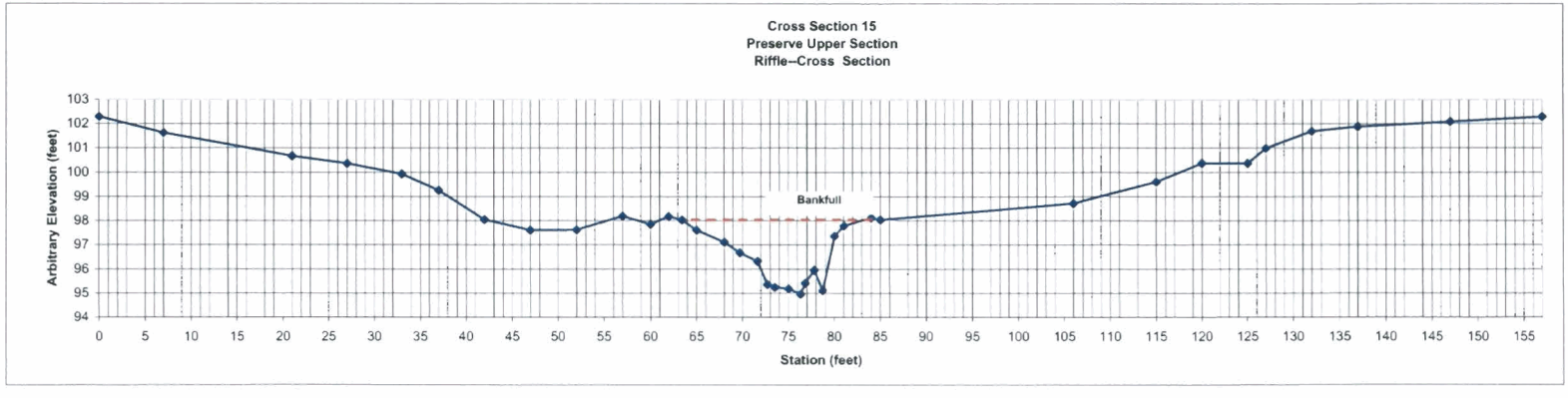
UMMARY DATA (TOB)

A(BKF)	107.1
W(BKF)	69.0
Max d	4.3
Mean d	1.6

Bank Erosion Hazard Index (BEHI)

Criteria	Value	Index	Bank Erosion
Bank Ht/Bkf Ht	1.1	1.9	low
Root Depth/Bank Ht	0.45	4.4	moderate
Root Density (%)	10	8.4	very high
Bank Angle (Degrees)	110	8.7	very high
Surface Protection (%)	5	10	extreme
Bank Materials	Silt/Clay	10	
		43.4	very high

CS Looking Upstream



Cat Creek
Preserve Tract
Macon County

Field Crew:	Amanda Todd and George Lankford
River Basin:	Little Tennessee
Watershed:	**Cat Creek**
Stream Reach:	Preserve Tract-UT4
Drainage Area:	0.17
Date:	12/903
Station:	Small Trib on Preserve From Waldroop property and
Feature:	Junkyard

STATION (Feet)	HI (Feet)	Fa (Feet)	ELEVATION (Feet)	NOTES
0+00.0	100.00	3.96	96.04	
0+10.0	100.00	437	95.63	
0+14.0	100.00	4.51	95.49	
0+19.2	100.00	478	95.22	
0+22.0	100.00	5.06	94.94	
0+22.8	100.00	5.22	94.78	LBKF/TOB
0+24.0	100.00	5.46	94.54	
0+24.3	100.00	LBO	94.20	
0+25.5	100.00	6.62	93.38	LEOW/TW
0+26.4	100.00	6 Y	93.46	ws=6.48
0+27.2	100.00	6.54	93.46	REOW
0+28.0	100.00	5.72	94.28	
0+30.0	100.00	5.54	94.46	
0+33.0	100.00	5.30	94.62	
0+36.0	imm	5.22	94.78	RBKF
0+44.0	100.00	5.57	94.43	
0+50.0	100.00	5.64	94.36	
0+55.0	100.00	5.56	94.44	
0+60.0	100.00	5.46	94.52	

BANKFULL (BKF) Hydraulic Geometry

	Width (Feet)	Depth (Feet)	Area (Sq. Ft.)
	0.0	0.0	0.0
	1.2	0.2	0.1
	0.3	0.6	0.1
	1.2	1.4	1.2
	0.9	1.3	1.2
	0.8	1.3	1.1
	0.8	0.5	0.7
	2.0	0.3	0.8
	3.0	0.2	0.7
	3.0	0.0	0.2
TOTALS	13.2		6.2

TOP OF BANK (TOB) Hydraulic Geometry

	Width (Feet)	Depth (Feet)	Area (Sq. Ft.)
	0.0	0.0	0.0
	1.2	0.2	0.1
	0.3	0.6	0.1
	1.2	1.4	1.2
	0.9	1.3	1.2
	0.8	1.3	1.1
	0.8	0.5	0.7
	2.0	0.3	0.8
	3.0	0.2	0.7
	3.0	0.0	0.2
TOTALS	13.2		6.2

SUMMARY DATA (BANKFULL)

A(BKF)	6.2	W(FPA)	100
W(BKF)	13.2	Slope	
Max d	1.4	Sinuosity	
Mean d	0.5	Area=	A
W/D	27.9	Width=	W
Entrenchment	7.6	Depth=	D
Stream Type	C	Bankfull=	BKF
Area from Rural Regional Curve			7

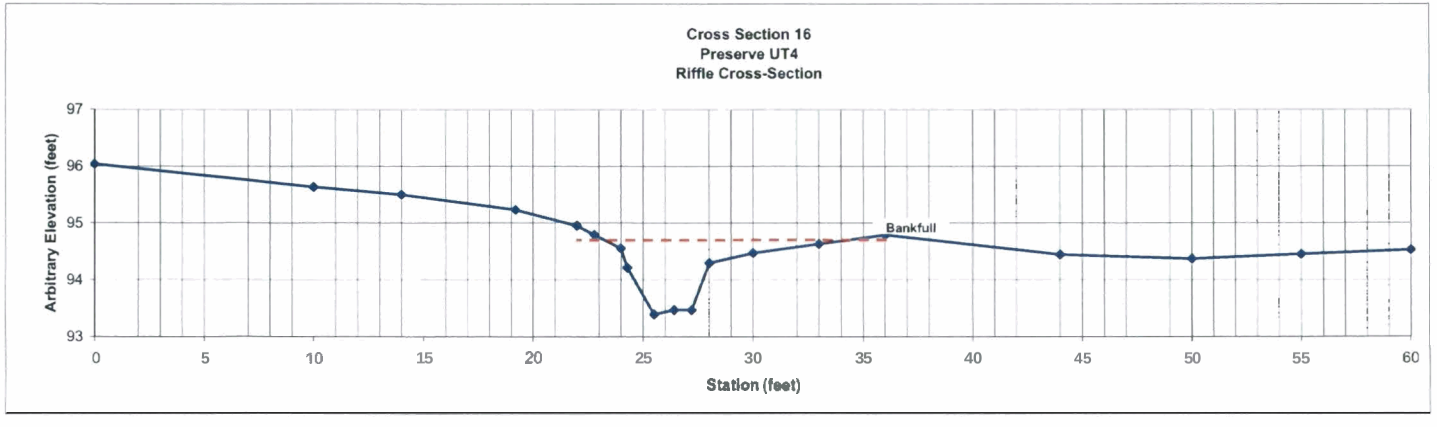
SUMMARY DATA (TOB)

A(BKF)	6.2
W(BKF)	13.2
Max d	1.4
Mean d	0.5

Bank Erosion Hazard Index (BEHI)

Criteria	Value	Index	Bank Erosion
Bank Ht/Bkf Ht			
Root Depth/Bank Ht			
	NOT DONE		
Root Density (%)			
Bank Angle (Degrees)			
Surface Protection (%)			
Bank Materials			

Looking upstream



Cat Creek
Preserve Tract
Macon County

Field Crew:	Amanda Todd and George Lankford
River Basin:	Little Tennessee
Watershed:	Cat Creek
Stream Reach:	Preserve Tract
Drainage Area:	3.40
Date:	12/903
Station:	Lower
Feature:	Riffle Cross-Section #3

STATION (Feet)	HI (Feet)	FS (Feet)	ELEVATION (Feet)	NOTES
0+00.0	100.00	4.89	95.11	
0+04.0	100.00	5.17	94.83	
0+06.0	100.00	5.39	94.61	
0+10.0	100.00	5.54	94.46	
0+16.5	100.00	6.05	93.95	
0+18.4	100.00	6.20	93.80	LTOB
0+20.0	100.00	6.47	93.53	
0+21.0	100.00	6.95	93.05	
0+22.0	100.00	7.29	92.71	
0+23.0	100.00	7.50	92.50	
0+26.0	100.00	7.76	92.24	
0+27.0	100.00	7.90	92.10	
0+28.2	100.00	7.88	92.12	
0+29.7	100.00	8.10	91.90	
0+30.4	100.00	8.30	91.70	
0+31.4	100.00	8.51	91.49	LBKF
0+34.0	100.00	8.66	91.34	
0+36.5	100.00	8.97	91.03	
0+38.5	100.00	9.40	90.60	
0+40.0	100.00	9.55	90.45	
0+40.7	100.00	9.78	90.22	
0+42.3	100.00	9.91	90.09	
0+43.7	100.00	10.20	89.80	
0+44.5	100.00	10.19	89.81	
0+46.0	100.00	10.29	89.71	
0+47.0	100.00	10.48	89.52	LEOW
0+47.8	100.00	10.72	89.28	
0+48.0	100.00	11	89.00	
0+49.4	100.00	11.06	88.94	
0+50.5	100.00	11.17	88.83	
0+51.5	100.00	11.21	88.79	TW
0+52.4	100.00	11.12	88.88	ws=10.61
0+52.7	100.00	10.71	89.29	
0+53.2	100.00	10.67	89.33	REOW
0+54.6	100.00	10.45	89.55	
0+57.0	100.00	10.41	89.59	
0+59.0	100.00	10.07	89.93	
0+61.1	100.00	8.98	91.02	
0+62.4	100.00	8.55	91.45	RBKF
0+62.8	100.00	8.44	91.56	
0+64.5	100.00	8.03	91.97	
0+66.0	100.00	7.87	92.13	
0+68.0	100.00	7.19	92.81	
0+70.0	100.00	7.87	92.13	
0+71.8	100.00	6.59	93.41	
0+73.0	100.00	6.33	93.67	RTOB
0+76.0	100.00	5.75	94.25	
0+79.0	100.00	5.40	94.60	
0+84.0	100.00	4.95	95.05	
0+88.0	100.00	4.80	95.20	

BANKFULL (BKF) Hydraulic Geometry

	Width (Feet)	Depth (Feet)	Area (Sq. Ft.)
	0.0	0.0	0.0
	2.6	0.1	0.2
	2.5	0.5	0.8
	2.0	0.9	1.3
	1.5	1.0	1.4
	0.7	1.3	0.8
	1.6	1.4	2.1
	1.4	1.7	2.2
	0.8	1.7	1.3
	1.5	1.8	2.6
	1.0	2.0	1.9
	0.8	2.2	1.7
	0.2	2.5	0.5
	1.4	2.6	3.5
	1.1	2.7	2.9
	1.0	2.7	2.7
	0.9	2.6	2.4
	0.3	2.2	0.7
	0.5	2.2	1.1
	1.4	1.9	2.9
	2.4	1.9	4.6
	2.0	1.6	3.5
	2.1	0.5	2.1
TOTALS	29.7		43.2

SUMMARY DATA (BANKFULL)

A(BKF)	43.2	W(FPA)	63
W(BKF)	29.7	Slope	0.01
Max d	2.7	Sinuosity	1.13
Mean d	1.5	Area=	A
W/D	20.4	Width=	W
Entrenchment	2.1	Depth=	D
Stream Type	C	Bankfull=	BKF
Area from Rural Regional Curve			49

TOP OF BANK Hydraulic Geometry

	Width (Feet)	Depth (Feet)	Area (Sq. Ft.)
	0.0	0.0	0.0
	1.6	0.3	0.2
	1.0	0.8	0.5
	1.0	1.1	0.9
	1.0	1.3	1.2
	3.0	1.6	4.3
	1.0	1.7	1.6
	1.2	1.7	2.0
	1.5	1.9	2.7
	0.7	2.1	1.4
	1.0	2.3	2.2
	2.6	2.5	6.2
	2.5	2.8	6.5
	2.0	3.2	6.0
	1.5	3.3	4.9
	0.7	3.6	2.4
	1.6	3.7	5.8
	1.4	4.0	5.4
	0.8	4.0	3.2
	1.5	4.1	6.1
	1.0	4.3	4.2
	0.8	4.5	3.5
	0.2	4.8	0.9
	1.4	4.9	6.8
	1.1	5.0	5.4
	1.0	5.0	5.0
	0.9	4.9	4.5
	0.3	4.5	1.4
	0.5	4.5	2.2
	1.4	4.3	6.1
	2.4	4.2	10.2
	2.0	3.9	8.1
	2.1	2.8	7.0
	1.3	2.3	3.3
	0.4	2.2	0.9
	1.7	1.8	3.5
	1.5	1.7	2.6
	2.0	1.0	2.7
	2.0	1.7	2.7
	1.8	0.4	1.9
	1.2	0.1	0.3
TOTALS	54.6		146.7

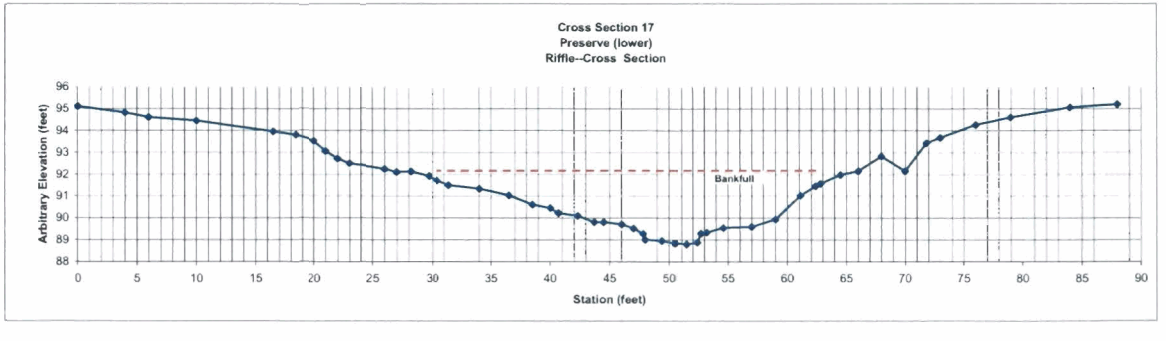
SUMMARY DATA (TOB)

A(BKF)	146.7
W(BKF)	54.6
Max d	4.9
Mean d	2.7

Bank Erosion Hazard Index (BEHI)

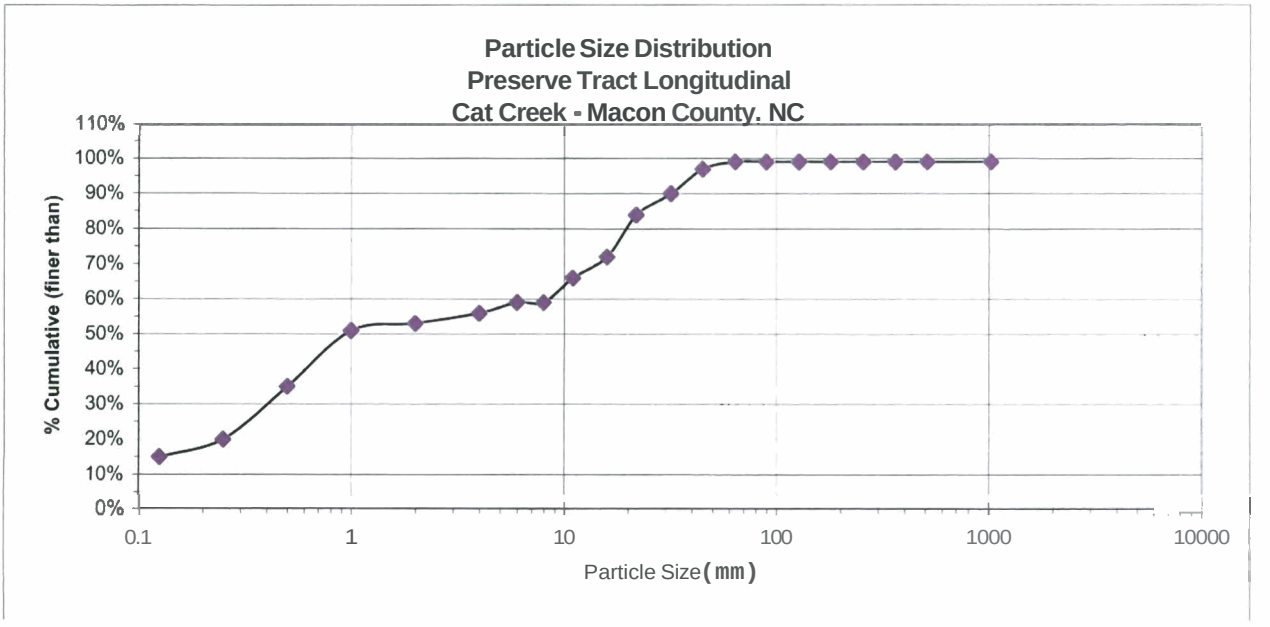
Criteria	Value	Index	Bank Erosion
Bank Ht/Bkf Ht	1.9	7.4	high
Root Depth/Bank Ht	1	1	very low
Root Density (%)	78	2.1	low
Bank Angle (Degrees)	20	1.9	very low
Surface Protection (%)	85	1.7	very low
Bank Materials	Silt/Clay	0	
		14.1	low

CS looking upstream



Cat Creek
Preserve Tract (upper)
Macon County

PEBBLE COUNT									
Site: Cat Creek							7/21/2003		
Party: Amanda Todd and George Lankford							Preserve Tract Longitudinal		
Particle Count									
Inches	Particle	Millimeter		Riffle	Run/Pool		Total No.	Item %	% Cumulativ
	Silt/Clay	< 0.062	S/C	4	7		11	11%	11%
	Very Fine	.062 - .125	S	3	1		4	4%	15%
	Fine	.125 - .25	A	1	4		5	5%	20%
	Medium	.25 - .50	N	7	8		15	15%	35%
	Coarse	.50 - 1.0	D	7	9		16	16%	51%
.04 -.08	Very Coarse	1.0 - 2.0	S	0	2		2	2%	53%
.08 - .16	Very Fine	2.0 - 4.0		2	1		3	3%	56%
.16 - .22	Fine	4.0 - 5.7	G	1	2		3	3%	59%
.22 - .31	Fine	5.7 - 8.0	R	0	0		0	0%	59%
.31 - .44	Medium	8.0 - 11.3	A	6	1		7	7%	66%
.44 - .63	Medium	11.3 - 16.0	V	3	3		6	6%	72%
.63 - .89	Coarse	16.0 - 22.6	E	5	7		12	12%	84%
.89 - 1.26	Coarse	22.6 - 32.0	L	4	2		6	6%	90%
1.26 - 1.77	Very Coarse	32.0 - 45.0	S	4	3		7	7%	97%
1.77 - 2.5	Very Coarse	45.0 - 64.0		2	0		2	2%	99%
2.5 - 3.5	Small	64 - 90	C	0	0		0	0%	99%
3.5 - 5.0	Small	90 - 128	O	0	0		0	0%	99%
5.0 - 7.1	Large	128 - 180	B	0	0		0	0%	99%
7.1 - 10.1	Large	180 - 256	L	0	0		0	0%	99%
10.1 - 14.3	Small	256 - 362	B	0	0		0	0%	99%
14.3 - 20	Small	362 - 512	L	0	0		0	0%	99%
20 - 40	Medium	512 - 1024	D	0	0		0	0%	99%
40 - 80	Lrg- Very Lr	1024 - 2048	R	0	0		0	0%	99%
	Bedrock		BDRK	1	0		1	1%	100%
			Totals	50	50		100	100%	100%



APPENDIX 3

PHOTO LOG

Photo Log

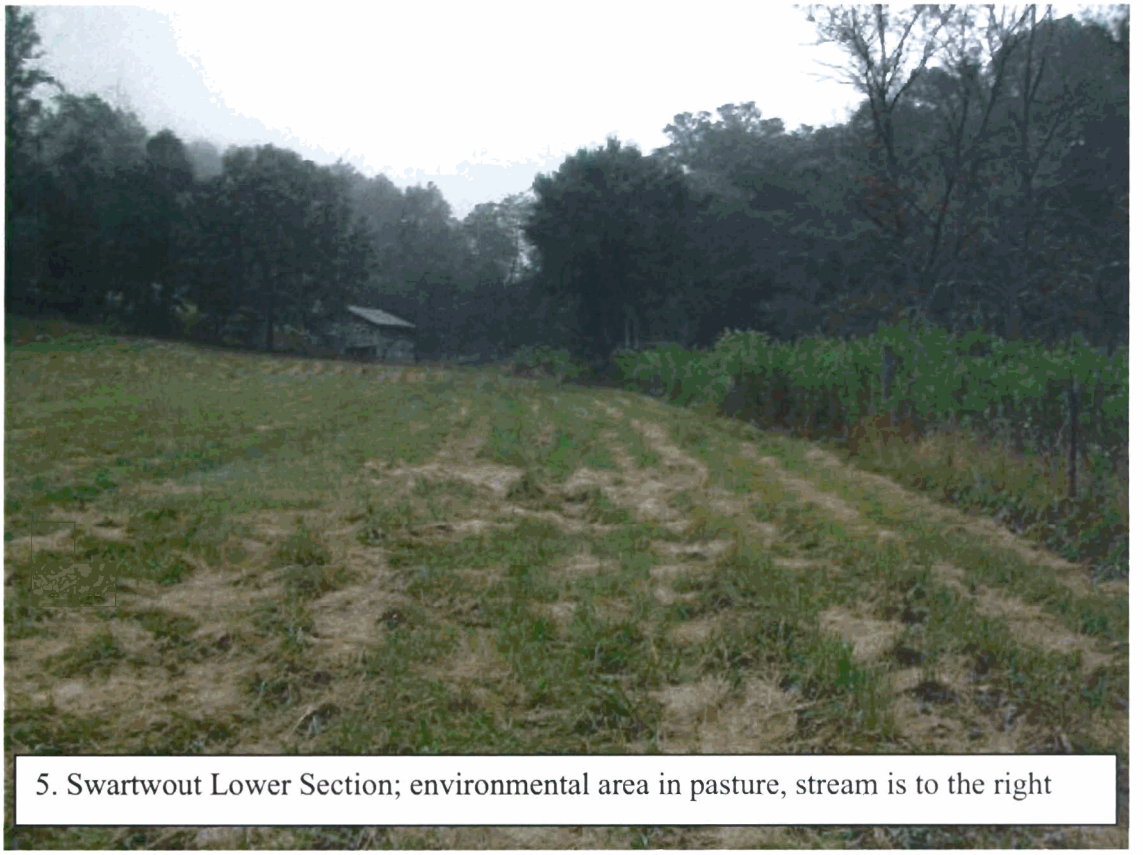
Cat Creek, Macon County, North Carolina

1. Swartwout Upper Section-eroded bend

2. Swartwout Upper Section

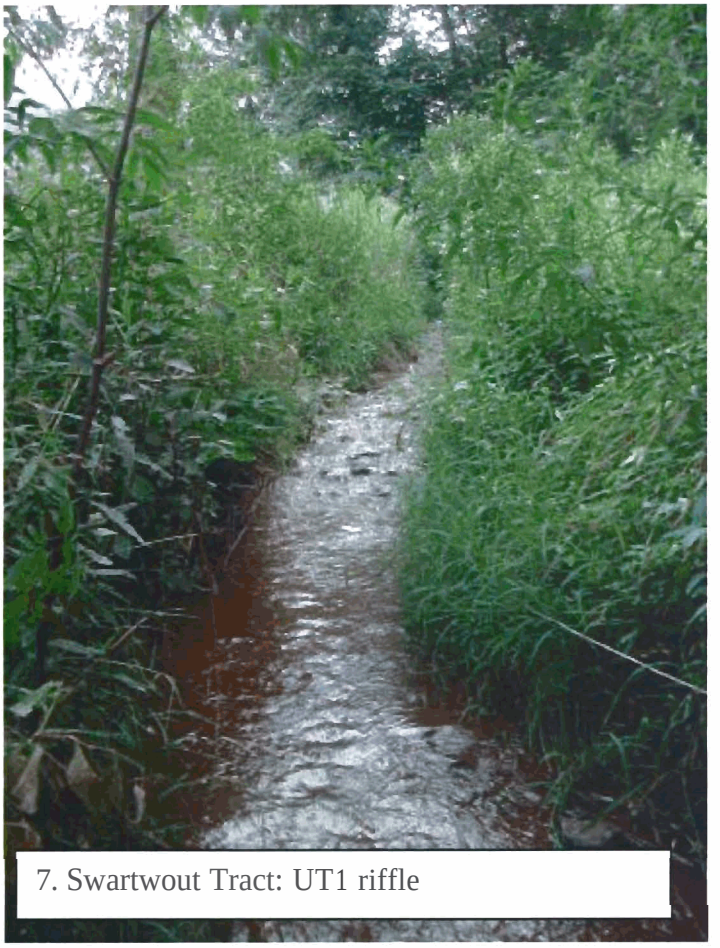
3. Swartwout looking upstream towards cross-section taken near riding ring

4. Upper Swartwout; grass pasture along right bank.



5. Swartwout Lower Section; environmental area in pasture, stream is to the right

6. Swartwout Tract: Cat Creek channel through pasture (lower section)



7. Swartwout Tract: UT1 riffle

8. Swartwout Tract: UT1 over widened pool and riffle

9. Waldroop Tract: Cattle crossing beside Waldroop barn looking upstream

10. Waldroop Tract: Narrow riffle and wide pool, fence on left top of bank

11. Waldmop Tract: Lower section wide riffle and pool

12. Waldroop Tract: Lower Section undercut bank

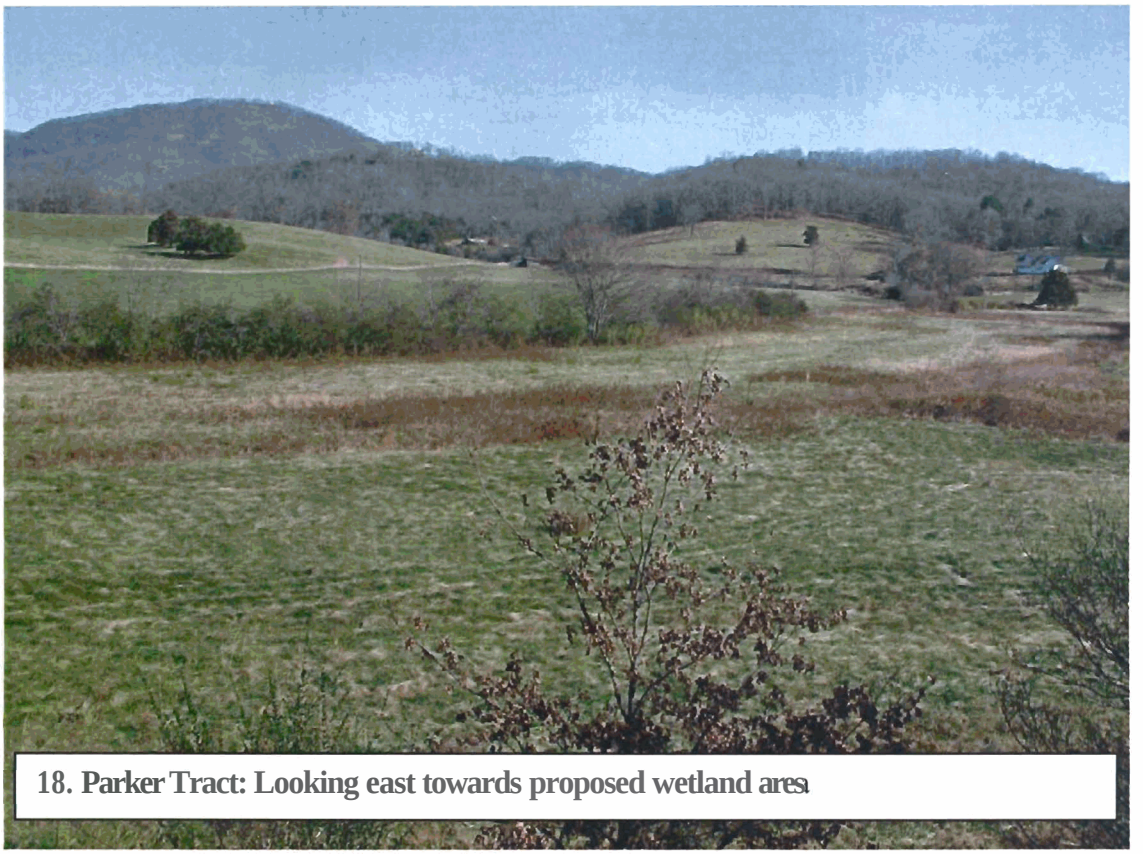
13. Waldroop Tract: Lower section wide pool looking upstream, notice large tree to the right

14. Parker Tract: Straight, long riffle run sequence

15. Parker Tract: UT3

16. Parker Tract: open field

17. Parker Tract: Meander bend just upstream of culvert for Ferguson Road



18. Parker Tract: Looking east towards proposed wetland area

19. Preserve Tract: Mid-channel point bar formed downstream of Ferguson Road culvert.

20. Preserve Tract: Eroded meander bend (location of pool cross-section)

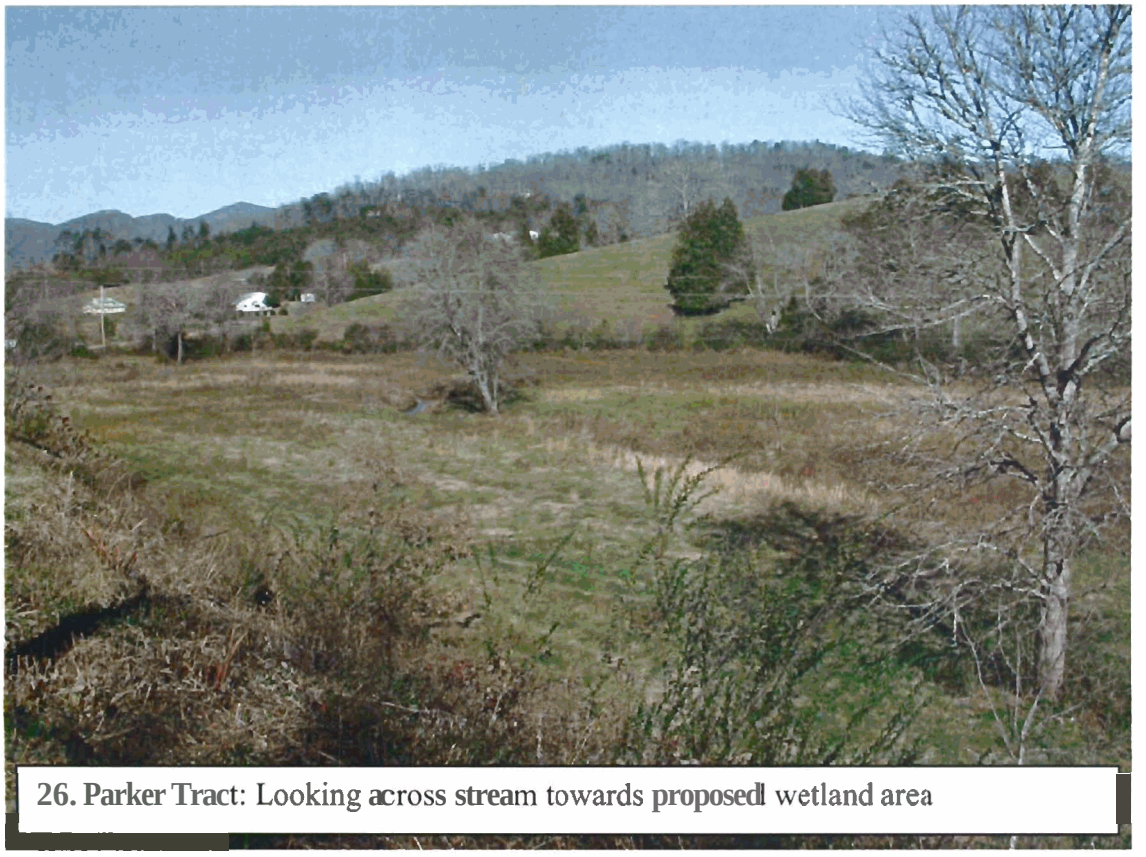
21. Preserve Tract: Lower section

22. Preserve Tract: Lower section

23. Preserve Tract: UT4

24. Preserve Tract: Lower section wetland area between stream and hillside

25. Preserve Tract: Old Pond Bed and wetland to the left



26. Parker Tract: Looking across stream towards proposed wetland area

APPENDIX 4

MORPHOLOGY TABLE

Parameter	Existing Channel (Upper Swartwout) Enhancement			Existing Channel (Lower Swartwout) Restoration			Existing Channel (UT Swartwout)			Existing Channel (Waldroop)			Existing Channel (Parker)			Existing Channel (UT 2)			Existing Channel (UT 3)			Existing Channel (Preserve)			Existing Channel (UT 4)		
Stream Type	C4			NA (C4)*			NA (Cb4)*			NA (C4)*			NA (G4)*			NA			NA			NA			NA (E)		
Drainage Area	1.2			1.2			0.9			2.5			2.6			0.47			0.24			3.4			0.17		
Dimension	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
BF Width (ft)			**17.5**			**19.9**			**16.03**			**22.89**			**18.48**			**8.2**			**6.7**			**32.98**			**13.2**
BF Cross Sectional Area (ft^2)			**17.1**			**16.74**			**20.22**			**39.12**			**40.34**			**12.92**			**6.88**			**50.23**			**6.2**
BF Mean Depth (ft)			**1**			**0.84**			**1.26**			**1.71**			**2.18**			**1.58**			**1.03**			**1.62**			**0.5**
BF Max Depth (ft)			**2.67**			**2**			**2.2**			**2.93**			**3.79**			**3.12**			**2.07**			**2.91**			**1.4**
Width/Depth Ratio			**17.86**			**23.69**			**12.72**			**13.39**			**8.48**			**5.19**			**6.5**			**21.7**			**27.9**
Entrenchment Ratio			**6.86**			**1.56**			**3.43**			**3.04**			**5.68**			**13.93**			**22.4**			**2.22**			**7.6**
Wetted Perimeter (ft)			**18.49**			**21.49**			**16.83**			**25.33**			**20.57**			**10.65**			**8.51**			**33.99**			**6.98**
Hydraulic radius (ft)			**0.93**			**0.78**			**1.2**			**1.54**			**1.96**			**1.21**			**0.81**			**1.48**			**0.45**
Bank Height Ratio			**1.53**			**1.32**			**1.41**			**1.37**			**1.38**			**1.33**			**1.5**			**1.52**			**1.3**
Pool Area/Riffle Area			**NA**			**NA**			**0.81**			**1.5**			**NA**			**NA**			**NA**			**1**			**NA**
Max riffle depth/mean riffle depth			**2.57**			**2.57**			**1.75**			**1.71**			**1.73**			**1.97**			**2.01**			**2.77**			**2.80**
Max pool depth/mean riffle depth			**2.66**			**2.66**			**1.92**			**2.73**			**NA**			**NA**			**NA**			**3.46**			**NA**
Pattern																											
Channel Beltwidth (ft)																											
Radius of Curvature (ft)																											
Meander Wavelength																											
Meander Width ratio																											
Meander Length ratio																											
Radius of Curvature/Riffle Width (ft)																											
Pool Length/Riffle Width	0.30	1.24	**0.74**	0.30	1.24	**0.74**	0.61	1.01	**0.81**	0.68	2.00	**1.23**	0.94	2.16	**1.56**	0.89	4.29	**2.89**	0.73	1.86	**1.39**	0.48	1.67	**1.16**	0.11	0.60	**0.35**
Pool to Pool Spacing/ Riffle Width	1.35	2.50	**1.95**	1.35	2.50	**1.95**	2.71	5.72	**4.29**	1.90	4.76	**3.07**	2.89	4.80	**3.84**	2.41	10.90	**6.43**	3.21	10.18	**6.00**	0.50	2.11	**1.20**	1.41	6.75	4.10
Profile																											
Pool length (ft)	5.68	23.27	**13.82**	5.68	23.27	**13.82**	9.85	16.18	**13.02**	15.61	46.69	**28.15**	17.66	40.65	**29.23**	7.32	35.2	**23.7**	4.91	12.47	**9.32**	22.31	77.85	**54.32**	1.42	7.94	**4.58**
Pool spacing (ft)	25.4	46.96	**36.61**	25.4	46.96	**36.61**	43.39	91.71	**68.8**	43.42	108.97	**70.31**	54.27	90.24	**72.26**	19.84	90	**52.74**	21.54	68.22	**40.25**	23.18	98.41	**56.05**	18.71	89.15	**53.93**
Riffle slope (ft/ft)	0.006	0.030	**0.018**	0.006	0.030	**0.018**	0.009	0.100	**0.040**	0.007	0.011	**0.014**	0.009	0.016	**0.012**	0.007	0.016	**0.012**	0.015	0.030	**0.022**	0.005	0.016	**0.010**	0.042	0.063	**0.056**
Pool slope (ft)	0.000	0.009	**0.004**	0.000	0.009	**0.004**	0.007	0.011	**0.008**	0.000	0.004	**0.002**	0.000	0.003	**0.002**	0.004	0.007	**0.005**	0.003	0.007	**0.004**	0.000	0.004	**0.002**	0.012	0.016	**0.014**
Run slope (ft)	0.020	0.054	**0.035**	0.020	0.054	**0.035**	0.011	0.044	**0.024**	0.006	0.017	**0.012**	0.010	0.012	**0.011**	0.018	0.028	**0.023**	0.011	0.034	**0.024**	0.020	0.042	**0.029**	0.082	0.090	**0.086**
Glide slope (ft)	0.000	0.010	**0.005**	0.000	0.010	**0.005**	0.002	0.106	**0.023**	0.001	0.005	**0.003**	0.000	0.006	**0.003**	0.003	0.005	**0.004**	0.007	0.009	**0.008**	0.002	0.007	**0.005**	0.007	0.013	**0.010**
Riffle Slope/Avg. Water Surface Slope	0.05	2.21	**1.35**	0.05	2.21	**1.35**	0.43	4.79	**1.73**	0.95	1.95	**1.50**	1.64	2.79	**2.08**	0.57	0.94	**1.24**	1.17	2.27	**1.66**	0.75	2.02	**1.24**	0.92	1.40	**1.24**
Run slope/Avg. Water Surface Slope	1.53	3.90	**2.58**	1.53	3.90	**2.58**	0.50	2.01	**1.11**	0.74	2.26	**1.61**	1.62	2.00	**1.84**	1.42	1.75	**2.11**	0.83	2.63	**1.84**	2.52	5.31	**3.59**	1.83	1.99	**1.91**
Pool Slope/Avg. Water Surface Slope	0.00	0.73	**0.32**	0.00	0.73	**0.32**	0.30	0.51	**0.39**	0.00	0.47	**0.22**	0.00	0.52	**0.26**	0.55	1.00	**0.72**	0.23	0.51	**0.34**	0.00	0.54	**0.24**	0.26	0.36	**0.31**
Glide Slope/Avg.Water Surface Slope	0.00	0.76	**0.38**	0.00	0.76	**0.38**	0.07	4.78	**1.05**	0.11	0.65	**0.46**	0.00	1.00	**0.46**	0.48	0.75	**0.61**	0.55	0.72	**0.63**	0.23	0.91	**0.62**	0.16	0.29	**0.22**
Substrate																											
d50 (mm)			**34.89**			**34.89**			**40.67**			**11.3**			**0.38**			**NA**			**NA**			**4**			**NA**
d84 (mm)			**90**			**90**			**106.3**			**57.67**			**55.45**			**NA**			**NA**			**32**			**NA**
Additional Reach Parameters																											
Valley Length (ft)			**870**			**690**			**440**			**1690**			**2150**			**240**			**160**			**1730**			**105**
Channel Length (ft)			**880**			**752**			**470**			**1705**			**2280**			**240**			**160**			**1830**			**110**
Valley Slope (ft)			**0.0150**			**0.0139**			**0.0230**			**0.0076**			**0.0062**			**0.0130**			**0.0130**			**0.0083**			**0.0480**
Water Surface Slope (ft/ft)			**0.0150**			**0.0150**			**0.0213**			**0.0077**			**0.0058**			**0.0130**			**0.0130**			**0.0072**			**0.0450**
Sinuosity			**1.01**			**1.01**			**1.06**			**1.01**			**1.06**			**1**			**1**			**1.13**			**1.05**

NA DUE TO LACK OF MEANDERS- CHANNEL HAS BEEN MODIFIED

*Channel has been significantly modified through channelization and is therefore difficult to classify using Rosgen system of classification for natural channels. Classification in parenthenses is closest match with natural channel.

A channel with low width/depth ratio without vegetation cannot be stable, and will widen and degrade. Streams that have been channelized or ditched, such as those on this project, typically have low widht to depth ratios (Rosgen, 2007).

Bank Height Ratios greater than 1.3 are indicative of incision and degradation- the flow must rise 30% higher than bankfull in order to reach the floodplain, which increases the depth and the velocity, and therefore the shear stress of the flow.

Parameter	Reference Reach- UT to Meadow Fork Creek			Reference Reach- Bent Creek		
Stream Type	**E4**			**C4**		
Drainage Area	**1.32**			**3.7**		
Dimension	Min	Max	**Avg**	Min	Max	**Avg**
BF Width (ft)			**11.81**			**26.00**
BF Cross Sectional Area (ft^2)			**15.34**			**65.00**
BF Mean Depth (ft)			**1.30**			**2.50**
BF Max Depth (ft)			**2.11**			**NA**
Width/Depth Ratio			**9.08**			**10.40**
Entrenchment Ratio			**28.11**			**5.00**
Wetted Perimeter (ft)			**14.34**			**31.00**
Hydraulic radius (ft)			**1.07**			**2.10**
Bank Height Ratio	1.03	1.05	**1.04**			**NA**
Pool Area/Riffle Area			**1.43**			**NA**
Max riffle depth/mean riffle depth			**1.62**			**NA**
Max pool depth/mean riffle depth			**2.51**			**NA**
Pattern						
Channel Beltwidth (ft)	22.00	57.10	**37.20**	71.00	118.00	**91.25**
Radius of Curvature (ft)	18.00	42.80	**25.00**	23.60	73.00	**48.30**
Meander Wavelength	78.50	149.90	**107.10**	82.00	484.00	**205.00**
Meander Width ratio	1.86	4.83	**3.15**	2.73	4.54	**3.51**
Meander Length ratio	6.65	12.69	**9.01**	3.15	18.62	**7.88**
Radius of Curvature/Riffle Width (ft)	1.52	3.62	**2.12**	0.91	2.81	**1.86**
Pool Length/Riffle Width	1.83	3.10	**2.67**	2.07	6.08	**3.48**
Pool to Pool Spacing/ Riffle Width	6.84	8.31	**7.79**	6.08	6.08	6.08
Profile						
Pool length (ft)	12.98	20.86	**18.02**	53.87	158.12	90.49
Pool spacing (ft)	79.48	96.97	**88.23**	158.12	158.12	**158.12**
Riffle slope (ft/ft)	0.011	0.021	**0.017**	0.009	0.010	**0.010**
Pool slope (ft)	0.003	0.004	**0.003**	0.001	0.002	**0.002**
Run slope (ft)	0.012	0.039	**0.029**	0.011	0.014	**0.012**
Glide slope (ft)	0.002	0.007	**0.005**	0.001	0.014	**0.008**
Riffle Slope/Avg. Water Surface Slope	0.92	1.70	**1.44**	0.96	1.07	**1.02**
Run slope/Avg. Water Surface Slope	1.05	3.23	**2.42**	1.10	1.42	**1.26**
Pool Slope/Avg. Water Surface Slope	0.20	0.33	**0.26**	0.15	0.17	**0.19**
Glide Slope/Avg.Water Surface Slope	0.14	0.56	**0.40**	0.09	1.42	**0.78**
Substrate						
d50 (mm)			**21.4**			**NA**
d84 (mm)			**58.82**			**NA**
Additional Reach Parameters						
Valley Length (ft)			**200**			**142**
Channel Length (ft)			**288**			**271**
Valley Slope (ft)			**0.0171**			**NA**
Water Surface Slope (ft/ft)			**0.0122**			**0.0097**
Sinuosity			**1.4**			**1.9**

Parameter	Proposed (Upper Swartwout) Enhancement			Proposed (Lower Swartwout) Restoration			Proposed (UT Swartwout)			Proposed (Waldroop Stabilization Only)			Proposed (Parker)			Proposed (Preserve)			Proposed (UT2)			Proposed (UT3)			Proposed (UT4)		
Stream Type	**C4**			**C4**			**Cb4**			**C4**			**C4**			**C4**			**C4**			**C4**			**Cb4**		
Drainage Area	**1.2**			**1.2**			**0.9**			**2.5**			**2.6**			**3.4**			**0.47**			**0.24**			**0.17**		
Dimension	Min	Max	**Avg**	Min	Max	**Avg**	Min	Max	**Avg**	Min	Max	**Avg**	Min	Max	**Avg**	Min	Max	**Avg**	Min	Max	**Avg**	Min	Max	**Avg**	Min	Max	**Avg**
BF Width (ft)			**16.2**			**16.2**			**15**			**21.6**			**21.5**			**23.9**			**13**			**9.9**			**9.1**
BF Cross Sectional Area (ft^2)			**22.4**			**22.4**			**18.9**			**38.8**			**39**			**47.7**			**12.75**			**7.4**			**6.3**
BF Mean Depth (ft)			**1.4**			**1.4**			**1.3**			**1.8**			**1.8**			**2**			**0.98**			**0.75**			**0.69**
BF Max Depth (ft)			**2**			**2**			**1.8**			**2.34**			**2.6**			**2.6**			**1.5**			**1.15**			**1.10**
Width/Depth Ratio			**11.8**			**11.8**			**11.9**			**12**			**11.9**			**12**			**13.25**			**13.24**			**13.1**
Entrenchment Ratio			**>2.2**			**>2.2**			**>2.2**			**>2.2**			**>2.2**			**>2.2**			**>2.2**			**>2.2**			**>2.2**
Wetted Perimeter (ft)			**17**			**17**			**17.6**			**25.2**			**25.1**			**27.9**			**14.96**			**11.39**			**10.48**
Hydraulic radius (ft)			**1.32**			**1.32**			**1.07**			**1.54**			**1.55**			**1.71**			**0.85**			**0.65**			**0.60**
Bank Height Ratio			**1**			**1**			**1**			**1**			**1**			**1**			**1**			**1**			**1**
Pool Area/Riffle Area			**2**			**2**			**1.43**			**1.43**			**1.66**			**1.43**			**1.43**			**1.43**			**1.43**
Max riffle depth/mean riffle depth			**1.43**			**1.43**			**1.38**			**1.3**			**1.3**			**1.3**			**1.3**			**1.3**			**1.3**
Max pool depth/mean riffle depth			**2.3**			**2.3**			**2.2**			**1.9**			**1.9**			**1.9**			**1.9**			**1.9**			**1.9**
Pattern																											
Channel Beltwidth (ft)	30.13	78.25	**51.03**	30.13	78.25	**51.03**	27.90	72.45	**47.25**	40.18	104.33	**68.04**	39.99	103.85	**67.73**	44.45	115.44	**75.29**	24.18	62.79	**40.95**	18.41	47.82	**31.19**	16.93	43.95	**28.67**
Radius of Curvature (ft)	24.62	58.64	**34.34**	24.62	58.64	**34.34**	22.80	54.30	**135.15**	32.83	78.19	**45.79**	32.68	77.83	**45.58**	36.33	86.52	**50.67**	19.76	47.06	**27.56**	15.05	35.84	**20.99**	13.83	32.94	**19.29**
Meander Wavelength	107.73	205.58	**145.96**	107.73	205.58	**145.96**	99.75	190.35	**31.80**	143.64	274.10	**194.62**	142.98	272.84	**193.72**	158.94	303.29	**215.34**	86.45	164.97	**117.13**	65.84	125.63	**89.20**	60.52	115.48	**81.99**
Meander Width ratio	1.86	4.83	**3.15**	1.86	4.83	**3.15**	1.86	4.83	**3.15**	1.86	4.83	**3.15**	1.86	4.83	**3.15**	1.86	4.83	**3.15**	1.86	4.83	**3.15**	1.86	4.83	**3.15**	1.86	4.83	**3.15**
Meander Length ratio	6.65	12.69	**9.01**	6.65	12.69	**9.01**	6.65	12.69	**9.01**	6.65	12.69	**9.01**	6.65	12.69	**9.01**	6.65	12.69	**9.01**	6.65	12.69	**9.01**	6.65	12.69	**9.01**	6.65	12.69	**9.01**
Radius of Curvature/Riffle Width (ft)	1.52	3.62	**2.12**	1.52	3.62	**2.12**	1.52	3.62	**2.12**	1.52	3.62	**2.12**	1.52	3.62	**2.12**	1.52	3.62	**2.12**	1.52	3.62	**2.12**	1.52	3.62	**2.12**	1.52	3.62	**2.12**
Pool Length/Riffle Width	1.83	3.10	**2.67**	1.83	3.10	**2.67**	1.83	3.10	**2.67**	1.83	3.10	**2.67**	1.83	3.10	**2.67**	1.83	3.10	**2.67**	1.83	3.10	**2.67**	1.83	3.10	**2.67**	1.83	3.10	**2.67**
Pool to Pool Spacing/ Riffle Width	6.84	8.31	**7.79**	6.84	8.31	**7.79**	6.84	8.31	**7.79**	6.84	8.31	**7.79**	6.84	8.31	**7.79**	6.84	8.31	**7.79**	6.84	8.31	**7.79**	6.84	8.31	**7.79**	6.84	8.31	**7.79**
Profile																											
Pool length (ft)	29.65	50.22	**43.25**	29.65	50.22	**43.25**	27.45	46.50	**40.05**	**39.53**	**66.96**	**57.67**	39.35	66.65	**57.41**	43.74	74.09	63.81	23.79	40.30	**34.71**	18.12	30.69	**26.43**	16.65	28.21	**24.30**
Pool spacing (ft)	110.81	134.62	**126.20**	110.81	134.62	**126.20**	102.60	124.65	**116.85**	**147.74**	**179.50**	**168.26**	147.06	178.67	**167.49**	163.48	198.61	186.18	88.92	108.03	**101.27**	67.72	82.27	**77.12**	62.24	75.62	**70.89**
Riffle slope (ft/ft)	NA	NA	**NA**	0.011	0.020	**0.017**	0.011	0.021	**0.018**	NA	NA	**NA**	0.005	0.009	**0.007**	NA	NA	**NA**	0.007	0.014	**0.012**	0.010	0.019	**0.016**	0.010	0.019	**0.016**
Pool slope (ft)	NA	NA	**NA**	0.002	0.004	**0.003**	0.013	0.040	**0.030**	NA	NA	**NA**	0.001	0.002	**0.001**	NA	NA	**NA**	0.002	0.003	**0.002**	0.002	0.004	**0.003**	0.002	0.004	**0.003**
Run slope (ft)	NA	NA	**NA**	0.012	0.037	**0.028**	0.003	0.004	**0.003**	NA	NA	**NA**	0.005	0.017	**0.013**	NA	NA	**NA**	0.008	0.026	**0.019**	0.012	0.037	**0.028**	0.012	0.037	**0.028**
Glide slope (ft)	NA	NA	**NA**	0.002	0.006	**0.005**	0.002	0.007	**0.005**	NA	NA	**NA**	0.001	0.003	**0.002**	NA	NA	**NA**	0.001	0.004	**0.003**	0.002	0.006	**0.004**	0.002	0.006	**0.004**
Riffle Slope/Avg. Water Surface Slope	0.92	1.70	**1.44**	0.92	1.70	**1.44**	0.92	1.70	**1.44**	0.92	1.70	**1.44**	0.92	1.70	**1.44**	0.92	1.70	**1.44**	0.92	1.70	**1.44**	0.92	1.70	**1.44**	0.92	1.70	**1.44**
Run slope/Avg. Water Surface Slope	1.05	3.23	**2.42**	1.05	3.23	**2.42**	1.05	3.23	**2.42**	1.05	3.23	**2.42**	1.05	3.23	**2.42**	1.05	3.23	**2.42**	1.05	3.23	**2.42**	1.05	3.23	**2.42**	1.05	3.23	**2.42**
Pool Slope/Avg. Water Surface Slope	0.20	0.33	**0.26**	0.20	0.33	**0.26**	0.20	0.33	**0.26**	0.20	0.33	**0.26**	0.20	0.33	**0.26**	0.20	0.33	**0.26**	0.20	0.33	**0.26**	0.20	0.33	**0.26**	0.20	0.33	**0.26**
Glide Slope/Avg.Water Surface Slope	0.14	0.56	**0.40**	0.14	0.56	**0.40**	0.14	0.56	**0.40**	0.14	0.56	**0.40**	0.14	0.56	**0.40**	0.14	0.56	**0.40**	0.14	0.56	**0.40**	0.14	0.56	**0.40**	0.14	0.56	**0.40**
Substrate																											
d50 (mm)			**NA**			**NA**			**NA**			**NA**			**NA**			**NA**			**NA**			**NA**			**NA**
d84 (mm)			**NA**			**NA**			**NA**			**NA**			**NA**			**NA**			**NA**			**NA**			**NA**
Additional Reach Parameters																											
Valley Length (ft)			**480**			**690**			**490**			**1690**			**1480**			**1752**			**311**			**318**			**217**
Channel Length (ft)			**490**			**832**			**581**			**1859**			**1809**			**1827**			**374**			**342**			**244**
Valley Slope (ft)			**0.0150**			**0.0139**			**0.0150**			**0.0076**			**0.0062**			**0.0051**			**0.0096**			**0.0125**			**0.0276**
Water Surface Slope (ft/ft)			**0.0147**			**0.0116**			**0.0125**			**0.0069**			**0.0052**			**0.0049**			**0.0080**			**0.0114**			**0.0251**
Sinuosity			**1.02**			**1.2**			**1.2**			**1.1**			**1.2**			**1.04**			**1.2**			**1.1**			**1.1**

APPENDIX 5

SOIL DATA AND USACE WETLAND DATA FORMS

Cat Creek Soil Profiles

Swartout Tract **7-30-03**
Profile 1 (Soil Boring B-30) Project 67812

Depth	Matrix	Mottles	Mottle Abundance	Texture
0-6	7.5 YR 4/4	--	--	Loam–small cobbles and rocks
6-12	10 YR 3/6	--	--	Loam–small cobbles and rocks
12-20	7.5 YR 4/4	--	--	Sandy loam-gravelly
20-27	7.5 YR 5/6	--	--	Sandy clay-gravelly
22-35	7.5 YR 8/1	7.5 YR 6/6	25%	
		7.5 YR 5/8	4%	
				Cobble layer at 12 inches

Swartout Tract **7-30-03**
Profile 2 (Soil Boring B-31) Project 67812

Depth	Matrix	Mottles	Mottle Abundance	Texture
0-4	7.5 YR 3/3	--	--	Loam
4-13	7.5 YR 4/4	5 YR 4/6	20%	Silt loam- micaceous
		5 YR 5/2	10%	
13-15	7.5 YR 3/1	5 YR 3/4	15%	Silt loam
15-26+	10 YR 7/2	5 YR 4/6	45%	Sandy clay

Swartout Tract **7-30-03**
Profile 3 (Soil Boring B-32) Project 67812

Depth	Matrix	Mottles	Mottle Abundance	Texture
0-4	7.5 YR 2.5/2	--	--	Loam
4-21	7.5 YR 5/2	2.5 YR 4/4	12%	Silt loam
21-27	10 YR 5/1	7.5 YR 4/6	35%	Silt loam
27-41	10 YR 2.5/1	--	--	Silt–partially decomposed organic material
				Gravel at 40 inches

Swartout Tract-Upper Field **7-30-03**
Soil Boring B-33 Project 67812

Depth	Matrix	Mottles	Mottle Abundance	Texture
0-20	2.5 YR 4/4	--	--	Loam
20-24	5 YR 4/4	5 YR 4/6	7%	Silt loam
24-33	7.5 YR 4/1	7.5 YR 5/8	20%	Sandy loam
33-47	7.5 YR 2.5/1	7.5 YR 6/2	5%	Sandy loam-small gravel

Parker Tract **7-30-03**
Soil Boring B-46 Project 67812

Depth	Matrix	Mottles	Mottle Abundance	Texture
0-20	5 YR 5/6	5 YR 3/3	20%	Silt loam
		7.5 YR 3/4	--	-saprolite-rocklike
		2.5 YR 4/8	--	-saprolite-rocklike
20-26	2.5 YR 4/4	7.5 YR 5/1	30%	Silt loam-
		7.5 YR 3/4	--	-saprolite-rocklike
		2.5 YR 4/8	--	-saprolite-rocklike
26-39	7.5 YR 4/1	7.5 YR 5/2	5%	Silt clay-small rounded gravel and partially decomposed organic material

Parker Tract **10-2-03**
Data Point DP-1 - Hydric Project 67812

Depth	Matrix	Mottles	Mottle Abundance	Texture
0-3	7.5 YR 3/3	--	--	Silt loam
3-6	7.5 YR 3/3	7.5 YR 4/1	25%	Silt loam-
6-11	7.5 YR 7/2	5 YR 5/8	20%	Clay loam
11-17	7.5 YR 6/1	10 YR 5/8	30%	Sandy clay
17-26+	7.5 YR 4/1	--	--	Sandy loam

Parker Tract **10-2-03**
Data Point DP-2 - Hydric Project 67812

Depth	Matrix	Mottles	Mottle Abundance	Texture
0-8	7.5 YR 3/2	--	--	Silt loam
8-12	7.5 YR 4/2	7.5 YR 3/4	10%	Silt
12-18+	N 3/-	--	--	Silt loam-

Parker Tract **10-3-03**
Data Point DP-3 – Non-hydric Project 67812

Depth	Matrix	Mottles	Mottle Abundance	Texture
0-15	7.5 YR 3/4	--	--	Silt loam and loam
15-18	5 B 4/1	7.5 YR 3/4	10%	Silt clay loam
18-26+	7.5 YR 6/1	5 YR 4/6	35% to 45% at 26 in	Sandy clay

Preserve Tract **7-31-03**

Data Point DP-4 – Hydric (Wetland) Project 67812

Depth	Matrix	Mottles	Mottle Abundance	Texture
0-2	5 YR 3/3	--	--	Sandy clay loam
2-15	5 YR 2.5/1	5 YR 5/1	40%	Silt clay loam
		5 YR 6/6	8%	
15-31+	5 YR 5/1	5 YR 2.5/1	45%	Sandy loam

Preserve Tract **8-1-03**

Data Point DP-5 – Non-hydric (Non-wetland) Project 67812

Depth	Matrix	Mottles	Mottle Abundance	Texture
0-2	7.5 YR 3/2	--	--	Silty clay loam
2-9	10 YR 3/6	--	--	Loam
9-14	5 YR 3/2	--	--	Silt loam
14-25	5 YR 3/1	5 YR 3/3	3%	Silty clay loam
25-34+	5 YR 5/1	5 YR 4/6	10%	Clay-massive

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

Project/Site:	*Cat Creek*		Date: *10/2/2003*
Applicant/Owner:	*NCDOT*		County: *Macon*
Investigator:	*George Lankford*		State: *NC*
Do Normal Circumstances exist on the site?	Yes ____	No X	Community ID: *Hydric Soil 3*
Is the site significantly disturbed (Atypical Situation)?	Yes X	No ____	Transect ID: *Parker Tract*
Is the area a potential Problem Area?	Yes X	No ____	Plot ID: *DP-1*
(If needed, explain in remarks.)			

VEGETATION

Dominant Plant Species	Stratum	Indicator		Dominant Plant Species	Stratum	Indicator
Andropogon virginicus	*Herb*	*FAC-*				
Juncus effusus	*Herb*	*FACW+*				
Solidago canadensis	*Herb*	*FACU*				
Vernonia noveboracensis	*Herb*	*FAC+*				
Aster puniceus	*Herb*	*OBL*				
Diodia virginiana	*Herb*	*FACW*				
Cyperus strigosus	*Herb*	*FACW*				

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-) 71

Remarks: *Area mowed in July/August*

HYDROLOGY

Recorded Data (Describe in Remarks:)
____ Stream, Lake or Tide Gauge
____ Aerial Photographs
____ Other
X No Recorded Data Available

Field Observations:

Depth of Surface Water: ____ (in.)

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

Depth to Saturated Soil: *10* (in.)

Wetland Hydrology Indicators:
Primary Indicators:
____ Inundated
X Saturated in Upper 12 inches
____ Water Marks
____ Drift Lines
____ Sediment Deposits
____ Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):
____ Oxidized Root Channels in Upper 12 in.
____ Water-Stained Leaves
____ Local Soil Survey Data
____ FAC-Neutral Test
____ Other (Explain in Remarks)

Remarks:

Community ID: *Hydric Soil 3*		Project/Site:	Cat Creek
Transect ID: *Parker Tract*		Date:	10/2/2003
Plot ID: *DP-1*			

SOILS

Map Unit Name (Series and Phase): *Nikwasi, fine sandy loam, 0-2%*

Drainage Class: *poorly or very poorly*

Confirm Mapped Type? ___ Yes X No

Taxonomy Subgroup: *mesic Cumulic Humaquepts*

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-3		7.5 YR 3/3	--	--	Silt Loam
3-6		7.5 YR 3/3	7.5 YR 4/1	25%	Silt Loam
6-11		7.5 YR 7/2	5 YR 5/8	20%	Clay Loam
11-17		7.5 YR 6/1	10 YR 5/8	30%	Sandy Clay
17-26+		7.5 YR 4/1	--	--	Sandy Loam

Hydric Soil Indicators:

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

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	X Yes	___ No
Wetland Hydrology Present?	X Yes	___ No
Hydric Soils Present?	X Yes	___ No
Is this Sampling Point Within a Wetland?	X Yes	___ No

Remarks: *Data Point located near Parker gauge 1 - at a bearing of 325 degrees at 50 feet*
Site is on fairway of abandoned golf course. There is evidence of soil manipulation across the site.

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

Project/Site:	*Cat Creek*		Date: *10/2/2003*
Applicant/Owner:	*NCDOT*		County: *Macon*
Investigator:	*George Lankford*		State: *NC*
Do Normal Circumstances exist on the site?	Yes ____	No X	Community ID: *Hydric Soil 3*
Is the site significantly disturbed (Atypical Situation)?	Yes X	No ____	Transect ID: *Parker Tract*
Is the area a potential Problem Area?	Yes X	No ____	Plot ID: *DP-2*
(If needed, explain in remarks.)			

VEGETATION

Dominant Plant Species	Stratum	Indicator		Dominant Plant Species	Stratum	Indicator
Rubus argutus	*Herb*	*FACU*				
Juncus effusus	*Herb*	*FACW+*				
Solidago canadensis	*Herb*	*FACU*				
Vernonia noveboracensis	*Herb*	*FAC+*				
Cyperus strigosus	*Herb*	*FACW*				
Dichanthelium clandestinum	*Herb*	*FACW*				
Clematis virginiana	*Herb*	*FAC+*				

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-) 71

Remarks: *Area mowed in July/August*

HYDROLOGY

Recorded Data (Describe in Remarks:)
____ Stream, Lake or Tide Gauge
____ Aerial Photographs
____ Other
X No Recorded Data Available

Field Observations:

Depth of Surface Water: ____ (in.)

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

Depth to Saturated Soil: *11* (in.)

Wetland Hydrology Indicators:
Primary Indicators:
____ Inundated
X Saturated in Upper 12 inches
____ Water Marks
____ Drift Lines
____ Sediment Deposits
X Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):
____ Oxidized Root Channels in Upper 12 in.
____ Water-Stained Leaves
____ Local Soil Survey Data
____ FAC-Neutral Test
____ Other (Explain in Remarks)

Remarks:

Project/Site: Cat Creek Date: 10/2/2003	Community ID: *Hydric Soil 3* Transect ID: *Parker Tract* Plot ID: *DP-2*

SOILS

Map Unit Name (Series and Phase): *Nikwasi, fine sandy loam, 0-2%*

Drainage Class: *poorly or very poorly*

Confirm Mapped Type? ___ Yes X No

Taxonomy Subgroup: *mesic Cumulic Humaquepts*

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-8		7.5 YR 3/2	--	--	Silt Loam
8-12		7.5 YR 4/2	7.5 YR 3/4	10%	Silt
12-18+		N 3/-	--	--	Silt Loam

Hydric Soil Indicators:

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

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	X Yes	___ No
Wetland Hydrology Present?	X Yes	___ No
Hydric Soils Present?	X Yes	___ No
Is this Sampling Point Within a Wetland?	X Yes	___ No

Remarks: *Data Point located near wetland point A-25 - at a bearing of 152 degrees at 30 feet*
Site is on fairway of abandoned golf course. There is evidence of soil manipulation across the site.

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

Project/Site:	*Cat Creek*		Date: *10/3/2003*
Applicant/Owner:	*NCDOT*		County: *Macon*
Investigator:	*George Lankford*		State: NC
Do Normal Circumstances exist on the site?	Yes ____	No X	Community ID: *Non-hydric soil*
Is the site significantly disturbed (Atypical Situation)?	Yes X	No ____	Transect ID: *Parker Tract*
Is the area a potential Problem Area?	Yes X	No ____	Plot ID: *DP-3*
(If needed, explain in remarks.)			

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
Plantago lanceolata	*Herb*	*FAC*			
Solanum carolinense	*Herb*	*FACU*			
Cyrilla racemiflora	*Herb*	*FACW*			
Tridens flavus	*Herb*	*FACU*			
Verbesina alternifolia	*Herb*	*FAC*			
Andropogon virginicus	*Herb*	*FAC-*			

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

Remarks: *Area mowed in July/August.*
Herbaceous vegetatio present only.

HYDROLOGY

Recorded Data (Describe in Remarks:)
____ Stream, Lake or Tide Gauge
____ Aerial Photographs
____ Other
X No Recorded Data Available

Field Observations:

Depth of Surface Water: ____ (in.)

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

Depth to Saturated Soil: *>26* (in.)

Wetland Hydrology Indicators:
Primary Indicators:
____ Inundated
X Saturated in Upper 12 inches
____ Water Marks
____ Drift Lines
____ Sediment Deposits
X Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):
____ Oxidized Root Channels in Upper 12 in.
____ Water-Stained Leaves
____ Local Soil Survey Data
____ FAC-Neutral Test
____ Other (Explain in Remarks)

Remarks:

Project/Site: Cat Creek Date: 10/3/2003	Community ID: *Non-hydric soil* Transect ID: *Parker Tract* Plot ID: *DP-3*

SOILS

Map Unit Name (Series and Phase): *Nikwasi, fine sandy loam, 0-2%*

Drainage Class: *poorly or very poorly*

Confirm Mapped Type? ___ Yes X No

Taxonomy Subgroup: *mesic Cumulic Humaquepts*

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-15		7.5 YR 3/4	--	--	Silt Loam and Loam
15-18		5 B 4/1	7.5 YR 3/4	10%	Silty Clay Loam
18-26+		7.5 YR 6/1	7.5 YR 4/6	35% to 45% with depth	Sandy Clay

Hydric Soil Indicators:

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

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	___ Yes	X No
Wetland Hydrology Present?	___ Yes	X No
Hydric Soils Present?	___ Yes	X No
Is this Sampling Point Within a Wetland?	___ Yes	X No

Remarks: *Site is on fairway of abandoned golf course. There is evidence of soil manipulation across the site.*

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

Project/Site:	*Cat Creek*		Date: *7/31/2003*
Applicant/Owner:	*NCDOT*		County: *Macon*
Investigator:	*George Lankford*		State: *NC*
Do Normal Circumstances exist on the site?	Yes ____	No X	Community ID: *Wetland-Old Pond*
Is the site significantly disturbed (Atypical Situation)?	Yes X	No ____	Transect ID: *Preserve Tract*
Is the area a potential Problem Area?	Yes ____	No X	Plot ID: *DP-4*
(If needed, explain in remarks.)			

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
Dichanthelium clandestinum	*Herb*	*FACW*			
Eupatorium perfoliatum	*Herb*	*FACW+*			
Aster puniceus	*Herb*	*OBL*			
Mimulus ringens	*Herb*	*OBL*			
Impatiens capensis	*Herb*	*FACW*			
Polygonum sagittatum	*Herb*	*OBL*			
Juncus effusus	*Herb*	*FACW+*			
Clematis virginiana	*Vine*	*FAC+*			

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

Remarks: *Area is within a small breached pondbed.*

HYDROLOGY

Recorded Data (Describe in Remarks:)
____ Stream, Lake or Tide Gauge
____ Aerial Photographs
____ Other
X No Recorded Data Available

Field Observations:
Depth of Surface Water: ____ (in.)
Depth to Free Water in Pit: *4* (in.)
Depth to Saturated Soil: *0* (in.)

Wetland Hydrology Indicators:
Primary Indicators:
____ Inundated
X Saturated in Upper 12 inches
____ Water Marks
____ Drift Lines
____ Sediment Deposits
X Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):
____ Oxidized Root Channels in Upper 12 in.
____ Water-Stained Leaves
____ Local Soil Survey Data
____ FAC-Neutral Test
____ Other (Explain in Remarks)

Remarks:

Project/Site: Cat Creek Date: 7/31/2003	Community ID: *Wetland-Old Pond* Transect ID: *Preserve Tract* Plot ID: *DP-4*

SOILS

Map Unit Name (Series and Phase): *Udorthents-Urban Land complex, 0-5%*

Drainage Class: *n/a*

Confirm Mapped Type? X Yes ___ No

Taxonomy Subgroup: *Udorthents*

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-2		5 YR 3/3	--	--	Sandy Clay Loam
2-15		5 YR 2.5/1	5 YR 5/1	40%	Silty Clay Loam
			5 YR 5/6	8%	
15-31+		5 YR 5/1	5 YR 2.5/1	45%	Sandy Loam

Hydric Soil Indicators:

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

Remarks: *Area upslope from top of bank slope into old pond.*

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	X Yes	___ No
Wetland Hydrology Present?	X Yes	___ No
Hydric Soils Present?	X Yes	___ No
Is this Sampling Point Within a Wetland?	X Yes	___ No

Remarks: *Site is in old breached pondbed beside fairway of abandoned golf course.*
There is evidence of soil manipulation across the site.
Data Point is locate ~5 feet from wetland point W-8.

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

Project/Site:	*Cat Creek*		Date: *8/1/2003*
Applicant/Owner:	*NCDOT*		County: *Macon*
Investigator:	*George Lankford*		State: *NC*
Do Normal Circumstances exist on the site?	Yes ____	No X	Community ID: *Non-wetland*
Is the site significantly disturbed (Atypical Situation)?	Yes X	No ____	Transect ID: *Preserve Tract*
Is the area a potential Problem Area?	Yes X	No ____	Plot ID: *DP-5*
(If needed, explain in remarks.)			

VEGETATION

Dominant Plant Species	Stratum	Indicator		Dominant Plant Species	Stratum	Indicator
Dichanthelium clandestinum	*Herb*	*FACW*				
Rubus argutus	*Herb*	*FACU*				

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

Remarks: *Area is near a small breached pond.*
Area recently mowed and only short herbaceous vegetation present.

HYDROLOGY

Recorded Data (Describe in Remarks:)
____ Stream, Lake or Tide Gauge
____ Acrial Photographs
____ Other
X No Recorded Data Available

Field Observations:

Depth of Surface Water: ____ (in.)

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

Depth to Saturated Soil: *>34* (in.)

Wetland Hydrology Indicators:
Primary Indicators:
____ Inundated
____ Saturated in Upper 12 inches
____ Water Marks
____ Drift Lines
____ Sediment Deposits
____ Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):
____ Oxidized Root Channels in Upper 12 in.
____ Water-Stained Leaves
____ Local Soil Survey Data
____ FAC-Neutral Test
____ Other (Explain in Remarks)

Remarks:

Project/Site: Cat Creek Date: 8/1/2003	Community ID: *Non-wetland* Transect ID: *Preserve Tract* Plot ID: *DP-5*

SOILS

Map Unit Name (Series and Phase): *Udorthents-Urban Land complex, 0-5%*

Drainage Class: *n/a*

Confirm Mapped Type? X Yes ___ No

Taxonomy Subgroup: *Udorthents*

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-2		7.5 YR 3/2	--	--	Silty Clay Loam
2-9		10 YR 5/6			Loam
9-14		5 YR 3/2			Silt Loam
14-25		5 YR 3/1	5 YR 3/3	3%	Silty Clay Loam
25-34+		5 YR 3/1	5 YR 4/6	10%	Clay - massive

Hydric Soil Indicators:

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

Remarks: *Area upslope from top of bank slope into old pond.*

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	___ Yes	X No
Wetland Hydrology Present?	___ Yes	X No
Hydric Soils Present?	X Yes	___ No
Is this Sampling Point Within a Wetland?	___ Yes	X No

Remarks: *Data point is outside of old pond and is in the fairway of abandoned golf course.*
There is evidence of soil manipulation across the site.
Data Point is locate ~21feet from wetland point W-7.

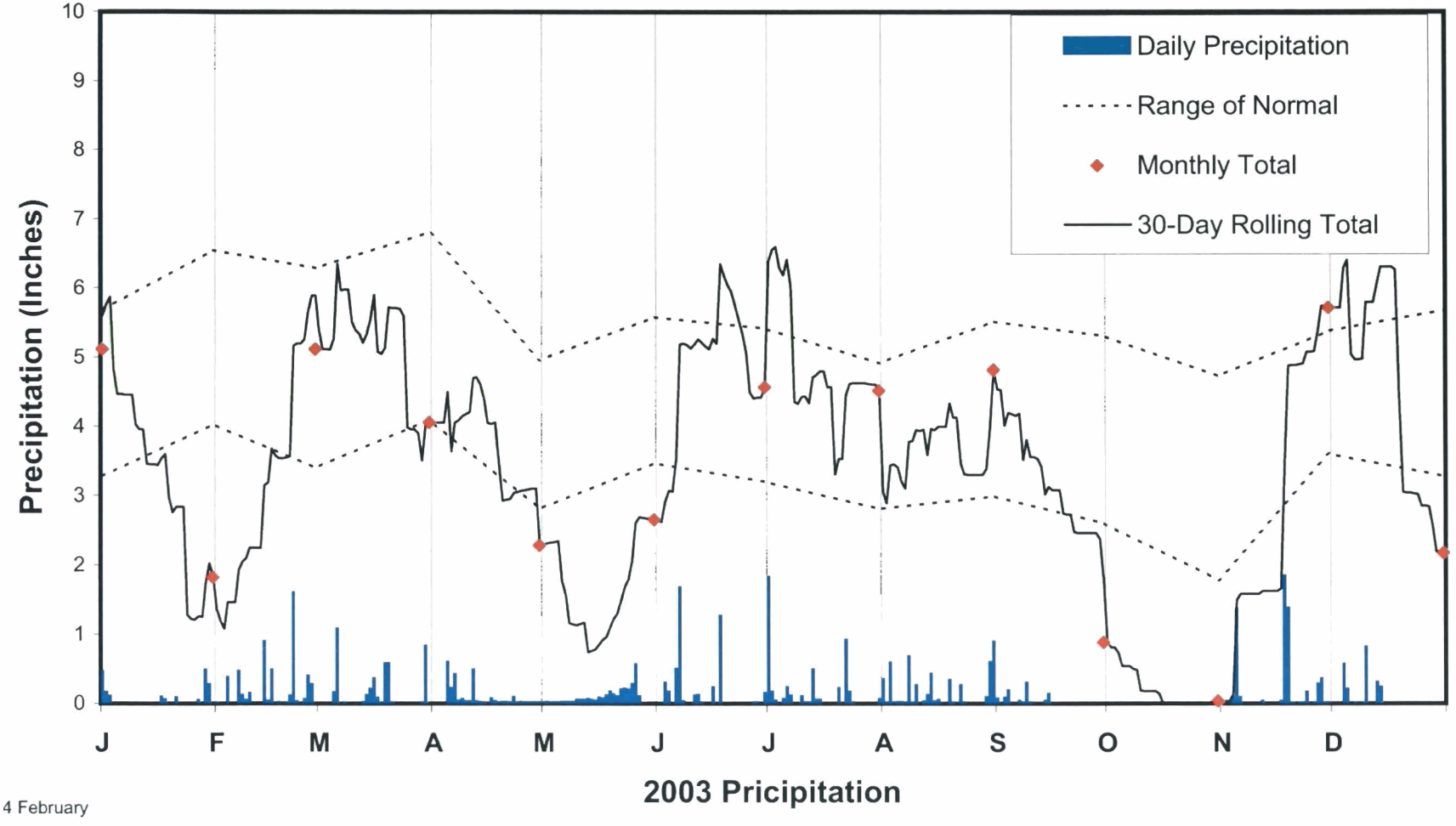
APPENDIX 6

HYDROGRAPHS AND PRECIPITATION DATA

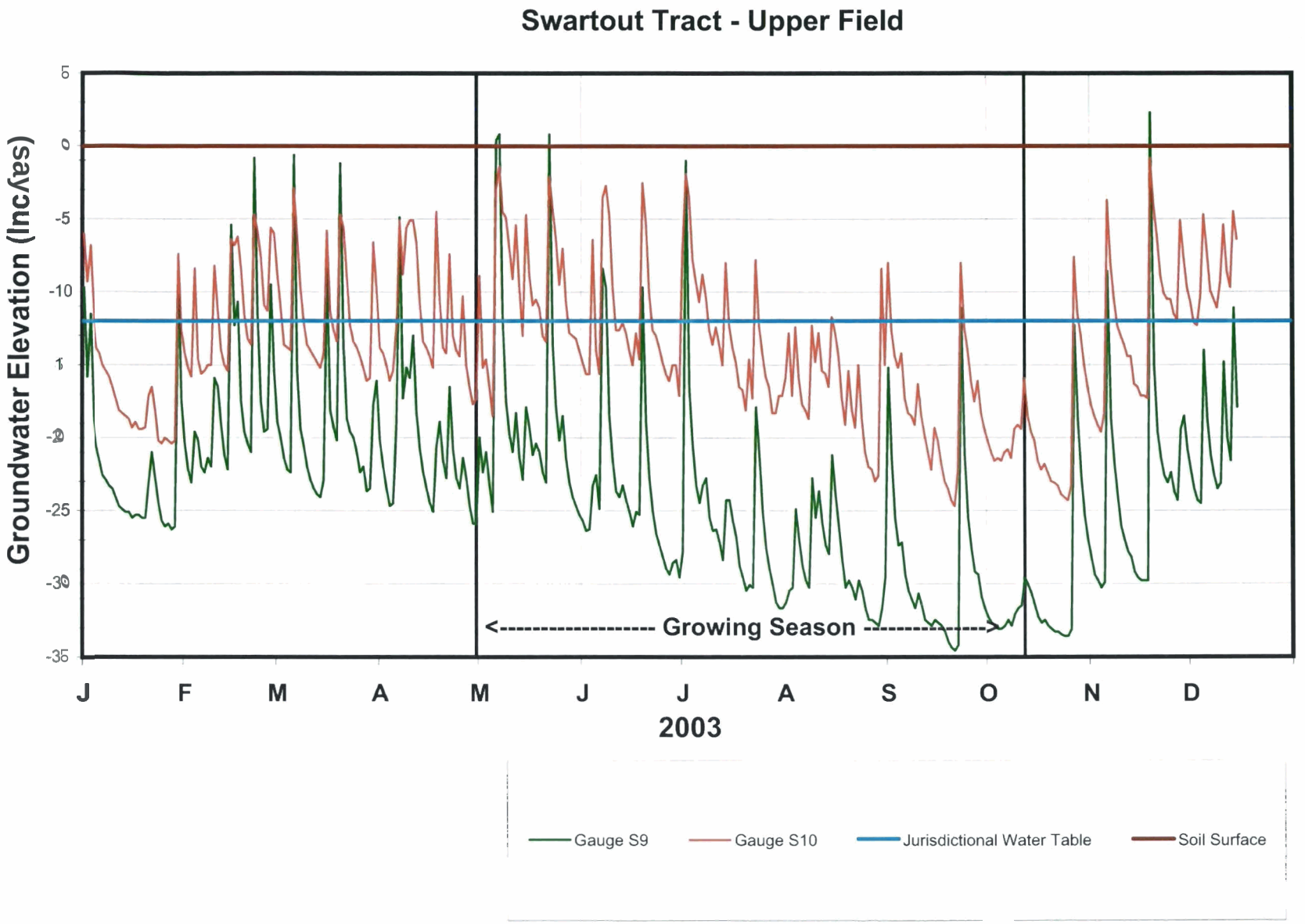
APPENDIX 6

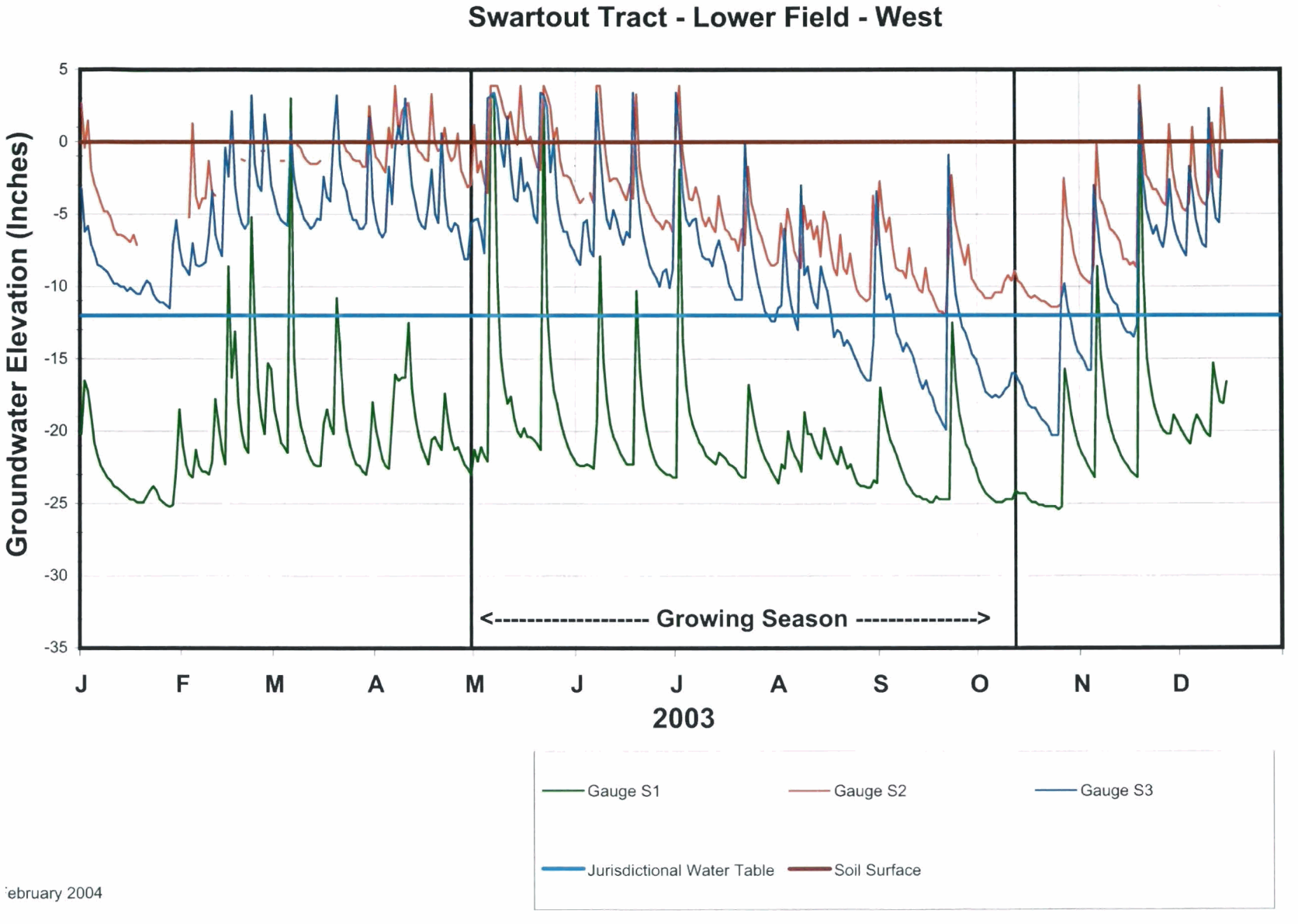
HYDROGRAPHS AND PRECIPITATION DATA

Cat Creek Mitigation Site
Macon County, NC

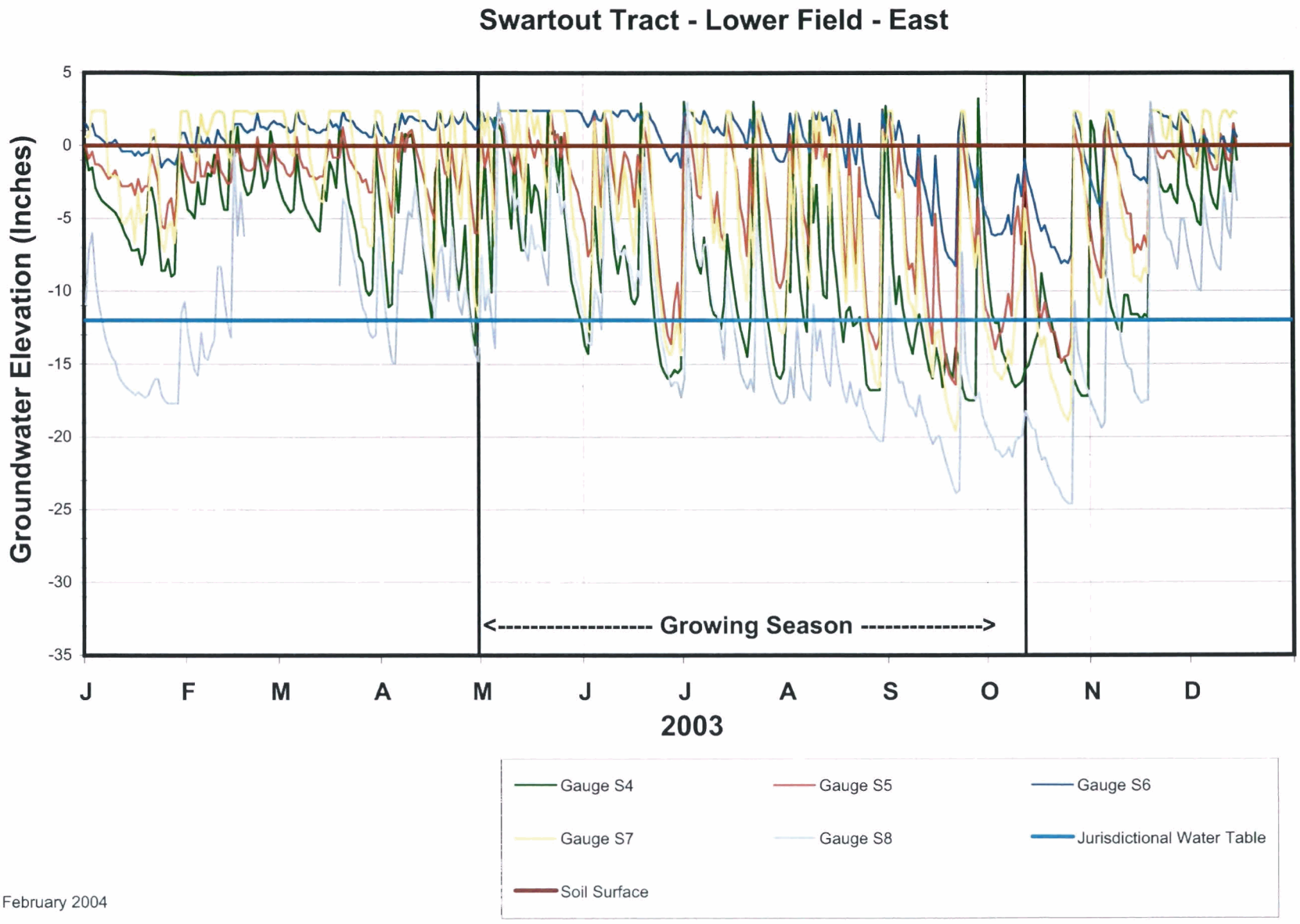


4 February

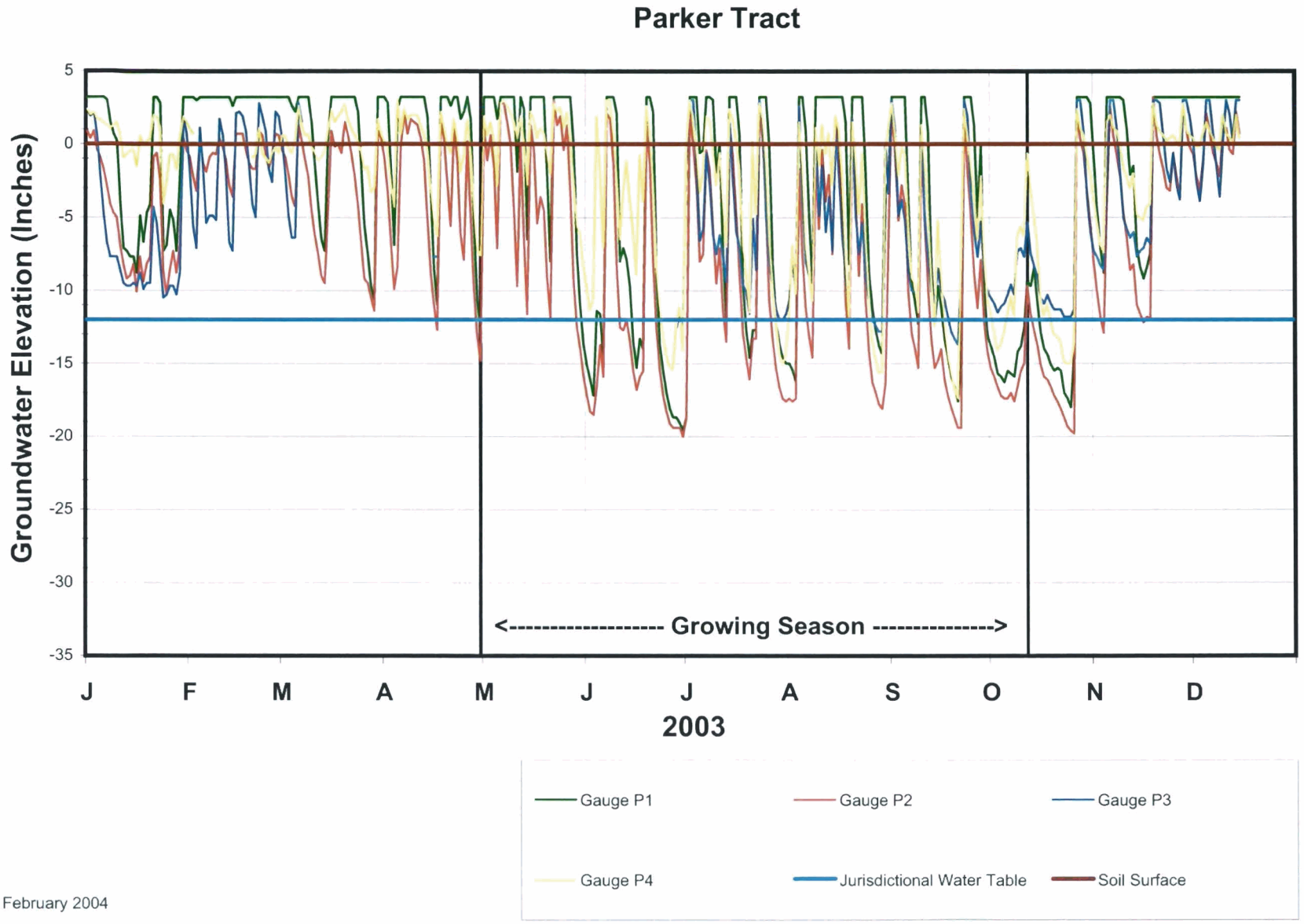

Swartout Tract - Upper Field
Groundwater Elevation (Inches)
5
0
-5
-10
-15
-20
-25
-30
-35
J
F
M
A
M
J
J
A
S
O
N
D
2003
<---------- Growing Season ---------->
Gauge S9
Gauge S10
Jurisdictional Water Table
Soil Surface



ebruary 2004

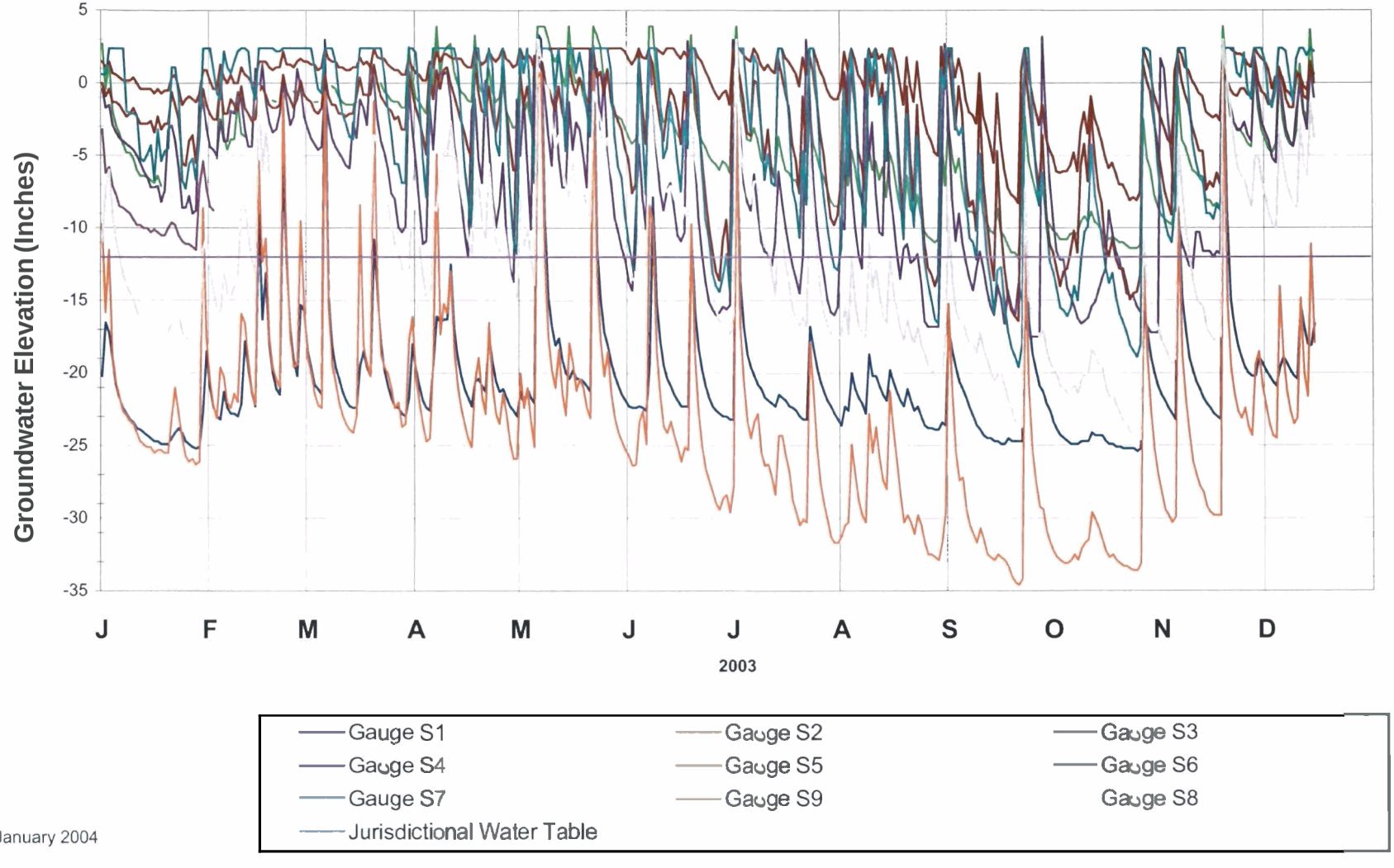


3 February 2004



3 February 2004

All Gauges in Swartout Tract



January 2004

APPENDIX 7

SEDIMENT TRANSPORT

ENTRAINMENT CALCULATION FORM

Stream:	Cat Creek	Reach:	Swartwout (field)
Team:	AJT and GKL	Date:	Jun-03

Information Input Area

43	D_{50}	Riffle bed material D50 (mm)			
14	$D^{\wedge}_{50}$	Bar sample D50 (mm)			
60.0	D_i	Largest particle from bar sample (mm)	0.20	(feet)	304.8 mm/foot
0.012	S_e	Existing bankfull water surface slope (ft/ft)			
1.46	d_e	Existing bankfull mean depth (ft)			
1.59	R	Hydraulic Radius of Riffle Cross Section (ft)			
1.65	g_s	Submerged specific weight of sediment			

Calculation of Critical Dimensionless Shear Stress

3.07	$D_{50}/D^{\wedge}_{50}$	If value is between 3-7	**Equation 1** will be used:	$t^{*}_{ci} = 0.0834(D_{50}/D^{\wedge}_{50})^{-0.872}$
1.40	D_i/D_{50}	If value is between 1.3-3.0	**Equation 2** will be used:	$t^{*}_{ci} = 0.0384(D_i/D_{50})^{-0.887}$
0.0313	t^{*}_{ci}	Critical Dimensionless Shear Stress	**Equation used:**	1

Calculation of **Bankfull** Mean Depth Required for Entrainment of Largest Particle in Bar Sample

0.85	d_r	Required **bankfull** mean depth (ft)	$d_r = \frac{t^{*}_{ci} g_s D_i}{S_e}$
1.46	de	Existing **bankfull** mean depth (ft)	

Calculation of BKF Water Surface Slope Required for Entrainment of Largest Particle in Bar Sample

0.0070	S_r	Required **bankfull** water surface slope (ft)	$S_r = \frac{t^{*}_{ci} g_s D_i}{d_e}$
0.0120	Se	Existing **bankfull** water surface slope (ft)	

Sediment Transport Validation

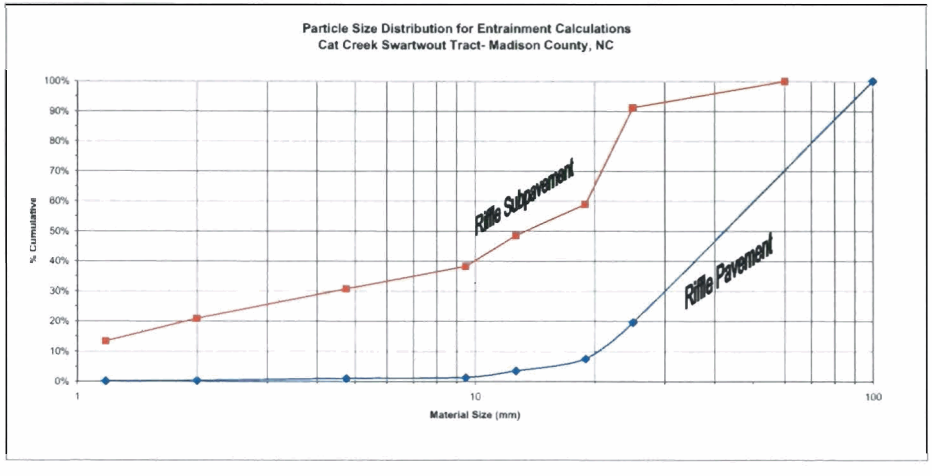
0.00	**Bankfull** Shear Stress $t_c = gRS$ (lb/ft2) where the Density of water = g = 62.4 lbs/ft^3
40-400	Moveable particle size (mm) at **bankfull** shear stress (predicted by the Revised Shields Diagram by Rosgen, 2002)
0.27	Predicted shear stress required to initiate movement of D_i (mm) (see Revised Shields Diagram, Rosgen, 2002)
	Note: If available **bankfull** shear stress exceeds D100 of bed, degradation potential exists.

Swartwout Tract
Cat Creek
Macon County, NC

RIFFLE SAMPLE	
River Basin:	Little Tennessee
Watershed:	Cat Creek
Stream Reach:	Swartwout Tract
DA (sq mi):	1.13
Date:	9/11/2003

Sieve Size (mm)										1.18	2	4.75	9.5	12.7	19	25	
micro																	
Tare Weight(lbs)										0.81	1.03	1.12	1.2	1.23	1.28	1.29	
Pave Sample Weight (lbs)										0.83	1.05	1.19	1.24	1.51	1.76	2.79	
Subpav Sample Weight (lbs)										4.17	2.88	3.56	3.08	3.78	3.84	9.34	
Pave Net Weight (lbs)										0.02	0.02	0.07	0.04	0.28	0.48	1.5	**12.37**
Subpave Net Weight(lbs)										3.36	1.85	2.44	1.88	2.55	2.56	8.05	**24.91**
% Pavement										0%	0%	1%	0%	2%	4%	12%	
% Cumulative Pavement										0%	0%	1%	1%	3%	7%	19%	**100%**
% Subpavement										13%	7%	10%	8%	10%	10%	32%	
% Cumulative Subpavement										13%	21%	31%	38%	48%	59%	91%	**100%**

	LP1	LP2
dia	100	61
weight	9.39	0.57
weight	1.29	0.93
dia	60	53



ENTRAINMENT CALCULATION FORM

Stream:	UT Cat Creek	Reach:	Swartwout UT
Team:	AJT and GLK	Date:	Jun-03

Information Input Area

28	D_{50}	Riffle bed material D50 (mm)			
20	$D^{\wedge}_{50}$	Bar sample D50 (mm)			
60.0	D_i	Largest particle from bar sample (mm)	0.20	(feet)	304.8 mm/foot
0.02	S_e	Existing bankfull water surface slope (ft/ft)			
1.78	d_e	Existing bankfull mean depth (ft)			
1.33	R	Hydraulic Radius of Riffle Cross Section (ft)			
1.65	g_s	Submerged specific weight of sediment			

Calculation of Critical Dimensionless Shear Stress

1.40	$D_{50}/D^{\wedge}_{50}$	If value is between 3-7	**Equation 1** will be used: $t^*_{ci} = 0.0834(D_{50}/D^{\wedge}_{50})^{-0.872}$
2.14	D_i/D_{50}	If value is between 1.3-3.0	**Equation 2** will be used: $t^*_{ci} = 0.0384(D_i/D_{50})^{-0.887}$

0.0286	t^*_{ci}	Critical Dimensionless Shear Stress	**Equation used:**	2

Calculation of Bankfull Mean Depth Required for Entrainment of Largest Particle in Bar Sample

0.46	d_r	Required bankfull mean depth (ft)	$d_r = \frac{t^*_{ci} g_s D_i}{S_e}$
1.78	de	Existing bankfull mean depth (ft)	

Calculation of BKF Water Surface Slope Required for Entrainment of Largest Particle in Bar Sample

0.0052	S_r	Required bankfull water surface slope (ft)	$S_r = \frac{t^*_{ci} g_s D_i}{d_e}$
0.0200	Se	Existing bankfull water surface slope (ft)	

Sediment Transport Validation

1.65	Bankfull Shear Stress $t_c = gRS$ (lb/ft2) where the Density of water = g = 62.4 lbs/ft^3
50-500	Moveable particle size (mm) at bankfull shear stress (predicted by the Revised Shields Diagram by Rosgen, 2002)
0.27	Predicted shear stress required to initiate movement of D_i (mm) (see Revised Shields Diagram, Rosgen, 2002)
	Note: If available bankfull shear stress exceeds D100 of bed, degradation potential exists.

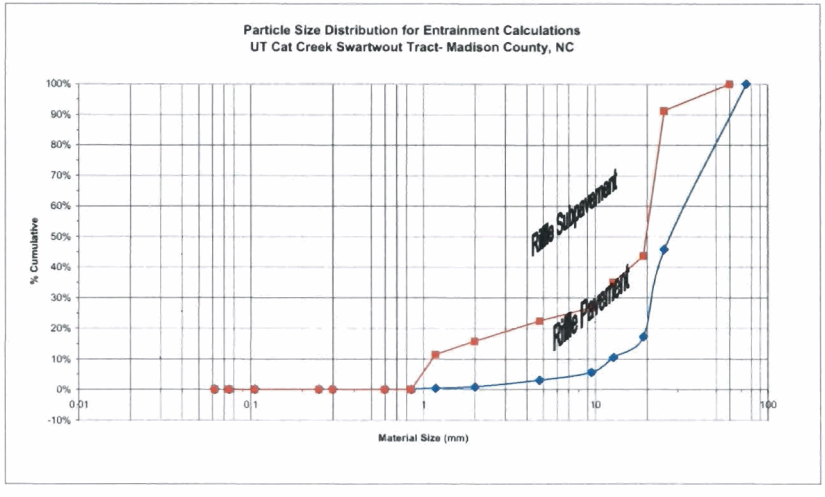
Swartwout Tract
UT to Cat Creek
Macon County, NC

RIFFLE SAMPLE	
River Basin:	Little Tennessee
Watershed:	Cat Creek
Stream Reach:	UT Swartwout Tract
DA (sq mi):	0.86
Date:	9/11/2003

*****JUST WITH SUBPAVEMENT SAMPLE 1**

Sieve Size (mm)	0.062			0.075	0.106	0.25	0.3	0.6	0.85	1.18	2	4.75	9.5	12.7	19	25	
micro				75	106	250	300	600	850								
Tare Weight(lbs)										0.81	1.03	1.12	1.2	1.23	1.28	1.29	
Pave Sample Weight (lbs)										0.83	1.05	1.24	1.34	1.5	1.65	2.86	
Subpav Sample Weight (lbs)										3.47	2.04	2.67	2.23	3.2	3.29	12.4	
Pave Net Weight (lbs)										0.02	0.02	0.12	0.14	0.27	0.37	1.57	**5.5**
Subpave Net Weight(lbs)										2.66	1.01	1.55	1.03	1.97	2.01	11.1	**23.39**
% Pavement	0%			0%	0%	0%	0%	0%	0%	0%	0%	2%	3%	5%	7%	29%	
% Cumulative Pavement	0%			0%	0%	0%	0%	0%	0%	0%	1%	3%	5%	10%	17%	46%	**100%**
% Subpavement	0%			0%	0%	0%	0%	0%	0%	11%	4%	7%	4%	8%	9%	48%	
% Cumulative Subpavement	0%			0%	0%	0%	0%	0%	0%	11%	16%	22%	27%	35%	44%	91%	**100%**

	LP1	LP2
dia	75	70
weight	1.98	1.01
weight	0.98	1.06
dia	60	75



ENTRAINMENT CALCULATION FORM

Stream:	Cat Creek	Reach:	Waldroop
Team:	AJT and GKL	Date:	Jun-03

Information Input Area

33	D_{50}	Riffle bed material D50 (mm)			
12.7	$D^{\wedge}_{50}$	Bar sample D50 (mm)			
85.0	D_i	Largest particle from bar sample (mm)	0.28	(feet)	304.8 mm/foot
0.008	S_e	Existing bankfull water surface slope (ft/ft)			
1.78	d_e	Existing bankfull mean depth (ft)			
1.73	R	Hydraulic Radius of Riffle Cross Section (ft)			
1.65	g_s	Submerged specific weight of sediment			

Calculation of Critical Dimensionless Shear Stress

2.60	$D_{50}/D^{\wedge}_{50}$	If value is between 3-7	**Equation 1** will be used:	$t^{*}_{ci} = 0.0834(D_{50}/D^{\wedge}_{50})^{-0.872}$
2.58	D_i/D_{50}	If value is between 1.3-3.0	**Equation 2** will be used:	$t^{*}_{ci} = 0.0384(D_i/D_{50})^{-0.887}$
0.0286	t^{*}_{ci}	Critical Dimensionless Shear Stress	**Equation used:**	2

Calculation of Bankfull Mean Depth Required for Entrainment of Largest Particle in Bar Sample

1.64	d_r	Required bankfull mean depth (ft)	$d_r = \frac{t^{*}_{ci} g_s D_i}{S_e}$
1.78	de	Existing bankfull mean depth (ft)	

Calculation of BKF Water Surface Slope Required for Entrainment of Largest Particle in Bar Sample

0.0074	S_r	Required bankfull water surface slope (ft)	$S_r = \frac{t^{*}_{ci} g_s D_i}{d_e}$
0.0080	Se	Existing bankfull water surface slope (ft)	

Sediment Transport Validation

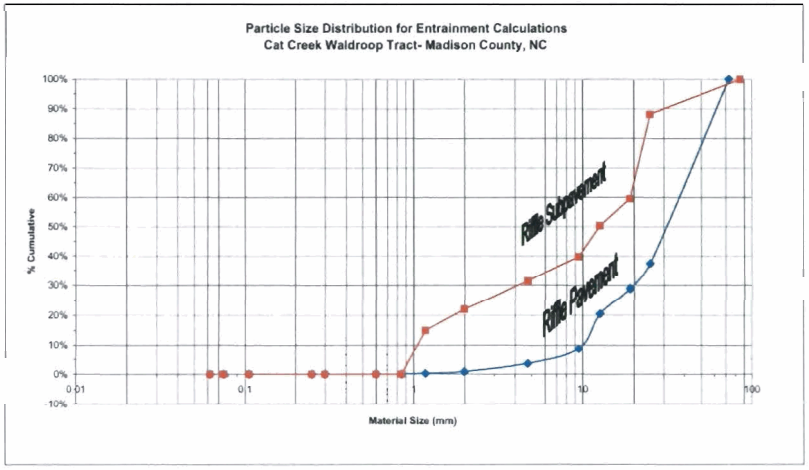
0.86	Bankfull Shear Stress $t_c = gRS$ (lb/ft2) where the Density of water = g = 62.4 lbs/ft^3
20-200	Moveable particle size (mm) at bankfull shear stress (predicted by the Revised Shields Diagram by Rosgen, 2002)
0.38	Predicted shear stress required to initiate movement of D_i (mm) (see Revised Shields Diagram, Rosgen, 2002)
	Note: If available bankfull shear stress exceeds D100 of bed, degradation potential exists.

Waldroop Tract
Cat Creek
Macon County, NC

RIFFLE SAMPLE	
River Basin:	Little Tennessee
Watershed:	Cat Creek
Stream Reach:	Waldroop Tract
DA (sq mi):	2.5
Date:	9/11/2003

Sieve Size (mm)	0.062	0.075		0.106	0.25	0.3	0.6	0.85	1.18	2	4.75	9.5	12.7	19	25	
micro		75		106	250	300	600	850								
Tare Weight(lbs)									0.81	1.03	1.12	1.2	1.23	1.28	1.29	
Pave Sample Weight (lbs)									0.82	1.06	1.24	1.43	1.78	1.67	1.68	
Subpav Sample Weight (lbs)									5.71	3.36	4.18	3.9	4.7	4.3	10.67	
Pave Net Weight (lbs)									0.01	0.03	0.12	0.23	0.55	0.39	0.39	4.6
Subpave Net Weight(lbs)									4.9	2.33	3.06	2.7	3.47	3.02	9.38	32.74
% Pavement	0%	0%		0%	0%	0%	0%	0%	0%	1%	3%	5%	12%	8%	8%	
% Cumulative Pavement	0%	0%		0%	0%	0%	0%	0%	0%	1%	3%	8%	20%	29%	37%	100%
% Subpavement	0%	0%		0%	0%	0%	0%	0%	15%	7%	9%	8%	11%	9%	29%	
% Cumulative Subpavement	0%	0%		0%	0%	0%	0%	0%	15%	22%	31%	40%	50%	59%	88%	100%

	LP1	LP2
dia	73	70
weight	1.82	1.06
weight	2.57	1.31
dia	85	80



ENTRAINMENT CALCULATION FORM

Stream:	Cat Creek	Reach:	Parker
Team:	AJT and GKL	Date:	1-Jun

Information Input Area

23	D_{50}	Riffle bed material D50 (mm)			
3.5	$D^{\wedge}_{50}$	Bar sample D50 (mm)			
50.0	D_i	Largest particle from bar sample (mm)	0.16	(feet)	304.8 mm/foot
0.006	S_e	Existing bankfull water surface slope (ft/ft)			
1.6	d_e	Existing bankfull mean depth (ft)			
1.84	R	Hydraulic Radius of Riffle Cross Section (ft)			
1.65	g_s	Submerged specific weight of sediment			

Calculation of Critical Dimensionless Shear Stress

6.57	$D_{50}/D^{\wedge}_{50}$	If value is between 3-7	**Equation 1** will be used:	$t^{*}_{ci} = 0.0834(D_{50}/D^{\wedge}_{50})^{-0.872}$
2.17	D_i/D_{50}	If value is between 1.3-3.0	**Equation 2** will be used:	$t^{*}_{ci} = 0.0384(D_i/D_{50})^{-0.887}$
0.0313	t^{*}_{ci}	Critical Dimensionless Shear Stress	**Equation used:**	1

Calculation of Bankfull Mean Depth Required for Entrainment of Largest Particle in Bar Sample

1.41	d_r	Required bankfull mean depth (ft)	$d_r = \frac{t^{*}_{ci} g_s D_i}{S_e}$
1.60	de	Existing bankfull mean depth (ft)	

Calculation of BKF Water Surface Slope Required for Entrainment of Largest Particle in Bar Sample

0.0053	S_r	Required bankfull water surface slope (ft)	$S_r = \frac{t^{*}_{ci} g_s D_i}{d_e}$
0.0060	Se	Existing bankfull water surface slope (ft)	

Sediment Transport Validation

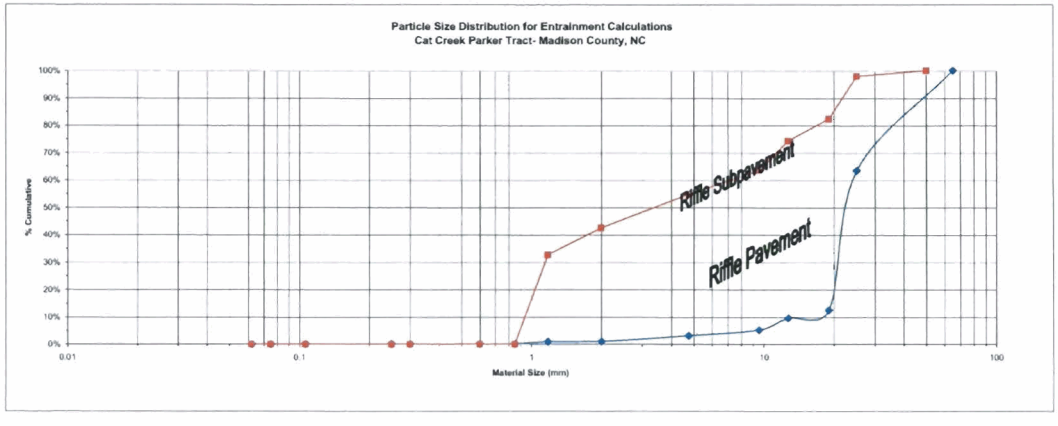
0.69	Bankfull Shear Stress $t_c = gRS$ (lb/ft2) where the Density of water = g = 62.4 lbs/ft^3
20-150	Moveable particle size (mm) at bankfull shear stress (predicted by the Revised Shields Diagram by Rosgen, 2002)
0.21	Predicted shear stress required to initiate movement of D, (mm) (see Revised Shields Diagram, Rosgen, 2002)
	Note: If available bankfull shear stress exceeds D100 of bed, degradation potential exists.

Parker Tract
Cat Creek
Macon County, NC

RIFFLE SAMPLE	
River Basin:	Little Tennessee
Watershed:	Cat Creek
Stream Reach:	Parker Tract
DA (sq mi):	2.6
Date:	9/11/2003

Sieve Size (mm)	0.062	0.075	0.106	0.25	0.3	0.6	0.85	1.18	2	4.75	9.5	12.7	19	25	
micro		75	106	250	300	600	850								
Tare Weight(lbs)								0.81	1.03	1.12	1.2	1.23	1.28	1.29	
Pave Sample Weight (lbs)								0.87	1.04	1.27	1.35	1.56	1.5	5.08	
Subpav Sample Weight (lbs)								9.67	3.7	4.48	3.59	4.16	3.44	5.5	
Pave Net Weight (lbs)								0.06	0.01	0.15	0.15	0.33	0.22	3.79	**7.42**
Subpave Net Weight(lbs)								8.86	2.67	3.36	2.39	2.93	2.16	4.21	**27.15**
% Pavement	0%	0%	0%	0%	0%	0%	0%	1%	0%	2%	2%	4%	3%	51%	
% Cumulative Pavement	0%	0%	0%	0%	0%	0%	0%	1%	1%	3%	5%	9%	12%	63%	**100%**
% Subpavement	0%	0%	0%	0%	0%	0%	0%	33%	10%	12%	9%	11%	8%	16%	
% Cumulative Subpavement	0%	0%	0%	0%	0%	0%	0%	33%	42%	55%	64%	74%	82%	98%	**100%**

	LP1	LP2
dia	65	54
weight	2.08	0.63
weight	0.33	0.24
dia	50	37



ENTRAINMENT CALCULATION FORM

Stream:	Cat Creek	Reach:	Preserve
Team:	AJT and GKL	Date:	Jun-03

Information Input Area

13	D_{50}	Riffle bed material D50 (mm)			
9	$D^{\wedge}_{50}$	Bar sample D50 (mm)			
31.0	D_l	Largest particle from bar sample (mm)	0.10	(feet)	304.8 mm/foot
0.005	S_e	Existing bankfull water surface slope (ft/ft)			
1.4	d_e	Existing bankfull mean depth (ft)			
1.84	R	Hydraulic Radius of Riffle Cross Section (ft)			
1.65	g_s	Submerged specific weight of sediment			

Calculation of Critical Dimensionless Shear Stress

1.44	$D_{50}/D^{\wedge}_{50}$	If value is between 3-7	**Equation 1** will be used: $t^{*}_{ci} = 0.0834(D_{50}/D^{\wedge}_{50})^{-0.872}$
2.38	D_l/D_{50}	If value is between 1.3-3.0	**Equation 2** will be used: $t^{*}_{ci} = 0.0384(D_l/D_{50})^{-0.887}$
0.0286	t^{*}_{ci}	Critical Dimensionless Shear Stress	**Equation used:** 2

Calculation of Bankfull Mean Depth Required for Entrainment of Largest Particle in Bar Sample

0.96	d_r	Required bankfull mean depth (ft)	$d_r = \frac{t^{*}_{ci} g_s D_l}{S_e}$
1.40	de	Existing bankfull mean depth (ft)	

Calculation of BKF Water Surface Slope Required for Entrainment of Largest Particle in Bar Sample

0.0034	S_r	Required bankfull water surface slope (ft)	$S_r = \frac{t^{*}_{ci} g_s D_l}{d_e}$
0.0050	Se	Existing bankfull water surface slope (ft)	

Sediment Transport Validation

0.57	Bankfull Shear Stress $t_c = gRS$ (lb/ft2) where the Density of water = g = 62.4 lbs/ft^3
18-200	Moveable particle size (mm) at bankfull shear stress (predicted by the Revised Shields Diagram by Rosgen, 2002)
0.13	Predicted shear stress required to initiate movement of D, (mm) (see Revised Shields Diagram, Rosgen, 2002)
	Note: If available bankfull shear stress exceeds D100 of bed, degradation potential exists.

Preserve Tract
Cat Creek
Macon County, NC

RIFFLE SAMPLE	
River Basin:	Little Tennessee
Watershed:	Cat Creek
Stream Reach:	Preserve Tract
DA (sq mi):	3.63
Date:	9/11/2003

Sieve Size (mm)	0.062	0.075	0.106	0.25	0.3	0.6	0.85	1.18	2	4.75	9.5	12.7	19	25	
micro		75	106	250	300	600	850								
Tare Weight(lbs)								0.81	1.03	1.12	1.2	1.23	1.28	1.29	
Pave Sample Weight (lbs)								0.84	1.05	1.23	1.33	1.5	1.36	1.44	
Subpav Sample Weight (lbs)								3.52	1.66	2.13	1.77	1.7	1.86	1.38	
Pave Net Weight (lbs)								0.03	0.02	0.11	0.13	0.27	0.08	0.15	**1.02**
Subpave Net Weight(lbs)								2.71	0.63	1.01	0.57	0.47	0.58	0.09	**6.48**
% Pavement	0%	0%	0%	0%	0%	0%	0%	3%	2%	11%	13%	26%	8%	15%	
% Cumulative Pavement	0%	0%	0%	0%	0%	0%	0%	3%	5%	16%	28%	55%	63%	77%	**100%**
% Subpavement	0%	0%	0%	0%	0%	0%	0%	42%	10%	16%	9%	7%	9%	1%	
% Cumulative Subpavement	0%	0%	0%	0%	0%	0%	0%	42%	52%	67%	76%	83%	92%	94%	**100%**

	LP1	LP2
dia	33	30
weight	0.15	0.08
weight	0.23	0.19
dia	31	31