Moccasin Creek Buffer & Wetland Restoration, Enhancement & Preservation
Wake and Franklin Counties
North Carolina

Report and Restoration Plan

November 22, 2004

For:
Ecosystem Enhancement Program
Parker Lincoln Building
2728 Capital Boulevard, Suite 1H-103
Raleigh, North Carolina 27606

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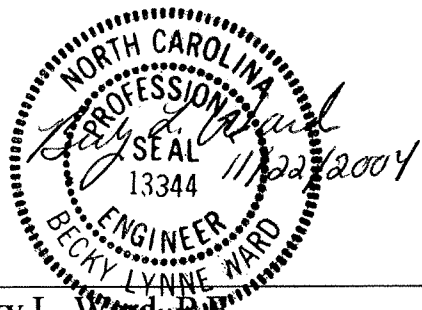
Report and Restoration Plans Prepared By:

Ward Consulting Engineers, P.C.
1512 Eglantyne Court
Raleigh, North Carolina 27613
Ph: 919-870-0526
Fax: 919-870-5359



Becky L. Ward, P.E.

The Catena Group, Inc.
410-B Millstone Drive
Hillsborough, North Carolina 27278
Ph: 919-732-1300
Fax: 919-732-1303

Michael G. Wood, LSS

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1.0 INTRODUCTION

The North Carolina Ecosystem Enhancement Program (EEP) purchased the Moccasin Creek Project Site to preserve, enhance, and restore wetlands and streams. The site is an 84-acre undeveloped tract along Moccasin Creek, located off NC 39 between NC 96 and NC 296 in Wake and Franklin Counties. The property is subject to the zoning restrictions of the Town of Zebulon, which is within 3 miles of the project site. Moccasin Creek, which runs north-south through the site, serves as the Wake and Franklin County line.

1.1 BACKGROUND

The site was originally forested with a thirty to forty year old hardwood forest, which was timbered in the early 1980's by the previous owner. Pine trees were then replanted in a majority of the timbered area. The planted pines were pre-commercially thinned approximately four to five years ago to promote growth of the larger trees. A small area straddling Moccasin Creek that was deemed too wet for pine was left to naturally regenerate in hardwoods, although a majority of this area has failed to regenerate, and more recently appears to have been actively maintained as a cleared area.

Haul roads were established for accessing timber removal in the early 1980's. There are four culverts located along the main access road within the cleared area: one in Wolf Creek, two in Moccasin Creek, and one in an unnamed tributary west of Moccasin Creek (referred to as S3). One additional pipe was placed at a crossing along the east side of the property during the construction of haul roads on an additional unnamed tributary (referred to as S2).

Aerial photographs were reviewed at the Wake County Soil and Water Conservation District office in Raleigh. Aerial photographs from 1954, 1965, and 1971 show the site as entirely wooded. A 1988 photo reveals the clearing that occurred in the early 1980's as a result of logging on the property. The 1993 aerial photo displays the new growth emerging from the replanted areas east of Moccasin Creek as well as braided channels between Moccasin Creek and Wolf Creek in the area that was not re-vegetated. In addition below the confluence with Beaverdam Creek overflow channels in the floodplain are also evident. The remnants of these wide shallow channels are present in the current site topography.

Beavers were a problem to the previous owner after the land was cleared of timber. A professional trapper informed the previous owner that beavers were most likely moving down from a large wetland located on Beaverdam Creek just west of NC 39. It was the owners understanding that the upstream property owner did not do any trapping, allowing the beavers to proliferate. The beavers migrated downstream to Moccasin Creek after the timber harvesting conducted in the 1980's. At one point beaver dams created a very broad, shallow, large pond on the property, which extended upstream from the confluence of Beaverdam and Moccasin Creeks to the property line. The previous owner routinely removed the dams and beaver trapping was performed every other year.

1.2 PROJECT DESCRIPTION

The project involves 1) wetland restoration, enhancement, and preservation, 2) stream restoration, and 3) riparian buffer restoration and preservation. Wetland restoration of approximately 0.41 acres of the wetlands will be accomplished with the removal of approximately 500 linear feet of existing road bed material. Wetland enhancement will include planting of previously cleared wetlands and plugging of selected ditches. Wetland preservation will incorporate all remaining wetlands not proposed for riparian buffer preservation. Stream restoration includes the removal of five culverts and the restoration of stream dimensions at Moccasin Creek, Wolf Creek, S1, S2, and S3. Riparian buffer restoration will entail re-planting buffers within the cleared area, and haul roads. Riparian buffer preservation will be accomplished by protecting the remaining wooded buffers along the jurisdictional streams.

The project will restore, enhance, and preserve many wetland functions and values, stabilizing and preserving streams throughout the site. These activities, coupled with the riparian buffer restoration, will improve the water quality of Moccasin Creek, its tributaries: Wolf Creek, Beaverdam Creek, and the three unnamed tributaries, and the Neuse River Basin.

1.3 GOALS AND OBJECTIVES

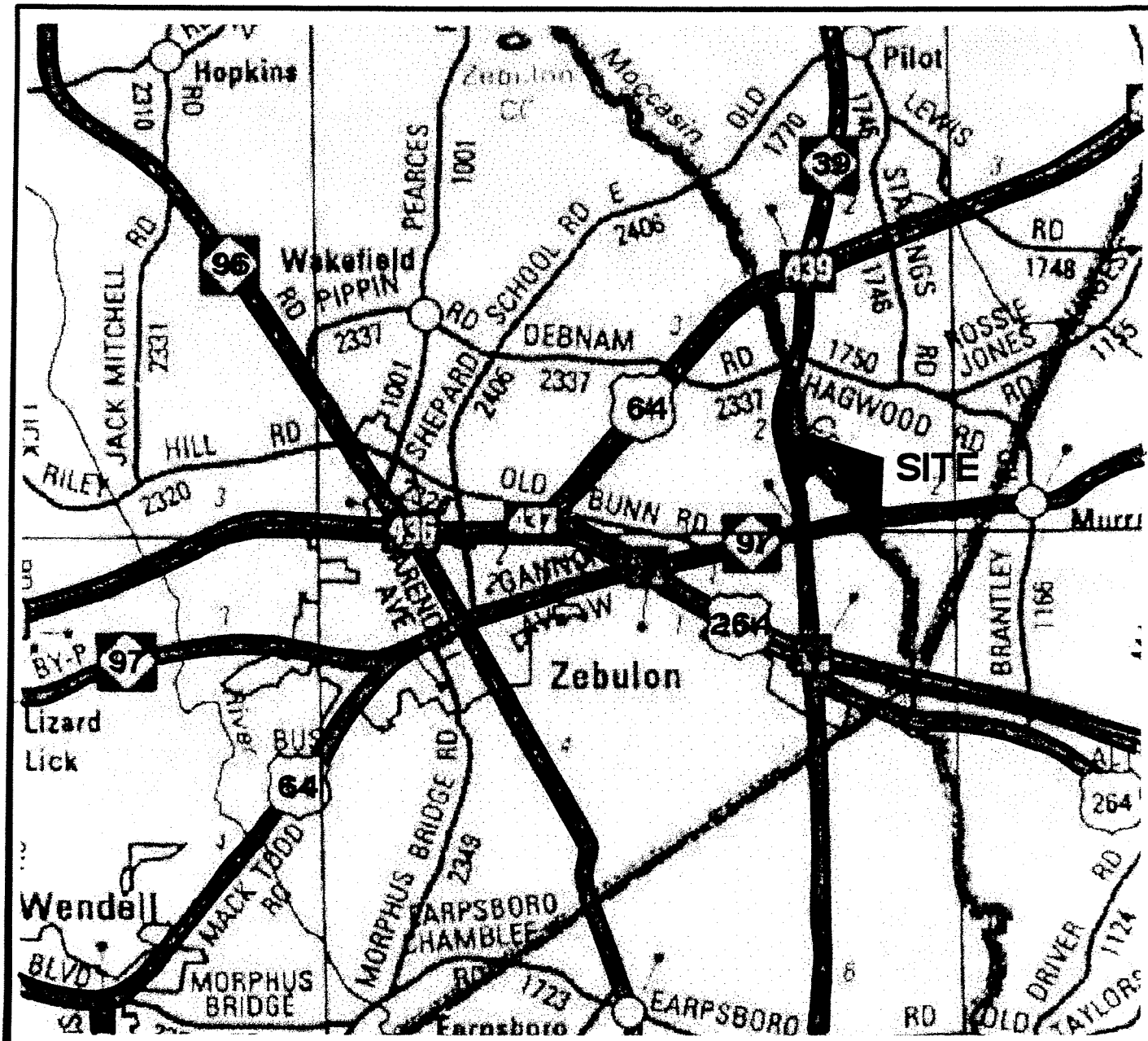
The goals and objectives of this restoration project are to improve water quality in Moccasin Creek and in the Neuse River Basin by:

1. Providing 0.42 acres of wetland restoration.
2. Wetland Enhancement of 5.3 acres of wetlands.
3. Preservation of 39.7 acres of wetlands.
4. Restoration of approximately 180 linear feet of stream.
5. Providing 3.7 acres of riparian buffer restoration along Moccasin Creek, Wolf Creek, S1, S2, and S3.
6. Preservation of 14.4 acres of riparian buffer along Moccasin Creek, Beaverdam Creek, and unnamed tributaries on the property.

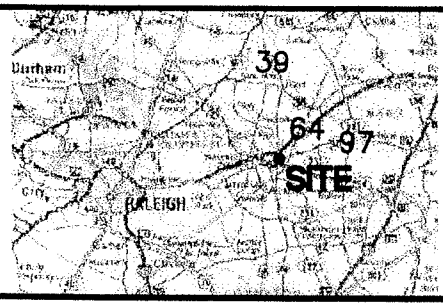
The acreages are approximate values that will be finalized following site construction and discussions with the state as to the restoration needs for the drainage basin. (i.e. reducing riparian buffer restoration and increasing wetland enhancement.)

2.0 LOCATION INFORMATION

The project property is located on NC 39 approximately 0.6 miles north of the intersection of NC 39 and NC 79 in Wake County (Figure 1). A gated, gravel road off NC 39 accesses the property (Latitude 35°50'33" and Longitude 78°16'17", Figure 2). Moccasin Creek runs through the northern one-third of the project site and forms the western property boundary below the intersection of Moccasin and Beaverdam Creeks. Within the site, Moccasin Creek forms the county line between Franklin and Wake counties. The nearest municipality to the site is the town of Zebulon.



Map Source: ADC North Carolina State Road Atlas



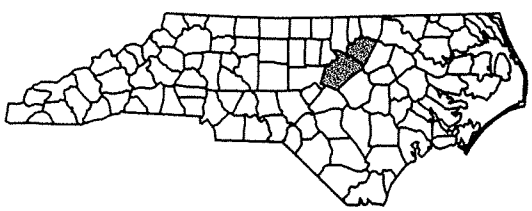


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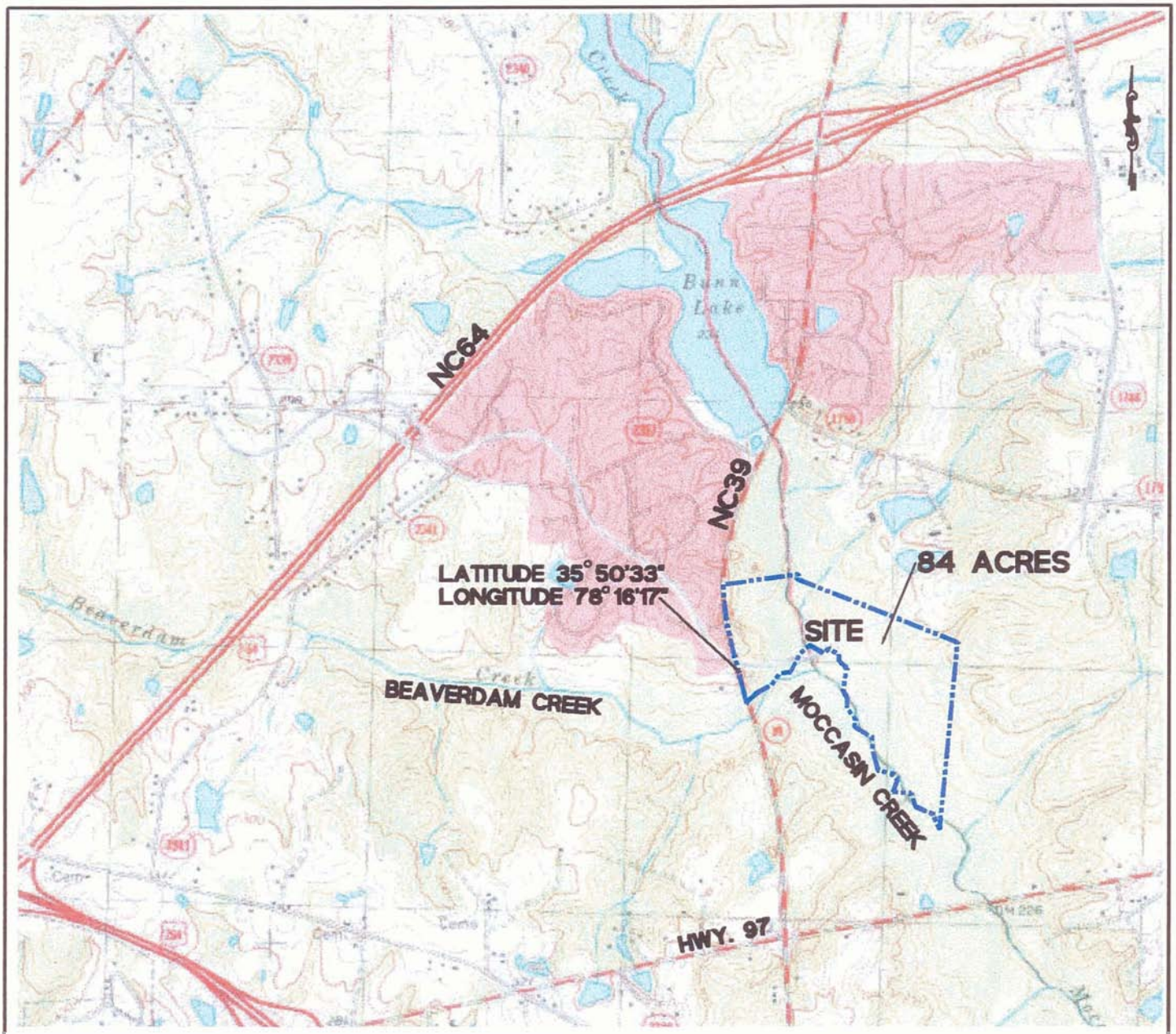
FIGURE 1

SITE LOCATION MAP A

600 300 0 600 1200

SCALE IN FEET



Map Sources: Zebulon, NC Quadrangle, 1999

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FIGURE 2

SITE LOCATION MAP B

2000 1000 0 2000 4000

SCALE IN FEET

3.0 GENERAL WATERSHED INFORMATION

The Moccasin Creek Site is located in the headwaters of the Neuse River Basin. Moccasin Creek is an E type sand bed stream (Rosgen, 1996) located in the 03020201 Hydrologic Unit as listed in the USDA Soil Conservation Service North Carolina Hydrologic Unit Study, September 1994. Moccasin Creek flows into the Buckhorn Reservoir in Wilson County where it becomes Contentnea Creek, which then flows into the Neuse River at the Pitt-Craven County line. The watershed above the confluence of Moccasin and Beaverdam Creeks is approximately 20.4 square miles (Figure 3). Ninety-five percent of the watershed flows into Bunn Lake, which is located approximately 2,500 feet above the project site on Moccasin Creek. A weir outflow controls Bunn Lake's water surface elevation. Storm events are accommodated over this same weir system.

Franklin and Wake Counties approximately split the watershed north to south. The watershed is primarily rural, zoned for single-family residential use, with farming as the predominant land use. However, it is anticipated with the development of the Highway 540 outer loop that future land use will be converted into suburban land uses, particularly on the Wake County side of the watershed.

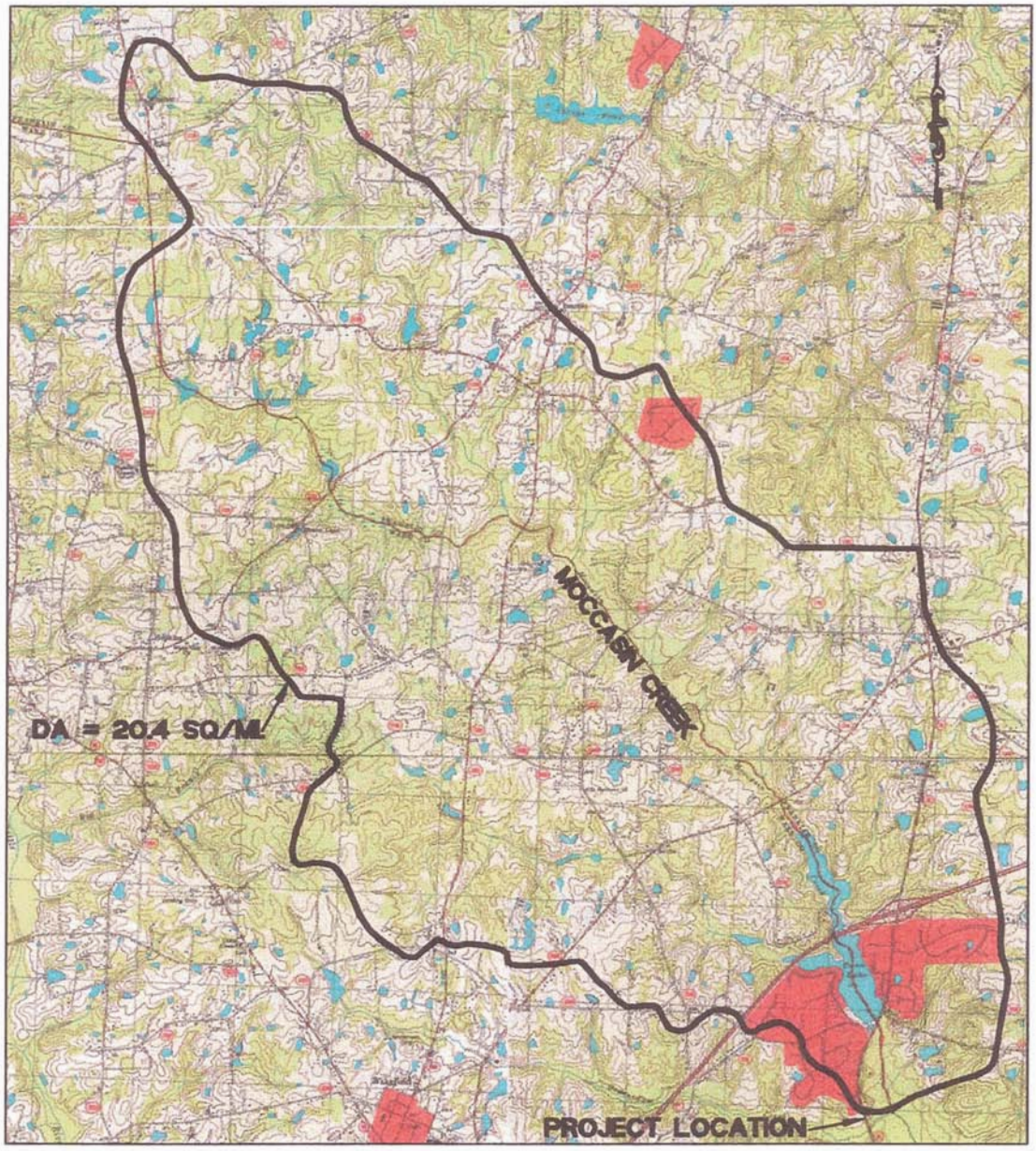
4.0 DESCRIPTION OF EXISITING WETLANDS

The existing jurisdictional wetlands consist of bottomland swamp hardwoods in various stages of succession, freashwater marsh, and pine plantation, encompassing approximately 65 acres of the 84-acre site. On-site wetland functions are directly related to the landscape setting and hydrologic attributes. The characteristic hydroperiod (Cowardin et al. 1979) of these wetland types is semipermanently flooded, but varies to seasonally saturated in areas with relatively higher landscape position. The fluctuating hydroperiod promotes alternating cycles of aerobic and anaerobic soil conditions and increases the potential primary productivity, organic matter decomposition, nutrient mineralization, and denitrification functions.

Seasonally saturated wetlands are usually located at relatively higher microtopographic positions and exhibit high subsurface water storage functions. Depressional wetlands located at relatively low landscape positions generally exhibit high floodflow retention functions. The high degree of microrelief in both hydrologic regimes promotes retention of surface flow/upland runoff and increases the sediment trapping functions within the wetlands. The short-term surface water retention also results in increased contact time between organic matter and surface water, and increased carbon export functions. (Schafale and Weakley, 1990)

4.1 EXISTING HYDROLOGICAL FEATURES

Based on USGS topographic maps, there are two named streams on the site, Beaverdam Creek, and Moccasin Creek. The name of Wolf Creek was provided by the former property owner and was not found referenced on any available map. Wolf and Beaverdam Creeks



Map Sources: Bunn West, NC Quadrangle, 1998
Zebulon, NC Quadrangle, 1999

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FIGURE 3

WATERSHED MAP

6000 3000 0 6000 12000

SCALE IN FEET

converge with Moccasin within the project site. Three additional unnamed tributaries were identified on the property during the field review,these being named S1, S2, and S3 (Figure 4) Stream S3 was also mapped in the NRCS Soil Survey for Wake County. All three of these streams converge with Moccasin Creek within the project site.

The site hydrology is derived from precipitation and over bank flooding from Moccasin Creek, which collects in the wetlands during storm events. The hydrology has been altered by beavers that have constructed a series of dams throughout the project area, significantly increasing the duration of inundation and saturation in the wetlands. This increased inundation has resulted in the formation of a number of drainage ways and braided overflow channels throughout the wetlands.

In addition to streams, there were several ditches identified on the project site (Figure 4). In some cases, it was difficult to determine if these were manmade ditches or were formed as a result of the beaver activities. Nevertheless, they were not determined to be jurisdictional stream features.

4.2 SOILS

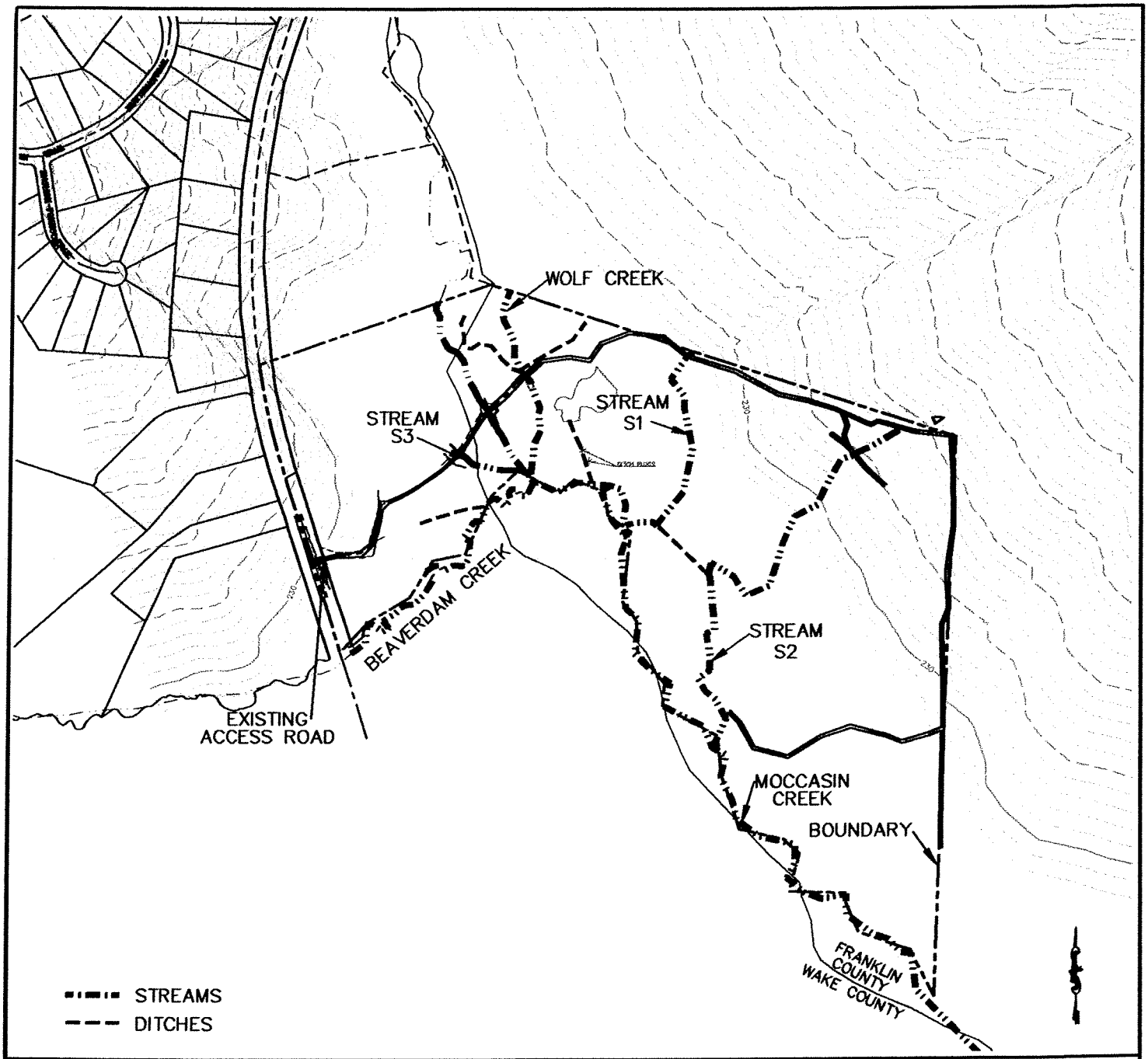
Project success is dependent on the presence of hydric soils and wetland hydrology within the wetland areas. Three major Soil Units were identified within the property and are shown in Figure 5 and are summarized in Table 4.2.1.

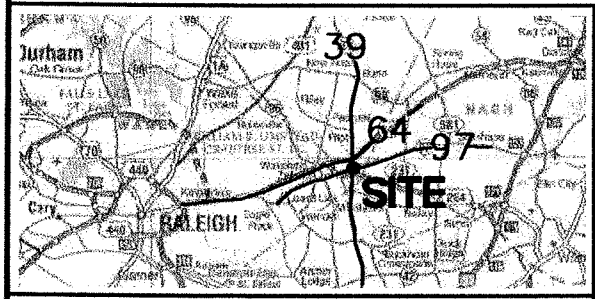
In order to characterize soils, a series of hand auger borings were conducted throughout the site to depths ranging from 24 to 60 inches. The depth, color, texture, structure, consistence of the soil material within each of the horizons, and the depth to groundwater were determined for each boring. These site-specific characteristics were compared to NRCS soils mapping.

The auger borings confirmed that NRCS soils mapped for the site are mostly accurate. Soils located in wetlands were hydric and closely associated with the Wehadkee soil series. Wetland soils within the Wake County portion of the site are mapped as Chewacla soils by NRCS, however these soils more closely resemble Wehadkee soils and are included with Soil Unit 1. This soil typically derives from deep, poorly drained material that washes from higher, better-drained soils and is deposited in strips on first bottoms of floodplains. The surface soils are usually of low chroma loams and have subsurface layers of gray to mottled brownish clays.

As previously noted, the main logging road is comprised of fill material placed on top of Soil Unit 1. The fill material is a reddish (5YR 4/6) clayey material deposited over a 0.5- acre section at depths varying from 0.5 feet to over 2 feet.

Soils within upland areas are most similar to Georgeville and Wedowee. The Georgeville series (Soil Unit 2) consists of very deep, well-drained, moderately permeable soils on gently sloping to moderately steep Piedmont uplands. The surface horizons consist of loam to silt loam and the lower horizons consist of clayey materials. The Wedowee





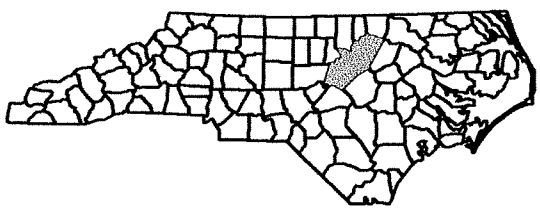


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FIGURE 4

HYDROLOGIC FEATURES

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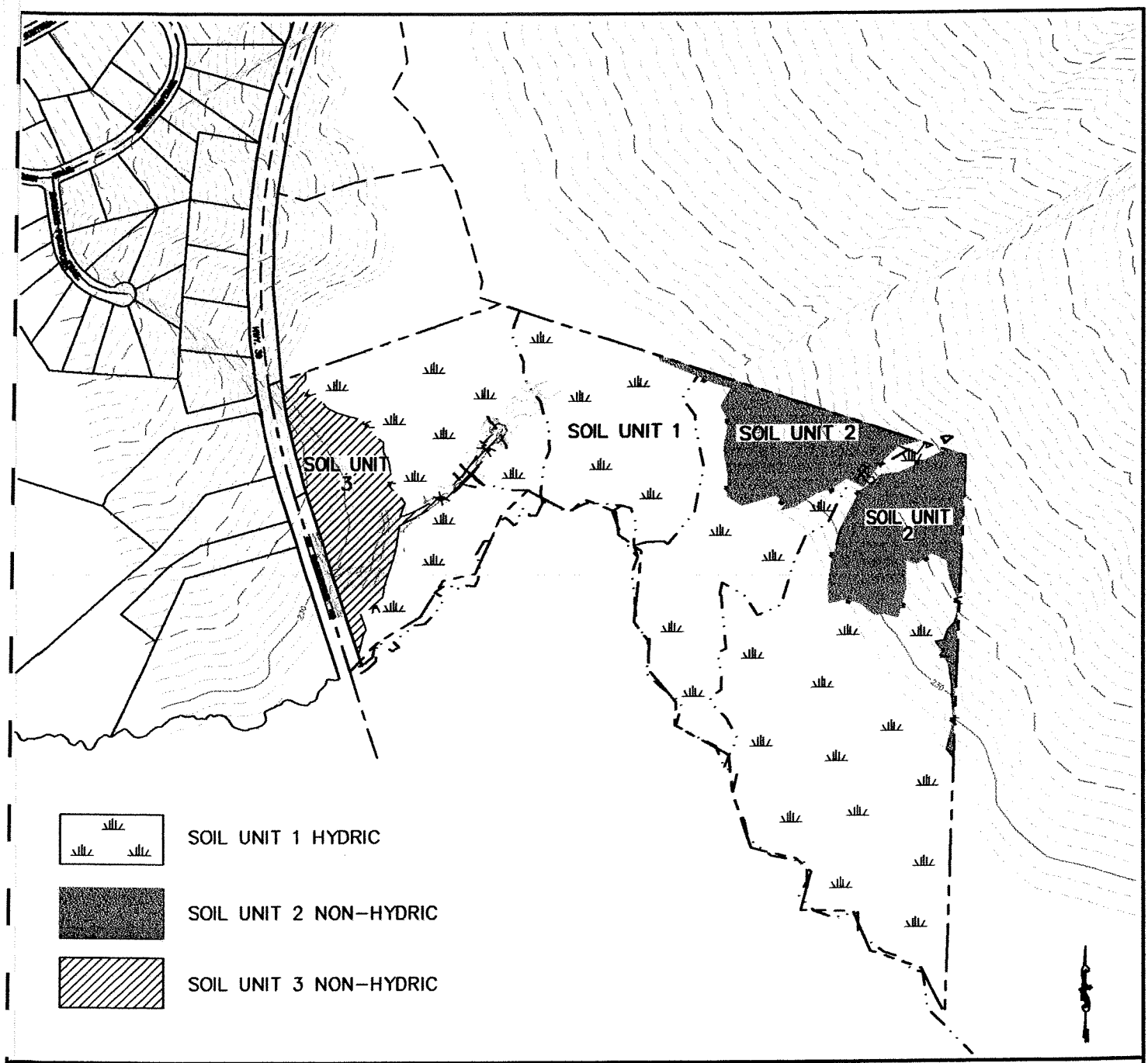
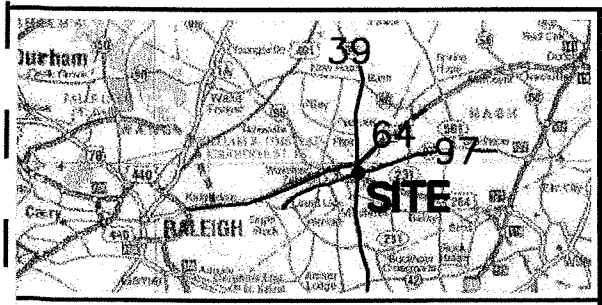
SCALE IN FEET





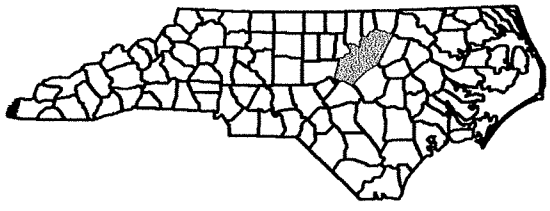


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FIGURE 5

SOILS MAP

600 300 0 600 1200

SCALE IN FEET

series (Soil Unit 3) consists of very deep, well-drained, moderately permeable soils that formed in residuum from weathered crystalline rock of the Piedmont Plateau. These soils are on narrow ridges and on side slopes of uplands. The surface horizon is sandy loam and subsurface horizons are loamy to clayey. Representative soil profiles for the different Soil Units are provided below. In addition, a summary of the Soil Units, associated mapping units, their hydric status and depth and duration of water table is shown in Table 4.2.1.

Horizon Name	Depth	Soil Color*	Textures
Soil Unit 1:			
A	0-4	10YR 4/2	loamy sand
Bg1	4-12	10 YR 5/1	silty clay loam
Bg2	12-30	10 YR 6/1	sandy clay loam
BCg	30-36	10 YR 7/1	fine sandy clay loam
Cg	36-48+	10YR 7/1	sandy loam
Soil Unit 2:			
Ap	0-8	10 YR 4/3	silt loam
E	8-13	2.5Y 6/4	loamy sand
Bt	13-40	7.5 YR 5/8	clay
BC	40-48+	2.5YR 4/6	silty clay loam w/ prominent 7.5YR 6/8 & 10YR 4/6 mottles
Soil Unit 3:			
Ap	0-6	10YR 4/3	sandy loam
B	6-14	10 YR 6/4	sandy clay loam
Bt	14-28	7.5 YR 5/6	clay loam
BC	28-34	7.5 YR 5/6	sandy clay loam
C	34-48+	mottled red and brownish –yellow sandy clay loam	

*Munsell moist soil color notation

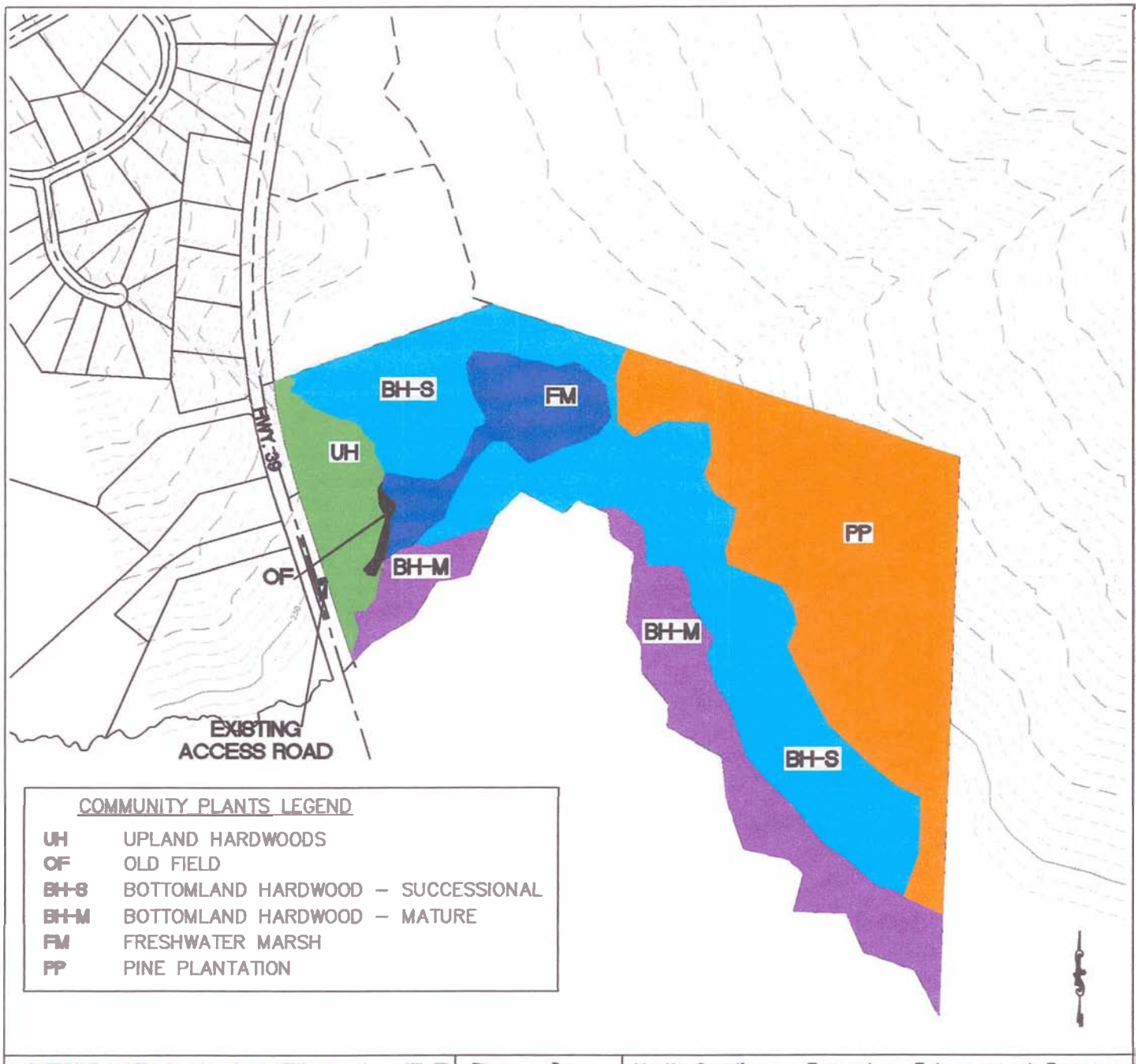
Table 4.2.1 – Summary of Soil Units

Soil Unit	Soil Type (most similar)	Soil Subgroup	Hydric Status[a]	Depth and Duration of High Water Table[b]	Estimated Extent %
1	Wehadkee	Fluvaquentic Endoaquepts	Hydric	0-8 inches	77
2	Georgeville	Typic Kanhapludults	Non-hydric	60+	11
3	Wedowee	Typic Kanhapludults	Non-hydric	60+	12

[a] Hydric soils list for North Carolina
[b] Based on soil taxonomy for undrained conditions

4.3 EXISITNG PLANT COMMUNITIES

The existing plant communities within the project site (Figure 6) are representative of both natural communities and communities resulting from human disturbance. Approximately 86 percent (56 acres) of the tract is currently forested while the remaining 14 percent (8.8 acres)



COMMUNITY PLANTS LEGEND

UH	UPLAND HARDWOODS
OF	OLD FIELD
BH-S	BOTTOMLAND HARDWOOD – SUCCESSIONAL
BH-M	BOTTOMLAND HARDWOOD – MATURE
FM	FRESHWATER MARSH
PP	PINE PLANTATION

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FIGURE 6

EXISTING PLANT COMMUNITIES

600 300 0 600 1200

SCALE IN FEET

is open, emergent marsh. Forested areas include bottomland hardwood forest in various stages of succession and loblolly pine plantation. The emergent marsh is attributable to both human activities and the beaver dams discussed previously. Descriptions of plant community types are included in Table 4.3.1 and a summary of each community is provided below.

Table 4.3.1: Summary of Existing Plant Communities and Wetland Types

Plant community description[a]	Estimated Area	Upland / Wetland	Activity
Pine Plantation – Within Jurisdictional Wetland	15.8	Riverine Wetland	Preservation
Pine Plantation - Non-Wetland	13.7	Upland	Preservation
Freshwater Marsh	5.2	Riverine Wetland	Enhancement
Bottomland Hardwood – Successional (Riverine)	30.3	Riverine Wetland	Preservation
Bottomland Hardwood – Mature (Riverine)	11.8	Riverine Wetland	Preservation
Upland Hardwoods	6.5	Upland	Preservation
Old Field	0.13	Upland	Preservation
Disturbed – Road Creation	0.42	Upland – Restore to Riverine Wetland	Restoration

[a]follows principles of Schafale and Weakley (1990);

Pine Plantation

Planted loblolly pine (*Pinus taeda*) occurs within upland and wetland areas in the eastern one-third portion of the property. The stand is approximately 15-20 years of age and some pre-commercial thinning has occurred. The dense understory consits of common greenbriar (*Smilax rotundifolia*), sweetgum (*Liquidambar styraciflua*), and sourwood (*Oxydendron arboreum*). Portions of this community also support tree species such as river birch (*Betula nigra*), hazel alder (*Alnus serrulata*), wax myrtle (*Morella cerifera*), and ironwood (*Carpinus caroliniana*).

Freshwater Marsh

Freshwater marsh occurs in the logged areas of the Moccasin Creek floodplain that remain unplanted and where woody vegetation has not succeeded beyond heights of 3 feet; herbaceous and emergent vegetation are dominant. The hydrologic regime is seasonally to semipermantly flooded, in part due to beaver damming activities.

Dominant plant species are bur marigold (*Bidens* sp.), marsh mallow (*Hibiscus* sp.), tearthumb (*Polygonum sagittatum*), smartweed (*Polygonum* sp.), softrush (*Juncus effuses*), rice cutgrass (*Leersia oryzoides*), plume grass (*Saccharum* sp.), and climbing hempweed (*Mikania scandens*).

Bottomland Swamp Hardwood (BSH) Wetlands

The geomorphic description of a BSH wetland is a depressional, low-gradient, precipitation, and vertically fluctuating setting. The inundation is continuous during the cool season from precipitation and low evapotranspiration (ET). These wetland areas provide good conditions for fluctuating water tables and are conducive to rapid biogeochemical cycling and strong atmospheric exchanges. As a nutrient trap, food web support is strong and reducing conditions strongly favor Obligate and Facultative Wet plant species. Qualitative evidence of inundation is supported by muck soils and amphibian breeding, which indicate prolonged anaerobiosis and ponding. These areas provide significant functions for groundwater storage and for depressional wetland community development (Schafale and Weakley 1990).

The BSH swales and sloughs are more frequently inundated and remain flooded for a major portion of the growing season. The soils in the BSH habitats are dominantly anaerobic and tend to accumulate organic detritus in addition to silt and clay particles. Based on vegetation, two types of BSH wetlands are located on the site – successional and mature.

BSH - Successional

This area occurs along a majority of the Moccasin Creek floodplain where logging has taken place within the past 15 years. These areas are seasonally to semipermanently flooded, partially due to beaver dam activities. Young woody trees and shrubs including swamp tupelo (*Nyssa biflora*), red maple (*Acer rubrum*), river birch, tulip poplar (*Liriodendron tulipifera*), ironwood, hazel alder, and blackhaw (*Viburnum nudum*) occur in dense clumps. The stand is interspersed with clearings and backwater sloughs dominated by emergents such as smartweed, marsh mallow, arrowhead (*Sagittaria* sp.), false nettle (*Boehmeria cylindrica*), and lizard's tail (*Saururus cernuus*).

BSH – Mature

Mature bottomland hardwoods occur in a wide belt along the western property and within the floodplain west of Moccasin Creek. This area is seasonally or intermittently flooded and supports a mature canopy of typical bottomland hardwood tree species. There are numerous tree gaps and some logging roads present, indicating past thinning practices. Tree species include American elm (*Ulmus americana*), red maple, sweetgum, swamp chestnut oak (*Quercus michauxii*), cherrybark oak (*Q. pagoda*), river birch, loblolly pine, American holly (*Ilex opaca*), and swamp tupelo. The shrub and vine layer is extremely dense and dominated by Chinese privet (*Ligustrum sinense*); other shrub and vine species present are deciduous holly (*Ilex decidua*), highbush blueberry (*Vaccinium corymbosum*), common greenbriar, and giant cane (*Arundinaria gigantea*).

Upland Hardwoods

Upland hardwoods occur on the western side slopes of the Moccasin Creek floodplain adjacent to NC 39. The plant community is a mature oak-hickory forest intermixed with occasional loblolly pines. Soils are dry at top to mid slope, but become mesic at the slope base adjacent to the bottomland hardwoods. Dominant tree and shrub species are white oak (*Quercus alba*), northern red oak (*Q. rubra*), pignut hickory (*Carya glabra*), mockernut

hickory (*C. tomentosa*), tulip poplar, American holly, sourwood, red mulberry (*Morus rubra*), and American dogwood (*Cornus florida*).

Old Field
Old field is represented by a small cleared area of upland soils adjacent the freshwater marsh. This area was probably used as a staging area for logging and likely is supported by fill material used in construction of the central access road. Early successional species such as broomsedge (*Andropogon virginica*), bur marigold, lespedeza (*Lespedeza* sp.), and frost aster (*Aster pilosus*) dominate the clearing.

4.4 ENDANGERED & THREATENED SPECIES

Federally Threatened and Endangered species are protected under the Endangered Species Act (ESA) of 1973. Many species have become endangered, threatened, or are species of concern primarily due to land use changes and related habitat fragmentation. Environmental degradation of natural resources has also contributed to the decline of numerous species. There are five Threatened/Endangered species listed by the U.S. Fish and Wildlife Service as occurring in Wake and Franklin counties. These species are listed in Table 4.4.1. A brief description of each of these species and the surveying efforts are provided below.

Table 4.4.1 Federal Threatened and Endangered Species Listed for the Project Area

Common Name	Scientific Name	Status
Red-Cockaded Woodpecker	(*Picoides borealis*)	Endangered
Bald Eagle	(*Haliaeetus leucocephalus*)	Threatened
Michaux Sumac	(*Rhus michauxii*)	Endangered
Tar Spinymussel	(*Elliptio steinstansana*)	Endangered
Dwarf Wedge Mussel	(*Alasmidonta heterodon*).	Endangered

Bald Eagle (*Haliaeetus leucocephalus*) - Threatened
The bald eagle is a large raptor. The characteristic adult plumage consists of a white head and tail with a dark brown body. Juvenile eagles are completely dark brown and do not fully develop the majestic white head and tail until the fifth or sixth year. Fish are the primary food source but bald eagles will also take a variety of birds, mammals, and turtles (both live and as carrion) when fish are not readily available. Adults average about three feet from head to tail, weigh approximately 10 to 12 pounds and have a wingspread that can reach seven feet. Generally, female bald eagles are somewhat larger than the males.

No bald eagles were observed during the field surveys. No large bodies of water with suitable nest trees or perch trees occur on the site. Therefore no impacts to bald eagles are expected as a result of project activities.

Red-cockaded woodpecker (*Picoides borealis*) – Endangered
About the size of the common cardinal, the red-cockaded woodpecker (RCW) is approximately 7 inches long with a wingspan of about 15 inches. Its back is barred with

black and white horizontal stripes. The red-cockaded woodpecker's most distinguishing feature is a black cap and nape that encircle large white cheek patches.

This bird's range is closely tied to the distribution of southern pines. Historically, the red-cockaded woodpecker occurred from Texas and Oklahoma east to Florida and north to New Jersey. The present distribution is similar, except the species has been extirpated from Missouri, Maryland, and New Jersey.

The red-cockaded woodpecker makes its home in mature pine forests. Longleaf pines (*Pinus palustris*) are most commonly preferred, but other species of southern pine are also acceptable. While other woodpeckers bore out cavities in dead trees where the wood is rotten and soft, the red-cockaded woodpecker is the only one that excavates cavities exclusively in living pine trees.

No RCW were observed during the field visit. While pine trees do exist, the planted trees are too young to be suitable for nest sites and the understory is too dense to be favored as foraging habitat. Therefore, no impacts to RCW are expected by project activities.

Michaux's sumac (*Rhus michauxii*) - Endangered
Michaux's sumac is a rhizomatous, densely hairy shrub, with erect stems from 1 to 3 feet in height. The compound leaves contain evenly serrated, oblong to lanceolate, acuminate leaflets. Most plants are unisexual; however, more recent observations have revealed plants with both male and female flowers on one plant. The flowers are small, borne in a terminal, erect, dense cluster, and colored greenish yellow to white. Flowering usually occurs from June to July , and the fruit, a red drupe,, is produced through the months of August to October.

Michaux's sumac grows in sandy or rocky open woods in association with basic soils. Apparently, this plant survives best in areas where some form of disturbance has provided an open area. At least twelve of the plant's populations in North Carolina are on highway rights-of way, roadsides, or on the edges of artificially maintained clearings. Two other populations are in areas with periodic fires, and two populations exist on sites undergoing natural succession. One population is situated in a natural opening on the rim of a Carolina bay.

Suitable habitat for Michaux's sumac does not occur on the project site. Therefore, no impacts to the species are expected by project activities.

Tar spinymussel (*Elliptio steinstansana*) - Endangered
The Tar spinymussel, one of only three freshwater mussels in the world with spines, is a medium-sized mussel reaching about 2.5 inches in length. In young specimens, the shell's outer surface (periostracum) is an orange-brown color with greenish rays; adults are darker with inconspicuous rays.

Two relatively good populations are known to exist in two tributaries of the Tar River. They have also been occasionally found in the main stem of the Tar River and another tributary. However, individuals are becoming harder to find. This species typically inhabits larger streams with constant flow. Streams of the project site to not provide preferred habitat for

Tar spinymussel, and surveys conducted for this project did not locate detect the species. Therefore, this project is not expected to impact Tar spinymussel.

Dwarf-wedge mussel (*Alasmidonta heterodon*) - Endangered
The dwarf-wedge mussel is relatively small, rarely exceeding 1.5 inches in length. The shell's outer surface (periostracum) is usually brown or yellowish brown in color, with faint green rays that are most noticeable in young specimens. Unlike some mussel species, the male and female shells differ slightly, with the female being wider to allow greater space for egg development. A distinguishing characteristic of this mussel is its dentition pattern; the right valve possesses two lateral teeth, while the left valve has only one. This trait is opposite of all other North American species having lateral teeth (Clark 1981).

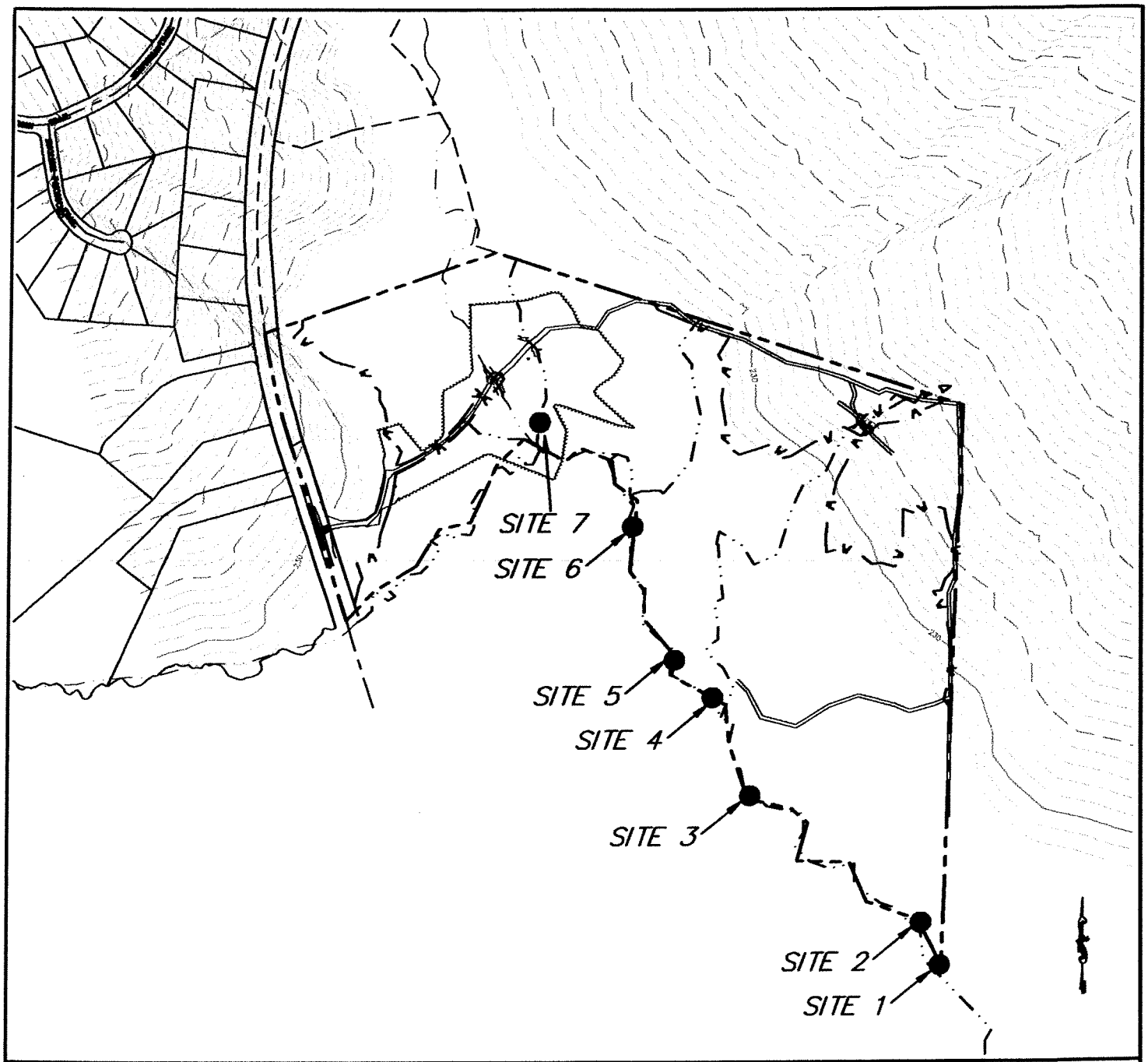
The dwarf-wedge mussel inhabits creeks and rivers with slow to moderate current and a sand, gravel, or muddy bottom. Toxic effects from industrial, domestic and agricultural pollution are the primary threats to this mussel's survival. The dwarf-wedge was not found during surveys for this project. The details of the mussel survey are included in Section 4.5.

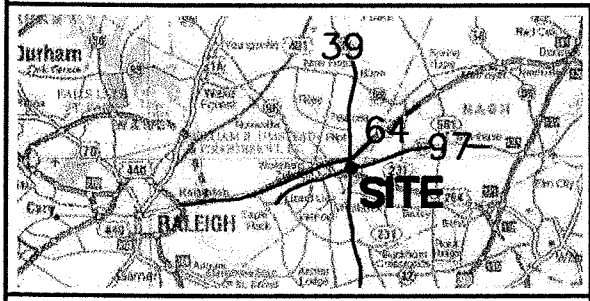
Other Wildlife
This site is especially interesting in terms of wildlife because it is contiguous with large areas of natural bottomland hardwoods and open freshwater marsh. Thus it supports a number of whitetail deer, herons and other migratory birds, river otters, beavers, raccoons, etc. In addition, a rich population of mussels occurs in the southernmost sections of Moccasin Creek with the project site boundary (see Section 4.5). Restoration of this site to natural conditions is expected to enhance wildlife abundance and diversity.

4.5 MUSSEL SURVEY RESULTS

The federally endangered dwarf-wedge mussel (*Alasmidonta heterodon*) is listed by the US Fish and Wildlife Service (USFWS) as occurring in Wake and Franklin counties and is documented as occurring in Moccasin Creek downstream of the project. Recent surveys have extended the range of dwarf-wedge upstream to approximately 3 river miles below the end of the project area. Potential habitat for the dwarf-wedge mussel exists in Moccasin Creek throughout the project area; therefore surveys for this and other freshwater mussel species were conducted within the confines of the project site.

Methodology and Results
Mussel surveys were conducted on two separate dates by members of The Catena Group; on October 20, 2004 by Michael Wood and Sharon Snider and on October 24, 2004 by Michael Wood and Steve Melin. Mussel survey limits were from the property's southern boundary upstream to the access road. Visual (using batiscopes) and tactile methods were used to survey for mussels. Water clarity was good during the site visit. A total of seven sites were surveyed, each chosen by appearance of suitable habitat; distance between sites varied from 300 to 800 feet (Figure 7). Water level ranged from less than 6 inches in riffles to over 2 feet in pooled areas. Survey results, including the catch per unit effort (CPUE), are presented in Table 4.4.2.





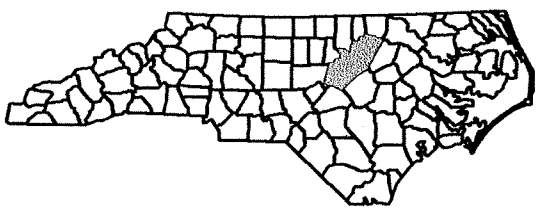


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FIGURE 7

MUSSEL SURVEY LOCATIONS

600 300 0 600 1200

SCALE IN FEET

Table 4.4.2 Freshwater Mussel Survey Results, Moccasin Creek Site

Site	Person hours	*Elliptio* spp. Total/CPUE	*Elliptio* sp. (lance-form) Total/CPUE	*Utterbackia imbecellis* Total/CPUE
1 (property edge)	1.33	220 / 165	0	0 / 0
2	1.0	500+ / 500+	2 / 2	0 / 0
3	0.3	23 / 77	0 / 0	0 / 0
4	1.5	67 / 45	1 / 0.7	0 / 0
5	1.0	66 / 66	0 / 0	0 / 0
6	0.5	46 / 94	1 / 2	0 / 0
7 (~ 1000' downstream from access road)	1.0	90 / 90	0 / 0	2 / 2

Discussion

While still geographically located in the Piedmont region of the state, the stream in the surveyed reach possesses many qualities more commonly associated with coastal plain topographies: low banks and sand-dominated substrate supporting large numbers of *Elliptio* species. In fact, the most dominant elliptio species form was *Elliptio cistelliformis*, which is most commonly found in coastal plain streams.

At the property's edge (Sites 1 & 2), the substrate becomes predominantly gravel, providing excellent freshwater mussel habitat as evidenced by the abundance of mussels located there. In addition to Moccasin Creek, cursory surveys of Beaverdam Creek also found a healthy elliptio population. An introduced species, the Asian clam (*Corbicula fluminea*) was also abundant throughout the surveyed stretch. Although suitable habitat for the dwarf-wedge mussel exists in Moccasin Creek within the project boundaries, the species was not detected during the surveys. Therefore, it is concluded that restoration activities in Moccasin Creek and the associated tributaries will not adversely affect dwarf-wedge mussel.

The Moccasin Creek Project Site offers an excellent opportunity to help ensure high water quality in a water body supporting a federally Endangered species. As previously noted, 95% of the watershed above the site enters Bunn Lake. Whatever washes down from Bunn Lake drains through project site. The active floodplain and wetlands in the project site undoubtedly maintains and improves the water quality, which in turn supports the dwarf-wedge mussel. While the mussel seems to be expanding its range upstream, the extent of this expansion has not been determined. However, the Moccasin Creek Restoration Site should be considered a project that is preserving and improving habitat for an endangered species.

5.0 DESCRIPTION OF EXISTING STREAMS

Three named streams and three unnamed streams are located on the project site (Figure 4). Moccasin Creek, the main drainage feature, is a perennial stream and enters the property through the northern property line, travels south to bisect the upper one-third of the property, and then becomes the western property line below Beaverdam Creek. The overall length within the project site is approximately 3,600 feet. Moccasin Creek is a stable E type sand bed channel. A wooded buffer exists along most of the stream length except in the cleared,

wetland marsh area. Moccasin Creek has been impacted by two culverts, a 72-inch corrugated metal pipe (CMP) and a 24-inch CMP, that were placed in the stream for the existing access roadway.

Beaverdam Creek is a perennial stream entering the project site from a culvert located under NC 39. Beaverdam Creek forms the southern property boundary until it joins Moccasin Creek approximately 500 feet downstream of the access road. There is an established wooded buffer of mature hardwood trees surrounding Beaverdam Creek for its entire length within the project site.

Wolf Creek is a perennial stream entering the property on the northeastern property boundary. Beaver activity is evident in this area. A specific channel is not evident in the forested sections of the stream due to the extensive flooding; however, the stream is well-formed within the cleared area. Wolf Creek is approximately 850 feet long within the project site and enters Moccasin Creek just downstream of Beaverdam Creek.

The unnamed tributary S1 is at least intermittent and enters the property along the northeast property line. The channel is crossed by a logging haul road just below the property line. The stream above the property is a stable E channel, but the channel within the project site has been impacted from logging practices. The stream has begun to recover by establishing a bed and bank, however there are portions of the stream that still have braided channel segments due to these past impacts.

Unnamed tributary S2 is a perennial stream that enters the project site at the northeast corner of the property. The stream feeds a small pond that was formed with bermed earthen material, and then continues a short distance before being crossed by a haul road. The stream continues flowing southward and is crossed by a second haul road approximately 180 feet downstream of the first crossing where a 15 inch CMP has been placed. This reach of stream has not been disturbed as much as S1 and has a vegetated buffer for its entire length.

The tributary S3 is an intermittent stream beginning downstream of the culvert located in the access roadway (west of the large culverts in Moccasin Creek). The stream flows south approximately 270 feet into Moccasin Creek. This stream is in an area where buffers have almost entirely been removed. The Wake County Soil maps indicate this is a defined stream north of the culvert to the property line, although it was not possible to determine if a defined channel exists upstream due to the presence of standing water.

5.1 SOILS

Soils within the existing stream corridor exhibit characteristics similar to soils grouped in Soil Unit 1. These soils were determined to be most similar to Wehadkee soils, which is a poorly drained series on the floodplains of streams.

5.2 EXISITNG PLANT COMMUNITIES

A summary of the plant communities is detailed in the Table 5.2.1 and stream locations are shown in Figure 4, Hydrologic Features.

Table 5.2.1. Existing Plant Communities Adjacent to Streams

Stream	Location	Vegetation present
Moccasin Creek	Entire length of property	Moccasin Creek is predominately located within bottomland swamp hardwood (BSH) vegetative community. Areas of mature forest contain native hardwood trees including swamp tupelo, red maple, river birch, tulip poplar, swamp chestnut oak, and cherrybark oak. Successional areas (located on the western portions) have increased quantities of blackberry and privet located on the stream corridor. In addition, a portion of the stream is bordered by the emergent freshwater marsh vegetative community, which consists primarily of herbaceous vegetation.
Beaverdam Creek	Runs along south-east corridor of property until confluence with Moccasin Creek	Beaverdam Creek is bordered by mature BSH. Vegetation includes river birch, yellow poplar, swamp chestnut, swamp tupelo, red maple, and sweetgum, However areas of privet are dense near the confluence of Moccasin Creek.
Wolf Creek	West of Moccasin Creek - in freshwater emergent vegetation location	Vegetation closely resembles the freshwater emergent marsh vegetative community. The stream is located almost entirely within this community from the time it enters the property until it reaches the confluence of Moccasin Creek. This area is dominated by herbaceous vegetation previously described in Section 4.3.
S1 (UT)	West of Moccasin Creek – in pine plantation to Moccasin Creek	S1 enters the property in the pine plantation area and merges with Moccasin Creek within the successional BSH location.
S2 (UT)	Northwest property boundary to Moccasin Creek	S2 enters the property within the pine plantation location and its channel is impounded in the NW property corner. After the impoundment the stream flows through the pine plantation and successional BSH communities before entering Moccasin Creek.
S3 (UT)	Starts downstream of first culvert until reaching Moccasin Creek	Vegetation closely resembles the freshwater emergent marsh vegetative community. S3 is located entirely within this community from the first culvert to its confluence of Moccasin Creek. This area is dominated by herbaceous vegetation previously described in Section 4.3.

6.0 STREAM REFERENCE

In this project, all stream restoration will be completed in conjunction with the removal of culverts on the access road, on tributary S1, and on S2. Therefore, Moccasin Creek (directly up and downstream of the area impacted by the culvert) was studied and utilized as the stream reference for the restoration efforts. A classification section was taken approximately 100 feet downstream of the 72- inch culvert in which bankfull was determined. Bankfull cross

sectional areas and flows were calculated and compared to the regional curve data, and the results of the comparison showed that these two parameters were lower than predicted by the regional curve. This is most likely due to the effects of Bunn Lake directly upstream. Since the removal of the culverts will only impact at most 55 feet of any one stream, a comprehensive morphological study was not conducted. Tie in locations for the channel restoration will be identified by stable cross sectional geometry up and downstream within the restoration area. The reconstructed channel within the removed pipe reach will be constructed to the dimensions of these sections.

7.0 REFERENCE WETLAND

The reference wetland is located to the west of Moccasin Creek and is shown in Figure 8. The reference wetland location was established in an undisturbed bottomland swamp hardwood adjacent to Moccasin and Beaverdam creeks and wetland meets 1987 Corps Manual criteria for jurisdictional wetlands. This wetland area was delineated by The Catena Group personnel and will be verified by the U.S. Army Corps of Engineers in December 2004. Monitoring of this reference location will follow guidelines outlined in a later section of this Plan. The target conditions for the restoration will be similar to that of undisturbed bottomland swamp hardwood wetlands as described in Section 7.1.

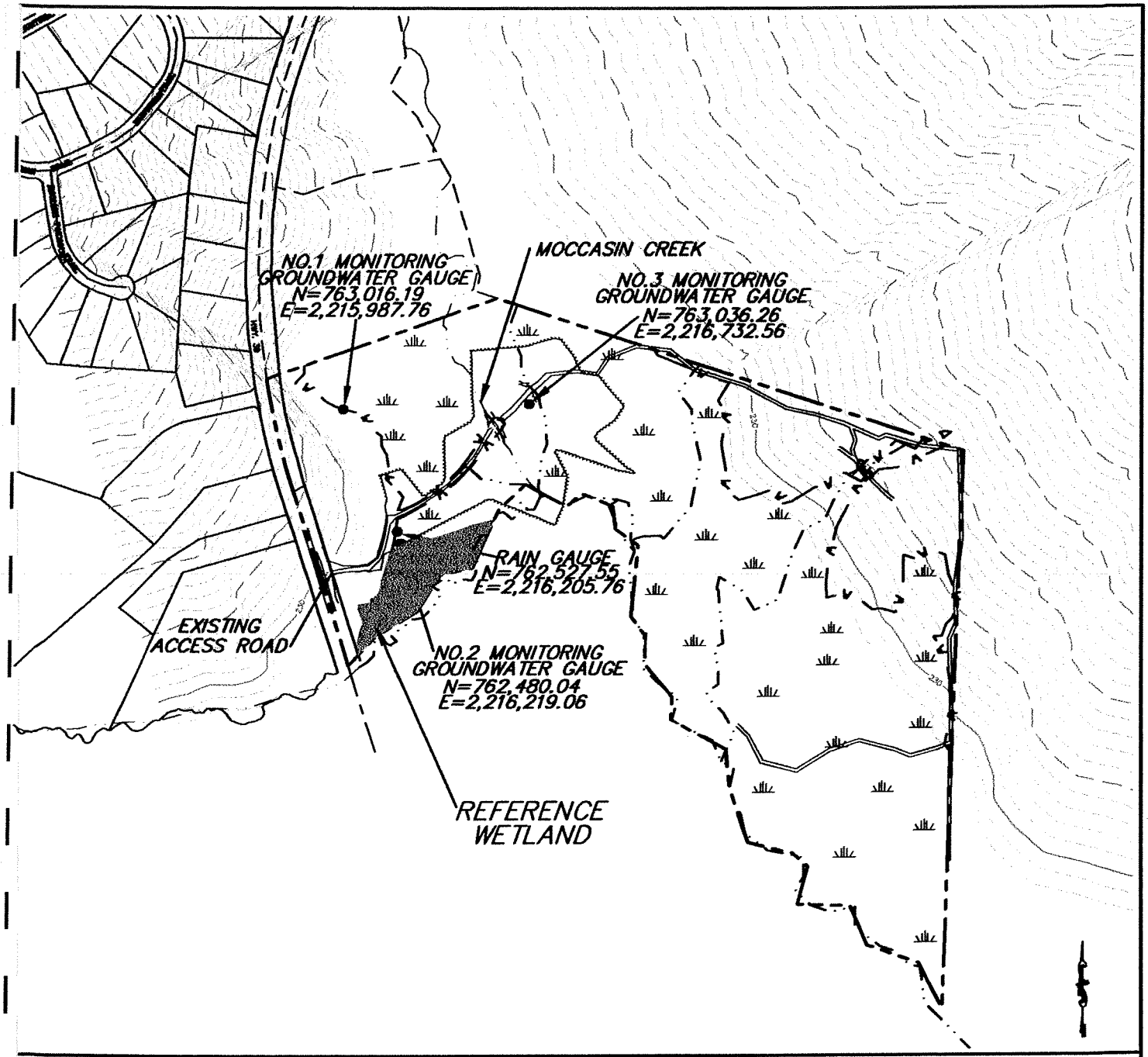
7.1 PLANT COMMUNITY CHARACTERIZATION

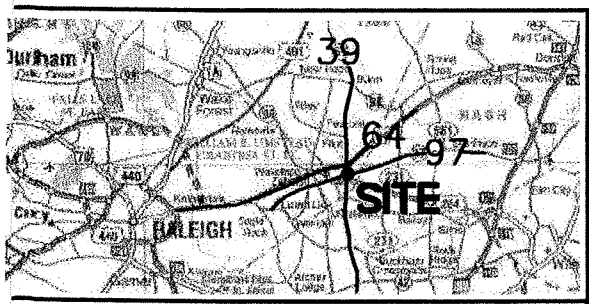
The reference wetland closely resembles the mature bottomland swamp hardwood detailed in Schafale and Weakley (1990). This area is both seasonally and intermittently flooded and supports a mature canopy of typical coastal plain bottomland hardwood tree species. Tree species include American elm, red maple, sweetgum, swamp chestnut oak, cherrybark oak, river birch, loblolly pine, American holly, and swamp tupelo. The shrub and vine species include deciduous holly, highbush blueberry, common greenbriar, and giant cane.

7.2 HYDROLOGICAL CHARACTERIZATION

The hydrology of the reference wetland is principally derived from two sources: precipitation and overbank flooding from Moccasin Creek. Once the wetland floods, the water becomes impounded and slowly recedes until replenished by rainfall or by the next flooding event. Ground water hydrology of the reference wetland was not necessary. However, once construction activities are complete a groundwater-monitoring gauge will be installed.

From field observations throughout September to November 2004, it was noted that the water table was near the soil surface during all site visits. In addition, the soil data indicated a reduced soil matrix (chroma less than 2) throughout its profile, thus indicating the reference area is saturated for extended periods of time during the growing season.





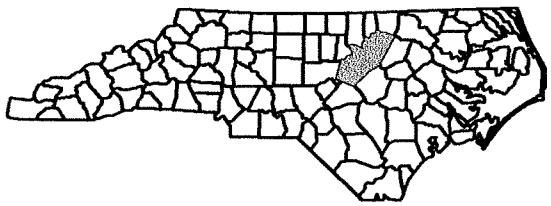


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FIGURE 8

REFERENCE WETLAND LOCATED ON PROJECT SITE

600 300 0 600 1200

SCALE IN FEET

7.3 SOILS CHARACTERIZATION

Soil characterized in the reference wetland was representative of the Wehadkee soil series. This soil is indicative of wetlands, and is an alluvial soil that has a low-chroma matrix of less than 2 throughout its profile. This soil series is identical to the soils located in the freshwater marsh community, which is proposed for proposed wetland enhancement and restoration.

8.0 WETLAND RESTORATION STUDIES

The objective of this wetland restoration portion of the project is to restore the wetlands under the access road, enhance the jurisdictional wetlands in the cleared section, and preserve existing jurisdictional wetlands. In order to detail the current status of the existing wetlands and determine restoration/ enhancement efforts, the following activities were conducted:

- Wetland delineation, installation of groundwater monitoring gauges, vegetative community assessment (including invasive species), road fill assessment, stream and ditch condition and assessment, impacts of beaver impoundments, soil delineations, reference wetland characterization, wildlife surveys, and documentation of all other significant site data.

These data were utilized to determine the efforts required to restore the site to its original condition.

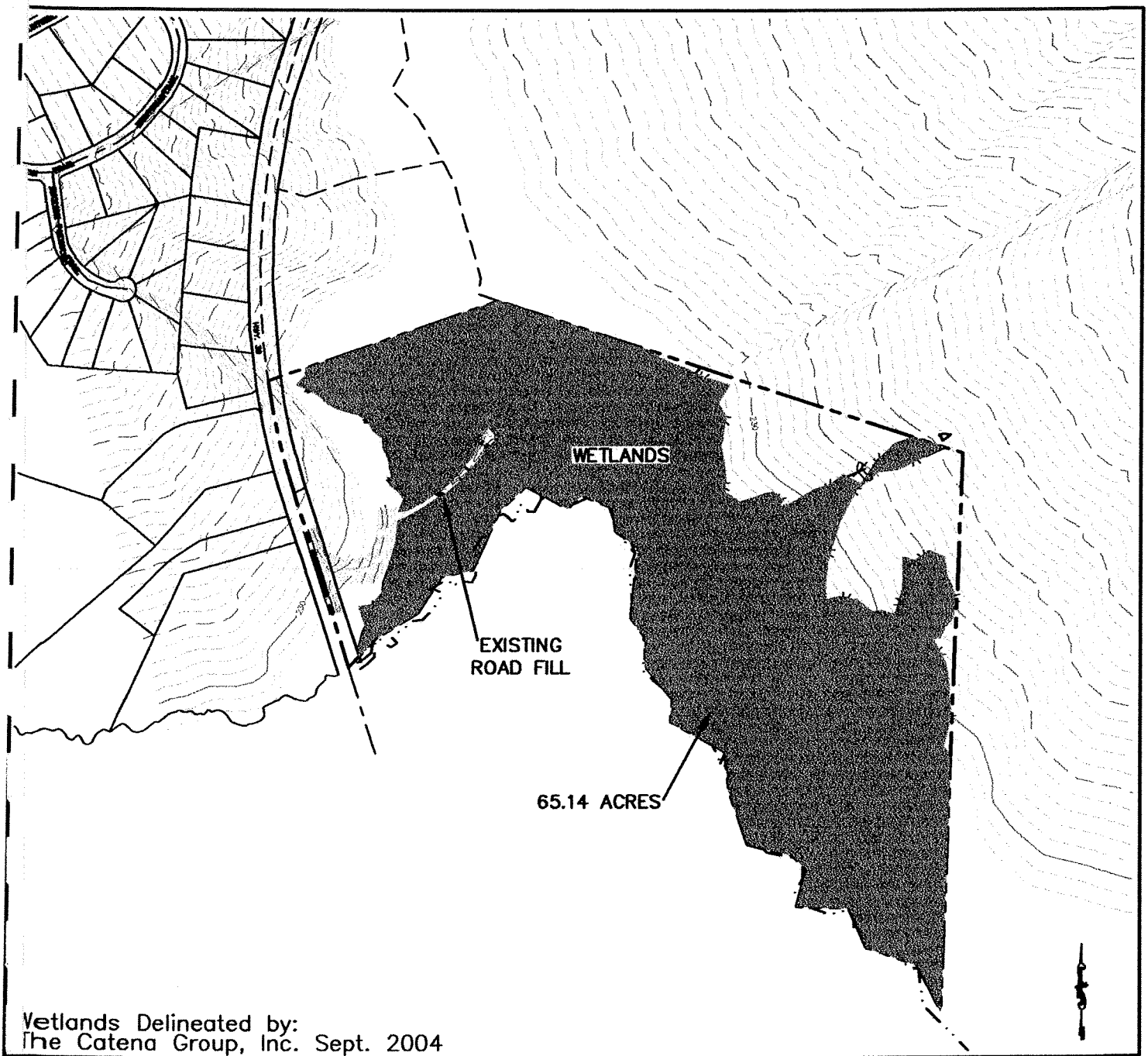
8.1 WETLAND DELINEATION

A wetland delineation was surveyed and recorded by Robert G. Williams on November 26, 1997; however, it is unknown if the delineation was verified by the U.S. Army Corps of Engineers (USACE). Five years have expired (typical duration of a USACE wetland verification) since the delineation, and possible changes may have occurred due to the removal of the beaver impoundments. Therefore, a new wetland delineation was performed utilizing the three parameter criteria outlined in the 1987 Corps of Engineers Wetlands Delineation Manual.

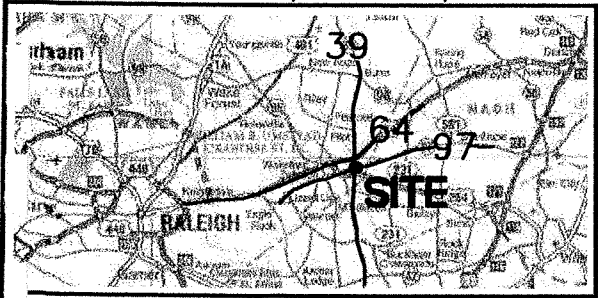
Steve Melin, a NC Licensed Soil Scientist with The Catena Group, was the lead in evaluating jurisdictional wetlands. The wetland boundary was flagged in the field and located via a handheld GPS unit with sub-meter accuracy; the resultant point data was used to generate base maps. The flagged wetlands encompass approximately 65 acres out of the 84-acre site, under existing conditions. Figure 9 depicts the boundary location of existing jurisdictional wetland systems.

8.2 GROUND WATER ANALYSIS

Three Infinite water level data loggers were placed on-site on September 23, 2004, and monitoring commenced on September 27, 2004 (locations shown in Figure 10). These groundwater gauges were placed throughout the wetland enhancement area with an effort to characterize groundwater / surface water relationship late in the growing season. Gauges



Wetlands Delineated by:
The Catena Group, Inc. Sept. 2004



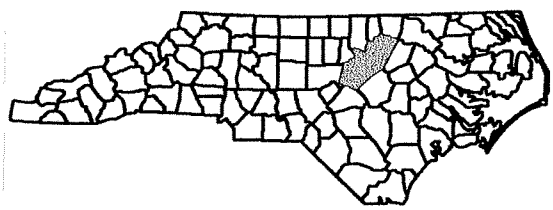


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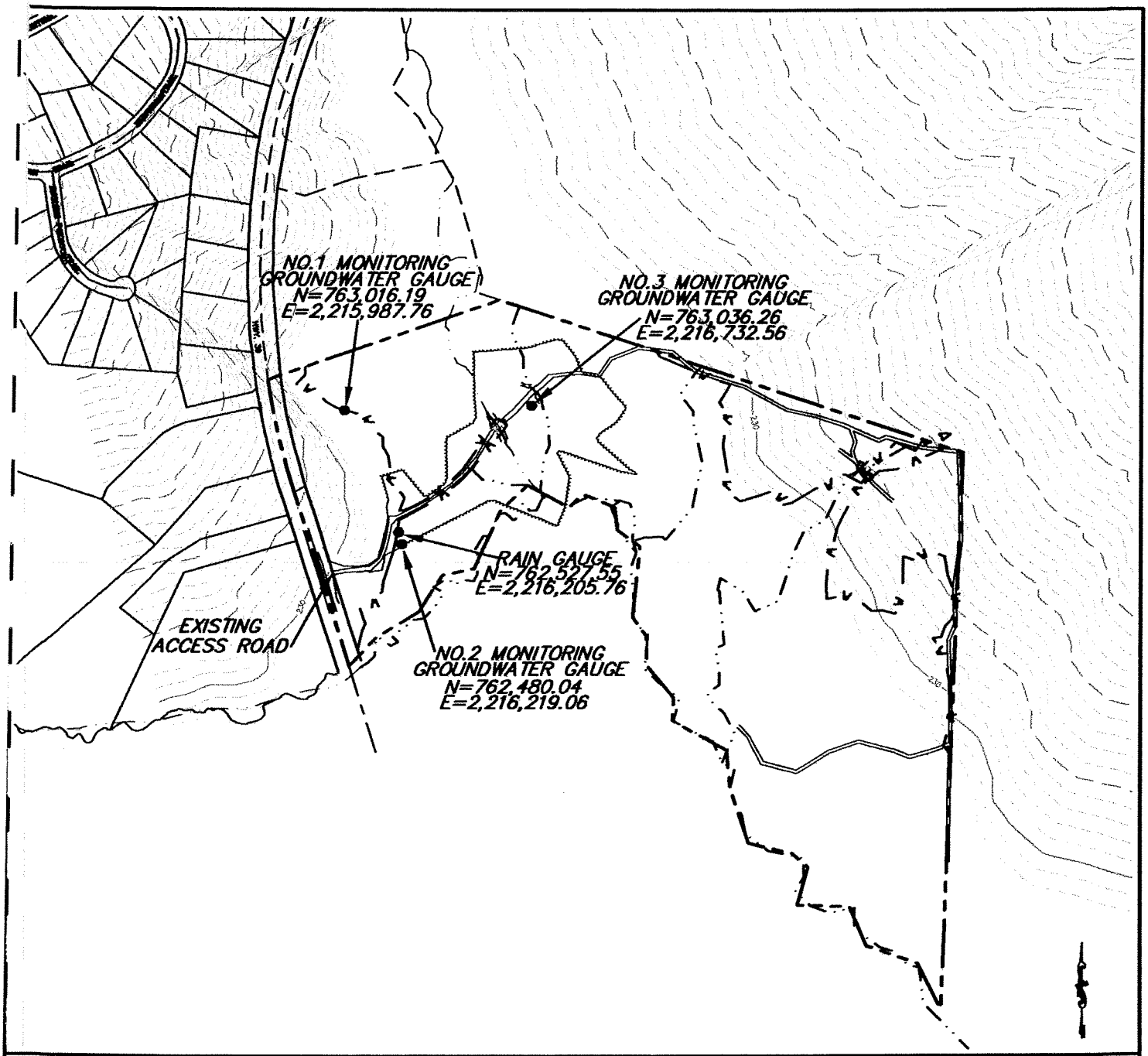
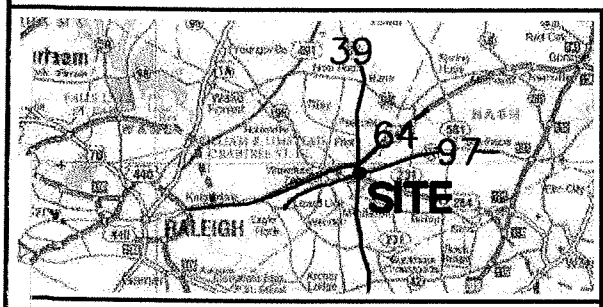
FIGURE 9

WETLAND DELINEATION MAP

600 300 0 600 1200

SCALE IN FEET





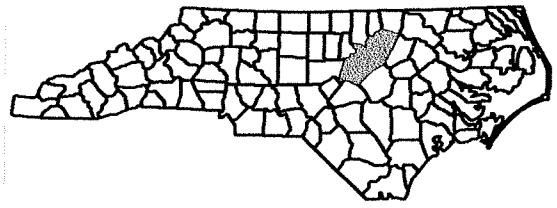


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FIGURE 10

GAUGE LOCATIONS

600 300 0 600 1200

SCALE IN FEET

were placed in varying distances from Moccasin Creek in an effort to determine duration of saturation. The results are illustrated in Figures 11 through 13.

Figure 11: Ground Water Gauge 1
2004 Hydrologic Monitoring Data

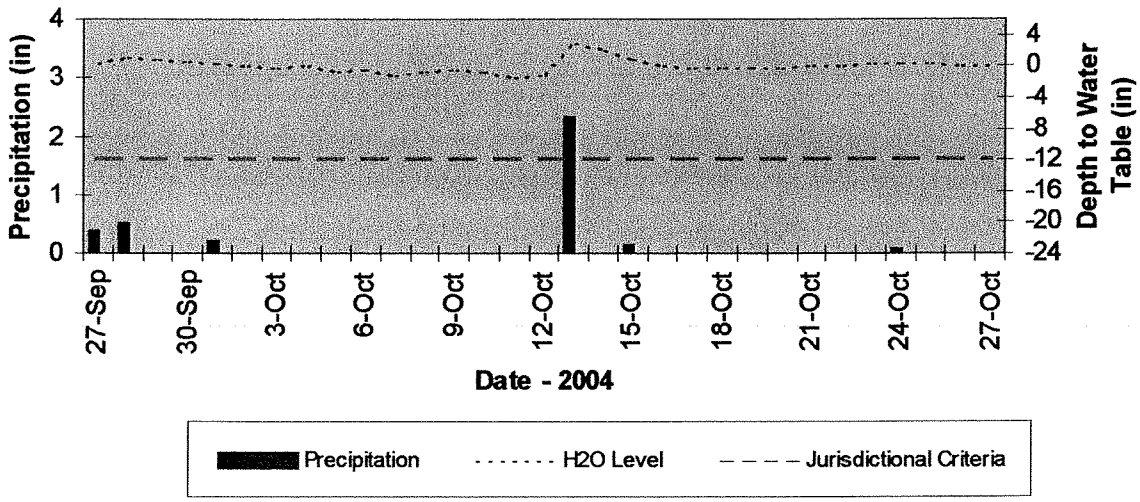


Figure 12: Groundwater Gauge 2
2004 Hydrologic Monitoring Data

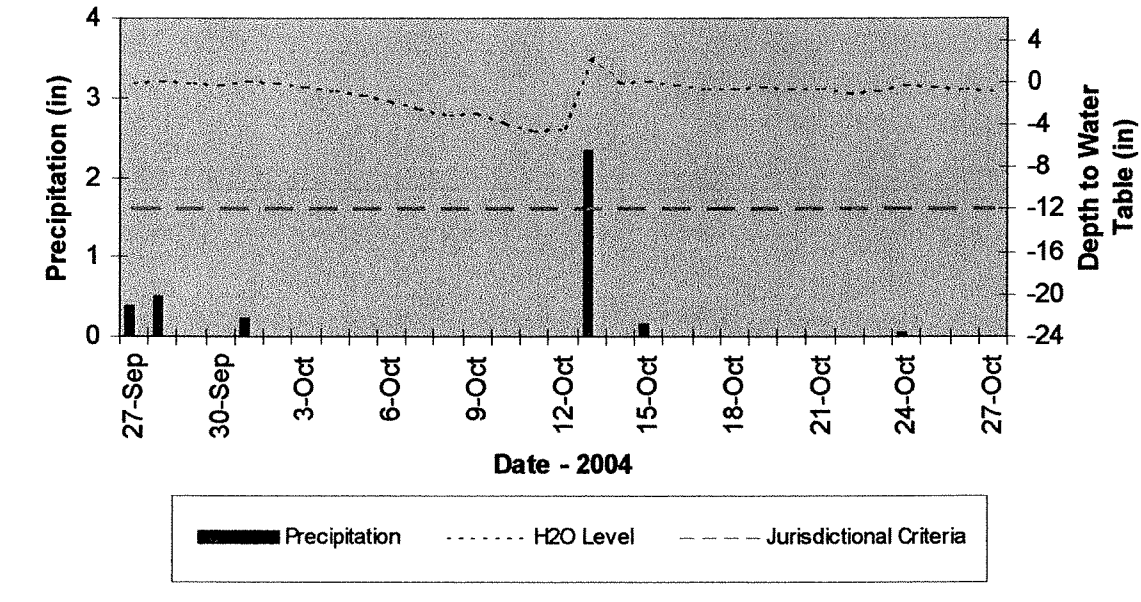
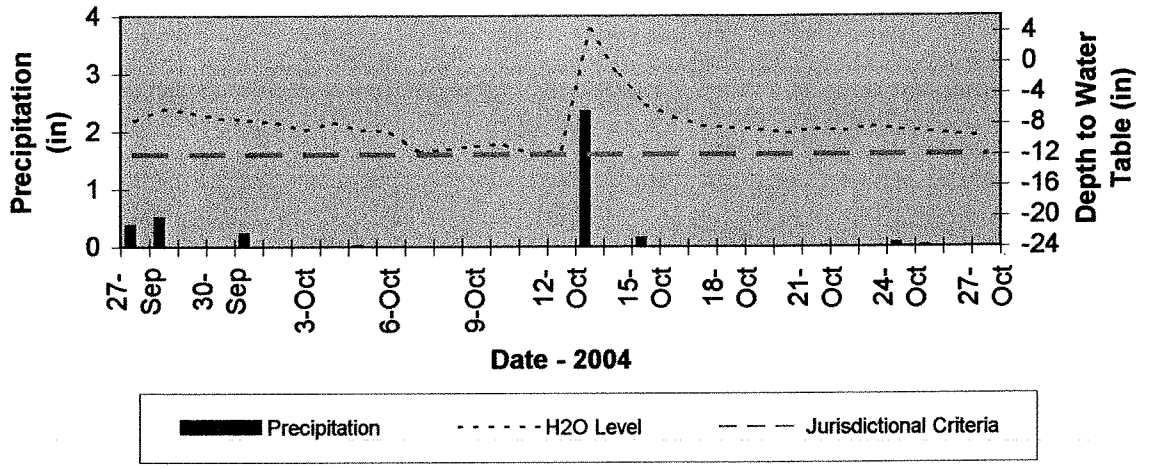


Figure 13: Groundwater Gauge 3
2004 Hydrologic Monitoring Data



While data collected from the Data Loggers does not provide long-term information (due to the short duration of the monitoring period), it is sufficient to describe the general groundwater / surface water relationship. This information was combined with on-site observations of water levels and a detailed photographic map of the site to ascertain an overall picture of the hydrologic regime and confirm presence of wetland hydrology in the enhancement area.

The monitoring gauges will be relocated prior to monitoring of the restoration activities. One gauge will be placed in the wetland restoration area (current road fill placement), a second in the fringe of the enhanced wetlands, and a third (reference) in mature bottomland swamp hardwoods west of Moccasin Creek.

9.0 STREAM RESTORATION STUDIES

Moccasin Creek will be restored at four culvert locations along the existing access roadway. The restoration analysis involved obtaining typical sections of stream segments immediately upstream and downstream of the culverts, then applying these measurements as a reference for reconstructing each channel after culvert removal. A classification section was evaluated approximately 100 feet downstream of culverts (at a riffle) to establish a typical section and evaluate bankfull. The results of the field data indicate bankfull to be at the top of the banks and that stream type is an E type sand bed channel with very little incision. Bankfull cross sectional areas and predicted discharges from the surveyed cross section were compared to the North Carolina Regional Curves. The FEMA HEC-RAS model discharges were also compared to the surveyed section predicted data. The results are summarized in Table 9.0.1.

Table 9.0.1 Summary of Selected Stream Parameters Moccasin Creek

Parameter	Surveyed Section	NC Rural Piedmont Regional Curves	FEMA
Bankfull Area (Abkf)	72.3 sq.ft.	160 sq ft (85-300 range)	--
Bankfull Depth (Dbkf)	2.49 ft.	3.5 ft (2.4-6 range)	--
Bankfull Width (Wbkf)	29 ft.	43 ft (25-60 ft range)	--
Discharge (Qbkf)	435 cfs	800 cfs (500 – 1500 range)	1200 cfs

The results of the analysis indicate that the surveyed section is at the low range of the North Carolina Regional Curve data. Since approximately 95% of the watershed above the project site drains into Bunn Lake, results suggests Bunn Lake has an impact in reducing bankfull flows in Moccasin Creek at the project site. The FEMA discharges were at the high end of the range; however, in FEMA studies, no consideration is typically made for detention of water by lake structures unless they are specifically placed for flood control.

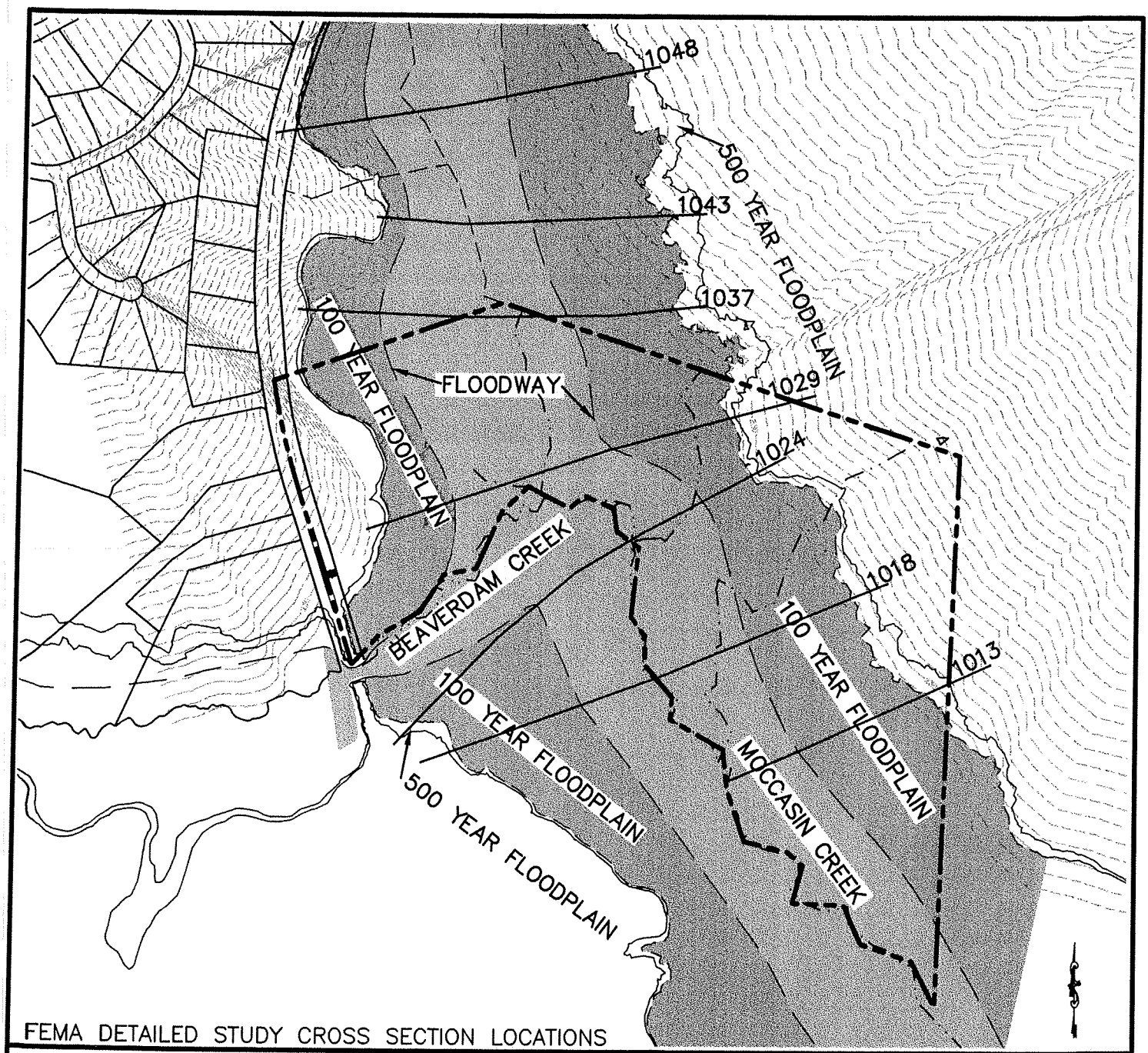
Tributary S1 and S2 will be restored for approximately 20 feet within the existing haul road. Reference sections immediately upstream and downstream were used as a reference for the restoration segments.

The drainage features were classified as either streams or ditches. Six streams were identified; Moccasin Creek, Beaverdam Creek, Wolf Creek, and three unnamed tributaries. North Carolina Department of Water Quality Stream Classification Forms were completed for each identified stream. Additional information including classification cross-sections, pebble counts, and stream classification forms are may be found in Appendix A, Existing Conditions Data.

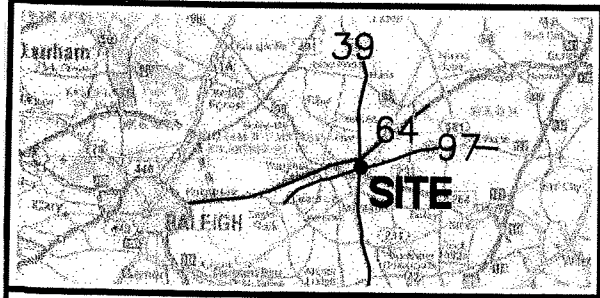
9.1 HYDRAULIC ANALYSIS FOR CULVERT & ROADWAY REMOVAL

In response to a request for updated hydraulic models of Moccasin Creek, the NC Flood Mapping Program provided new multiple profile and floodway model files from Watershed Concepts, which are currently under pre-release conditions. After reviewing the models, it was determined that the four culverts under the access road (located between FEMA Cross Sections 103134.7 and 103174.7) were included in the new detailed study. Therefore, a study was performed to evaluate the impacts to the model with culverts removed. The 100-year storm event floodway and floodplain shape files were downloaded from the North Carolina Flood Mapping Program Website. These shape files reflect the latest modeling detailed study cross sections and flood boundary data (Figure 14).

A detailed survey was preformed by a registered land surveyor to obtain an accurate topographic map of the existing roadway and culverts. This data was utilized to determine the amount of fill that was deposited during the construction of the access road. The surveyed top of fill was compared to the present FEMA model data, and a good correlation was found confirming the existing FEMA model elevations. The effective FEMA model was used as the pre-project model in this analysis. In addition to the surveyed information, soil borings were



FEMA DETAILED STUDY CROSS SECTION LOCATIONS



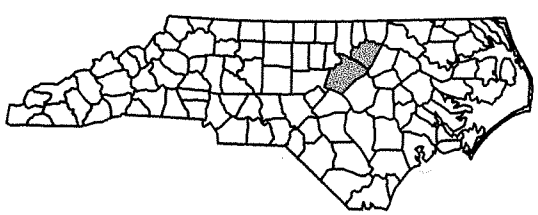


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FIGURE 14

FLOOD BOUNDARY MAP

600 300 0 600 1200

SCALE IN FEET

established at fifty-foot intervals along the roadway to determine depth from deposited fill to natural ground. With the combined topographic survey and soil borings, a roadway profile showing the top of the existing fill and a profile of the natural ground level upon fill removal were established. Modifications were made to the effective model to provide a modified post-project geometry file.

Multiple and floodway HEC-RAS models were run for the post-project conditions showing the removal of the roadway fill and culverts. The post-project conditions were compared to the pre-project conditions model to determine impacts to the regulated floodplain and floodway 100-year flood elevations.

9.2 FEMA IMPACTS-MODEL RESULTS

The existing road fill and culvert removal within the floodplain and floodway of Moccasin Creek will not cause a rise in the water surface elevations. The natural and floodway water surface elevations from the existing culvert locations to the base of Bunn Lake Dam show a slight drop in water surface elevation. The pre and post project water surface elevations for the 100-year storm event are shown in the tables below. Complete output summary tables have been included in Appendix C.

Table 9.2.1: 100 Year Natural Water Surface Elevations Moccasin Creek

Cross Section	Pre-Project 100 Year Natural Water Surface Elev (ft)	Post-Project 100 Year Natural Water Surface Elev. (ft)	Difference in Elevation (ft)
106352.7	232.18	232.18	0.00
106193.6	231.49	231.48	-0.01
106123.6	229.31	229.30	-0.01
105518.5	228.33	228.31	-0.02
104823.3	227.64	227.62	-0.02
104282.0	227.00	226.97	-0.03
103679.7	226.45	226.41	-0.04
*103174.7	226.10	226.10	0.00
*103134.7	226.09	226.08	-0.01
102912.8	225.94	225.94	0.00

* Culvert and road fill removal cross sections.

Table9.2.2: 100 Year Floodway Water Surface Elevations Moccasin Creek

Cross Section	Pre-Project 100 Year Floodway Water Surface Elev (ft)	Post-Project 100 Year Floodway Water Surface Elev. (ft)	Difference in Elevation (ft)
106352.7	232.78	232.77	-0.01
106193.6	232.29	232.27	-0.02
106123.6	230.19	230.18	-0.01
105518.5	229.31	229.29	-0.02
104823.3	228.58	228.56	-0.02

104282.0	227.94	227.91	-0.03
103679.7	227.42	227.38	-0.04
*103174.7	227.1	227.09	-0.01
*103134.7	227.08	227.07	-0.01
102912.8	226.92	226.92	0.00

* Culvert and road fill removal cross sections.

The proposed improvement calculations and cross-sections are included in Appendix C. Pre-project and post-project HEC-RAS data files are available at Ward Consulting Engineers, P.C. utilized in this design as listed below:

Pre-Project Files:

Project:	Moccasin Creek-Detailed Study	Moccasin_Creek_Final.prj
Plan:	Floodway	Moccasin_Creek_Final.p02
ID:	100YR_FW	
Geometry File:	Gem01 by Code H2 for Windows	Moccasin_Creek_Final.g01
Steady Flow File:	Floodway	Moccasin_Creek_Final.f02

Post-Project Files:

Project:	Moccasin Creek-Detailed Study	Moccasin_Creek_Final.prj
Plan:	Final fw no culverts	Moccasin_Creek_Final.p07
ID:	Final nc	
Geometry File:	Geom01 rev no culverts at 103154.7	Moccasin_Creek_Final.g02
Steady Flow File:	Rev Floodway	Moccasin_Creek_Final.f03

10.0 WETLAND RESTORATION PLAN

The Section 404 (b)(1) guidelines of the clean Water Act (16 USC 1344), as described in 40 CFR Part 230, states that unavoidable wetland loss resulting from filling activities may be offset by effective mitigation actions. According to the National Environmental Policy Act (NEPA) of 1969, mitigation actions should include avoidance, minimization, restoration, enhancement and compensation for unavoidable impacts. After all practical attempts to avoid and minimize wetland losses have been accomplished; compensatory mitigation in any of the forms (i.e. wetland creation, restoration, enhancement, and/or preservation) should be developed.

The Federal Guidance for the Establishment, Use and Operation of Mitigation Banks (Federal Register, 1995) defines wetland restoration, enhancement and preservation as follows:

Restoration – Re-establishment of previously existing wetland or other aquatic resource character and function(s) at a site where they have ceased to exist or exist only in a substantially degraded state.

Enhancement – Activities conducted in existing wetlands or other aquatic resources to achieve specific management objectives or provide conditions which previously did not exist, and which increase one or more aquatic functions.

Preservation – The protection of ecologically important wetlands or other aquatic resources in perpetuity through the implementation of appropriate legal and physical mechanisms.

Wetlands on the Moccasin Creek project site will be enhanced in the altered fields by restoring natural forested communities in 8.8 acres of the project site (5.3 acres wetland enhancement and 3.5 acres stream buffer enhancement). Approximately 0.42 acres of wetland restoration will be accomplished by removing road fill material and 39.7 acres of forested wetlands will be preserved. The Restoration Plans show the planned construction activities for project enhancement, restoration and preservation (Appendix F).

10.1 PLANNED HYDROLOGICAL MODIFICATIONS

Saturated soil conditions are present at the proposed Moccasin Creek enhancement and restoration areas throughout the majority of the growing season, as evidenced by field observations. This was confirmed by groundwater monitoring wells, which were established according to guidelines outlined by the U.S. Army Corps, Waterways Experiment Station (WRP, 1993).

The plan for wetland hydrological modifications includes culvert removal, road removal, and ditch plugging. Permanent ditch plugs that conform to NRCS Guidelines will be used for establishing final water levels on the site and to ensure that natural, wetland hydrologic regimes are maintained.

A total of three ditches will be plugged. The first ditch is located east of the access road culvert on Wolf Creek. The second ditch traverses the north side of the access road and drains into Moccasin Creek immediately upstream of the culvert crossing. The third ditch drains portions of the emergent marsh wetland south of Wolf Creek and empties into Moccasin Creek downstream of Wolf Creek. On-site material will be utilized for ditch plugging unless otherwise specified on the Restoration Plans.

10.2 VEGETATION COMMUNITY RESTORATION

Vegetation will be restored to reflect historic BSH species composition and abundance. The wetland enhancement area is approximately 5.3 acres and planted tree communities will vary according to subtle variations in elevation and hydrologic regime.

Site selection is critical when establishing a bottomland swamp hardwood wetland. Existing published data (i.e. soil surveys, hydraulic conductivities, etc.) are useful to determine general site characteristics, but detailed information is necessary for proper design of the system. Detailed field study provides data regarding microsite variation, existing soil fertility, in-situ soil texture and morphology, and water table depth. These site-specific data are essential to provide species recommendations and maintenance recommendations.

The soils at the site are ideal for a variety of hardwood trees and a minimal amount of site preparation is required to ensure the survival of planted trees. Since much of the restoration area is densely populated with herbaceous growth, the site should be bush-hogged where possible, especially in planting zone 2. In addition, an application of a pre-emergent herbicide to control herbaceous competition is recommended before planting.

Plants will be established at 6 x 10 foot spacing (726 plants/acre) within ripped planting rows using 1-2 year-old stock in the wetland enhancement and restoration areas. This planting density is slightly higher than the normal, however given the beaver activity which will inevitably occur within the restoration area, a six-foot spacing is a small initial investment that is anticipated to greatly aid in meeting the vegetation success criteria. Planting of seedlings should occur between December 1 and March 31 when trees are dormant. Tree and shrub mixtures will be matched to specific hydrologic zones within the field area. Our strategy of planting 726 tree/acre is to provide adequate insurance of meeting the required plant survival even under severe abiotic and biotic conditions. This spacing will also compensate for potential competition due to herbaceous competition and deer browsing and will allow for quick canopy closure. No ground cover plants will be planted given the seed bank within the surface soils and the extensive recruitment of propaguels associated with flooding. In addition, there is expected to be a high germination of indigenous wetland tree and shrub species and ground flora after the initial planting.

Only the highest quality, 1/0 bare root seedlings will be planted from the North Carolina Forestry Nursery or other suitable nursery approved by the Ecosystem Enhancement Program. Species and quantities to be planted are provided in Table 10.2.1, however the actual amount will depend upon seedling availability. The proposed planting plan assumes the availability of high quality stock at the time of planting. If the quality of seedlings of a particular species is not available at the time of planting, that species will be removed and an appropriate substitute found.

Planting strategies have been designed to simulate undisturbed mature, forested community types and to increase the proportion of species valuable for wildlife. This objective may require post-planting selective removal of undesirable species. In the event that circumstances arise due to the late procurement of seedlings, or in the event of low initial survival, supplemental planting may need to be conducted. It is also recommended that competing vegetation be kept to a minimum and mechanically or chemically removed if necessary.

The proposed wetland restoration measures include:

1. Removal of fill material within access roadbed
2. Placement of fill materials into ditches to restore natural hydrology.
3. Preparation of the construction areas as noted on the restoration plans.
4. Planting selected hardwoods and woody understory species to restore target wetland community types

The proposed wetland enhancement measures include:

1. Preparation of the site by removing existing herbaceous vegetation when possible.
2. Planting selected hardwoods and woody understory species to restore target wetland community types
3. Planting selected hardwoods and woody understory species to restore target wetland community types

Table 10.2.1: Canopy Tree Species for BLH Planting in Wetland Enhancement Areas

Genus / Species	Common Name
Taxodium distichum	Bald Cypress
Nyssa sylvatica var biflora	Swamp Black Gum
Quercus michauxii	Swamp Chestnut Oak
Quercus lyrata	Overcup Oak
Betula nigra	River Birch
Fraxinus pennsylvanica	Green Ash
Platanus occidentalis	Sycamore
Quercus phellos	Willow Oak

10.3 SOIL RESTORATION

A hydric soil restoration process is not applicable at the Moccasin Creek Restoration Site. Hydric soil are already present have been delineated by The Catena Group using criteria outlined in Hydric Soils of the United States (1987) in conjunction with the field indicators of hydric soils listed in the U.S. Army Corps of Engineers 1987 Wetland Delineation Manual.

Fill material will be removed from the access road on-site, exposing the natural hydric soils and restoring this area to its natural condition. No removed access road fill will be placed in the floodplain or floodway of Moccasin or Beaverdam Creeks. With the exception of lime and fertilizer applications to the ditch plugs, it is unlikely that soil fertility will need to be enhanced as part of restoration procedures

11.0 STREAM & BUFFER ENHANCEMENT/ RESTORATION PLAN

Stream and buffer restoration will be completed in conjunction with vegetation establishment and the removal of the existing culverts and roadway. Removal of culverts will restore natural channel configurations to sections of Moccasin Creek, Wolf Creek, unnamed tributary S1, S2, and S3. Riparian vegetation will be established for buffer restoration and preservation on the project site. Buffer restoration will occur on Moccasin Creek, Wolf Creek, in the cleared area surrounding Tributary S3 as well as within the existing haul roads on S1 and S2. Areas of Moccasin Creek where a wooded buffer exists will be preserved. In addition, buffer

preservation will occur along the north side of Beaverdam Creek, on unnamed tributary S1, and unnamed tributary S2.

11.1 STREAM RESTORATION - CULVERT REMOVAL

Approximately 180 feet of stream will be restored to the natural channel cross section at five stream locations within the project site. Culverts will be removed along with fill material and the streambed and bank will be re-established to match the stable channel conditions directly upstream and downstream. The typical channel sections for each culvert removal location and stream crossing location on S1 are shown in Figure 15.

11.2 BUFFER VEGETATION COMMUNITY RESTORATION

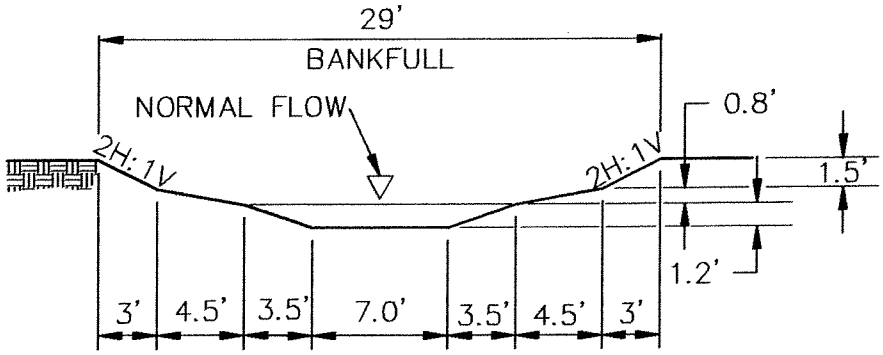
Vegetation will be established with restoration of 3.56 acres of steam buffers in the open areas and stream buffers will be preserved in 14.4 acres that are currently forested.

Riparian vegetation plays a crucial role in maintaining bank stability and control of bed erosion in streams and can be directly linked to water quality issues. The amount of sediment and associated pollutants entering the stream are reduced by adequately vegetating the stream. Research suggests that stream and riverbanks that are sparsely vegetated erode at a much higher rate than those banks that are densely vegetated. A well-vegetated streambank is resistant to streambank erosion due to the extra stability provided by the roots and other plant material, and because it can reduce flow velocity at the edges of the stream. Riparian vegetation also plays a role in increasing biodiversity and serves to provide habitat for native fauna.

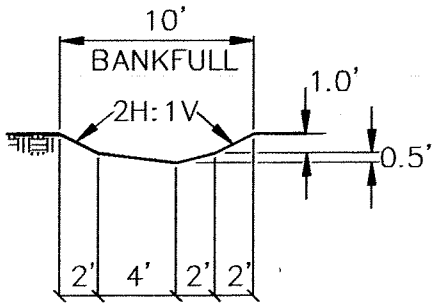
The objective of the revegetation plan is to plant a variety of native species that will maximize stream buffer functions. The plants chosen were based on their facultative status, professional judgment, and reference species (See Table 11.2.1). Each species is native to upper Coastal Plain and Piedmont palustrine forested floodplains wetlands.

Table 11.2.1: Canopy Tree and Woody Shrub Species for BLH Planting in Stream Buffer Area.

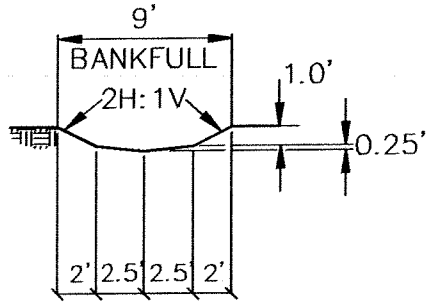
Genus / Species	Common Name
Cephalanthus occidentalis	Button Bush
Alnus serrulata	Hazel Alder
Quercus lyrata	Overcup Oak
Taxodium distichum	Bald Cypress
Nyssa sylvatica var biflora	Swamp Black Gum
Virburnum nudum	Possomhaw Viburnum
Salix nigra	Black Willow
Sambucus Canadensis	Elderberry
Alnus serrultata	Hazel Alder



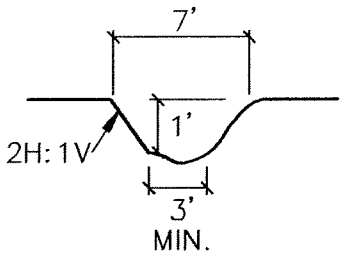
MOCCASIN CREEK CHANNEL
RESTORATION SECTION



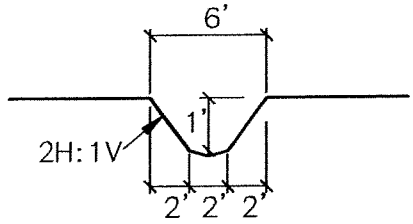
WOLF CREEK
RESTORATION SECTION



UNNAMED TRIBUTARY – S3
RESTORATION SECTION



TYPICAL CHANNEL S1
SECTION B–B



TYPICAL CHANNEL S2
SECTION B–B

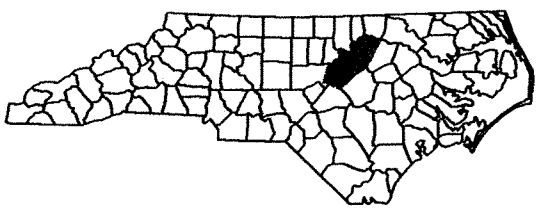
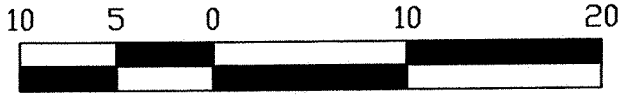


FIGURE 15
STREAM CHANNEL TYPICAL RESTORATION SECTIONS



SCALE IN FEET

Planting of seedlings should occur between December 1 and March 31 when trees are dormant. Plants will be established at 6 x 10 foot spacing (726 plants/acre) in each designated area. Also rooted plant plugs are proposed in the stream restoration areas in addition to transplanting native vegetation onsite. Moreover, there is expected to be a high germination of indigenous wetland tree and shrub species and ground flora after the initial planting. The proposed planting plan assumes the availability of high quality planting stock at the time of planting. If the quality of seedlings of a particular species is not available at the time of planting, that species will be removed and an appropriate substitute found. The U.S. Army Corps of Engineers Compensatory Hardwood Mitigation Guidelines (1993) were utilized in developing the planting plan.

12.0 WETLAND PREFORMANCE CRITERIA

Monitoring provides an accounting of ecosystem processes to ensure that functioning wetlands are established, which is the project objective. Performance of a mitigation project is assessed by comparing monitored data from mitigation sites relative to undisturbed, reference wetland habitats. The intensity of monitoring varies with the degree of disturbance at the project site (White 1991) and the probability of successfully achieving targeted wetland functions. Our monitoring program will measure and evaluate structural and functional parameters of each project component of the mitigation effort.

12.1 SUCCESS CRITERIA FOR HYDROLOGY

The ground water monitoring gauges will be relocated following restoration/ enhancement construction. One gauge will be placed in the wetland restoration area (current road fill placement), a second gauge will be placed in the fringe of the enhanced wetlands, and a third (reference) gauge will be placed in the mature bottomland swamp forest just west of Moccasin Creek.

The hydrologic success criteria for wetland areas will be met if gauge data from the restoration areas indicates that the site is saturated within 12 inches of the soil surface or inundated for a minimum of 8% of the growing season under normal conditions.

Verification of wetland hydrology will be determined by automatic recording ground water and rainfall gauge data collected within the Moccasin Creek project area and reference plots. Automatic recording gauges will be established within the enhancement area, restoration area and reference wetland area. Daily data will be collected from automatic gauges throughout the year and over the 5-year monitoring period.

12.2 SUCCESS CRITERIA FOR VEGETATION

The success criteria for the preferred species in the restoration areas will be based on annual and cumulative survival and growth over 5 years. Survival of preferred species must be at a minimum 320 stems/ac at the end of 5 years of monitoring. Height growth must average 6.0 ft. Species composition will be compared with reference stands and will be subject to review and approval. Average annual height increment of preferred species will be 1.25 ft./yr over

the 5-year monitoring period. Determining sampling strategy for woody trees and shrubs depends on the size and uniformity of the plants. The size and spacing of the trees determines plot size and number of plots (Spurr, 1952). Larger trees whose density per acre is low require larger plots while smaller trees whose density is higher per unit area are more accurately assessed using smaller plots. The uniformity of vegetation is also a factor in sampling design, where high variation in vegetative composition generally requires larger plot sizes, while more uniform vegetation can be measured accurately with smaller plots (Spurr, 1952). In addition, if competing vegetation is dense enough to impair visibility, then inaccuracy is introduced into sampling due to missed trees with larger plot sizes (Avery and Burkehart, 1994). While it is not uncommon in the forest industry to use small plots to evaluate plantation survival and growth, one-tenth acre plots are appropriate for evaluating survival and growth at the Moccasin Creek Restoration Project.

12.3 SUCCESS CRITERIA FOR SOILS

The hydric soil success criterion is not applicable in this project. The soils within the wetland enhancement area already meet hydric soil status. Ditch plugging activities and other hydrologic controls to restore the natural hydrology of the site will ensure that soils retain their hydric characteristics. The preservation areas have been delineated as jurisdictional by, among other indicators, the presence of hydric soils. Since the soils present are hydric, the success criterion has already been met.

12.4 MONITORING METHODS AND SCHEDULE

The Moccasin Creek Project will be determined to be successful once vegetation success criteria have been met within the restoration and enhancement areas. The vegetation growth data will be matched with groundwater data and rain data to determine if abnormal conditions were present. During vegetation monitoring, planted and volunteer stem densities will be measured in addition to the relative abundance and diversity of herbaceous vegetation within the monitoring plots. Species will be listed and identified by wetland indicator status. Planting locations and methods will be completed in the first year Annual Report. Survival, numbers per acre by species, and tree height will be measured at the end of each growing season just prior to leaf fall.

Hydrologic monitoring data will be collected for the same duration to ensure wetland hydrology is present. Monitoring data will be collected for a period of 5 years or until all success criteria are achieved, whichever is longer. Annual Reports will be submitted to the EEP prior to the end of each calendar year, documenting plant community conditions within the restoration areas and documenting hydrologic data within these areas and reference plots. The project areas will be photographed from permanent photo stations and changes in any of the above variables will be recorded and included in each annual report. The Annual Report will also include a proposed plan of action for the following year including maintenance activities.

13.0 STREAM BUFFER PREFORMANCE CRITERIA

Stream restoration areas will be visually reviewed on a yearly basis to determine if they are trending towards stability or to detect potential problems. Stream buffer vegetation will be monitored for success on a yearly basis.

13.1 SUCCESS CRITERIA FOR VEGETATION

Vegetation plots will be established within the stream buffers restored on the project site. The success criteria for vegetation will be determined as stated in section 12.2 of this report.

13.2 MONITORING METHODS AND SCHEDULE

The stream monitoring methods and schedule for the stream buffer vegetation will be preformed as described in section 12.4 of this report.

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Appendix A: Existing Conditions Data

Project: Moccasin Creek
Location: Approximately 100 feet downstream of the culvert
Date: 9/30/2004

			USGS Grid Coordinates North	USGS Grid Coordinates East	Plan Sheet Ref. No.
Left Permanent Benchmark Elevation:	221.38				

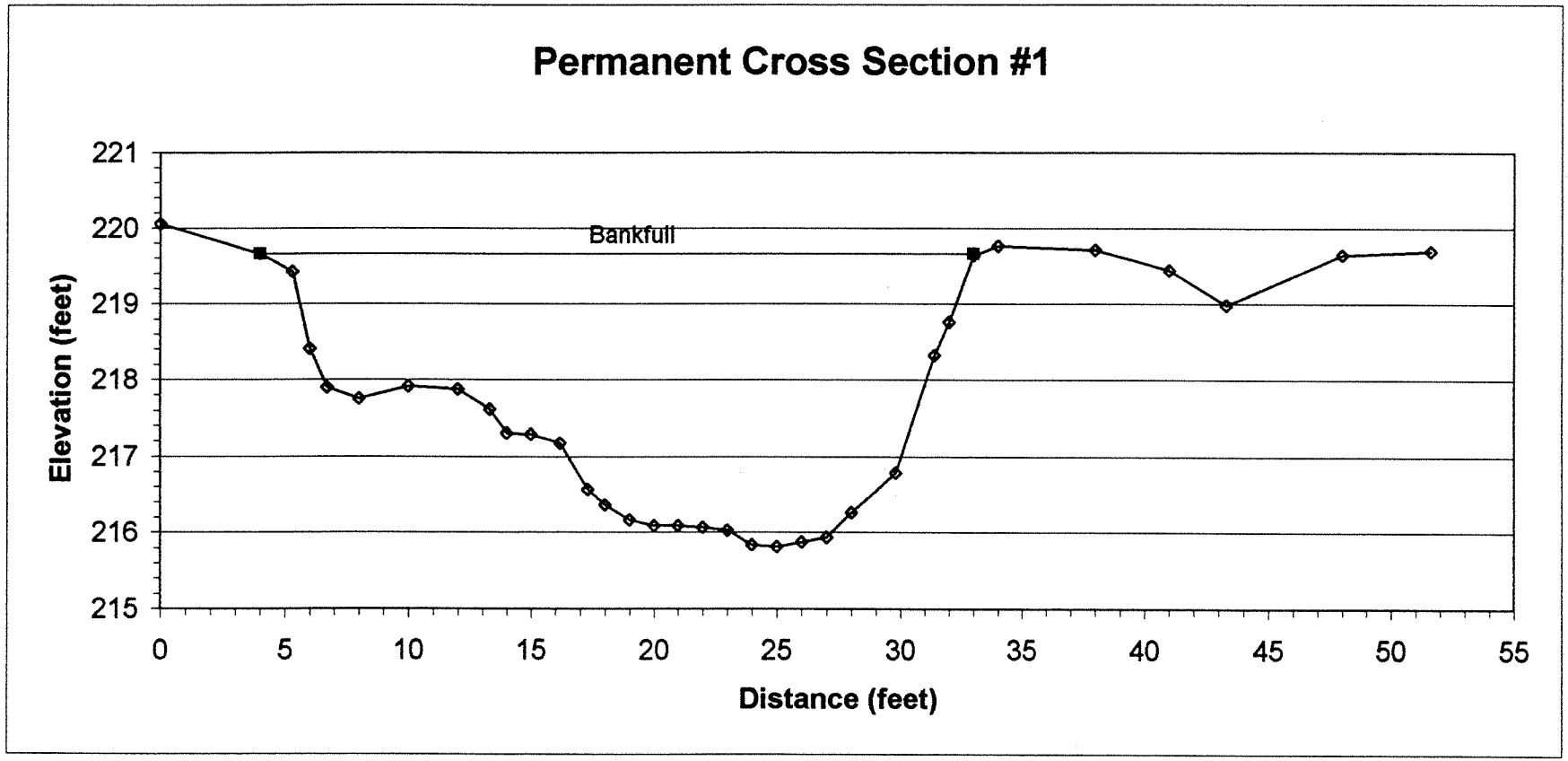
Benchmark description: Top of wooden stake set at SE corner of existing large culvert
Note: Cross Section taken from left to right looking downstream
Photo Reference Location:

Station	Back-Sight BS	Height of Instrument HI	Fore-Sight FS	Height Elevation	Notes Comments Remarks
Feet	Feet	Feet	Feet	Feet	
	3.04	224.42			Top of Wooden stake
0.00			4.36	220.06	
4.00			4.76	219.66	
5.30			4.99	219.43	Bankfull
6.00			6.01	218.41	
6.70			6.52	217.90	
8.00			6.66	217.76	
10.00			6.50	217.92	
12.00			6.54	217.88	
13.30			6.80	217.62	
14.00			7.11	217.31	
15.00			7.13	217.29	
16.20			7.24	217.18	top of bank
17.30			7.85	216.57	toe
18.00			8.05	216.37	
19.00			8.25	216.17	
20.00			8.33	216.09	
21.00			8.33	216.09	
22.00			8.35	216.07	
23.00			8.39	216.03	
24.00			8.58	215.84	
25.00			8.60	215.82	TW
26			8.54	215.88	
27			8.48	215.94	
28.00			8.15	216.27	

Stream Morphology

Classification	E5
Wbkf =	29 ft
dbkf =	2.49 ft
Abkf =	72.3 sqft
dmbkf =	3.84 ft
Wfpa =	1130 ft
ER =	39
D50 =	1.6 mm
Qbkf =	435 cfs
DA =	20.4 sqmi
Slope =	0.0017
Sinuosity =	

29.80			7.63	216.79	Toe
31.40			6.09	218.33	
32.00			5.65	218.77	
33.00			4.78	219.64	Top of bank
34			4.65	219.77	
38			4.7	219.72	
41			4.98	219.44	
43.3			5.43	218.99	
48			4.77	219.65	
51.6			4.72	219.70	
			7.09	217.33	Water Surface



Bankfull Cross Section

Width= 29

Bankfull Elevation 219.66

Station	Elevation	Elevation from Bankfull	Incremental Avg.Height Ft.	Incremental Distance Ft.	Incremental Area Sq.Ft.
4	219.66	0			
			0.115	1.3	0.1495
5.3	219.43	0.23			
			0.74	0.7	0.518
6	218.41	1.25			
			1.505	0.7	1.0535
6.7	217.9	1.76			
			1.83	1.3	2.379
8	217.76	1.9			
			1.82	2	3.64
10	217.92	1.74			
			1.76	2	3.52
12	217.88	1.78			
			1.91	1.3	2.483
13.3	217.62	2.04			
			2.195	0.7	1.5365
14	217.31	2.35			
			2.36	1	2.36
15	217.29	2.37			
			2.425	1.2	2.91
16.2	217.18	2.48			
			2.785	1.1	3.0635
17.3	216.57	3.09			
			3.19	0.7	2.233
18	216.37	3.29			
			3.39	1	3.39
19	216.17	3.49			
			3.53	1	3.53
20	216.09	3.57			
			3.57	1	3.57
21	216.09	3.57			
			3.58	1	3.58

22	216.07	3.59			
			3.61	1	3.61
23	216.03	3.63			
			3.725	1	3.725
24	215.84	3.82			
			3.83	1	3.83
25	215.82	3.84			
			3.81	1	3.81
26	215.88	3.78			
			3.75	1	3.75
27	215.94	3.72			
			3.555	1	3.555
28	216.27	3.39			
			3.13	1.8	5.634
29.8	216.79	2.87			
			2.1	1.6	3.36
31.4	218.33	1.33			
			1.11	0.6	0.666
32	218.77	0.89			
			0.445	1	0.445
33	219.66	0			

Total Area 72.301 Sq. Feet

NC Rural Piedmont Regional Curves

Drainage Basin area = 20.4 sq. mi

Bankfull

Q_{bkf} = 800 cfs Range (1500 – 500 cfs)

A_{bkf} = 160 sq. ft. Range (85 – 300 sq. ft)

W_{bkf} = 43 ft Range (25 – 60 ft)

d_{bkf} = 3.5 ft

Due to lake above watershed seen reduced flow for bankfull events possibly -

Data from Measured Cross Section -

W_{bkf} = 29 ft

d_{bkf} = 2.49 ft

A_{bkf} = 72.3 sqft

d_{mbkf} = 3.84 ft

W_{fpa} = 1130 ft

ER = 39

$$Slope = \frac{10}{6000\ ft} = .0017$$

Returned Discharge

pg. 186 $d / D_{84} = \frac{3.84}{0.0331} = 116 \Rightarrow \frac{u}{u^*} = 14$

$D_{84} = 10.1\ mm \times \frac{1\ in}{25.4\ mm} \times \frac{1\ ft}{12\ in} = 0.0331\ ft$

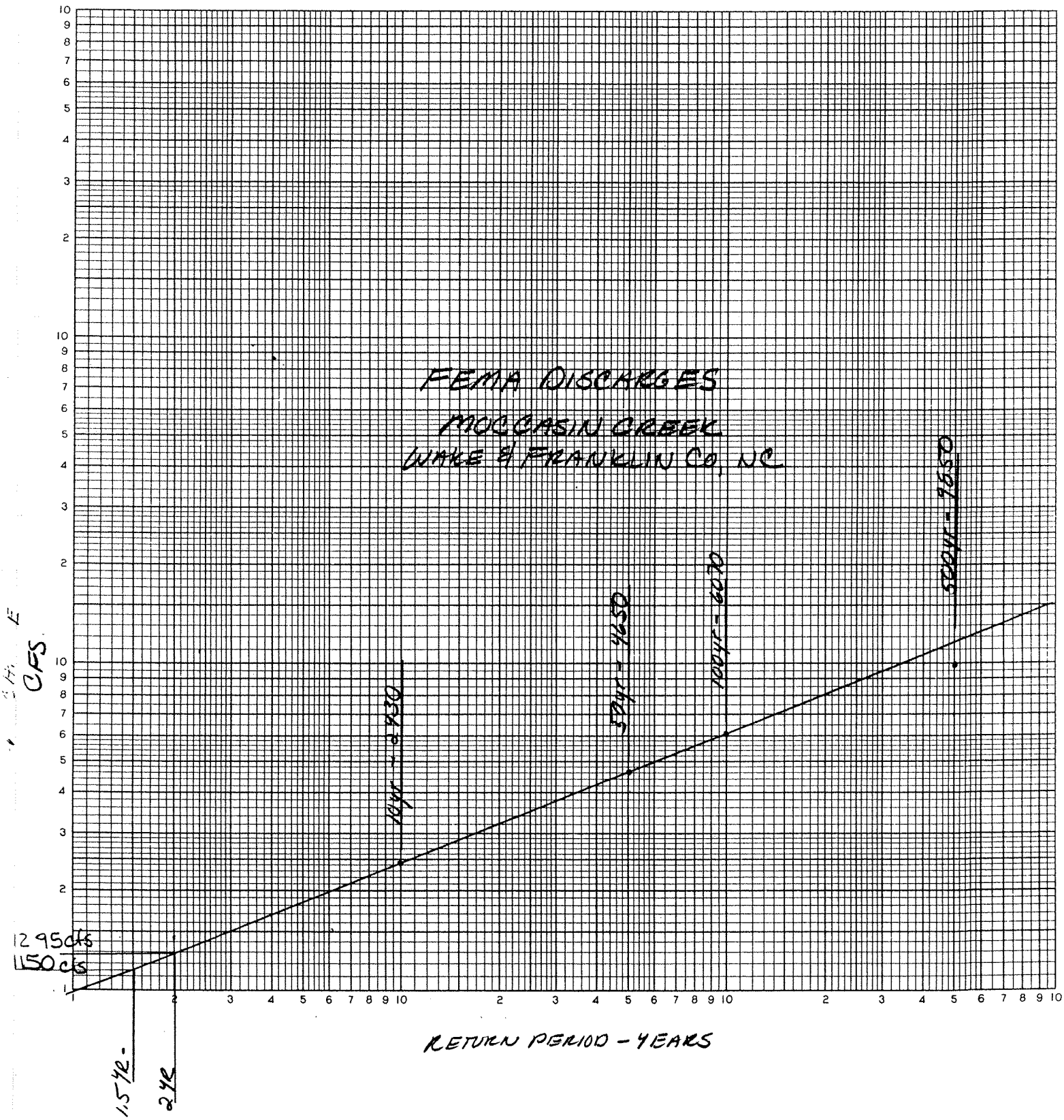
$14 \Rightarrow 189 \Longrightarrow$ "n" = .025

S = 0.0017
R = 3.84 ft

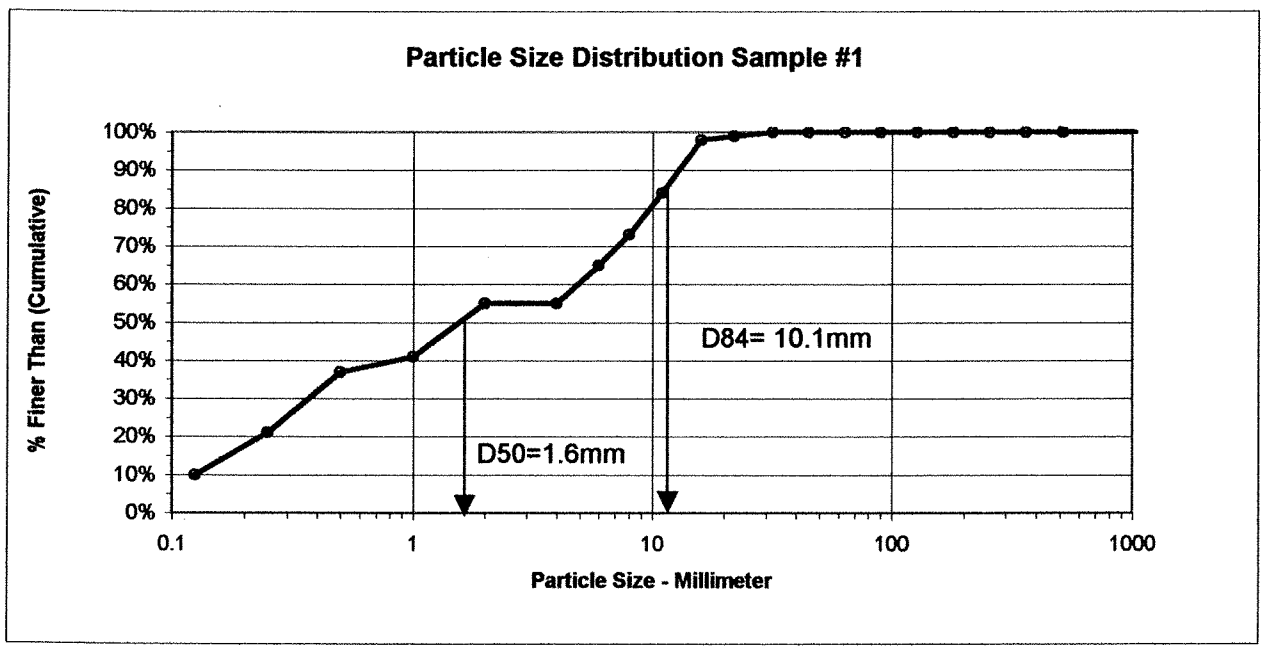
$$Q = \frac{1.486}{n}(A)(R)^{2/3}(S^{1/2})$$

$$Q = \frac{1.486}{.025}(72.3)(3.84)^{2/3}(.0017)^{1/2}$$

Q_{bkf} = 435 cfs.



PEBBLE COUNT								
Project:	Moccasin Creek					**Date:**	09/03/04	
Location:	Riffle location just below large culvert to be removed on Moccasin Creek							
				Particle Counts				
Inches	Particle	Millimeter		Riffles	Pools	Total No.	Item %	% Cumulative
	Silt/Clay	< 0.062	S/C	0		0	0%	0%
	Very Fine	.062 - .125	S	10	0	10	10%	10%
	Fine	.125 - .25	A	11	0	11	11%	21%
	Medium	.25 - .50	N	16	0	16	16%	37%
	Coarse	.50 - 1.0	D	4	0	4	4%	41%
.04 -.08	Very Coarse	1.0 - 2.0	S	14	0	14	14%	55%
.08 - .16	Very Fine	2.0 - 4.0		0	0	0	0%	55%
.16 - .22	Fine	4.0 - 5.7	G	10	0	10	10%	65%
.22 - .31	Fine	5.7 - 8.0	R	8	0	8	8%	73%
.31 - .44	Medium	8.0 - 11.3	A	11	0	11	11%	84%
.44 - .63	Medium	11.3 - 16.0	V	14	0	14	14%	98%
.63 - .89	Coarse	16.0 - 22.6	E	1	0	1	1%	99%
.89 - 1.26	Coarse	22.6 - 32.0	L	1	0	1	1%	100%
1.26 - 1.77	Very Coarse	32.0 - 45.0	S	0	0	0	0%	100%
1.77 - 2.5	Very Coarse	45.0 - 64.0		0	0	0	0%	100%
2.5 - 3.5	Small	64 - 90	C	0	0	0	0%	100%
3.5 - 5.0	Small	90 - 128	O	0	0	0	0%	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	Lrg- Very Lrg	1024 - 2048	R	0	0	0	0%	100%
	Bedrock		BDRK	0	0	0	0%	100%
			Totals	**100**	**0**	**100**	**100%**	**100%**



Wildland Hydrology | Field Data Form | 1999RAM

BANK EROSION POTENTIAL

Stream Name: Moccasin Creek Date: 9-30-2004

Xsec. No.: Classification Crew: B. Ward & Sharon S

Location/Note: X-section

Bank Height (ft): 3.6 ft.

Bankfull Height (ft): 2.49

Root Density (%): 75% Root Depth 2-2.5 ft.

Bank Angle (degrees): 75-80°

Surface Protection (%): 70%

BANK EROSION POTENTIAL

CRITERIA	VERY LOW		LOW		MODERATE		HIGH		VERY HIGH		EXTREME	
	VALUE	INDEX	VALUE	INDEX	VALUE	INDEX	VALUE	INDEX	VALUE	INDEX	VALUE	INDEX
Bank Ht/Bkf Ht	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	(1.2-1.5)	4.0-5.9 5.5	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
Root Depth/Bank Ht	(1.0-0.9)	1.0-1.9 1.5	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	0.29-1.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
Root Density (%)	80-100	1.0-1.9	(55-79)	2.0-3.9 3.7	30-54	4.0-5.9	15-29	6.0-7.9	5-14	8.0-9.0	<5.0	10
Bank Angle (Degrees)	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	(81-90)	6.0-7.9 6.5	91-119	8.0-9.0	>119	10
Surface Prot. (%)	80-100	1.0-1.9	(55-79)	2.0-3.9 3.5	30-54	4.0-5.9	15-29	6.0-7.9	10-15	8.0-9.0	<10	10
TOTALS		1.5		7.4		5.5		6.5				
		5-9.5		10-19.5		20-29.5		30-39.5		40-45		46-50
Numerical Adjustments N/A												

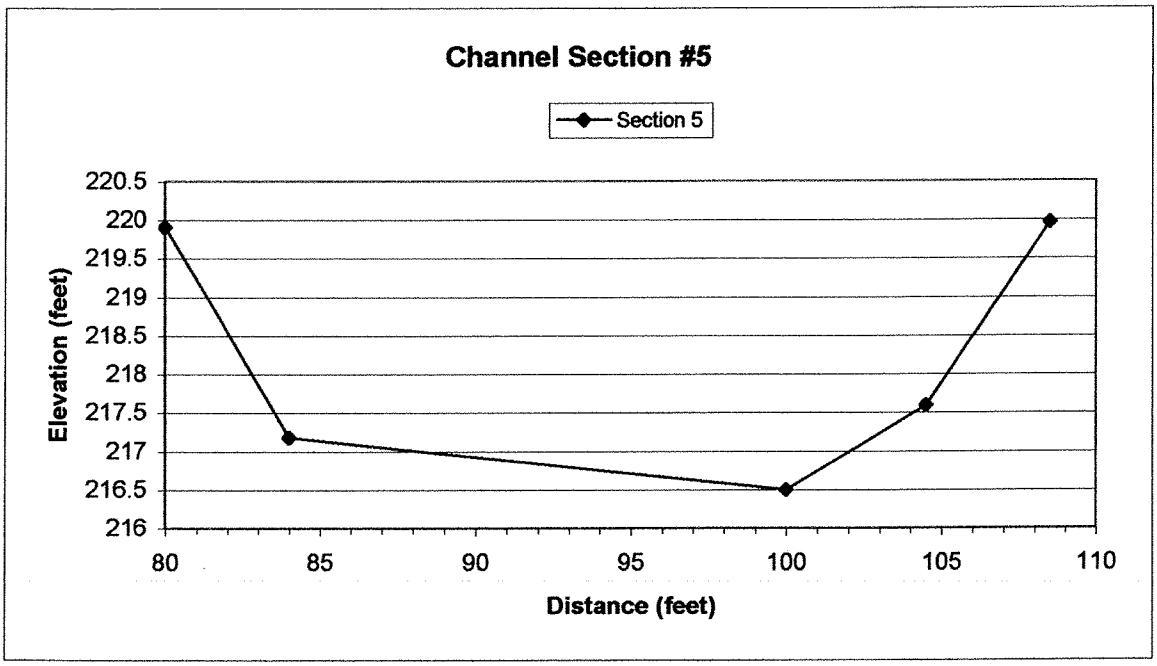
BANK MATERIALS: BEDROCK: BANK EROSION POTENTIAL ALWAYS VERY LOW
BOULDERS: BANK EROSION POTENTIAL LOW
COBBLE: DECREASE BY ONE CATEGORY UNLESS MIXTURE OF GRAVEL/SAND IS OVER 50%. THEN NO ADJUSTMENT
GRAVEL: ADJUST VALUES UP BY 5-10 POINTS DEPENDING ON COMPOSITION OF SAND
SAND: ADJUST VALUES UP BY 10 POINTS
SILT/CLAY: NO ADJUSTMENT

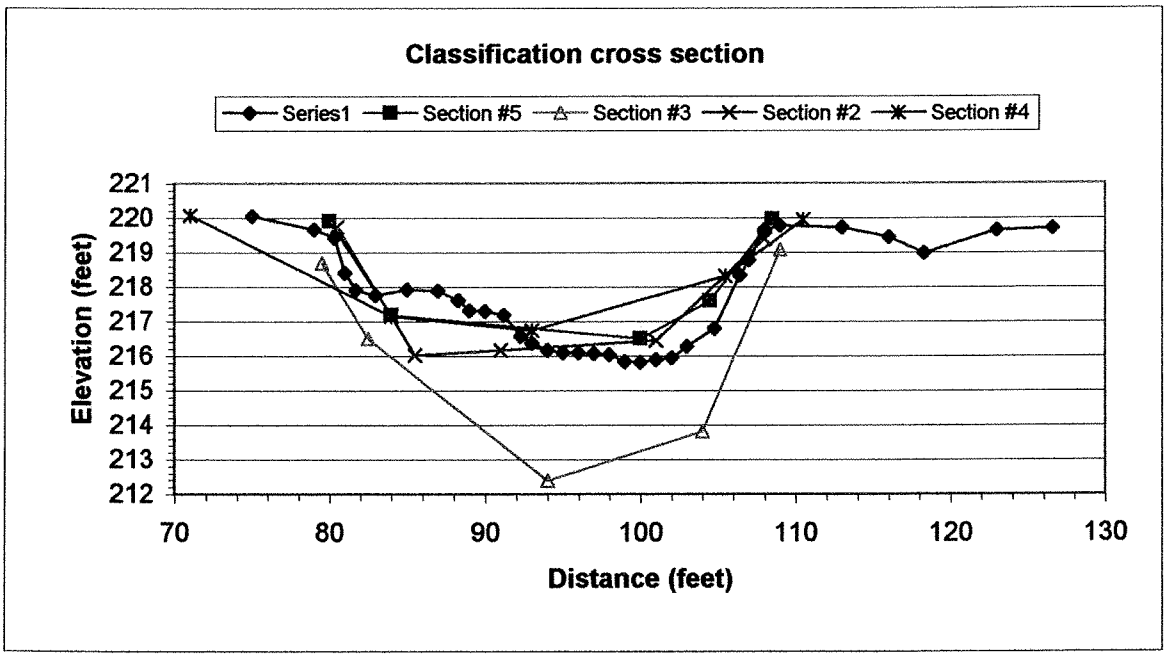
STRATIFICATION: 5-10 POINTS (UPWARD) DEPENDING ON POSITION OF UNSTABLE LAYERS IN RELATION TO BANKFULL STAGE

BEHI 20.9 Low to moderate

Cross Section #1 for Classification

	Adj CL	3.04	224.42			Top of Wooden stake
0.00	75.00			4.36	220.06	
4.00	79.00			4.76	219.66	
5.30	80.30			4.99	219.43	Bankfull
6.00	81.00			6.01	218.41	
6.70	81.70			6.52	217.90	
8.00	83.00			6.66	217.76	
10.00	85.00			6.50	217.92	
12.00	87.00			6.54	217.88	
13.30	88.30			6.80	217.62	
14.00	89.00			7.11	217.31	
15.00	90.00			7.13	217.29	
16.20	91.20			7.24	217.18	top of bank
17.30	92.30			7.85	216.57	toe
18.00	93.00			8.05	216.37	
19.00	94.00			8.25	216.17	
20.00	95.00			8.33	216.09	
21.00	96.00			8.33	216.09	
22.00	97.00			8.35	216.07	
23.00	98.00			8.39	216.03	
24.00	99.00			8.58	215.84	
25.00	100.00			8.60	215.82	TW
26	101.00			8.54	215.88	
27	102.00			8.48	215.94	
28.00	103.00			8.15	216.27	
29.80	104.80			7.63	216.79	Toe
31.40	106.40			6.09	218.33	
32.00	107.00			5.65	218.77	
33.00	108.00			4.78	219.64	Top of bank
34	109.00			4.65	219.77	
38	113.00			4.7	219.72	
41	116.00			4.98	219.44	
43.3	118.30			5.43	218.99	
48	123.00			4.77	219.65	
51.6	126.60			4.72	219.70	
				7.09	217.33	Water Surface


Channel Section #5
Section 5
220.5
220
219.5
219
218.5
218
217.5
217
216.5
216
Elevation (feet)
80
85
90
95
100
105
110
Distance (feet)


Classification cross section
Series1
Section #5
Section #3
Section #2
Section #4
221
220
219
218
217
216
215
214
213
212
Elevation (feet)
70
80
90
100
110
120
130
Distance (feet)

Surveyor channel section #2

Station	Elevation	
80.5	219.75 Top	89.5
85.5	216.01 Toe	94.5
91	216.16 CL	100
101	216.45 Toe	110
108	219.38 Top	117

Surveyor channel section #3

Station	Elevation	
79.5	218.69 Top	85.5
82.5	216.5 Toe	88.5
94	212.39 CL	100
104	213.82 Toe	110
109	219.07 Top	115

Surveyor channel section #4

Station	Elevation	
71	220.07 Top	78
84	217.14 Toe	91
93	216.75 CL	100
105.5	218.32 Toe	112.5
110.5	219.94 Top	117.5

Surveyor channel section #5

Station	Elevation
80	219.91 Top
84	217.18 Toe
100	216.5 CL
104.5	217.59 Toe
108.5	219.97 Top

Cross Sections Repair Area S1
Moccasin Creek
11-Nov-04

Cross Section Uptream of Culvert on S1

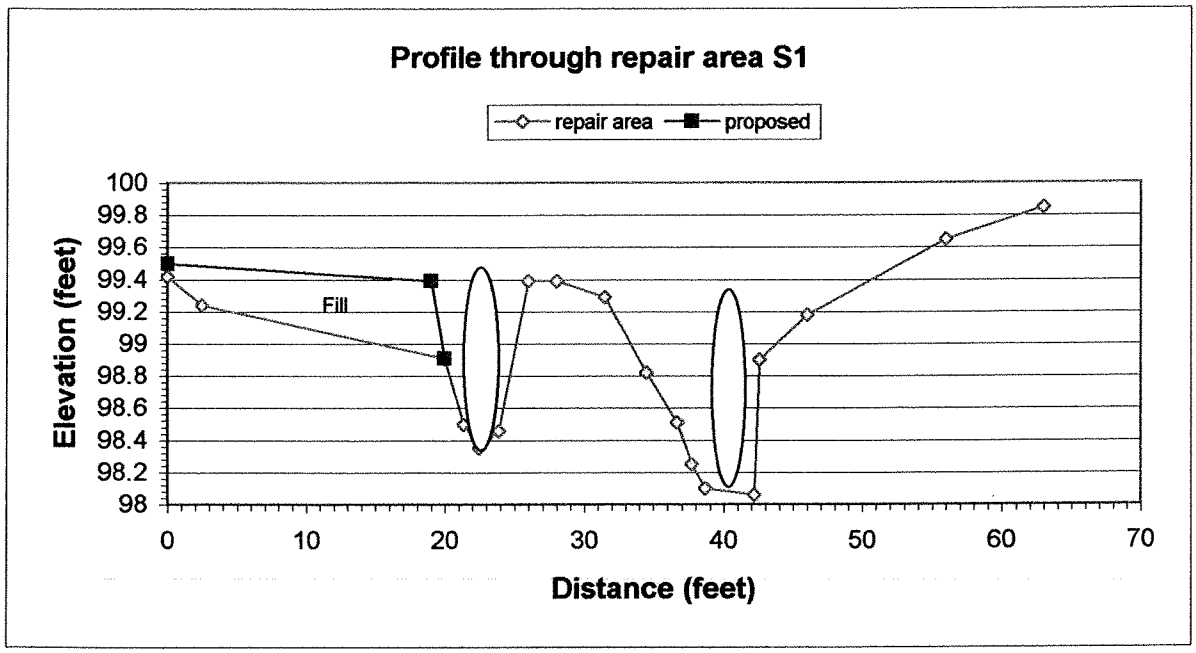
Top of Wooden stake elevation assumed 100

Station	BS	HI	FS	Elevation	Comments	
	4.21	104.21				
0			4.14	100.07		9.5
5.3			4.35	99.86		14.8
11			4.48	99.73	TOB	20.5
11.3			5.53	98.68	Toe	20.8
12.5			5.81	98.4		22
13.7			5.85	98.36		23.2
14.5			5.51	98.7	Toe	24
14.9			4.73	99.48	TOB	24.4
18			4.38	99.83		27.5
27			4.12	100.09		36.5
			5.4	98.81	Water surface	9.5

Profile through repair Area on S1

Top of Wooden stake elevation assumed 100

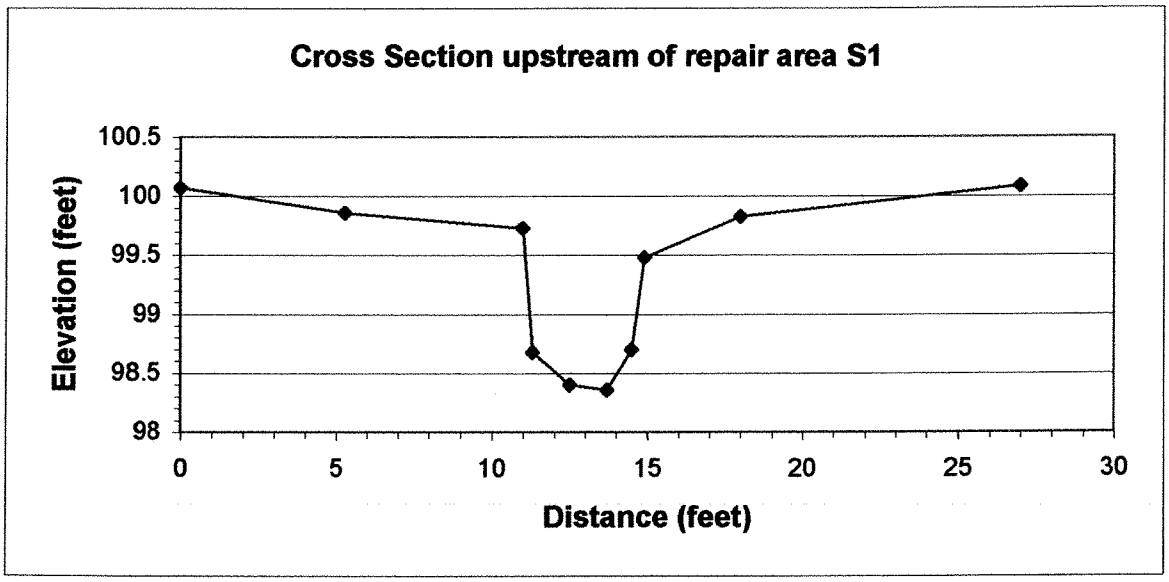
Station	BS	HI	FS	Elevation	Comments
	4.21	104.21			
0			4.79	99.42	
2.5			4.97	99.24	
20			5.3	98.91	Tob
21.4			5.71	98.5	Toe
22.5			5.86	98.35	Center line
23.9			5.75	98.46	Toe
26			4.82	99.39	Tob
28			4.82	99.39	
31.5			4.92	99.29	
34.5			5.39	98.82	
36.7			5.7	98.51	
37.7			5.96	98.25	
38.7			6.11	98.1	
42.2			6.15	98.06	
42.6			5.31	98.9	
46			5.03	99.18	
56			4.56	99.65	
63			4.36	99.85	
			6.63	97.58	Tie in location downstream
			5.86	98.35	Tie in location upstream

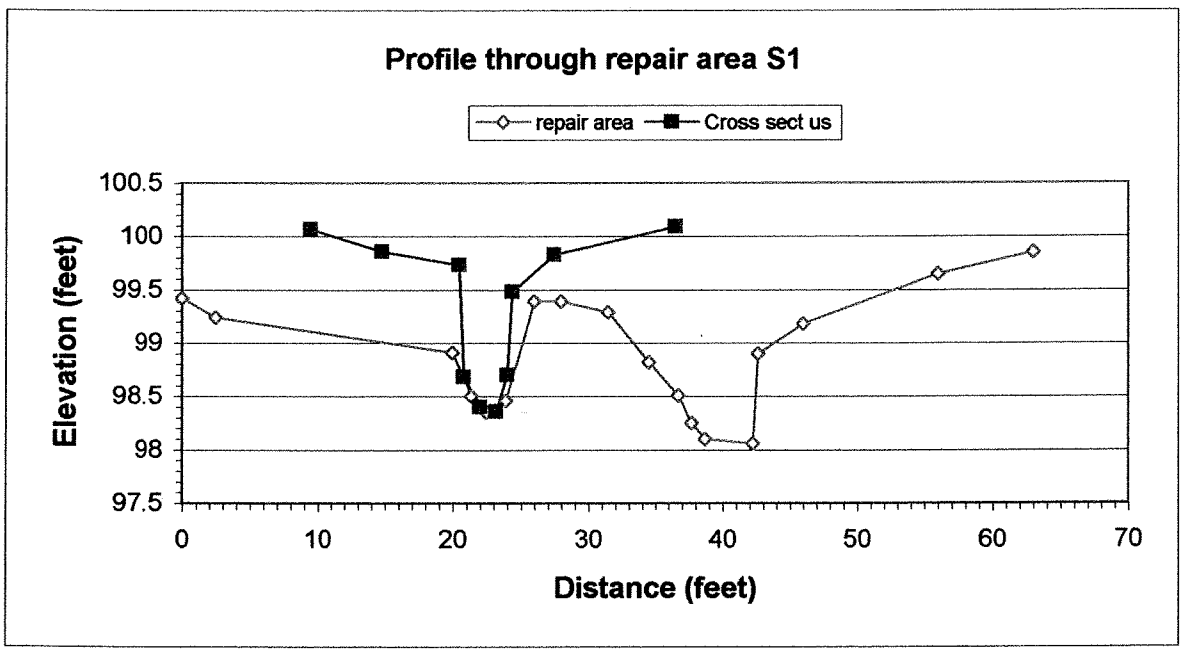


Proposed Roadway Fill

Station	Elevation
0	99.5
19	99.39
20	98.91

Cross Sections Repair Area S1
Moccasin Creek
11-Nov-04





Cross Section Downstream of Culvert on S2
Longitudinal Station 81.5
Top of Wooden stake elevation assumed 100

Station	BS	HI	FS	Elevation	Comments
	3.81	103.81			
6			7.91	95.9	
36			8.73	95.08	
46			8.24	95.57	
52.7			8.55	95.26	Tob
53			9.61	94.2	Toe
54			9.9	93.91	Center
55.2			9.58	94.23	
55.6			8.58	95.23	
61			7.9	95.91	Tob
68			7.02	96.79	
76			5.71	98.1	
			9.42	94.39	Water surface

Cross Secti
Longitudina
Top of Wo

Station	
39.5	0
45.5	6
50	10.5
51	11.5
51.9	12.4
52.3	12.8
53.9	14.4
55.3	15.8
56.2	16.7
56.8	17.3
61.5	22
65.5	26
68.5	29

Cross Section Profile top of Roadway

Top of Wooden stake elevation assumed 100

Station	BS	HI	FS	Elevation	Comments
	3.81	103.81			
0			4.67	99.14	Start wetlands
9			5.07	98.74	Cross section station 10
27			6.15	97.66	Center of culvert
58			5.8	98.01	Cross section station 58
78			5.12	98.69	End wetlands

Roadway Cross section #1 Station 10+00

Top of Wooden stake elevation assumed 100

Station	BS	HI	FS	Elevation	Comments
	3.81	103.81			
10			6.66	97.15	
18			5.17	98.64	
29.5			4.65	99.16	top of road
34.5			5	98.81	
40			7.15	96.66	

Roadway Cross section #2 Station 58+00

Top of Wooden stake elevation assumed 100

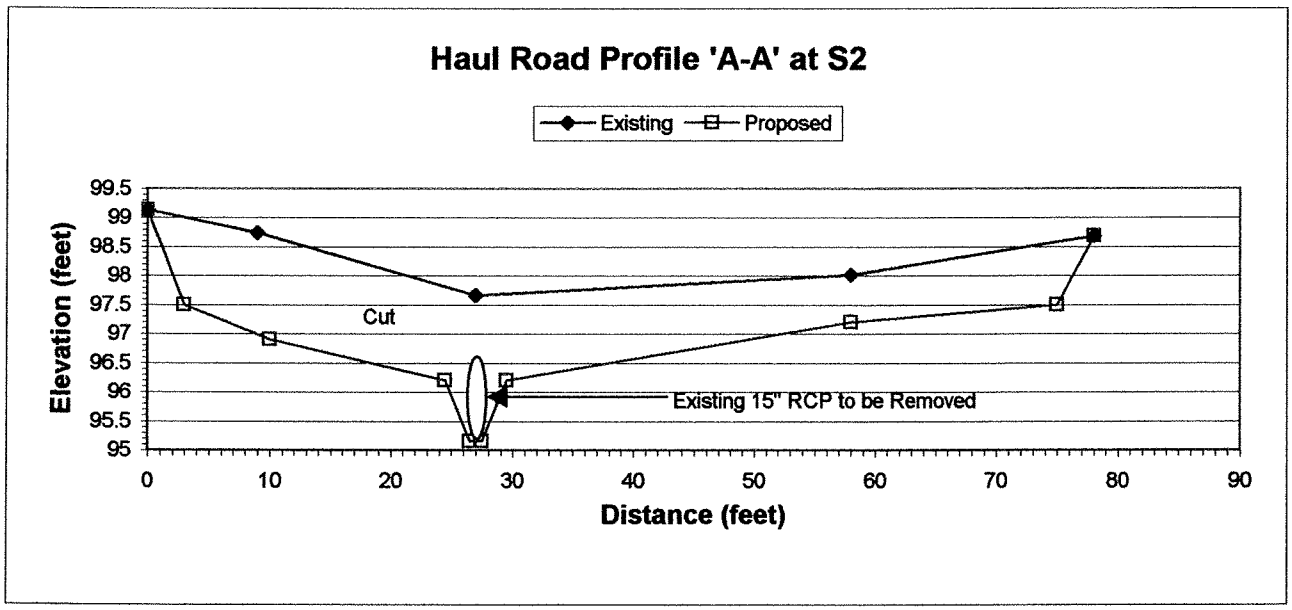
Station	BS	HI	FS	Elevation	Comments
	3.81	103.81			
0			6.8	97.01	
8			6.11	97.7	

18	5.71	98.1	edge of road	
29.5	5.69	98.12	edge of road	
33.5	5.83	97.98		
35.7	6.46	97.35		

Longitudinal Profile through culvert

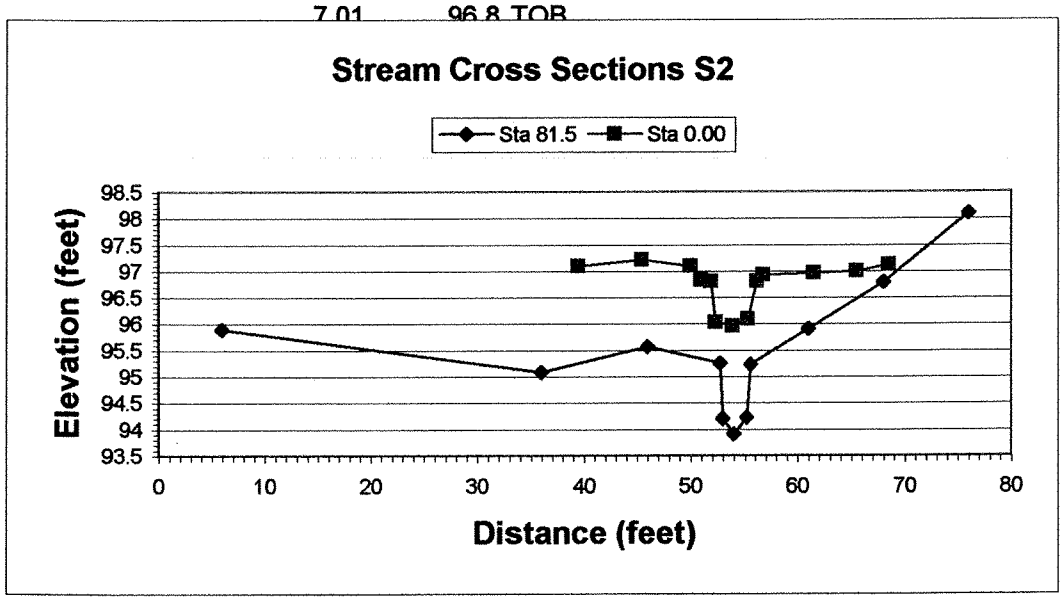
Top of Wooden stake elevation assumed 100

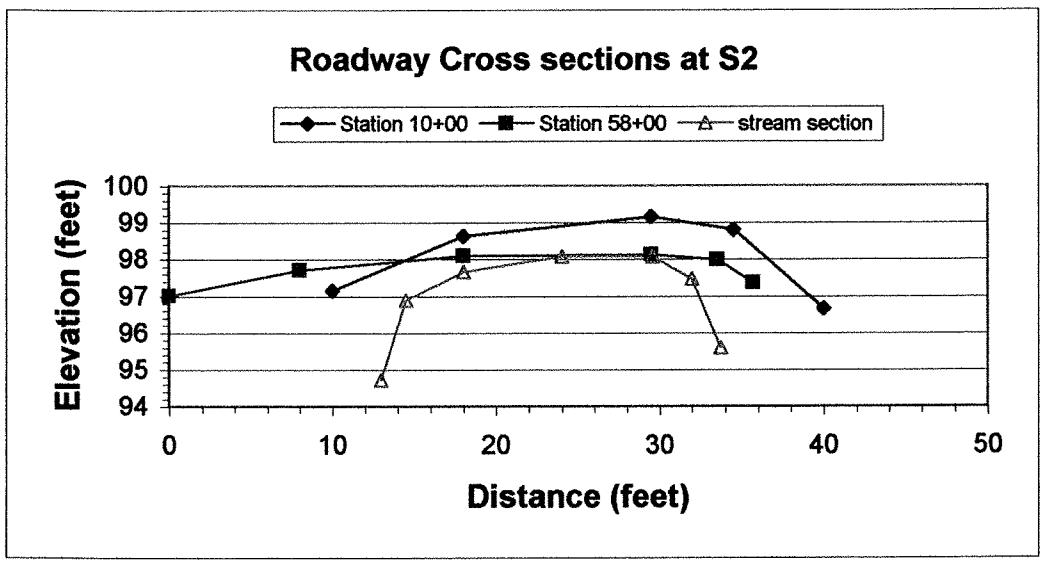
Station	BS	HI	FS	Elevation	Comments		
	3.81	103.81					
18.3			8.22	95.59	Invert 15" cmp	13.9	33.7
20			6.34	97.47		15.6	32
22.4			5.74	98.07	edge of road	18	29.6
28			5.73	98.08	cl road	23.6	24
34			6.18	97.63	edge of road	29.6	18
37.5			6.93	96.88	top of fill	33.1	14.5
39			9.1	94.71	Invert 15" cmp	34.6	13



lion Upstream of Culvert on S2
al Station 0.0
ɔden stake elevation assumed 100

BS	HI	FS	Elevation	Comments
3.81	103.81			
		6.72	97.09	
		6.59	97.22	
		6.72	97.09	
		6.98	96.83	
		7.01	96.8	TOB
		7.78	96.03	
		7.85	95.96	
		7.72	96.09	
		7.01	96.8	TOB





13	94.71
14.5	96.88
18	97.65
24	98.08
29.6	98.07
32	97.47
33.7	95.59

New profile for Cut

Station	Elevation
0	99.14
3	97.5
10	96.9
24.5	96.2
26.5	95.15
27.5	95.15
29.5	96.2
58	97.2
75	97.5
78	98.69

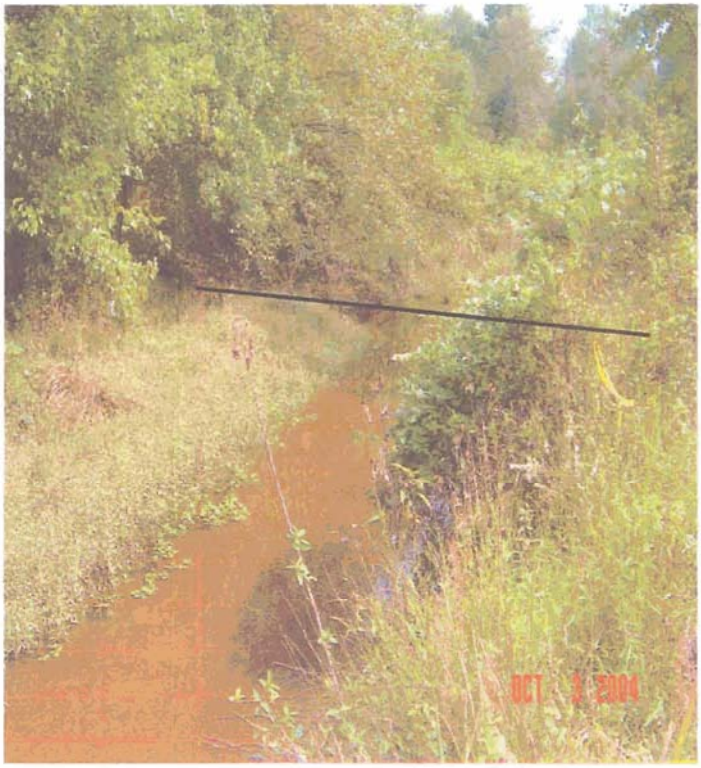
Appendix B: Photo Log

Photo Log

Existing Roadway on the project site that crosses Moccasin Creek , Stream S3, and Wolf Creek.

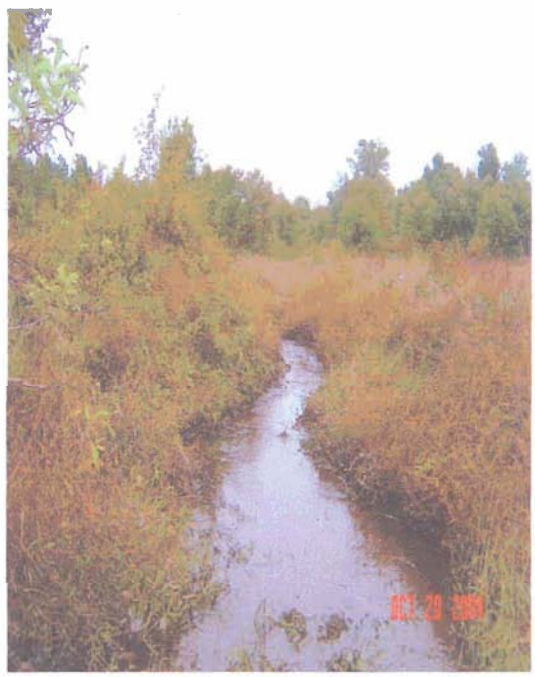
Moccasin Creek as viewed upstream of the large culverts – water impounding due to restrictions at the culvert.

Upstream face of the 72 inch metal culvert – currently restricted to one half it's capacity.



Classification cross section on Moccasin Creek approximately 100 feet downstream of the 72" culvert.

Existing roadway and wetlands as viewed looking east from the existing culverts in Moccasin Creek.



Wolf Creek as viewed looking north from the existing culvert.

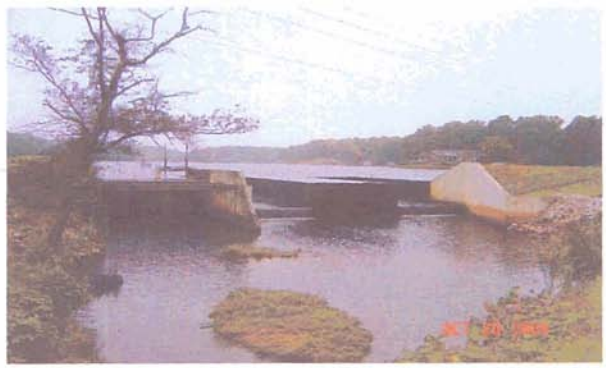
Stream S1 in a previously logged area of the site. The photograph below shows the stream condition outside of the logging area just upstream of the haul road culvert on S1.

Existing pond located on line with stream S2 at the south east corner of the project site.

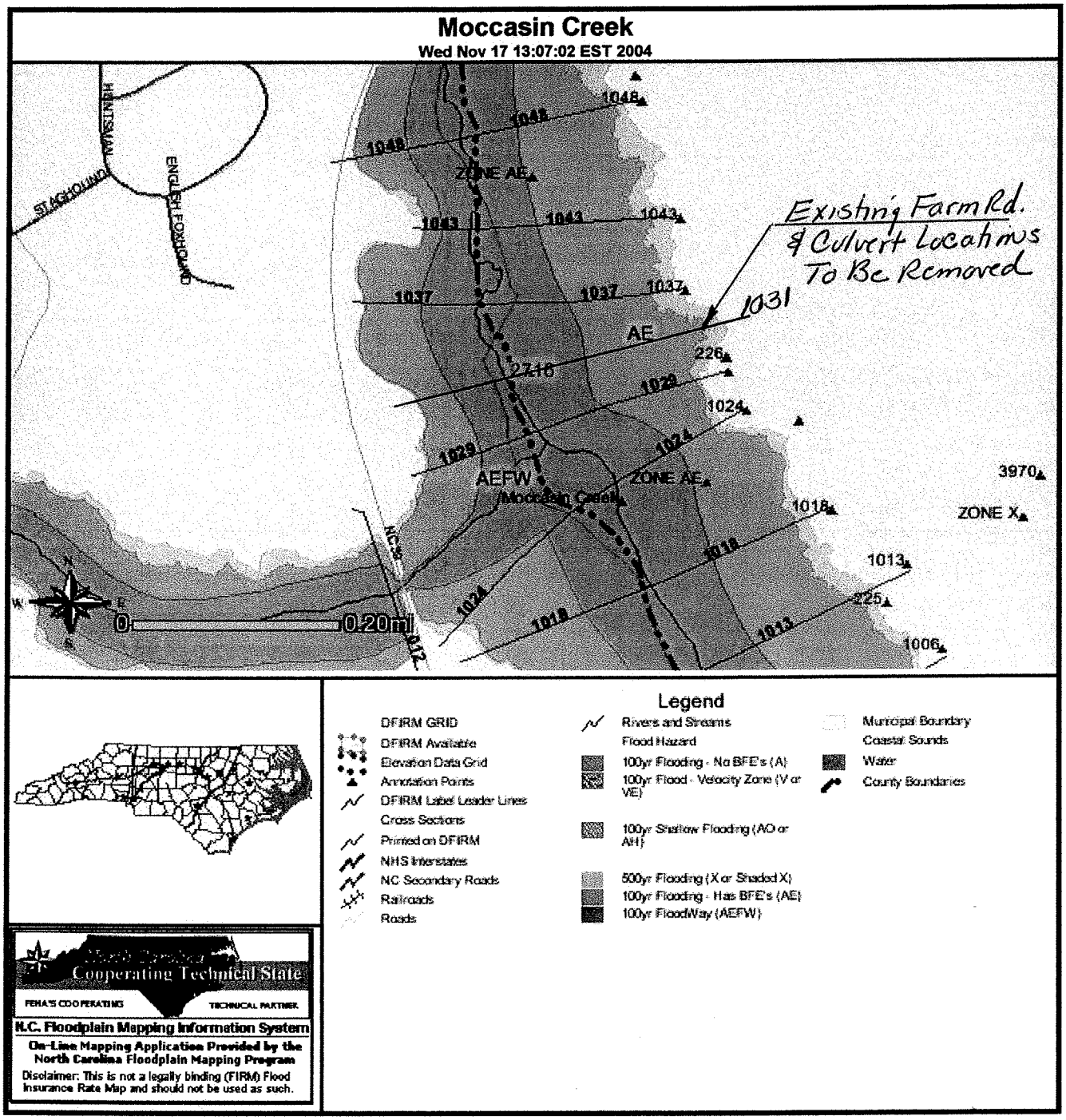
Stream S2 located downstream of the pond. Stream recovering from timbering impacts.

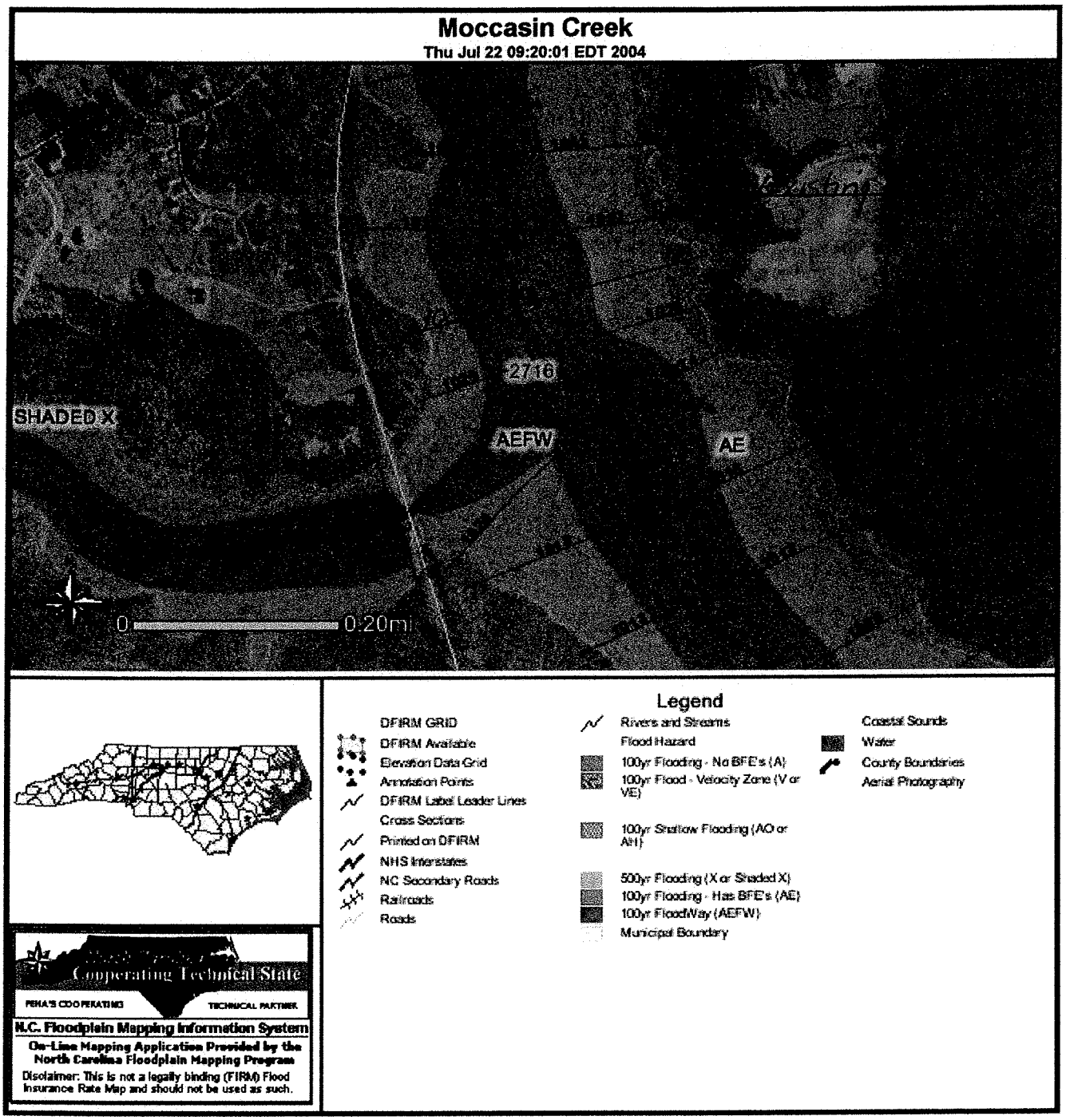
Typical haul roads on the project site with selective pre-commercial thinning.

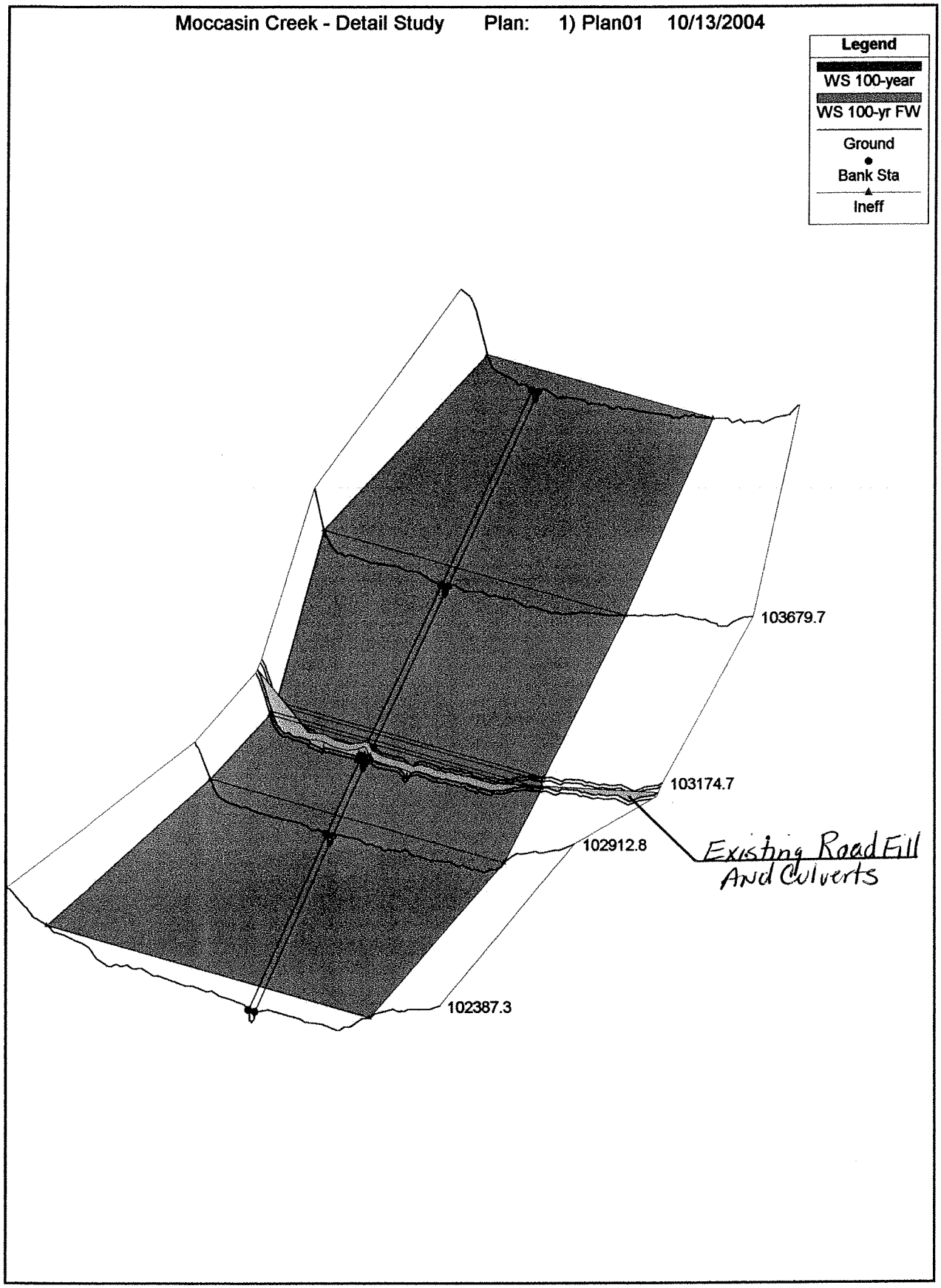
Haul road on S2 with a typical culvert installation under the roadway.

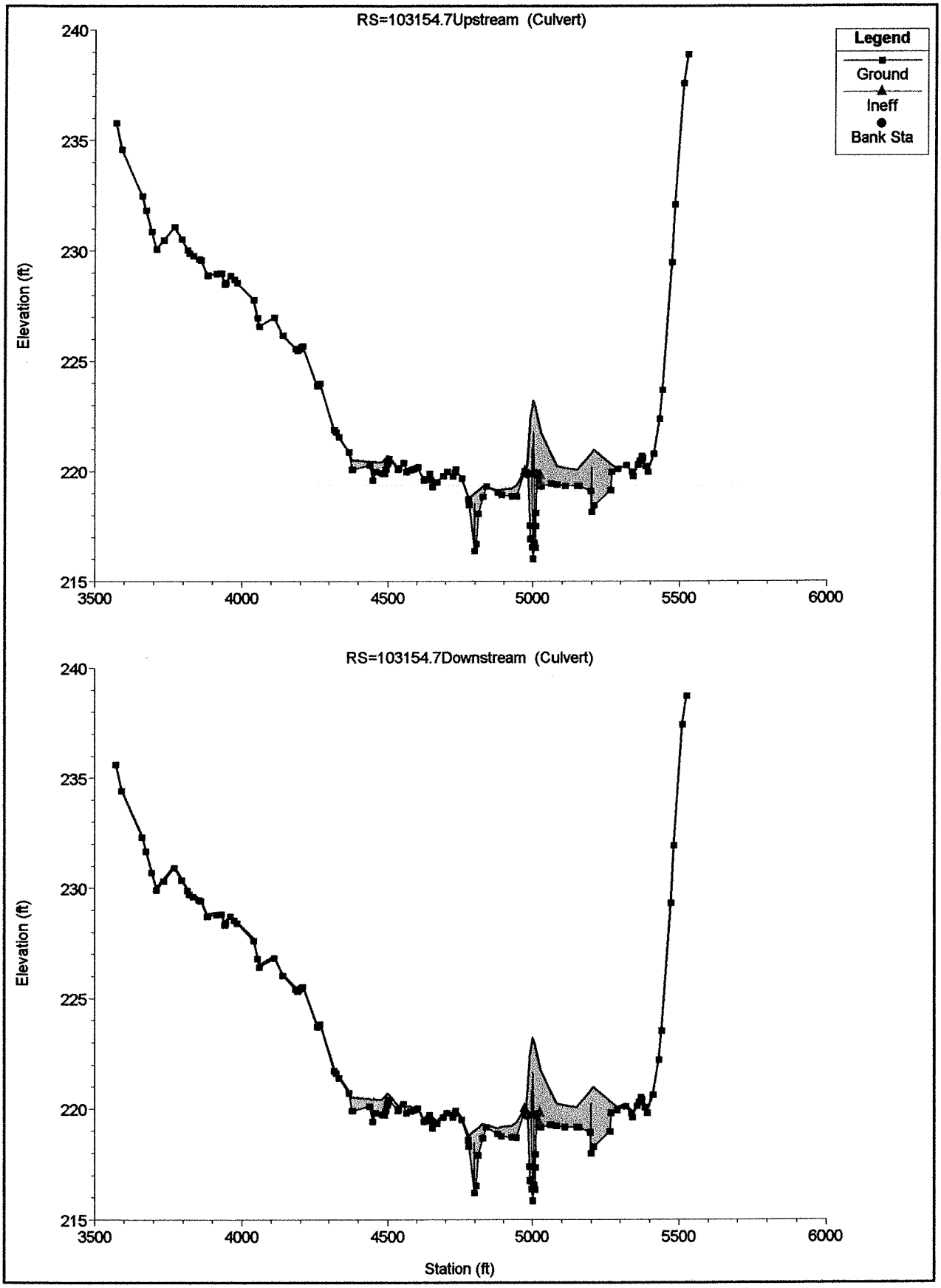


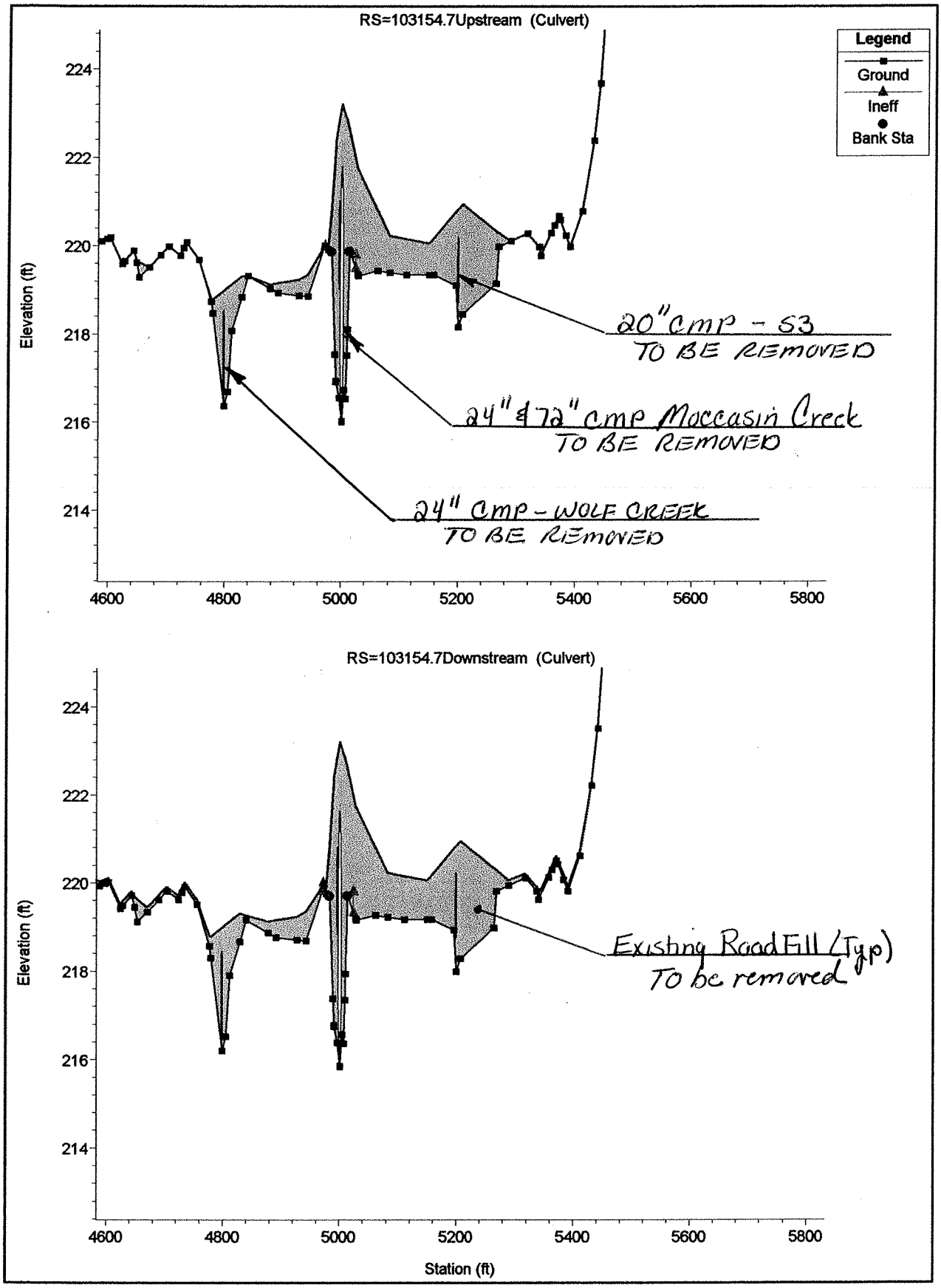
Appendix C: FEMA Data

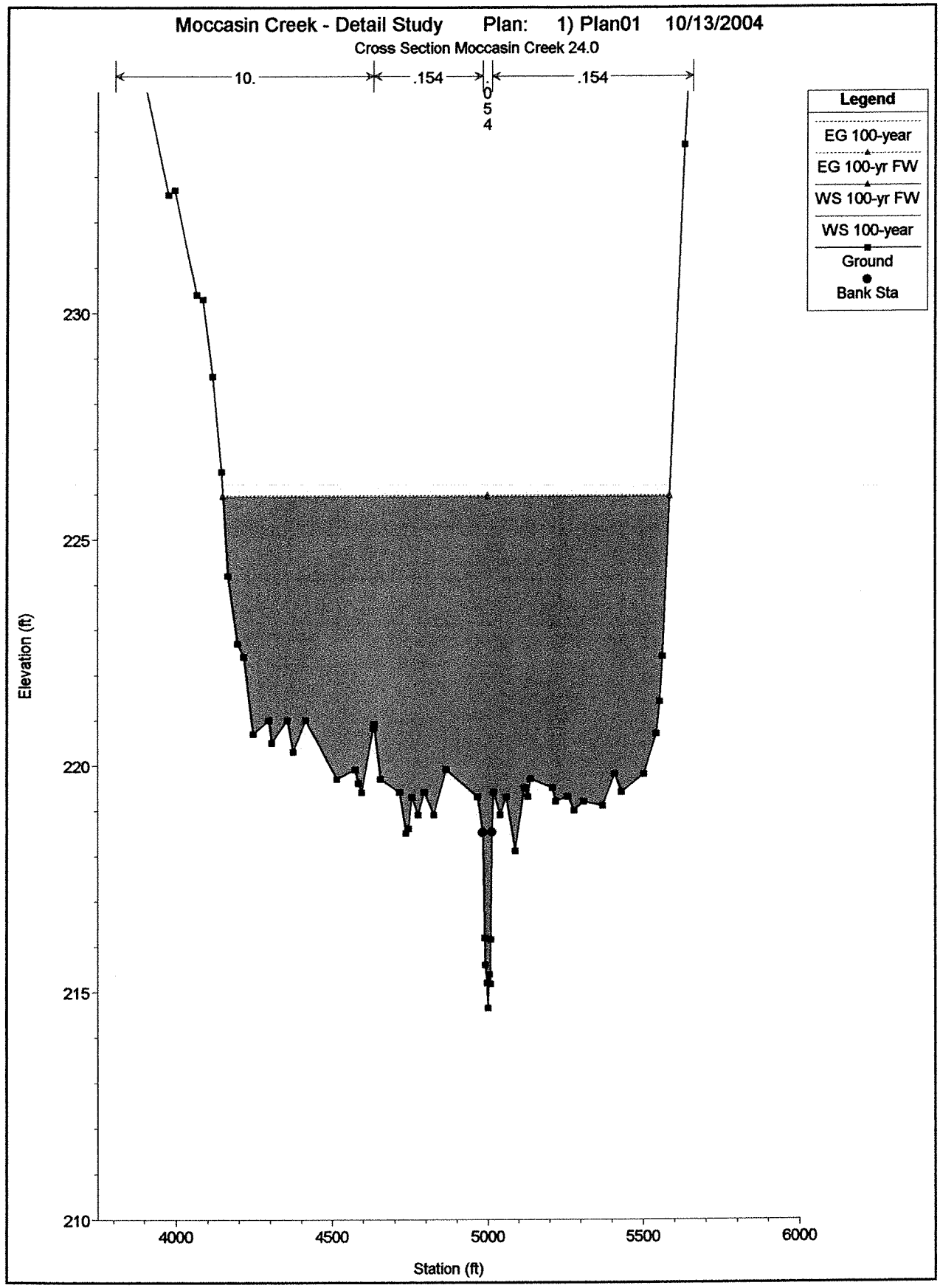

Moccasin Creek
Wed Nov 17 13:07:02 EST 2004
HUNTSMAN
STAGHOUND
ENGLISH FOXHOUND
1048
1048
1048
ZONE AE
1043
1043
1043
1037
1037
1037
Existing Farm Rd.
& Culvert Locations
To Be Removed
1031
AE
226
2716
1029
1029
1024
1024
AEFW
Moccasin Creek
ZONE AE
3970
ZONE X
1018
1018
1013
225
1006
NC-96
0
0.20mi
Legend
DFIRM GRID
DFIRM Availalble
Elevation Data Grid
Annotation Points
DFIRM Label Leader Lines
Cross Sections
Primted on DFIRM
NHS Interstates
NC Secondary Roads
Railroads
Roads
Rivers and Streams
Flood Hazard
100yr Flooding - No BFE's (A)
100yr Flood - Velocity Zone (V or VE)
100yr Shallow Flooding (AO or AH)
500yr Flooding (X or Shaded X)
100yr Flooding - Has BFE's (AE)
100yr FloodWay (AEFW)
Municipal Boundary
Coastal Sounds
Water
County Boundaries
Cooperating Technical State
FEMA'S COOPERATING
TECHNICAL PARTNER
N.C. Floodplain Mapping Information System
On-Line Mapping Application Provided by the North Carolina Floodplain Mapping Program
Disclaimer: This is not a legally binding (FIRM) Flood Insurance Rate Map and should not be used as such.

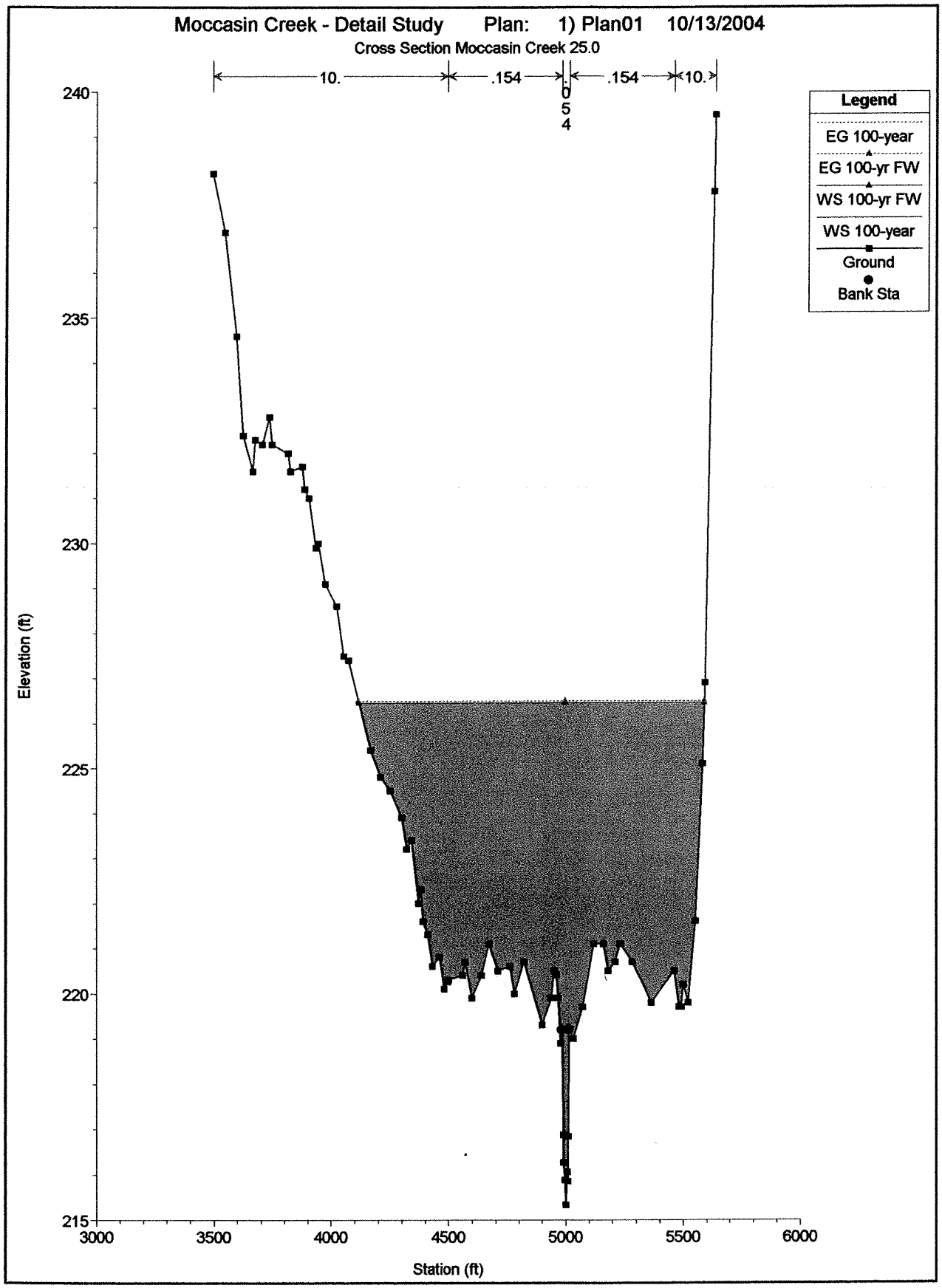

Moccasin Creek
Thu Jul 22 09:20:01 EDT 2004
SHADED X
AEFW
AE
2710
0
0.20mi
Legend
DFIRM GRID
DFIRM Available
Elevation Data Grid
Annotation Points
DFIRM Label Leader Lines
Cross Sectors
Printed on DFIRM
NHS Interstates
NC Secondary Roads
Railroads
Roads
Rivers and Streams
Flood Hazard
100yr Flooding - No BFE's (A)
100yr Flood - Velocity Zone (V or VE)
100yr Shallow Flooding (AO or AH)
500yr Flooding (X or Shaded X)
100yr Flooding - Has BFE's (AE)
100yr FloodWay (AEFW)
Municipal Boundary
Coastal Sounds
Water
County Boundaries
Aerial Photography
Cooperating Technical State
FEMA'S COOPERATING
TECHNICAL PARTNER
N.C. Floodplain Mapping Information System
On-Line Mapping Application Provided by the North Carolina Floodplain Mapping Program
Disclaimer: This is not a legally binding (FIRM) Flood Insurance Rate Map and should not be used as such.


Moccasin Creek - Detail Study Plan: 1) Plan01 10/13/2004
Legend
WS 100-year
WS 100-yr FW
Ground
Bank Sta
Ineff
103679.7
103174.7
102912.8
102387.3
Existing Road Fill
And Culverts


RS=103154.7Upstream (Culvert)
Legend
Ground
Ineff
Bank Sta
Elevation (ft)
240
235
230
225
220
215
3500
4000
4500
5000
5500
6000
RS=103154.7Downstream (Culvert)
Elevation (ft)
240
235
230
225
220
215
3500
4000
4500
5000
5500
6000
Station (ft)


RS=103154.7Upstream (Culvert)
Legend
Ground
Ineff
Bank Sta
Elevation (ft)
224
222
220
218
216
214
4600
4800
5000
5200
5400
5600
5800
20" CMP - S3
TO BE REMOVED
24" & 72" CMP Moccasin Creek
TO BE REMOVED
24" CMP - WOLF CREEK
TO BE REMOVED
RS=103154.7Downstream (Culvert)
Elevation (ft)
224
222
220
218
216
214
4600
4800
5000
5200
5400
5600
5800
Station (ft)
Existing Road Fill (Typ)
To be removed


Moccasin Creek - Detail Study Plan: 1) Plan01 10/13/2004
Cross Section Moccasin Creek 24.0
10.
.154
.054
.154
Legend
EG 100-year
EG 100-yr FW
WS 100-yr FW
WS 100-year
Ground
Bank Sta
230
225
220
215
210
Elevation (ft)
4000
4500
5000
5500
6000
Station (ft)


Moccasin Creek - Detail Study Plan: 1) Plan01 10/13/2004
Cross Section Moccasin Creek 25.0
10.
.154
.054
.154
10.
Legend
EG 100-year
EG 100-yr FW
WS 100-yr FW
WS 100-year
Ground
Bank Sta
Elevation (ft)
240
235
230
225
220
215
3000
3500
4000
4500
5000
5500
6000
Station (ft)

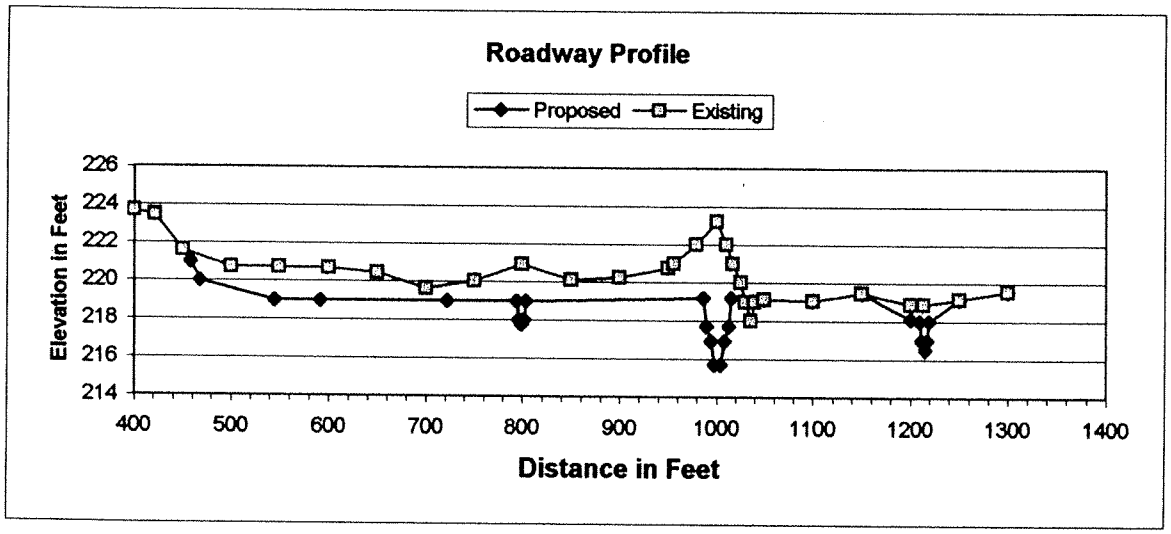
Moccasin Creek Roadway Profile
Final 11/16
Proposed Roadway

Station	Elevation	Fema Stations
458	221	5542
468	220	5532
545	219	5455
591	219	5409
722	219	5278
794.5	219	5205.5
796.6	218	5203.4
799	217.75	5201
801.5	218	5198.5
803.5	219	5196.5
986.5	219.2	5013.5
989.5	217.7	5010.5
994	216.9	5006
997.5	215.7	5002.5
1004.5	215.7	4995.5
1008	216.9	4992
1012.5	217.7	4987.5
1015.5	219.2	4984.5
1050	219.13	4950
1100	219.06	4900
1150	219.46	4850
1200	218.1	4800
1209.5	218	4790.5
1211.5	217	4788.5
1215.5	216.5	4784.5
1217.5	217	4782.5
1219.5	218	4780.5
1250	219.15	4750
1300	219.57	4700

Surveyed station 400 =FEMA station 5650

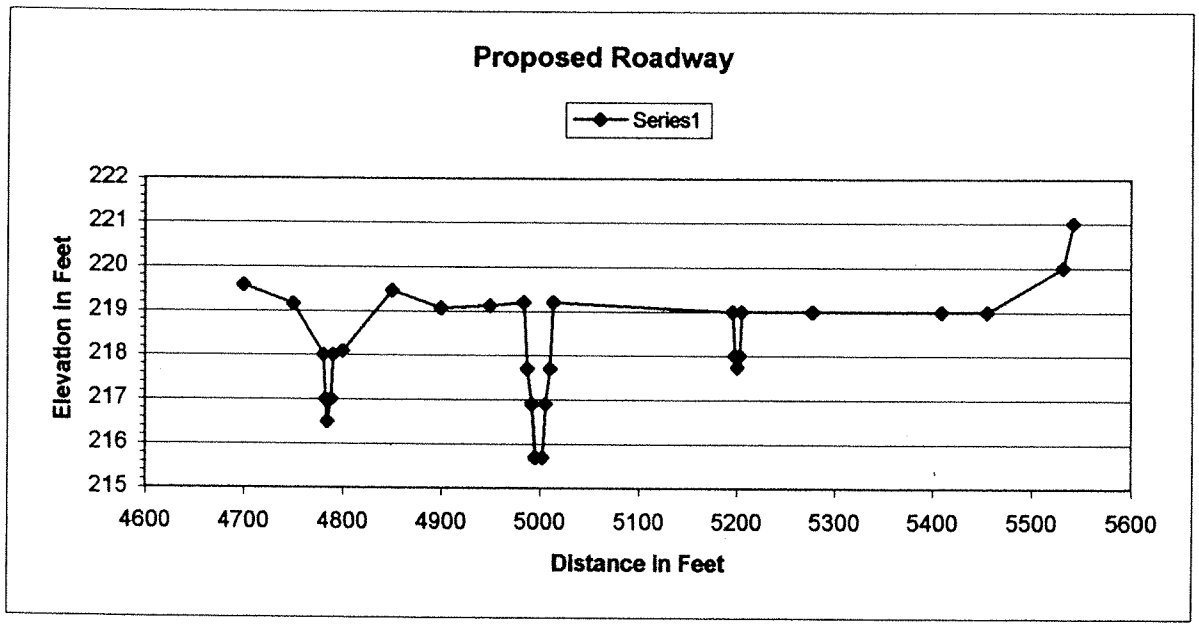
Surveyed Existing Profile

400	223.69
421.7	223.46
450	221.58
500	220.72
550	220.71
600	220.69
650	220.43
700	219.62
750	220.02
800	220.9
850	220.09
900	220.23
950	220.75
956	221
979	222
1000	223.22
1010	222
1017	221
1025	220
1030	219
1036	218
1040	219
1050	219.13
1100	219.06
1150	219.46
1200	218.89
1213	218.89
1250	219.15
1300	219.57



Fema Stat	Elevation
5542	221
5532	220
5455	219
5409	219
5278	219
5205.5	219
5203.4	218
5201	217.75
5198.5	218
5196.5	219
5013.5	219.2
5010.5	217.7
5006	216.9
5002.5	215.7
4995.5	215.7
4992	216.9
4987.5	217.7
4984.5	219.2
4950	219.13
4900	219.06
4850	219.46
4800	218.1
4790.5	218
4788.5	217
4784.5	216.5
4782.5	217
4780.5	218
4750	219.15
4700	219.57

Fema Stat	Elevation
4700	219.57
4750	219.15
4780.5	218
4782.5	217
4784.5	216.5
4788.5	217
4790.5	218
4800	218.1
4850	219.46
4900	219.06
4950	219.13
4984.5	219.2
4987.5	217.7
4992	216.9
4995.5	215.7
5002.5	215.7
5006	216.9
5010.5	217.7
5013.5	219.2
5196.5	219
5198.5	218
5201	217.75
5203.4	218
5205.5	219
5278	219
5409	219
5455	219
5532	220
5542	221

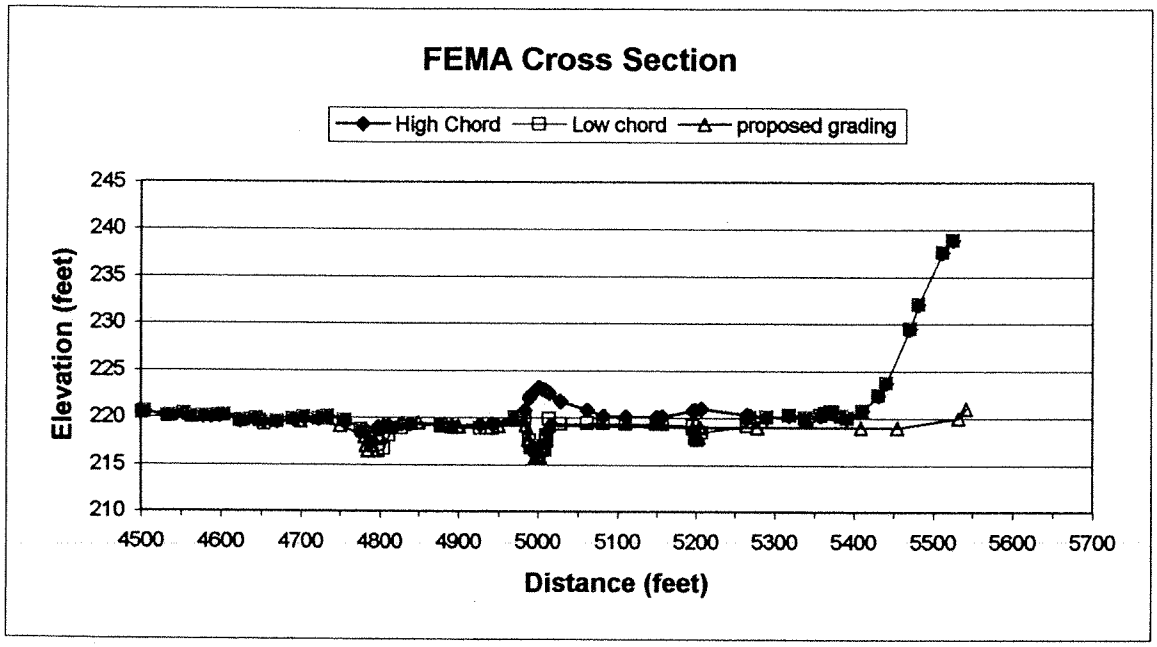


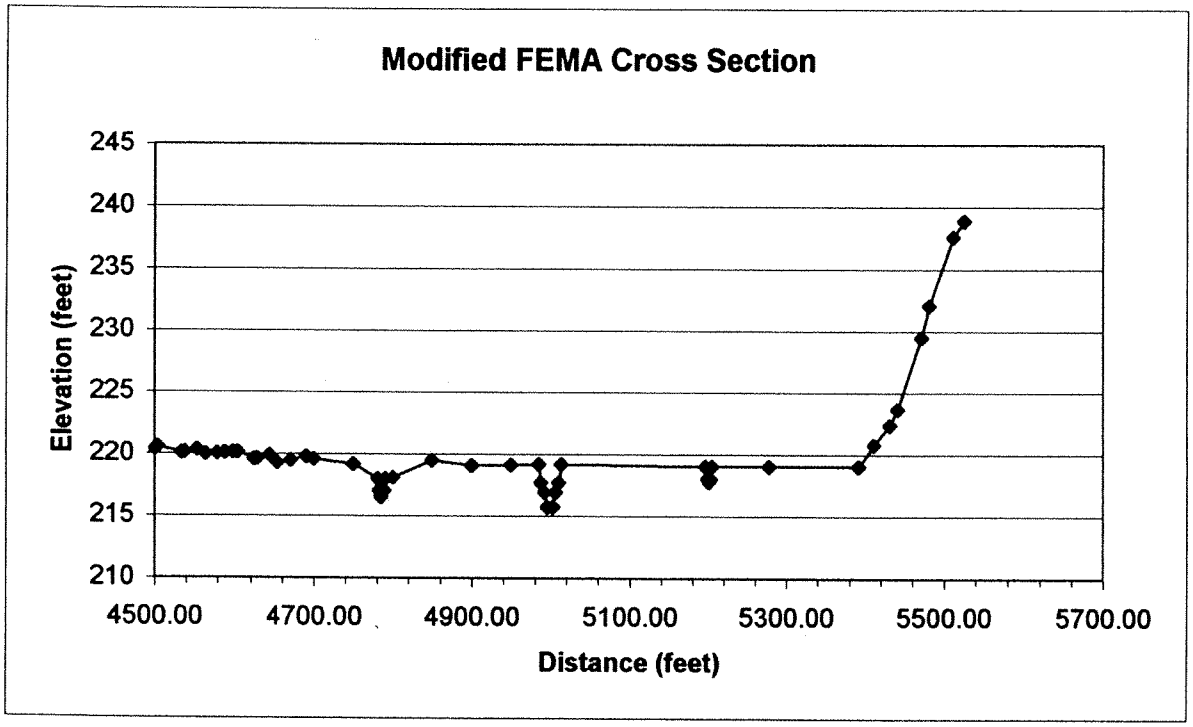
FEMA Cross Section

Station	High Chord	Low chord
3570.9	235.78	235.78
3590.9	234.58	234.58
3660.9	232.48	232.48
3674.4	231.83	231.83
3694.4	230.87	230.87
3710.9	230.08	230.08
3734.4	230.47	230.47
3770.9	231.08	231.08
3794.4	230.52	230.52
3814.4	230.04	230.04
3820.9	229.88	229.88
3834.4	229.78	229.78
3854.4	229.63	229.63
3860.9	229.58	229.58
3880.9	228.88	228.88
3884.4	228.89	228.89
3914.4	228.95	228.95
3930.9	228.98	228.98
3940.9	228.48	228.48
3944.4	228.55	228.55
3974.4	228.69	228.69
3984.4	228.56	228.56
4040.9	227.78	227.78
4054.4	226.97	226.97
4060.9	226.58	226.58
4110.9	226.98	226.98
4140.9	226.18	226.18
4184.4	225.57	225.57
4190.9	225.48	225.48
4194.4	225.52	225.52
4198.9	225.58	225.58
4204.4	225.63	225.63
4208.9	225.68	225.68
4258.9	223.88	223.88
4268.9	223.98	223.98
4318.9	221.88	221.88
4324.4	221.77	221.77
4334.4	221.57	221.57
4368.9	220.88	220.88
4378.9	220.51	220.08
4381	220.5	220.09
4438.9	220.44	220.28
4448.9	220.43	219.58
4458.9	220.42	219.98
4481	220.4	219.91
4488.9	220.52	219.88
4494.1	220.6	220.08

4499.4	220.68	220.34
4501	220.7	220.43
4504.1	220.65	220.58
4534.1	220.17	220.08
4538.6	220.15	220.15
4554.1	220.38	220.38
4564.1	220.1	219.98
4578.6	220.1	220.05
4588.6	220.1	220.1
4598.6	220.15	220.15
4604.1	220.18	220.18
4624.1	219.58	219.58
4628.6	219.65	219.65
4644.1	219.88	219.88
4648.6	219.7	219.61
4654.1	219.63	219.28
4670.7	219.51	219.51
4690.7	219.79	219.79
4704.1	219.98	219.98
4724.1	219.78	219.78
4729.9	219.95	219.95
4734.1	220.08	220.08
4755.3	219.68	219.68
4777	218.81	218.74
4779.5	218.78	218.47
4798.7	218.98	216.37
4805.7	219.06	216.69
4812.3	219.12	218.07
4829	219.3	218.83
4839.6	219.32	219.32
4878.1	219.12	219.03
4891.7	219.15	218.93
4927.7	219.23	218.87
4943.4	219.35	218.85
4971.6	220	220
4978.1	219.92	219.92
4983.7	220.79	219.86
4989.6	222.02	217.54
4991.1	222.33	216.94
4991.5	222.41	216.91
4997.1	222.86	216.55
5001.4	223.2	216
5001.5	223.21	216.02
5005.9	223.03	216.73
5008.6	222.93	216.53
5010.4	222.85	217.51
5011.5	222.81	218.1
5014.8	222.61	219.87
5028.6	221.75	219.35
5029.3	221.73	219.32
5062.1	220.81	219.43

5082.6	220.23	219.39
5110.8	220.15	219.34
5150.2	220.05	219.34
5157.3	220.16	219.34
5195.8	220.77	219.1
5199.7	220.83	218.16
5207.1	220.95	218.45
5207.2	220.95	218.45
5265.1	220.33	219.14
5268.8	220.29	219.98
5289.9	220.11	220.11
5318.8	220.28	220.28
5338.6	219.98	219.98
5338.8	219.98	219.98
5341.5	219.78	219.78
5358.6	220.29	220.29
5364	220.46	220.46
5371.5	220.68	220.68
5374	220.59	220.59
5384	220.24	220.24
5391.5	219.98	219.98
5411.5	220.78	220.78
5431.5	222.38	222.38
5441.5	223.68	223.68
5471.5	229.48	229.48
5481.5	232.08	232.08
5511.5	237.58	237.58
5525.1	238.88	238.88





Cross Section left to right as viewed looking downstream.

Sections entered in to the post project HEC-Ras Model 11/17/2004

New Fema Cross section with the road fill removed Upstream Station 103174.7

US 103174.7			**DS 103134.7**		
Station	Low chord	N-value	Station	Low chord	N-value
3570.90	235.78	10	3570.9	235.51	10
3590.90	234.58		3590.9	234.31	
3660.90	232.48		3660.9	232.21	
3674.40	231.83		3674.4	231.56	
3694.40	230.87		3694.4	230.6	
3710.90	230.08		3710.9	229.81	
3734.40	230.47		3734.4	230.2	
3770.90	231.08		3770.9	230.81	
3794.40	230.52		3794.4	230.25	
3814.40	230.04		3814.4	229.77	
3820.90	229.88		3820.9	229.61	
3834.40	229.78		3834.4	229.51	
3854.40	229.63		3854.4	229.36	
3860.90	229.58		3860.9	229.31	
3880.90	228.88		3880.9	228.61	
3884.40	228.89		3884.4	228.62	
3914.40	228.95		3914.4	228.68	
3930.90	228.98		3930.9	228.71	
3940.90	228.48		3940.9	228.21	
3944.40	228.55		3944.4	228.28	
3974.40	228.69		3974.4	228.42	
3984.40	228.56		3984.4	228.29	
4040.90	227.78		4040.9	227.51	
4054.40	226.97		4054.4	226.7	
4060.90	226.58		4060.9	226.31	
4110.90	226.98		4110.9	226.71	
4140.90	226.18		4140.9	225.91	
4184.40	225.57		4184.4	225.3	
4190.90	225.48		4190.9	225.21	
4194.40	225.52		4194.4	225.25	
4198.90	225.58		4198.9	225.31	
4204.40	225.63		4204.4	225.36	
4208.90	225.68		4208.9	225.41	
4258.90	223.88		4258.9	223.61	
4268.90	223.98		4268.9	223.71	
4318.90	221.88		4318.9	221.61	
4324.40	221.77		4324.4	221.5	
4334.40	221.57		4334.4	221.3	
4368.90	220.88		4368.9	220.61	
4378.90	220.08		4378.9	219.81	
4381.00	220.09		4381	219.82	
4438.90	220.28		4438.9	220.01	
4448.90	219.58		4448.9	219.31	
4458.90	219.98		4458.9	219.71	
4481.00	219.91		4481	219.64	
4488.90	219.88		4488.9	219.61	
4494.10	220.08		4494.1	219.81	

4499.40	220.34	0.154	4499.4	220.07	0.154
4501.00	220.43		4501	220.16	
4504.10	220.58		4504.1	220.31	
4534.10	220.08		4534.1	219.81	
4538.60	220.15		4538.6	219.88	
4554.10	220.38		4554.1	220.11	
4564.10	219.98		4564.1	219.71	
4578.60	220.05		4578.6	219.78	
4588.60	220.1		4588.6	219.83	
4598.60	220.15		4598.6	219.88	
4604.10	220.18		4604.1	219.91	
4624.10	219.58		4624.1	219.31	
4628.60	219.65		4628.6	219.38	
4644.10	219.88		4644.1	219.61	
4648.60	219.61		4648.6	219.34	
4654.10	219.28		4654.1	219.01	
4670.70	219.51		4670.7	219.24	
4690.70	219.79		4690.7	219.52	
4700.00	219.57		4700	219.3	
4750.00	219.15		4750	218.88	
4780.50	218	0.054	4780.5	217.73	0.054
4782.50	217		4782.5	216.73	
4784.50	216.5		4784.5	216.23	
4788.50	217		4788.5	216.73	
4790.50	218	0.154	4790.5	217.73	0.154
4800.00	218.1		4800	217.83	
4850.00	219.46		4850	219.19	
4900.00	219.06		4900	218.79	
4950.00	219.13		4950	218.86	
4984.50	219.2	0.054	4984.5	218.93	0.054
4987.50	217.7		4987.5	217.43	
4992.00	216.9		4992	216.63	
4995.50	215.7		4995.5	215.43	
5002.50	215.7		5002.5	215.43	
5006.00	216.9		5006	216.63	
5010.50	217.7		5010.5	217.43	
5013.50	219.2	0.154	5013.5	218.93	0.154
5196.50	219	0.054	5196.5	218.73	0.054
5198.50	218		5198.5	217.73	
5201.00	217.75		5201	217.48	
5203.40	218		5203.4	217.73	
5205.50	219	0.154	5205.5	218.73	0.154
5278.00	219		5278	218.73	
5391.50	219		5391.5	218.73	
5411.50	220.78		5411.5	220.51	
5431.50	222.38		5431.5	222.11	
5441.50	223.68		5441.5	223.41	
5471.50	229.48		5471.5	229.21	
5481.50	232.08		5481.5	231.81	
5511.50	237.58		5511.5	237.31	
5525.10	238.88		5525.1	238.61	

Original Fema Cross Section			Original Fema Cross Section			Difference	Difference
103174.7 Upstream			103134.7 Downstream			in station	in elev
3570.9	235.79	10	3570.9	235.52	10	0	0.27
3590.9	234.59		3590.9	234.32		0	0.27
3660.9	232.49		3660.9	232.22		0	0.27
3674.4	231.84		3674.4	231.57		0	0.27
3694.4	230.88		3694.4	230.61		0	0.27
3710.9	230.09		3710.9	229.82		0	0.27
3734.4	230.48		3734.4	230.21		0	0.27
3770.9	231.09		3770.9	230.82		0	0.27
3794.4	230.53		3794.4	230.26		0	0.27
3814.4	230.05		3814.4	229.78		0	0.27
3820.9	229.89		3820.9	229.62		0	0.27
3834.4	229.79		3834.4	229.52		0	0.27
3854.4	229.64		3854.4	229.37		0	0.27
3860.9	229.59		3860.9	229.32		0	0.27
3880.9	228.89		3880.9	228.62		0	0.27
3884.4	228.9		3884.4	228.63		0	0.27
3914.4	228.96		3914.4	228.69		0	0.27
3930.9	228.99		3930.9	228.72		0	0.27
3940.9	228.49		3940.9	228.22		0	0.27
3944.4	228.56		3944.4	228.29		0	0.27
3960.9	228.89		3960.9	228.62		0	0.27
3974.4	228.7		3974.4	228.43		0	0.27
3984.4	228.57		3984.4	228.3		0	0.27
4040.9	227.79		4040.9	227.52		0	0.27
4054.4	226.98		4054.4	226.71		0	0.27
4060.9	226.59		4060.9	226.32		0	0.27
4110.9	226.99		4110.9	226.72		0	0.27
4140.9	226.19		4140.9	225.92		0	0.27
4184.4	225.58		4184.4	225.31		0	0.27
4190.9	225.49		4190.9	225.22		0	0.27
4194.4	225.53		4194.4	225.26		0	0.27
4198.9	225.59		4198.9	225.32		0	0.27
4204.4	225.64		4204.4	225.37		0	0.27
4208.9	225.69		4208.9	225.42		0	0.27
4258.9	223.89		4258.9	223.62		0	0.27
4268.9	223.99		4268.9	223.72		0	0.27
4318.9	221.89		4318.9	221.62		0	0.27
4324.4	221.78		4324.4	221.51		0	0.27
4334.4	221.58		4334.4	221.31		0	0.27
4368.9	220.89		4368.9	220.62		0	0.27
4378.9	220.09		4378.9	219.82		0	0.27
4381	220.1		4381	219.83		0	0.27
4438.9	220.29		4438.9	220.02		0	0.27
4448.9	219.59		4448.9	219.32		0	0.27
4458.9	219.99		4458.9	219.72		0	0.27
4481	219.92		4481	219.65		0	0.27
4488.9	219.89		4488.9	219.62		0	0.27
4494.1	220.09		4494.1	219.82		0	0.27
4499.4	220.35	0.154	4499.4	220.08	0.154	0	0.27

4501	220.44		4501	220.17		0	0.27
4504.1	220.59		4504.1	220.32		0	0.27
4534.1	220.09		4534.1	219.82		0	0.27
4538.6	220.16		4538.6	219.89		0	0.27
4554.1	220.39		4554.1	220.12		0	0.27
4564.1	219.99		4564.1	219.72		0	0.27
4578.6	220.06		4578.6	219.79		0	0.27
4588.6	220.11		4588.6	219.84		0	0.27
4598.6	220.16		4598.6	219.89		0	0.27
4604.1	220.19		4604.1	219.92		0	0.27
4624.1	219.59		4624.1	219.32		0	0.27
4628.6	219.66		4628.6	219.39		0	0.27
4644.1	219.89		4644.1	219.62		0	0.27
4648.6	219.62		4648.6	219.35		0	0.27
4654.1	219.29		4654.1	219.02		0	0.27
4670.7	219.52		4670.7	219.25		0	0.27
4690.7	219.8		4690.7	219.53		0	0.27
4704.1	219.99		4704.1	219.72		0	0.27
4724.1	219.79		4724.1	219.52		0	0.27
4729.9	219.96		4729.9	219.69		0	0.27
4734.1	220.09		4734.1	219.82		0	0.27
4755.3	219.69		4755.3	219.42		0	0.27
4777	218.75		4777	218.48		0	0.27
4779.5	218.48		4779.5	218.21		0	0.27
4798.7	216.38		4798.7	216.11		0	0.27
4805.7	216.7		4805.7	216.43		0	0.27
4812.3	218.08		4812.3	217.81		0	0.27
4829	218.84		4829	218.57		0	0.27
4839.6	219.33		4839.6	219.06		0	0.27
4878.1	219.04		4878.1	218.77		0	0.27
4891.7	218.94		4891.7	218.67		0	0.27
4927.7	218.88		4927.7	218.61		0	0.27
4943.4	218.86		4943.4	218.59		0	0.27
4971.6	220.01		4971.6	219.74		0	0.27
4978.1	219.93		4978.1	219.66		0	0.27
4983.7	219.87	0.054	4983.7	219.6	0.054	0	0.27
4989.6	217.55		4989.6	217.28		0	0.27
4991.1	216.95		4991.1	216.68		0	0.27
4991.5	216.92		4991.5	216.65		0	0.27
4997.1	216.56		4997.1	216.29		0	0.27
5001.4	216.01		5001.4	215.74		0	0.27
5001.5	216.03		5001.5	215.76		0	0.27
5005.9	216.74		5005.9	216.47		0	0.27
5008.6	216.54		5008.6	216.27		0	0.27
5010.4	217.52		5010.4	217.25		0	0.27
5011.5	218.11		5011.5	217.84		0	0.27
5014.8	219.88	0.154	5014.8	219.61	0.154	0	0.27
5028.6	219.36		5028.6	219.09		0	0.27
5029.3	219.33		5029.3	219.06		0	0.27
5062.1	219.44		5062.1	219.17		0	0.27
5082.6	219.4		5082.6	219.13		0	0.27

5110.8	219.35	5110.8	219.08	0	0.27
5150.2	219.35	5150.2	219.08	0	0.27
5157.3	219.35	5157.3	219.08	0	0.27
5195.8	219.11	5195.8	218.84	0	0.27
5199.7	218.17	5199.7	217.9	0	0.27
5207.1	218.46	5207.1	218.19	0	0.27
5207.2	218.46	5207.2	218.19	0	0.27
5265.1	219.15	5265.1	218.88	0	0.27
5268.8	219.99	5268.8	219.72	0	0.27
5289.9	220.12	5289.9	219.85	0	0.27
5318.8	220.29	5318.8	220.02	0	0.27
5338.6	219.99	5338.6	219.72	0	0.27
5338.8	219.99	5338.8	219.72	0	0.27
5341.5	219.79	5341.5	219.52	0	0.27
5358.6	220.3	5358.6	220.03	0	0.27
5364	220.47	5364	220.2	0	0.27
5371.5	220.69	5371.5	220.42	0	0.27
5374	220.6	5374	220.33	0	0.27
5384	220.25	5384	219.98	0	0.27
5391.5	219.99	5391.5	219.72	0	0.27
5411.5	220.79	5411.5	220.52	0	0.27
5431.5	222.39	5431.5	222.12	0	0.27
5441.5	223.69	5441.5	223.42	0	0.27
5471.5	229.49	5471.5	229.22	0	0.27
5481.5	232.09	5481.5	231.82	0	0.27
5511.5	237.59	5511.5	237.32	0	0.27
5525.1	238.89	5525.1	238.62	0	0.27

Pre-Project : Effective FEMA

HEC-RAS Plan: 100YR_FW River: Moccasin Creek Reach: Reach - 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach - 1	142883.0	100-year	1130.00	300.33	306.63		306.66	0.002670	3.55	1262.91	487.74	0.27
Reach - 1	142883.0	100-yr FW	1130.00	300.33	307.64		307.69	0.002976	4.21	806.93	200.00	0.30
Reach - 1	142506.8	100-year	1520.00	298.14	305.08		305.16	0.005662	5.58	939.26	316.64	0.40
Reach - 1	142506.8	100-yr FW	1520.00	298.14	306.07		306.20	0.005040	5.85	716.63	140.00	0.39
Reach - 1	142085.5	100-year	1520.00	296.19	304.02		304.05	0.001485	3.14	1688.76	481.28	0.21
Reach - 1	142085.5	100-yr FW	1520.00	296.19	305.00		305.04	0.001664	3.64	1216.71	225.00	0.23
Reach - 1	141695.4	100-year	1520.00	295.44	302.23		302.60	0.018746	9.99	536.11	208.56	0.73
Reach - 1	141695.4	100-yr FW	1520.00	295.44	302.96		303.47	0.017784	10.53	406.21	95.00	0.73
Reach - 1	141400.5	100-year	1520.00	293.17	299.93		300.02	0.004798	5.47	1241.48	515.92	0.40
Reach - 1	141400.5	100-yr FW	1520.00	293.17	300.92		301.06	0.004356	5.80	836.12	205.00	0.39
Reach - 1	141031.6	100-year	1520.00	292.29	298.52		298.57	0.003244	4.38	1890.24	608.38	0.34
Reach - 1	141031.6	100-yr FW	1520.00	292.29	299.37		299.50	0.004087	5.44	787.30	170.00	0.39
Reach - 1	140546.1	100-year	1520.00	290.14	295.74		295.93	0.010781	7.13	1194.95	576.23	0.60
Reach - 1	140546.1	100-yr FW	1520.00	290.14	296.45		296.71	0.008587	7.03	606.77	165.00	0.55
Reach - 1	140118.9	100-year	1520.00	288.09	295.57		295.57	0.000234	1.40	3487.14	729.87	0.10
Reach - 1	140118.9	100-yr FW	1520.00	288.09	296.44		296.44	0.000141	1.18	3573.56	520.00	0.08
Reach - 1	139764.2	100-year	1520.00	286.82	295.45		295.46	0.000399	2.00	2393.06	491.19	0.13
Reach - 1	139764.2	100-yr FW	1520.00	286.82	296.37		296.38	0.000243	1.69	2494.03	360.00	0.10
Reach - 1	139512.7	100-year	1520.00	285.92	295.22		295.27	0.001977	4.13	1108.87	215.59	0.25
Reach - 1	139512.7	100-yr FW	1520.00	285.92	296.20		296.25	0.001436	3.79	1060.92	140.00	0.22
Reach - 1	139440.4	100-year	1520.00	285.85	295.08	292.09	295.15	0.001154	3.67	1257.01	249.34	0.23
Reach - 1	139440.4	100-yr FW	1520.00	285.85	295.88	292.10	296.08	0.001966	5.09	691.66	87.00	0.30
Reach - 1	139425.9		Inl Struct									
Reach - 1	139411.4	100-year	1520.00	285.82	290.78	290.78	291.71	0.028702	11.21	384.48	178.30	1.00
Reach - 1	139411.4	100-yr FW	1520.00	285.82	291.61	290.98	292.58	0.020156	10.67	323.01	87.00	0.86
Reach - 1	139228.8	100-year	1520.00	276.87	284.28	284.28	285.31	0.032234	14.03	376.55	148.99	0.98
Reach - 1	139228.8	100-yr FW	1520.00	276.87	284.56	284.56	286.76	0.049014	17.79	212.19	45.14	1.21
Reach - 1	139021.6	100-year	1520.00	273.32	282.06	278.71	282.40	0.002735	5.04	567.90	222.37	0.33
Reach - 1	139021.6	100-yr FW	1520.00	273.32	283.08	278.71	283.38	0.001929	4.63	462.86	82.00	0.29
Reach - 1	139001.1		Bridge									
Reach - 1	138980.6	100-year	1520.00	273.24	281.16	278.63	281.68	0.004630	6.05	398.78	166.03	0.42
Reach - 1	138980.6	100-yr FW	1520.00	273.24	282.12	278.63	282.52	0.002950	5.30	390.83	82.00	0.35
Reach - 1	138602.6	100-year	1520.00	273.44	280.22		280.28	0.002233	3.70	2214.60	894.29	0.28
Reach - 1	138602.6	100-yr FW	1520.00	273.44	281.15		281.30	0.002842	4.66	889.11	225.00	0.33
Reach - 1	137952.6	100-year	1900.00	270.66	277.88		278.07	0.005088	5.84	1509.81	562.98	0.43
Reach - 1	137952.6	100-yr FW	1900.00	270.66	278.86		279.08	0.003989	5.75	848.12	175.00	0.39
Reach - 1	137434.3	100-year	1900.00	268.67	277.13		277.15	0.000824	2.68	2578.89	727.29	0.18
Reach - 1	137434.3	100-yr FW	1900.00	268.67	278.12		278.16	0.000913	3.08	1942.74	400.00	0.19
Reach - 1	136882.8	100-year	1900.00	268.13	276.65		276.68	0.000891	2.80	2918.56	774.29	0.19
Reach - 1	136882.8	100-yr FW	1900.00	268.13	277.61		277.66	0.000913	3.09	1914.41	385.52	0.19
Reach - 1	136336.7	100-year	1900.00	267.77	275.49		275.70	0.004834	6.02	1526.00	667.57	0.43
Reach - 1	136336.7	100-yr FW	1900.00	267.77	276.34		276.66	0.004835	6.56	782.96	190.00	0.43
Reach - 1	135928.1	100-year	2370.00	265.31	274.49		274.57	0.001837	4.27	1805.78	443.21	0.27
Reach - 1	135928.1	100-yr FW	2370.00	265.31	275.47		275.58	0.001652	4.39	1415.43	210.00	0.26
Reach - 1	135324.2	100-year	2370.00	262.91	274.09		274.11	0.000390	2.32	3405.57	610.15	0.13
Reach - 1	135324.2	100-yr FW	2370.00	262.91	275.06		275.09	0.000449	2.65	2617.36	350.00	0.14
Reach - 1	134820.4	100-year	2370.00	260.03	273.87		273.91	0.000403	2.77	3184.10	600.40	0.14
Reach - 1	134820.4	100-yr FW	2370.00	260.03	274.81		274.86	0.000438	3.03	2326.96	290.00	0.15
Reach - 1	134563.1	100-year	2370.00	259.18	273.74	267.92	273.79	0.000469	3.08	2742.49	492.16	0.15
Reach - 1	134563.1	100-yr FW	2370.00	259.18	274.57	267.92	274.69	0.000761	4.08	1451.16	145.00	0.19

HEC-RAS Plan: 100YR_FW River: Moccasin Creek Reach: Reach - 1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach - 1	134518.6		Culvert									
Reach - 1	134474.1	100-year	2370.00	259.22	271.39	267.96	271.55	0.001500	4.84	1654.83	395.68	0.25
Reach - 1	134474.1	100-yr FW	2370.00	259.22	272.38	267.81	272.61	0.001559	5.23	1128.69	145.00	0.26
Reach - 1	134327.0	100-year	2370.00	258.90	271.29		271.34	0.000722	3.35	2537.61	506.13	0.17
Reach - 1	134327.0	100-yr FW	2370.00	258.90	272.27		272.37	0.000925	4.00	1638.99	205.00	0.20
Reach - 1	133904.0	100-year	2370.00	259.07	270.27		270.66	0.005387	8.30	952.13	213.49	0.45
Reach - 1	133904.0	100-yr FW	2370.00	259.07	271.24		271.61	0.004257	7.83	799.83	100.00	0.41
Reach - 1	133386.8	100-year	2370.00	258.76	269.89		269.91	0.000532	2.70	2851.25	449.62	0.15
Reach - 1	133386.8	100-yr FW	2370.00	258.76	270.88		270.91	0.000534	2.88	2379.11	275.67	0.15
Reach - 1	132897.3	100-year	2370.00	257.46	269.59		269.63	0.000615	3.09	2269.52	394.36	0.16
Reach - 1	132897.3	100-yr FW	2370.00	257.46	270.58		270.63	0.000617	3.27	1913.13	215.95	0.16
Reach - 1	132466.4	100-year	2370.00	257.40	269.40		269.42	0.000386	2.43	3266.15	504.33	0.13
Reach - 1	132466.4	100-yr FW	2370.00	257.40	270.41		270.43	0.000329	2.37	2890.17	310.00	0.12
Reach - 1	132105.9	100-year	2370.00	256.86	269.31		269.32	0.000185	1.73	4599.91	712.04	0.09
Reach - 1	132105.9	100-yr FW	2370.00	256.86	270.31		270.32	0.000264	2.18	3006.78	320.00	0.11
Reach - 1	131939.0	100-year	2370.00	256.78	269.21		269.26	0.000752	3.47	2816.33	882.95	0.18
Reach - 1	131939.0	100-yr FW	2370.00	256.78	270.20		270.25	0.000640	3.38	2069.00	325.00	0.17
Reach - 1	131747.7	100-year	3470.00	256.57	269.14		269.16	0.000387	2.51	3951.00	533.28	0.13
Reach - 1	131747.7	100-yr FW	3470.00	256.57	270.13		270.16	0.000391	2.67	3352.83	325.00	0.13
Reach - 1	131543.9	100-year	3470.00	255.42	268.99		269.04	0.000798	3.81	2895.80	424.96	0.19
Reach - 1	131543.9	100-yr FW	3470.00	255.42	269.98		270.04	0.000802	4.01	2382.44	225.43	0.19
Reach - 1	131200.0	100-year	3470.00	253.20	267.86	262.43	268.43	0.002403	7.16	1151.48	411.57	0.35
Reach - 1	131200.0	100-yr FW	3470.00	253.20	268.57	262.42	269.36	0.002671	7.81	708.92	62.00	0.37
Reach - 1	131177.5		Bridge									
Reach - 1	131155.0	100-year	3470.00	253.06	266.68	262.29	267.50	0.003552	8.24	915.13	358.95	0.41
Reach - 1	131155.0	100-yr FW	3470.00	253.06	267.51	262.27	268.43	0.003387	8.40	651.83	62.00	0.41
Reach - 1	130822.0	100-year	3470.00	252.68	265.48		266.12	0.004218	7.98	1003.70	179.15	0.42
Reach - 1	130822.0	100-yr FW	3470.00	252.68	266.47		267.14	0.003622	7.82	835.61	88.00	0.40
Reach - 1	130443.0	100-year	3470.00	251.31	264.17		264.68	0.003276	7.14	1103.67	187.30	0.38
Reach - 1	130443.0	100-yr FW	3470.00	251.31	265.05		265.77	0.003546	7.81	769.66	78.00	0.40
Reach - 1	130071.6	100-year	3470.00	250.93	263.28		263.59	0.002389	5.97	1442.07	249.35	0.32
Reach - 1	130071.6	100-yr FW	3470.00	250.93	264.24		264.63	0.002292	6.19	1127.34	125.00	0.32
Reach - 1	129838.9	100-year	3470.00	250.86	261.98		262.70	0.006297	8.73	891.74	159.99	0.50
Reach - 1	129838.9	100-yr FW	3470.00	250.86	262.98		263.79	0.005564	8.78	752.40	89.00	0.48
Reach - 1	129460.5	100-year	3470.00	249.10	260.09		260.55	0.004791	7.54	1198.60	246.48	0.44
Reach - 1	129460.5	100-yr FW	3470.00	249.10	260.94		261.67	0.005511	8.58	851.42	125.00	0.48
Reach - 1	128933.7	100-year	3470.00	247.91	259.04		259.13	0.001516	4.29	2547.28	520.10	0.25
Reach - 1	128933.7	100-yr FW	3470.00	247.91	260.03		260.15	0.001451	4.48	2126.52	315.00	0.25
Reach - 1	128450.1	100-year	3470.00	247.33	258.28		258.38	0.001591	4.34	2543.05	580.38	0.25
Reach - 1	128450.1	100-yr FW	3470.00	247.33	259.27		259.41	0.001637	4.71	1997.73	300.00	0.26
Reach - 1	127746.3	100-year	3800.00	246.60	256.88		257.01	0.002386	5.05	2449.76	612.86	0.30
Reach - 1	127746.3	100-yr FW	3800.00	246.60	257.66		257.88	0.002895	5.89	1750.98	295.00	0.34
Reach - 1	127143.2	100-year	3800.00	245.41	254.66		254.93	0.005327	6.92	2240.26	773.94	0.45
Reach - 1	127143.2	100-yr FW	3800.00	245.41	255.68		255.91	0.003689	6.27	1783.01	375.00	0.38
Reach - 1	126527.0	100-year	3800.00	244.55	253.00		253.05	0.001867	3.80	4472.17	1316.32	0.26
Reach - 1	126527.0	100-yr FW	3800.00	244.55	253.99		254.09	0.002324	4.65	2574.79	575.00	0.30
Reach - 1	126045.7	100-year	3800.00	242.58	252.21		252.26	0.001449	3.73	3824.44	873.98	0.23
Reach - 1	126045.7	100-yr FW	3800.00	242.58	253.19		253.25	0.001315	3.84	2891.64	490.00	0.23
Reach - 1	125457.5	100-year	3800.00	241.26	251.69		251.71	0.000634	2.63	5868.47	1135.47	0.16
Reach - 1	125457.5	100-yr FW	3800.00	241.26	252.68		252.72	0.000648	2.86	3877.96	570.00	0.16

HEC-RAS Plan: 100YR_FW River: Moccasin Creek Reach: Reach - 1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach - 1	124805.9	100-year	4060.00	239.08	250.48	247.13	250.82	0.002911	5.59	2041.75	787.30	0.34
Reach - 1	124805.9	100-yr FW	4060.00	239.08	251.39	247.13	251.81	0.002733	5.81	1318.33	321.00	0.34
Reach - 1	124784.9		Bridge									
Reach - 1	124763.9	100-year	4060.00	238.92	249.87	246.98	250.34	0.003998	6.32	1701.71	770.02	0.40
Reach - 1	124763.9	100-yr FW	4060.00	238.92	250.82	246.97	251.33	0.003380	6.27	1187.93	321.00	0.37
Reach - 1	124014.4	100-year	4060.00	238.11	249.22		249.26	0.000545	2.78	6039.62	1327.76	0.16
Reach - 1	124014.4	100-yr FW	4060.00	238.11	250.22		250.27	0.000545	2.97	3786.84	555.70	0.16
Reach - 1	123368.2	100-year	4310.00	237.85	248.69		248.77	0.001068	3.78	4698.32	995.98	0.22
Reach - 1	123368.2	100-yr FW	4310.00	237.85	249.67		249.79	0.001057	4.02	2825.67	415.00	0.22
Reach - 1	122925.1	100-year	4310.00	237.75	248.04		248.18	0.001673	4.54	2606.22	484.80	0.27
Reach - 1	122925.1	100-yr FW	4310.00	237.75	249.00		249.19	0.001702	4.91	2083.44	296.35	0.28
Reach - 1	122598.2	100-year	4310.00	236.96	247.48		247.63	0.001683	4.63	2771.88	594.64	0.27
Reach - 1	122598.2	100-yr FW	4310.00	236.96	248.45		248.64	0.001648	4.91	2152.44	325.00	0.27
Reach - 1	122143.5	100-year	4310.00	236.61	247.09		247.13	0.000689	2.91	5695.52	1223.87	0.17
Reach - 1	122143.5	100-yr FW	4310.00	236.61	248.09		248.14	0.000694	3.14	4059.36	625.00	0.18
Reach - 1	121736.5	100-year	4310.00	235.40	246.85		246.88	0.000532	2.74	6773.74	1234.50	0.15
Reach - 1	121736.5	100-yr FW	4310.00	235.40	247.81		247.87	0.000620	3.15	3908.64	535.00	0.17
Reach - 1	121068.7	100-year	4440.00	234.46	246.18		246.33	0.001341	4.51	2750.38	507.41	0.25
Reach - 1	121068.7	100-yr FW	4440.00	234.46	247.13		247.30	0.001194	4.53	2418.42	340.00	0.24
Reach - 1	120527.0	100-year	4440.00	234.10	245.31		245.52	0.001668	4.84	2355.27	453.50	0.28
Reach - 1	120527.0	100-yr FW	4440.00	234.10	246.26		246.53	0.001653	5.13	1743.38	225.00	0.28
Reach - 1	119927.0	100-year	4440.00	233.90	244.69		244.75	0.000913	3.32	3907.52	749.90	0.20
Reach - 1	119927.0	100-yr FW	4440.00	233.90	245.69		245.77	0.000864	3.48	3193.78	445.00	0.20
Reach - 1	119290.8	100-year	4440.00	232.26	244.36		244.39	0.000376	2.38	7206.57	1144.12	0.13
Reach - 1	119290.8	100-yr FW	4440.00	232.26	245.36		245.40	0.000404	2.63	4471.35	550.00	0.14
Reach - 1	118650.0	100-year	4440.00	231.80	244.06		244.11	0.000505	2.79	4956.26	748.01	0.15
Reach - 1	118650.0	100-yr FW	4440.00	231.80	245.03		245.10	0.000543	3.07	3577.74	425.00	0.16
Reach - 1	118089.0	100-year	4440.00	231.29	243.83		243.86	0.000367	2.44	5155.54	759.91	0.13
Reach - 1	118089.0	100-yr FW	4440.00	231.29	244.79		244.84	0.000384	2.64	4219.61	500.00	0.14
Reach - 1	117432.3	100-year	4840.00	231.03	243.64		243.66	0.000260	2.07	7902.44	1330.12	0.11
Reach - 1	117432.3	100-yr FW	4840.00	231.03	244.57		244.61	0.000318	2.42	5296.30	625.00	0.13
Reach - 1	116770.7	100-year	4840.00	230.09	243.34		243.41	0.000552	3.14	4440.08	817.93	0.16
Reach - 1	116770.7	100-yr FW	4840.00	230.09	244.16		244.29	0.000734	3.79	2800.54	325.00	0.19
Reach - 1	116102.9	100-year	4840.00	228.07	242.80		242.98	0.000735	3.96	2461.33	332.45	0.20
Reach - 1	116102.9	100-yr FW	4840.00	228.07	243.52		243.76	0.000821	4.34	1698.67	150.00	0.21
Reach - 1	115955.1	100-year	4840.00	227.43	242.28	235.85	242.74	0.001575	5.48	929.86	258.83	0.29
Reach - 1	115955.1	100-yr FW	4840.00	227.43	243.16	235.84	243.57	0.001253	5.14	990.26	84.00	0.26
Reach - 1	115927.1		Bridge									
Reach - 1	115899.1	100-year	4840.00	227.55	241.28	235.97	241.84	0.002233	6.09	833.18	228.21	0.33
Reach - 1	115899.1	100-yr FW	4840.00	227.55	242.11	235.95	242.61	0.001748	5.68	892.13	84.00	0.30
Reach - 1	115658.3	100-year	4840.00	228.67	241.12		241.29	0.001043	4.14	2891.84	545.66	0.23
Reach - 1	115658.3	100-yr FW	4840.00	228.67	241.93		242.14	0.001045	4.35	2081.94	250.00	0.23
Reach - 1	115259.5	100-year	4840.00	228.00	240.96		241.01	0.000403	2.65	6415.40	1083.64	0.14
Reach - 1	115259.5	100-yr FW	4840.00	228.00	241.61		241.76	0.000823	3.93	2615.75	300.00	0.20
Reach - 1	114797.6	100-year	4840.00	227.75	240.83		240.85	0.000269	2.16	7469.13	1062.97	0.11
Reach - 1	114797.6	100-yr FW	4840.00	227.75	241.29		241.39	0.000704	3.59	3137.90	350.00	0.18
Reach - 1	114253.0	100-year	4840.00	226.55	240.61		240.67	0.000429	2.92	4872.43	657.50	0.14
Reach - 1	114253.0	100-yr FW	4840.00	226.55	240.80		240.96	0.000899	4.26	2574.18	270.00	0.21
Reach - 1	113726.0	100-year	4840.00	225.92	240.44		240.48	0.000279	2.13	4943.85	662.64	0.12
Reach - 1	113726.0	100-yr FW	4840.00	225.92	240.47		240.58	0.000534	2.95	2505.98	260.00	0.16

HEC-RAS Plan: 100YR_FW River: Moccasin Creek Reach: Reach - 1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach - 1	113253.0	100-year	4840.00	226.12	240.38		240.40	0.000097	1.20	4632.49	641.31	0.07
Reach - 1	113253.0	100-yr FW	4840.00	226.12	240.44		240.47	0.000099	1.22	4136.92	440.00	0.07
Reach - 1	112173.5	100-year	4840.00	224.71	240.35		240.36	0.000022	0.64	8188.15	834.93	0.03
Reach - 1	112173.5	100-yr FW	4840.00	224.71	240.41		240.42	0.000022	0.64	7715.57	690.00	0.03
Reach - 1	111041.4	100-year	5160.00	223.37	240.30		240.32	0.000045	1.03	5666.04	526.98	0.05
Reach - 1	111041.4	100-yr FW	5160.00	223.37	240.36		240.38	0.000047	1.05	5111.81	385.00	0.05
Reach - 1	110079.9	100-year	5160.00	222.72	239.86	232.35	240.13	0.000950	4.32	1447.39	783.19	0.22
Reach - 1	110079.9	100-yr FW	5160.00	222.72	239.89	232.35	240.18	0.000996	4.43	1364.32	132.00	0.22
Reach - 1	109999.9		Bridge									
Reach - 1	109919.9	100-year	5160.00	222.62	239.37	232.25	239.66	0.001071	4.49	1388.08	756.48	0.23
Reach - 1	109919.9	100-yr FW	5160.00	222.62	239.39	232.25	239.70	0.001118	4.59	1311.74	132.00	0.23
Reach - 1	109342.8	100-year	5160.00	222.30	239.48		239.49	0.000014	0.58	9059.41	729.36	0.03
Reach - 1	109342.8	100-yr FW	5160.00	222.30	239.52		239.52	0.000014	0.58	8964.60	662.80	0.03
Reach - 1	107795.2	100-year	6070.00	221.44	239.47		239.48	0.000006	0.37	17087.12	1413.09	0.02
Reach - 1	107795.2	100-yr FW	6070.00	221.44	239.51		239.51	0.000006	0.37	16576.72	1240.00	0.02
Reach - 1	106381.7	100-year	6070.00	219.37	239.46	224.71	239.47	0.000008	0.48	13611.31	1260.39	0.02
Reach - 1	106381.7	100-yr FW	6070.00	219.37	239.50	224.70	239.50	0.000008	0.49	12552.15	844.00	0.02
Reach - 1	106367.2		Inl Struct									
Reach - 1	106352.7	100-year	6070.00	218.38	232.18		232.34	0.000999	4.48	3839.43	674.46	0.23
Reach - 1	106352.7	100-yr FW	6070.00	218.38	232.78		233.05	0.001310	5.29	2390.80	250.00	0.26
Reach - 1	106193.6	100-year	6070.00	218.38	231.49	224.85	232.02	0.001825	5.92	1109.27	600.64	0.30
Reach - 1	106193.6	100-yr FW	6070.00	218.38	232.29	224.84	232.77	0.001510	5.62	1162.74	100.00	0.28
Reach - 1	106158.6		Culvert									
Reach - 1	106123.6	100-year	6070.00	218.23	229.31	224.70	230.10	0.003440	7.19	898.33	397.12	0.40
Reach - 1	106123.6	100-yr FW	6070.00	218.23	230.19	224.68	230.87	0.002639	6.66	967.89	100.00	0.36
Reach - 1	105518.5	100-year	6070.00	216.17	228.33		228.49	0.001459	4.82	3870.82	737.44	0.26
Reach - 1	105518.5	100-yr FW	6070.00	216.17	229.31		229.50	0.001372	4.96	3111.27	415.00	0.26
Reach - 1	104823.3	100-year	6070.00	216.59	227.64		227.68	0.000870	3.59	6954.32	1337.53	0.20
Reach - 1	104823.3	100-yr FW	6070.00	216.59	228.58		228.66	0.000999	4.09	4422.48	575.00	0.22
Reach - 1	104282.0	100-year	6070.00	215.31	227.00		227.09	0.001367	4.69	5441.08	1097.97	0.26
Reach - 1	104282.0	100-yr FW	6070.00	215.31	227.94		228.06	0.001226	4.71	3813.79	490.00	0.25
Reach - 1	103679.7	100-year	6070.00	215.33	226.45		226.49	0.000734	3.31	7900.36	1467.87	0.19
Reach - 1	103679.7	100-yr FW	6070.00	215.33	227.42		227.47	0.000742	3.55	5432.76	750.00	0.19
Reach - 1	103174.7	100-year	6070.00	216.01	226.10	221.39	226.12	0.000693	2.99	7513.94	1306.33	0.18
Reach - 1	103174.7	100-yr FW	6070.00	216.01	227.10	221.39	227.13	0.000595	2.98	5969.61	760.00	0.17
Reach - 1	103154.7		Culvert									
Reach - 1	103134.7	100-year	6070.00	215.74	226.09	221.11	226.11	0.000610	2.86	7859.09	1320.72	0.17
Reach - 1	103134.7	100-yr FW	6070.00	215.74	227.08	221.12	227.11	0.000536	2.87	6165.34	760.00	0.16
Reach - 1	102912.8	100-year	6070.00	214.65	225.94		225.97	0.000668	3.19	8635.67	1433.89	0.18
Reach - 1	102912.8	100-yr FW	6070.00	214.65	226.92		226.97	0.000727	3.55	5239.27	675.00	0.19
Reach - 1	102387.3	100-year	6960.00	212.66	225.60		225.64	0.000598	3.35	9354.56	1569.31	0.17
Reach - 1	102387.3	100-yr FW	6960.00	212.66	226.57		226.62	0.000604	3.55	6315.84	766.85	0.18
Reach - 1	101806.5	100-year	6960.00	212.99	225.27		225.30	0.000556	3.11	11172.26	1684.28	0.17
Reach - 1	101806.5	100-yr FW	6960.00	212.99	226.25		226.29	0.000551	3.27	6359.80	700.00	0.17
Reach - 1	101291.2	100-year	6960.00	212.43	225.01		225.04	0.000462	2.78	10165.49	1480.99	0.15
Reach - 1	101291.2	100-yr FW	6960.00	212.43	225.93		225.99	0.000605	3.36	5559.81	600.00	0.17
Reach - 1	100646.0	100-year	6960.00	211.07	224.76		224.79	0.000322	2.53	11581.13	1526.02	0.13
Reach - 1	100646.0	100-yr FW	6960.00	211.07	225.62		225.67	0.000405	2.97	6480.97	650.00	0.15
Reach - 1	100153.4	100-year	6960.00	210.84	224.64		224.66	0.000226	2.15	13770.86	1793.84	0.11
Reach - 1	100153.4	100-yr FW	6960.00	210.84	225.43		225.47	0.000375	2.89	6607.70	675.00	0.14

HEC-RAS Plan: 100YR_FW River: Moccasin Creek Reach: Reach - 1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach - 1	99443.3	100-year	7230.00	209.10	224.44		224.48	0.000280	2.54	11206.79	1437.72	0.12
Reach - 1	99443.3	100-yr FW	7230.00	209.10	225.07		225.16	0.000513	3.55	5227.39	500.00	0.17
Reach - 1	98683.1	100-year	7230.00	208.71	223.29	215.94	223.87	0.001843	6.24	1283.37	1258.44	0.30
Reach - 1	98683.1	100-yr FW	7230.00	208.71	223.75	215.89	224.35	0.001752	6.22	1224.90	90.00	0.29
Reach - 1	98661.6		Bridge									
Reach - 1	98640.1	100-year	7230.00	208.61	222.24	215.84	222.92	0.002355	6.72	1186.20	1243.76	0.33
Reach - 1	98640.1	100-yr FW	7230.00	208.61	223.12	215.79	223.76	0.001992	6.46	1176.97	90.00	0.31
Reach - 1	97238.8	100-year	7230.00	208.47	221.36		221.38	0.000445	2.80	9679.62	1466.58	0.15
Reach - 1	97238.8	100-yr FW	7230.00	208.47	222.34		222.38	0.000407	2.83	7583.99	850.00	0.14
Reach - 1	96590.9	100-year	7230.00	206.96	220.96		221.03	0.000682	3.69	6241.57	880.38	0.18
Reach - 1	96590.9	100-yr FW	7230.00	206.96	221.92		222.02	0.000772	4.13	5017.78	565.00	0.20
Reach - 1	95987.2	100-year	7230.00	206.43	220.58		220.64	0.000607	3.51	7346.61	1025.02	0.17
Reach - 1	95987.2	100-yr FW	7230.00	206.43	221.55		221.62	0.000554	3.52	6074.18	673.00	0.17
Reach - 1	95463.7	100-year	7230.00	204.92	220.33		220.37	0.000422	3.12	8900.44	1134.78	0.15
Reach - 1	95463.7	100-yr FW	7230.00	204.92	221.30		221.36	0.000425	3.28	6464.62	645.95	0.15
Reach - 1	94837.3	100-year	7230.00	204.38	220.06		220.10	0.000426	3.17	10599.98	1336.48	0.15
Reach - 1	94837.3	100-yr FW	7230.00	204.38	221.03		221.09	0.000429	3.33	6401.30	641.94	0.15
Reach - 1	94329.1	100-year	7470.00	203.98	219.88		219.91	0.000323	2.79	10819.73	1327.05	0.13
Reach - 1	94329.1	100-yr FW	7470.00	203.98	220.86		220.90	0.000325	2.93	7576.41	722.60	0.13
Reach - 1	93527.0	100-year	7470.00	203.76	219.70		219.71	0.000185	2.12	14482.04	1664.59	0.10
Reach - 1	93527.0	100-yr FW	7470.00	203.76	220.68		220.70	0.000178	2.17	10301.39	920.00	0.10
Reach - 1	92927.0	100-year	7470.00	202.73	219.61		219.62	0.000124	1.73	15418.75	1674.79	0.08
Reach - 1	92927.0	100-yr FW	7470.00	202.73	220.59		220.61	0.000143	1.94	10657.46	895.00	0.09
Reach - 1	92194.9	100-year	7470.00	202.36	219.50		219.52	0.000164	2.02	15289.77	1615.92	0.09
Reach - 1	92194.9	100-yr FW	7470.00	202.36	220.48		220.50	0.000155	2.04	10004.95	825.00	0.09
Reach - 1	91628.4	100-year	7470.00	201.83	219.43		219.45	0.000103	1.63	16604.48	1829.82	0.07
Reach - 1	91628.4	100-yr FW	7470.00	201.83	220.40		220.42	0.000122	1.85	10849.61	825.00	0.08
Reach - 1	91018.7	100-year	7470.00	201.65	219.37		219.38	0.000107	1.67	20450.95	2020.56	0.08
Reach - 1	91018.7	100-yr FW	7470.00	201.65	220.33		220.34	0.000128	1.90	10344.90	765.00	0.08
Reach - 1	89898.6	100-year	7470.00	198.13	219.25	207.55	219.27	0.000096	1.85	19627.51	2318.22	0.07
Reach - 1	89898.6	100-yr FW	7470.00	198.13	220.15	207.55	220.18	0.000147	2.36	7997.75	585.00	0.09
Reach - 1	89778.1		Culvert									
Reach - 1	89657.6	100-year	7470.00	197.85	211.04	207.27	211.27	0.001629	5.37	5334.04	1721.63	0.28
Reach - 1	89657.6	100-yr FW	7470.00	197.85	212.04	207.27	212.33	0.001596	5.62	3418.95	585.00	0.28
Reach - 1	88694.6	100-year	7470.00	197.68	210.05		210.10	0.000812	3.93	13477.13	2181.21	0.20
Reach - 1	88694.6	100-yr FW	7470.00	197.68	211.02		211.11	0.000885	4.32	5558.04	700.00	0.21
Reach - 1	88230.9	100-year	7470.00	197.20	209.76	205.12	209.82	0.000480	3.18	16884.50	2566.11	0.17
Reach - 1	88230.9	100-yr FW	7470.00	197.20	210.75	205.14	210.82	0.000433	3.20	6248.45	710.00	0.16
Reach - 1	88203.4		Bridge									
Reach - 1	88175.9	100-year	7470.00	197.14	209.04	205.05	209.11	0.000631	3.50	15342.80	2551.43	0.19
Reach - 1	88175.9	100-yr FW	7470.00	197.14	209.92	205.08	210.01	0.000572	3.52	5701.71	710.00	0.19
Reach - 1	87844.9	100-year	7470.00	196.44	208.48	205.24	208.72	0.002121	6.72	14930.76	2480.34	0.35
Reach - 1	87844.9	100-yr FW	7470.00	196.44	209.48	205.36	209.68	0.001494	5.97	3856.15	555.00	0.30

Post Project : With Culverts Removed

HEC-RAS Plan: final nc River: Moccasin Creek Reach: Reach - 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach - 1	142883.0	100-year	1130.00	300.33	306.63		306.66	0.002670	3.55	1262.91	487.74	0.27
Reach - 1	142883.0	100-yr FW	1130.00	300.33	307.64		307.69	0.002976	4.21	806.93	200.00	0.30
Reach - 1	142506.8	100-year	1520.00	298.14	305.08		305.16	0.005662	5.58	939.26	316.64	0.40
Reach - 1	142506.8	100-yr FW	1520.00	298.14	306.07		306.20	0.005040	5.85	716.63	140.00	0.39
Reach - 1	142085.5	100-year	1520.00	296.19	304.02		304.05	0.001485	3.14	1688.76	481.28	0.21
Reach - 1	142085.5	100-yr FW	1520.00	296.19	305.00		305.04	0.001664	3.64	1216.71	225.00	0.23
Reach - 1	141695.4	100-year	1520.00	295.44	302.23		302.60	0.018746	9.99	536.11	208.56	0.73
Reach - 1	141695.4	100-yr FW	1520.00	295.44	302.96		303.47	0.017784	10.53	406.21	95.00	0.73
Reach - 1	141400.5	100-year	1520.00	293.17	299.93		300.02	0.004798	5.47	1241.48	515.92	0.40
Reach - 1	141400.5	100-yr FW	1520.00	293.17	300.92		301.06	0.004356	5.80	836.12	205.00	0.39
Reach - 1	141031.6	100-year	1520.00	292.29	298.52		298.57	0.003244	4.38	1890.24	608.38	0.34
Reach - 1	141031.6	100-yr FW	1520.00	292.29	299.37		299.50	0.004087	5.44	787.30	170.00	0.39
Reach - 1	140546.1	100-year	1520.00	290.14	295.74		295.93	0.010781	7.13	1194.95	576.23	0.60
Reach - 1	140546.1	100-yr FW	1520.00	290.14	296.45		296.71	0.008587	7.03	606.77	165.00	0.55
Reach - 1	140118.9	100-year	1520.00	288.09	295.57		295.57	0.000234	1.40	3487.14	729.87	0.10
Reach - 1	140118.9	100-yr FW	1520.00	288.09	296.44		296.44	0.000141	1.18	3573.56	520.00	0.08
Reach - 1	139764.2	100-year	1520.00	286.82	295.45		295.46	0.000399	2.00	2393.06	491.19	0.13
Reach - 1	139764.2	100-yr FW	1520.00	286.82	296.37		296.38	0.000243	1.69	2494.03	360.00	0.10
Reach - 1	139512.7	100-year	1520.00	285.92	295.22		295.27	0.001977	4.13	1108.87	215.59	0.25
Reach - 1	139512.7	100-yr FW	1520.00	285.92	296.20		296.25	0.001436	3.79	1060.92	140.00	0.22
Reach - 1	139440.4	100-year	1520.00	285.85	295.08	292.09	295.15	0.001154	3.67	1257.01	249.34	0.23
Reach - 1	139440.4	100-yr FW	1520.00	285.85	295.88	292.10	296.08	0.001966	5.09	691.66	87.00	0.30
Reach - 1	139425.9		Inl Struct									
Reach - 1	139411.4	100-year	1520.00	285.82	290.78	290.78	291.71	0.028702	11.21	384.48	178.30	1.00
Reach - 1	139411.4	100-yr FW	1520.00	285.82	291.57	290.98	292.57	0.020783	10.78	319.72	87.00	0.87
Reach - 1	139228.8	100-year	1520.00	276.87	284.28	284.28	285.31	0.032234	14.03	376.55	148.99	0.98
Reach - 1	139228.8	100-yr FW	1520.00	276.87	284.67	284.67	286.79	0.046376	17.50	219.43	47.31	1.19
Reach - 1	139021.6	100-year	1520.00	273.32	282.06	278.71	282.40	0.002735	5.04	557.90	222.37	0.33
Reach - 1	139021.6	100-yr FW	1520.00	273.32	283.08	278.71	283.38	0.001929	4.63	462.86	82.00	0.29
Reach - 1	139001.1		Bridge									
Reach - 1	138980.6	100-year	1520.00	273.24	281.16	278.63	281.68	0.004630	6.05	398.78	166.03	0.42
Reach - 1	138980.6	100-yr FW	1520.00	273.24	282.12	278.63	282.52	0.002950	5.30	390.83	82.00	0.35
Reach - 1	138602.6	100-year	1520.00	273.44	280.22		280.28	0.002233	3.70	2214.60	894.29	0.28
Reach - 1	138602.6	100-yr FW	1520.00	273.44	281.15		281.30	0.002842	4.66	889.11	225.00	0.33
Reach - 1	137952.6	100-year	1900.00	270.66	277.88		278.07	0.005088	5.84	1509.81	562.98	0.43
Reach - 1	137952.6	100-yr FW	1900.00	270.66	278.86		279.08	0.003989	5.75	848.12	175.00	0.39
Reach - 1	137434.3	100-year	1900.00	268.67	277.13		277.15	0.000824	2.68	2578.89	727.29	0.18
Reach - 1	137434.3	100-yr FW	1900.00	268.67	278.12		278.16	0.000913	3.08	1942.74	400.00	0.19
Reach - 1	136882.8	100-year	1900.00	268.13	276.65		276.68	0.000891	2.80	2918.56	774.29	0.19
Reach - 1	136882.8	100-yr FW	1900.00	268.13	277.61		277.66	0.000913	3.09	1914.41	385.52	0.19
Reach - 1	136336.7	100-year	1900.00	267.77	275.49		275.70	0.004834	6.02	1526.00	667.57	0.43
Reach - 1	136336.7	100-yr FW	1900.00	267.77	276.34		276.66	0.004835	6.56	782.96	190.00	0.43
Reach - 1	135928.1	100-year	2370.00	265.31	274.49		274.57	0.001837	4.27	1805.78	443.21	0.27
Reach - 1	135928.1	100-yr FW	2370.00	265.31	275.47		275.58	0.001652	4.39	1415.43	210.00	0.26
Reach - 1	135324.2	100-year	2370.00	262.91	274.09		274.11	0.000390	2.32	3405.57	610.15	0.13
Reach - 1	135324.2	100-yr FW	2370.00	262.91	275.06		275.09	0.000449	2.65	2617.36	350.00	0.14
Reach - 1	134820.4	100-year	2370.00	260.03	273.87		273.91	0.000403	2.77	3184.10	600.40	0.14
Reach - 1	134820.4	100-yr FW	2370.00	260.03	274.81		274.86	0.000438	3.03	2326.96	290.00	0.15
Reach - 1	134563.1	100-year	2370.00	259.18	273.74	267.92	273.79	0.000469	3.08	2742.49	492.16	0.15
Reach - 1	134563.1	100-yr FW	2370.00	259.18	274.57	267.92	274.69	0.000761	4.08	1451.16	145.00	0.19

HEC-RAS Plan: final nc River: Moccasin Creek Reach: Reach - 1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach - 1	134518.6		Culvert									
Reach - 1	134474.1	100-year	2370.00	259.22	271.39	267.96	271.55	0.001500	4.84	1654.83	395.68	0.25
Reach - 1	134474.1	100-yr FW	2370.00	259.22	272.38	267.81	272.61	0.001559	5.23	1128.69	145.00	0.26
Reach - 1	134327.0	100-year	2370.00	258.90	271.29		271.34	0.000722	3.35	2537.61	506.13	0.17
Reach - 1	134327.0	100-yr FW	2370.00	258.90	272.27		272.37	0.000925	4.00	1638.99	205.00	0.20
Reach - 1	133904.0	100-year	2370.00	259.07	270.27		270.66	0.005387	8.30	952.13	213.49	0.45
Reach - 1	133904.0	100-yr FW	2370.00	259.07	271.24		271.61	0.004257	7.83	799.83	100.00	0.41
Reach - 1	133386.8	100-year	2370.00	258.76	269.89		269.91	0.000532	2.70	2851.25	449.62	0.15
Reach - 1	133386.8	100-yr FW	2370.00	258.76	270.88		270.91	0.000534	2.88	2379.11	275.67	0.15
Reach - 1	132897.3	100-year	2370.00	257.46	269.59		269.63	0.000615	3.09	2269.52	394.36	0.16
Reach - 1	132897.3	100-yr FW	2370.00	257.46	270.58		270.63	0.000617	3.27	1913.13	215.95	0.16
Reach - 1	132466.4	100-year	2370.00	257.40	269.40		269.42	0.000386	2.43	3266.15	504.33	0.13
Reach - 1	132466.4	100-yr FW	2370.00	257.40	270.41		270.43	0.000329	2.37	2890.17	310.00	0.12
Reach - 1	132105.9	100-year	2370.00	256.86	269.31		269.32	0.000185	1.73	4599.91	712.04	0.09
Reach - 1	132105.9	100-yr FW	2370.00	256.86	270.31		270.32	0.000264	2.18	3006.78	320.00	0.11
Reach - 1	131939.0	100-year	2370.00	256.78	269.21		269.26	0.000752	3.47	2816.33	882.95	0.18
Reach - 1	131939.0	100-yr FW	2370.00	256.78	270.20		270.25	0.000640	3.38	2069.00	325.00	0.17
Reach - 1	131747.7	100-year	3470.00	256.57	269.14		269.16	0.000387	2.51	3951.00	533.28	0.13
Reach - 1	131747.7	100-yr FW	3470.00	256.57	270.13		270.16	0.000391	2.67	3352.83	325.00	0.13
Reach - 1	131543.9	100-year	3470.00	255.42	268.99		269.04	0.000798	3.81	2895.80	424.96	0.19
Reach - 1	131543.9	100-yr FW	3470.00	255.42	269.98		270.04	0.000802	4.01	2382.44	225.43	0.19
Reach - 1	131200.0	100-year	3470.00	253.20	267.86	262.43	268.43	0.002403	7.16	1151.48	411.57	0.35
Reach - 1	131200.0	100-yr FW	3470.00	253.20	268.57	262.42	269.36	0.002671	7.81	708.92	62.00	0.37
Reach - 1	131177.5		Bridge									
Reach - 1	131155.0	100-year	3470.00	253.06	266.68	262.29	267.50	0.003552	8.24	915.13	358.95	0.41
Reach - 1	131155.0	100-yr FW	3470.00	253.06	267.51	262.27	268.43	0.003387	8.40	651.83	62.00	0.41
Reach - 1	130822.0	100-year	3470.00	252.68	265.48		266.12	0.004218	7.98	1003.70	179.15	0.42
Reach - 1	130822.0	100-yr FW	3470.00	252.68	266.47		267.14	0.003622	7.82	835.61	88.00	0.40
Reach - 1	130443.0	100-year	3470.00	251.31	264.17		264.68	0.003276	7.14	1103.67	187.30	0.38
Reach - 1	130443.0	100-yr FW	3470.00	251.31	265.05		265.77	0.003546	7.81	769.66	78.00	0.40
Reach - 1	130071.6	100-year	3470.00	250.93	263.28		263.59	0.002389	5.97	1442.07	249.35	0.32
Reach - 1	130071.6	100-yr FW	3470.00	250.93	264.24		264.63	0.002292	6.19	1127.34	125.00	0.32
Reach - 1	129838.9	100-year	3470.00	250.86	261.98		262.70	0.006297	8.73	891.74	159.99	0.50
Reach - 1	129838.9	100-yr FW	3470.00	250.86	262.98		263.79	0.005564	8.78	752.40	89.00	0.48
Reach - 1	129460.5	100-year	3470.00	249.10	260.09		260.55	0.004791	7.54	1198.60	246.48	0.44
Reach - 1	129460.5	100-yr FW	3470.00	249.10	260.94		261.67	0.005511	8.58	851.42	125.00	0.48
Reach - 1	128933.7	100-year	3470.00	247.91	259.04		259.13	0.001516	4.29	2547.28	520.10	0.25
Reach - 1	128933.7	100-yr FW	3470.00	247.91	260.03		260.15	0.001451	4.48	2126.52	315.00	0.25
Reach - 1	128450.1	100-year	3470.00	247.33	258.28		258.38	0.001591	4.34	2543.05	580.38	0.25
Reach - 1	128450.1	100-yr FW	3470.00	247.33	259.27		259.41	0.001637	4.71	1997.73	300.00	0.26
Reach - 1	127746.3	100-year	3800.00	246.60	256.88		257.01	0.002386	5.05	2449.76	612.86	0.30
Reach - 1	127746.3	100-yr FW	3800.00	246.60	257.66		257.88	0.002895	5.89	1750.98	295.00	0.34
Reach - 1	127143.2	100-year	3800.00	245.41	254.66		254.93	0.005327	6.92	2240.26	773.94	0.45
Reach - 1	127143.2	100-yr FW	3800.00	245.41	255.68		255.91	0.003689	6.27	1783.01	375.00	0.38
Reach - 1	126527.0	100-year	3800.00	244.55	253.00		253.05	0.001867	3.80	4472.17	1316.32	0.26
Reach - 1	126527.0	100-yr FW	3800.00	244.55	253.99		254.09	0.002324	4.65	2574.79	575.00	0.30
Reach - 1	126045.7	100-year	3800.00	242.58	252.21		252.26	0.001449	3.73	3824.44	873.98	0.23
Reach - 1	126045.7	100-yr FW	3800.00	242.58	253.19		253.25	0.001315	3.84	2891.64	490.00	0.23
Reach - 1	125457.5	100-year	3800.00	241.26	251.69		251.71	0.000634	2.63	5868.47	1135.47	0.16
Reach - 1	125457.5	100-yr FW	3800.00	241.26	252.68		252.72	0.000648	2.86	3877.96	570.00	0.16

HEC-RAS Plan: final nc River: Moccasin Creek Reach: Reach - 1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach - 1	124805.9	100-year	4060.00	239.08	250.48	247.13	250.82	0.002911	5.59	2041.75	787.30	0.34
Reach - 1	124805.9	100-yr FW	4060.00	239.08	251.39	247.13	251.81	0.002732	5.81	1318.33	321.00	0.34
Reach - 1	124784.9		Bridge									
Reach - 1	124763.9	100-year	4060.00	238.92	249.87	246.98	250.34	0.003998	6.32	1701.71	770.02	0.40
Reach - 1	124763.9	100-yr FW	4060.00	238.92	250.82	246.97	251.33	0.003380	6.27	1187.93	321.00	0.37
Reach - 1	124014.4	100-year	4060.00	238.11	249.22		249.26	0.000545	2.78	6039.62	1327.76	0.16
Reach - 1	124014.4	100-yr FW	4060.00	238.11	250.22		250.27	0.000545	2.97	3786.85	555.70	0.16
Reach - 1	123368.2	100-year	4310.00	237.85	248.69		248.77	0.001068	3.78	4698.32	995.98	0.22
Reach - 1	123368.2	100-yr FW	4310.00	237.85	249.67		249.79	0.001057	4.02	2825.67	415.00	0.22
Reach - 1	122925.1	100-year	4310.00	237.75	248.04		248.18	0.001673	4.54	2606.22	484.80	0.27
Reach - 1	122925.1	100-yr FW	4310.00	237.75	249.00		249.19	0.001702	4.91	2083.44	296.35	0.28
Reach - 1	122598.2	100-year	4310.00	236.96	247.48		247.63	0.001683	4.63	2771.88	594.64	0.27
Reach - 1	122598.2	100-yr FW	4310.00	236.96	248.45		248.64	0.001648	4.91	2152.45	325.00	0.27
Reach - 1	122143.5	100-year	4310.00	236.61	247.09		247.13	0.000689	2.91	5695.52	1223.87	0.17
Reach - 1	122143.5	100-yr FW	4310.00	236.61	248.09		248.14	0.000694	3.14	4059.38	625.00	0.18
Reach - 1	121736.5	100-year	4310.00	235.40	246.85		246.88	0.000532	2.74	6773.74	1234.50	0.15
Reach - 1	121736.5	100-yr FW	4310.00	235.40	247.82		247.87	0.000619	3.15	3908.67	535.00	0.17
Reach - 1	121068.7	100-year	4440.00	234.46	246.18		246.33	0.001341	4.51	2750.38	507.41	0.25
Reach - 1	121068.7	100-yr FW	4440.00	234.46	247.13		247.30	0.001194	4.53	2418.44	340.00	0.24
Reach - 1	120527.0	100-year	4440.00	234.10	245.31		245.52	0.001668	4.84	2355.27	453.50	0.28
Reach - 1	120527.0	100-yr FW	4440.00	234.10	246.26		246.53	0.001653	5.13	1743.39	225.00	0.28
Reach - 1	119927.0	100-year	4440.00	233.90	244.69		244.75	0.000913	3.32	3907.52	749.90	0.20
Reach - 1	119927.0	100-yr FW	4440.00	233.90	245.69		245.77	0.000864	3.48	3193.82	445.00	0.20
Reach - 1	119290.8	100-year	4440.00	232.26	244.36		244.39	0.000376	2.38	7206.57	1144.12	0.13
Reach - 1	119290.8	100-yr FW	4440.00	232.26	245.36		245.40	0.000404	2.63	4471.41	550.00	0.14
Reach - 1	118650.0	100-year	4440.00	231.80	244.06		244.11	0.000505	2.79	4956.26	748.01	0.15
Reach - 1	118650.0	100-yr FW	4440.00	231.80	245.03		245.10	0.000543	3.07	3577.80	425.00	0.16
Reach - 1	118089.0	100-year	4440.00	231.29	243.83		243.86	0.000367	2.44	5155.54	759.91	0.13
Reach - 1	118089.0	100-yr FW	4440.00	231.29	244.79		244.84	0.000384	2.64	4219.68	500.00	0.14
Reach - 1	117432.3	100-year	4840.00	231.03	243.64		243.66	0.000260	2.07	7902.44	1330.12	0.11
Reach - 1	117432.3	100-yr FW	4840.00	231.03	244.57		244.61	0.000318	2.42	5296.40	625.00	0.13
Reach - 1	116770.7	100-year	4840.00	230.09	243.34		243.41	0.000552	3.14	4440.08	817.93	0.16
Reach - 1	116770.7	100-yr FW	4840.00	230.09	244.16		244.29	0.000734	3.79	2800.60	325.00	0.19
Reach - 1	116102.9	100-year	4840.00	228.07	242.80		242.98	0.000735	3.96	2461.33	332.45	0.20
Reach - 1	116102.9	100-yr FW	4840.00	228.07	243.52		243.76	0.000821	4.34	1698.71	150.00	0.21
Reach - 1	115955.1	100-year	4840.00	227.43	242.28	235.85	242.74	0.001575	5.48	929.86	258.83	0.29
Reach - 1	115955.1	100-yr FW	4840.00	227.43	243.16	235.84	243.58	0.001253	5.14	990.28	84.00	0.26
Reach - 1	115927.1		Bridge									
Reach - 1	115899.1	100-year	4840.00	227.55	241.28	235.97	241.84	0.002233	6.09	833.18	228.21	0.33
Reach - 1	115899.1	100-yr FW	4840.00	227.55	242.11	235.95	242.61	0.001747	5.68	892.15	84.00	0.30
Reach - 1	115658.3	100-year	4840.00	228.67	241.12		241.29	0.001043	4.14	2891.84	545.66	0.23
Reach - 1	115658.3	100-yr FW	4840.00	228.67	241.93		242.14	0.001045	4.35	2082.00	250.00	0.23
Reach - 1	115259.5	100-year	4840.00	228.00	240.96		241.01	0.000403	2.65	6415.40	1083.64	0.14
Reach - 1	115259.5	100-yr FW	4840.00	228.00	241.61		241.76	0.000823	3.93	2615.84	300.00	0.20
Reach - 1	114797.6	100-year	4840.00	227.75	240.83		240.85	0.000269	2.16	7469.13	1062.97	0.11
Reach - 1	114797.6	100-yr FW	4840.00	227.75	241.29		241.39	0.000704	3.59	3138.02	350.00	0.18
Reach - 1	114253.0	100-year	4840.00	226.55	240.61		240.67	0.000429	2.92	4872.43	657.50	0.14
Reach - 1	114253.0	100-yr FW	4840.00	226.55	240.80		240.96	0.000899	4.26	2574.29	270.00	0.21
Reach - 1	113726.0	100-year	4840.00	225.92	240.44		240.48	0.000279	2.13	4943.85	662.64	0.12
Reach - 1	113726.0	100-yr FW	4840.00	225.92	240.48		240.58	0.000534	2.95	2506.10	260.00	0.16

HEC-RAS Plan: final nc River: Moccasin Creek Reach: Reach - 1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach - 1	113253.0	100-year	4840.00	226.12	240.38		240.40	0.000097	1.20	4632.49	641.31	0.07
Reach - 1	113253.0	100-yr FW	4840.00	226.12	240.44		240.47	0.000099	1.22	4137.12	440.00	0.07
Reach - 1	112173.5	100-year	4840.00	224.71	240.35		240.36	0.000022	0.64	8188.15	834.93	0.03
Reach - 1	112173.5	100-yr FW	4840.00	224.71	240.41		240.42	0.000022	0.64	7715.89	690.00	0.03
Reach - 1	111041.4	100-year	5160.00	223.37	240.30		240.32	0.000045	1.03	5666.04	526.98	0.05
Reach - 1	111041.4	100-yr FW	5160.00	223.37	240.36		240.38	0.000047	1.05	5111.99	385.00	0.05
Reach - 1	110079.9	100-year	5160.00	222.72	239.86	232.35	240.13	0.000950	4.32	1447.39	783.19	0.22
Reach - 1	110079.9	100-yr FW	5160.00	222.72	239.89	232.35	240.18	0.000996	4.43	1364.38	132.00	0.22
Reach - 1	109999.9		Bridge									
Reach - 1	109919.9	100-year	5160.00	222.62	239.37	232.25	239.66	0.001071	4.49	1388.08	756.48	0.23
Reach - 1	109919.9	100-yr FW	5160.00	222.62	239.39	232.25	239.70	0.001118	4.59	1311.81	132.00	0.23
Reach - 1	109342.8	100-year	5160.00	222.30	239.48		239.49	0.000014	0.58	9059.41	729.36	0.03
Reach - 1	109342.8	100-yr FW	5160.00	222.30	239.52		239.52	0.000014	0.58	8874.71	642.80	0.03
Reach - 1	107795.2	100-year	6070.00	221.44	239.47		239.48	0.000006	0.37	17087.12	1413.09	0.02
Reach - 1	107795.2	100-yr FW	6070.00	221.44	239.51		239.51	0.000006	0.37	16576.57	1240.00	0.02
Reach - 1	106381.7	100-year	6070.00	219.37	239.46	224.71	239.47	0.000008	0.48	13611.31	1260.39	0.02
Reach - 1	106381.7	100-yr FW	6070.00	219.37	239.50	224.70	239.50	0.000008	0.49	12552.05	844.00	0.02
Reach - 1	106367.2		Ini Struct									
Reach - 1	106352.7	100-year	6070.00	218.38	232.18		232.34	0.001000	4.48	3837.08	674.24	0.23
Reach - 1	106352.7	100-yr FW	6070.00	218.38	232.77		233.04	0.001315	5.30	2387.93	250.00	0.26
Reach - 1	106193.6	100-year	6070.00	218.38	231.48	224.85	232.01	0.001827	5.92	1108.86	600.33	0.30
Reach - 1	106193.6	100-yr FW	6070.00	218.38	232.27	224.84	232.76	0.001515	5.63	1161.47	100.00	0.28
Reach - 1	106158.6		Culvert									
Reach - 1	106123.6	100-year	6070.00	218.23	229.30	224.70	230.09	0.003449	7.19	897.55	396.82	0.40
Reach - 1	106123.6	100-yr FW	6070.00	218.23	230.18	224.68	230.86	0.002649	6.67	966.73	100.00	0.36
Reach - 1	105518.5	100-year	6070.00	216.17	228.31		228.47	0.001470	4.83	3860.14	737.12	0.26
Reach - 1	105518.5	100-yr FW	6070.00	216.17	229.29		229.49	0.001382	4.98	3103.99	415.00	0.26
Reach - 1	104823.3	100-year	6070.00	216.59	227.62		227.66	0.000879	3.60	6926.23	1336.75	0.20
Reach - 1	104823.3	100-yr FW	6070.00	216.59	228.56		228.63	0.001009	4.10	4408.63	575.00	0.22
Reach - 1	104282.0	100-year	6070.00	215.31	226.97		227.07	0.001386	4.72	5409.41	1095.79	0.26
Reach - 1	104282.0	100-yr FW	6070.00	215.31	227.91		228.03	0.001241	4.73	3798.42	490.00	0.25
Reach - 1	103679.7	100-year	6070.00	215.33	226.41		226.45	0.000748	3.34	7843.53	1465.85	0.19
Reach - 1	103679.7	100-yr FW	6070.00	215.33	227.38		227.43	0.000755	3.57	5402.95	750.00	0.19
Reach - 1	103174.7	100-year	6070.00	215.70	226.10		226.12	0.000563	2.78	7750.12	1307.15	0.16
Reach - 1	103174.7	100-yr FW	6070.00	215.70	227.09		227.12	0.000505	2.82	6084.80	760.00	0.16
Reach - 1	103134.7	100-year	6070.00	215.43	226.08		226.10	0.000501	2.68	8078.90	1320.64	0.15
Reach - 1	103134.7	100-yr FW	6070.00	215.43	227.07		227.10	0.000457	2.73	6276.41	760.00	0.15
Reach - 1	102912.8	100-year	6070.00	214.65	225.94		225.97	0.000668	3.19	8635.67	1433.89	0.18
Reach - 1	102912.8	100-yr FW	6070.00	214.65	226.92		226.97	0.000727	3.55	5239.27	675.00	0.19
Reach - 1	102387.3	100-year	6960.00	212.66	225.60		225.64	0.000598	3.35	9354.56	1569.31	0.17
Reach - 1	102387.3	100-yr FW	6960.00	212.66	226.57		226.62	0.000604	3.55	6315.84	766.85	0.18
Reach - 1	101806.5	100-year	6960.00	212.99	225.27		225.30	0.000556	3.11	11172.26	1684.28	0.17
Reach - 1	101806.5	100-yr FW	6960.00	212.99	226.25		226.29	0.000551	3.27	6359.80	700.00	0.17
Reach - 1	101291.2	100-year	6960.00	212.43	225.01		225.04	0.000462	2.78	10165.49	1480.99	0.15
Reach - 1	101291.2	100-yr FW	6960.00	212.43	225.93		225.99	0.000605	3.36	5559.81	600.00	0.17
Reach - 1	100646.0	100-year	6960.00	211.07	224.76		224.79	0.000322	2.53	11581.13	1526.02	0.13
Reach - 1	100646.0	100-yr FW	6960.00	211.07	225.62		225.67	0.000405	2.97	6480.97	650.00	0.15
Reach - 1	100153.4	100-year	6960.00	210.84	224.64		224.66	0.000226	2.15	13770.86	1793.84	0.11
Reach - 1	100153.4	100-yr FW	6960.00	210.84	225.43		225.47	0.000375	2.89	6607.70	675.00	0.14
Reach - 1	99443.3	100-year	7230.00	209.10	224.44		224.48	0.000280	2.54	11206.79	1437.72	0.12

HEC-RAS Plan: final nc River: Moccasin Creek Reach: Reach - 1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach - 1	99443.3	100-yr FW	7230.00	209.10	225.07		225.16	0.000513	3.55	5227.39	500.00	0.17
Reach - 1	98683.1	100-year	7230.00	208.71	223.29	215.94	223.87	0.001843	6.24	1283.37	1258.44	0.30
Reach - 1	98683.1	100-yr FW	7230.00	208.71	223.75	215.89	224.35	0.001752	6.22	1224.90	90.00	0.29
Reach - 1	98661.6		Bridge									
Reach - 1	98640.1	100-year	7230.00	208.61	222.24	215.84	222.92	0.002355	6.72	1186.20	1243.76	0.33
Reach - 1	98640.1	100-yr FW	7230.00	208.61	223.12	215.79	223.76	0.001992	6.46	1176.97	90.00	0.31
Reach - 1	97238.8	100-year	7230.00	208.47	221.36		221.38	0.000445	2.80	9679.62	1466.58	0.15
Reach - 1	97238.8	100-yr FW	7230.00	208.47	222.34		222.38	0.000407	2.83	7583.99	850.00	0.14
Reach - 1	96590.9	100-year	7230.00	206.96	220.96		221.03	0.000682	3.69	6241.57	880.38	0.18
Reach - 1	96590.9	100-yr FW	7230.00	206.96	221.92		222.02	0.000772	4.13	5017.78	565.00	0.20
Reach - 1	95987.2	100-year	7230.00	206.43	220.58		220.64	0.000607	3.51	7346.61	1025.02	0.17
Reach - 1	95987.2	100-yr FW	7230.00	206.43	221.55		221.62	0.000554	3.52	6074.18	673.00	0.17
Reach - 1	95463.7	100-year	7230.00	204.92	220.33		220.37	0.000422	3.12	8900.44	1134.78	0.15
Reach - 1	95463.7	100-yr FW	7230.00	204.92	221.30		221.36	0.000425	3.28	6464.62	645.95	0.15
Reach - 1	94837.3	100-year	7230.00	204.38	220.06		220.10	0.000426	3.17	10599.98	1336.48	0.15
Reach - 1	94837.3	100-yr FW	7230.00	204.38	221.03		221.09	0.000429	3.33	6401.30	641.94	0.15
Reach - 1	94329.1	100-year	7470.00	203.98	219.88		219.91	0.000323	2.79	10819.73	1327.05	0.13
Reach - 1	94329.1	100-yr FW	7470.00	203.98	220.86		220.90	0.000325	2.93	7576.41	722.60	0.13
Reach - 1	93527.0	100-year	7470.00	203.76	219.70		219.71	0.000185	2.12	14482.04	1664.59	0.10
Reach - 1	93527.0	100-yr FW	7470.00	203.76	220.68		220.70	0.000178	2.17	10301.39	920.00	0.10
Reach - 1	92927.0	100-year	7470.00	202.73	219.61		219.62	0.000124	1.73	15418.75	1674.79	0.08
Reach - 1	92927.0	100-yr FW	7470.00	202.73	220.59		220.61	0.000143	1.94	10657.46	895.00	0.09
Reach - 1	92194.9	100-year	7470.00	202.36	219.50		219.52	0.000164	2.02	15289.77	1615.92	0.09
Reach - 1	92194.9	100-yr FW	7470.00	202.36	220.48		220.50	0.000155	2.04	10004.95	825.00	0.09
Reach - 1	91628.4	100-year	7470.00	201.83	219.43		219.45	0.000103	1.63	16604.48	1829.82	0.07
Reach - 1	91628.4	100-yr FW	7470.00	201.83	220.40		220.42	0.000122	1.85	10849.61	825.00	0.08
Reach - 1	91018.7	100-year	7470.00	201.65	219.37		219.38	0.000107	1.67	20450.95	2020.56	0.08
Reach - 1	91018.7	100-yr FW	7470.00	201.65	220.33		220.34	0.000128	1.90	10344.90	765.00	0.08
Reach - 1	89898.6	100-year	7470.00	198.13	219.25	207.55	219.27	0.000096	1.85	19627.51	2318.22	0.07
Reach - 1	89898.6	100-yr FW	7470.00	198.13	220.15	207.55	220.18	0.000147	2.36	7997.75	585.00	0.09
Reach - 1	89778.1		Culvert									
Reach - 1	89657.6	100-year	7470.00	197.85	211.04	207.27	211.27	0.001629	5.37	5334.04	1721.63	0.28
Reach - 1	89657.6	100-yr FW	7470.00	197.85	212.04	207.27	212.33	0.001596	5.62	3418.95	585.00	0.28
Reach - 1	88694.6	100-year	7470.00	197.68	210.05		210.10	0.000812	3.93	13477.13	2181.21	0.20
Reach - 1	88694.6	100-yr FW	7470.00	197.68	211.02		211.11	0.000885	4.32	5558.04	700.00	0.21
Reach - 1	88230.9	100-year	7470.00	197.20	209.76	205.12	209.82	0.000480	3.18	16884.50	2566.11	0.17
Reach - 1	88230.9	100-yr FW	7470.00	197.20	210.75	205.14	210.82	0.000433	3.20	6248.45	710.00	0.16
Reach - 1	88203.4		Bridge									
Reach - 1	88175.9	100-year	7470.00	197.14	209.04	205.05	209.11	0.000631	3.50	15342.80	2551.43	0.19
Reach - 1	88175.9	100-yr FW	7470.00	197.14	209.92	205.08	210.01	0.000572	3.52	5701.71	710.00	0.19
Reach - 1	87844.9	100-year	7470.00	196.44	208.48	205.24	208.72	0.002121	6.72	14930.76	2480.34	0.35
Reach - 1	87844.9	100-yr FW	7470.00	196.44	209.48	205.36	209.68	0.001494	5.97	3856.15	555.00	0.30

Appendix D: DWQ Stream Classification Forms

NCDWQ Stream Classification Form

Project Name: Moccasin Creek Buffer & Wetland | River Basin: Neuse | County: Wake & Franklin | Evaluator: B. Ward & M. Wood
DWQ Project Number: | Nearest Named Stream: Moccasin Creek | Latitude: | Signature: B. Ward
Date: 10/20/04 | USGS QUAD: Zebulon | Longitude: | Location/Directions: Moccasin Creek

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

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

I. Geomorphology	Absent	Weak	Moderate	Strong
1) Is There A Riffle-Pool Sequence?	0	1	(2)	3
2) Is The USDA Texture In Streambed Different From Surrounding Terrain?	0	1 1.5	2	3
3) Are Natural Levees Present?	(0)	1	2	3
4) Is The Channel Sinuous?	0	1	(2)	3
5) Is There An Active (Or Relic) Floodplain Present?	0	1	2	(3)
6) Is The Channel Braided?	0	(1)	2	3
7) Are Recent Alluvial Deposits Present?	0	(1)	2	3
8) Is There A Bankfull Bench Present?	0	1	(2)	3
9) Is A Continuous Bed & Bank Present?	0	1	2	(3)

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

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

PRIMARY GEOMORPHOLOGY INDICATOR POINTS: 18.5

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

PRIMARY HYDROLOGY INDICATOR POINTS: 2

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

PRIMARY BIOLOGY INDICATOR POINTS: 12.0

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

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

SECONDARY GEOMORPHOLOGY INDICATOR POINTS: 2.0

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

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

SECONDARY HYDROLOGY INDICATOR POINTS: 7.0

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

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

SECONDARY BIOLOGY INDICATOR POINTS: 10

TOTAL POINTS** (Primary + Secondary)=51.5 **(If Greater Than Or Equal To 19 Points The Stream Is At Least Intermittent)

Perennial Stream

NCDWQ Stream Classification Form

Project Name: Maccasin Creek Buffer & Wetland | River Basin: Neuse | County: Wake & Franklin | Evaluator: S. Garriock

DWQ Project Number: | Nearest Named Stream: Beaverdam Creek | Latitude: | Signature:

Date: 11/8/04 | USGS QUAD: Zebulon | Longitude: | Location/Directions: Beaverdam Creek

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

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

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

PRIMARY GEOMORPHOLOGY INDICATOR POINTS: 22

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

PRIMARY HYDROLOGY INDICATOR POINTS: 3

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

PRIMARY BIOLOGY INDICATOR POINTS: 9

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

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

SECONDARY GEOMORPHOLOGY INDICATOR POINTS: 2.5

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

SECONDARY HYDROLOGY INDICATOR POINTS: 7

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

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

SECONDARY BIOLOGY INDICATOR POINTS: 3

***TOTAL POINTS** (Primary + Secondary)*= 46.5 *(If Greater Than Or Equal To 19 Points The Stream Is At Least Intermittent)*

Perennial Stream

NCDWQ Stream Classification Form

Project Name: Maccasin Creek Buffer & Wetland | River Basin: Neuse | County: Wake & Franklin | Evaluator: S. Garriock
DWQ Project Number: | Nearest Named Stream: Maccasin Creek | Latitude: | Signature:
Date: 11/6/04 | USGS QUAD: Zebulon | Longitude: | Location/Directions: Wolf Creek

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

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

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

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

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

PRIMARY GEOMORPHOLOGY INDICATOR POINTS: 12

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

PRIMARY HYDROLOGY INDICATOR POINTS: 3

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

PRIMARY BIOLOGY INDICATOR POINTS: 4

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

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

SECONDARY GEOMORPHOLOGY INDICATOR POINTS: 0.5

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

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

SECONDARY HYDROLOGY INDICATOR POINTS: 7

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

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

SECONDARY BIOLOGY INDICATOR POINTS: 3

***TOTAL POINTS** (Primary + Secondary)* 22.5 *(If Greater Than Or Equal To 19 Points The Stream Is At Least Intermittent)*

Intermittent Stream

NCDWQ Stream Classification Form

Project Name: Moccasin Creek Stream Buffer & Wetland | River Basin: Neuse | County: Wake & Franklin | Evaluator: B. Ward & S. Medlin
DWQ Project Number: | Nearest Named Stream: Moccasin Creek | Latitude: | Signature: B. Ward
Date: 10/20/04 | USGS QUAD: Zebulon | Longitude: | Location/Directions: Stream S-1

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

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

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

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

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

PRIMARY GEOMORPHOLOGY INDICATOR POINTS: 17

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

PRIMARY HYDROLOGY INDICATOR POINTS: 1

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

PRIMARY BIOLOGY INDICATOR POINTS: 6

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

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

SECONDARY GEOMORPHOLOGY INDICATOR POINTS: 2.5

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

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

SECONDARY HYDROLOGY INDICATOR POINTS: 9.5

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

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

SECONDARY BIOLOGY INDICATOR POINTS: 3.0

TOTAL POINTS *(Primary + Secondary)*= 35 *(If Greater Than Or Equal To 19 Points The Stream Is At Least Intermittent)*

Intermittent Stream

NCDWQ Stream Classification Form

Project Name: Moccasin Creek Stream Buffer & Wetlands | River Basin: Neuse | County: Wake & Franklin | Evaluator: B. Ward & Steve Medlin
DWQ Project Number: | Nearest Named Stream: | Latitude: | Signature: Beth L Ward
Date: 10/20/04 | USGS QUAD: Zebulon | Longitude: | Location/Directions: S-2

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

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

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

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

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

PRIMARY GEOMORPHOLOGY INDICATOR POINTS: 20

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

PRIMARY HYDROLOGY INDICATOR POINTS: _____

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

PRIMARY BIOLOGY INDICATOR POINTS: 7

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

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

SECONDARY GEOMORPHOLOGY INDICATOR POINTS: 2.0

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

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

SECONDARY HYDROLOGY INDICATOR POINTS: 6.0

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

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

SECONDARY BIOLOGY INDICATOR POINTS: 3.0

TOTAL POINTS *(Primary + Secondary)*=38 *(If Greater Than Or Equal To 19 Points The Stream Is At Least Intermittent)*

Intermittent Stream

NCDWQ Stream Classification Form

Project Name: Moccasin Creek Buffer & Wetland | River Basin: Neuse | County: Wake & Franklin | Evaluator: S. Gariock

DWQ Project Number: | Nearest Named Stream: Moccasin Creek | Latitude: | Signature:

Date: 11/8/04 | USGS QUAD: Zebulon | Longitude: | Location/Directions: Stream S-3

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

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

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

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

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

PRIMARY GEOMORPHOLOGY INDICATOR POINTS: 8

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

PRIMARY HYDROLOGY INDICATOR POINTS: 3

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

PRIMARY BIOLOGY INDICATOR POINTS: 2

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

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

SECONDARY GEOMORPHOLOGY INDICATOR POINTS: 0.5

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

SECONDARY HYDROLOGY INDICATOR POINTS: 8

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

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

SECONDARY BIOLOGY INDICATOR POINTS: 2

TOTAL POINTS *(Primary + Secondary)* 23.5 *(If Greater Than Or Equal To 19 Points The Stream Is At Least Intermittent)*

Intermittent Stream

Appendix E: Rain & Ground Water Gauge Data

Rain and Ground Water Gauge Data from September 27, 2004 to October 27, 2004 at the Moccasin Creek Site, Wake and Franklin

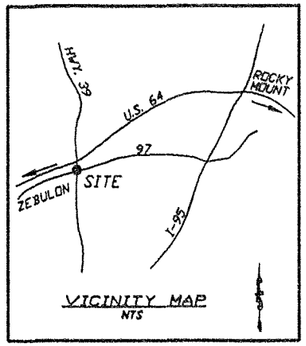
Date	Precipitation	Depth to Water Table		
		Gauge 1	Gauge 2	Gauge 3
9/27/2004	0.37	0.43	-0.09	-7.6
9/28/2004	0.5	1.22	0.06	-6.04
9/29/2004	0	0.9	-0.04	-6.5
9/30/2004	0	0.49	-0.18	-7.28
10/1/2004	0.22	0.47	0.12	-7.5
10/2/2004	0	0.23	-0.04	-7.86
10/3/2004	0	-0.23	-0.46	-8.81
10/4/2004	0	0.12	-0.76	-7.86
10/5/2004	0.01	-0.61	-1.18	-8.83
10/6/2004	0	-0.46	-1.82	-8.99
10/7/2004	0	-1.22	-2.51	-11.63
10/8/2004	0	-0.74	-3.02	-11.37
10/9/2004	0	-0.53	-2.86	-10.94
10/10/2004	0	-0.64	-3.86	-10.64
10/11/2004	0	-1.41	-4.59	-12.04
10/12/2004	0	-1.29	-4.3	-11.31
10/13/2004	2.34	3.04	2.17	4.22
10/14/2004	0	2.13	0.03	-1.67
10/15/2004	0.14	0.76	0.2	-5.47
10/16/2004	0	0.17	-0.18	-7.14
10/17/2004	0	-0.18	-0.51	-8.29
10/18/2004	0	-0.23	-0.53	-8.46
10/19/2004	0	-0.09	-0.5	-8.71
10/20/2004	0	-0.21	-0.61	-9.21
10/21/2004	0	0.02	-0.63	-8.65
10/22/2004	0	0.01	-0.91	-8.9
10/23/2004	0	0.35	-0.76	-8.32
10/24/2004	0.06	0.45	-0.31	-8.77
10/25/2004	0.01	0.41	-0.34	-9.03
10/26/2004	0	0.2	-0.66	-9.35
10/27/2004	0	0.06	-0.72	-9.78

Appendix F: Restoration Plans

MOCCASIN CREEK

STREAM, BUFFER, AND WETLAND RESTORATION, ENHANCEMENT, AND PRESERVATION

WAKE & FRANKLIN COUNTIES, NORTH CAROLINA



VICINITY MAP
NTS

Ward Consulting Engineers, P.C.
Storm Water Management Engineering
1512 Eglantyne Court
Raleigh, NC 27613
(919) 870-0526
FAX (919) 870-5359

ECOSYSTEM ENHANCEMENT PROGRAM
PARKER LINCON BUILDING
2728 CAPITAL BLVD., SUITE 1H-103
RALEIGH, NORTH CAROLINA 27606 - PH. 919-715-0476

PROFESSIONAL ENGINEER SEAL 19364 NORTH CAROLINA USA BECKY LYNN WARD

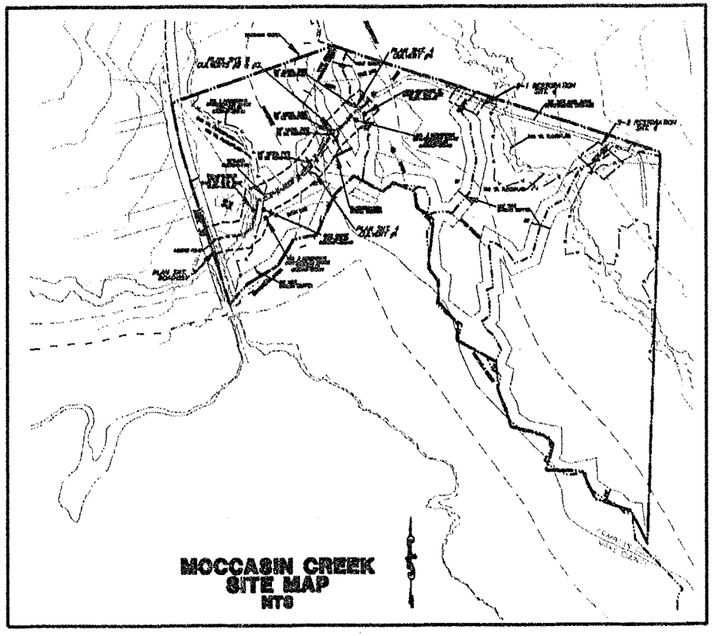
SEAL

GENERAL NOTES

1. ALL SEDIMENTATION AND EROSION CONTROLS TO BE BUILT TO STATE OF NORTH CAROLINA STANDARDS.
2. ALL DISTURBED AREAS TO BE SEEDED TO SPECIFICATIONS UNLESS OTHERWISE NOTED.
3. ALL AREAS SHOWN OUTSIDE THE DISTURBANCE LIMIT TO REMAIN IN THEIR NATURAL CONDITION. NO WORK WILL BE PERFORMED IN THE WETLANDS EXCEPT AS DESIGNATED ON THE PLANS.
4. FLOOD HAZARD ZONES EXIST ON THIS PROJECT ACCORDING TO FEMA FLOOD WAY MAP. SEE OVERALL PLAN FOR LOCATION.
5. CONTRACTOR SHALL VERIFY ALL DIMENSIONS IN FIELD. ANY DISCREPANCIES THEREOF SHALL BE REPORTED TO THE OWNER AND ENGINEER, PRIOR TO PROCEEDING WITH THE WORK.
6. CONTRACTOR SHALL VERIFY LOCATIONS AND ELEVATIONS OF ALL EXISTING UTILITIES. (UTILITIES ONLY ANTICIPATED IN HIGHWAY 39 - ROW)
7. THE OWNER AND FINANCIALLY RESPONSIBLE PARTY FOR THIS RESTORATION PROJECT IS THE NC ECOSYSTEM ENHANCEMENT PROGRAM.
8. THE CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTENANCE OF ALL EROSION CONTROL MEASURES DURING CONSTRUCTION.
9. CONTRACTOR IS RESPONSIBLE FOR HAVING ALL UTILITIES LOCATED 48 HOURS PRIOR TO MOBILIZATION ON SITE.
10. BASE TOPOGRAPHIC INFORMATION GENERATED FROM NCDOT 20' CONTOURS.
11. BASE PLANIMETRIC INFORMATION FROM WAKE COUNTY GIS INFORMATION.
12. PROPERTY LINE FROM SURVEY BY ROBERT E. WILLIAMS (11-26-1997).
13. FIELD SURVEYS OF EXISTING ACCESS ROAD BY JIMMY BARBOUR SURVEYING. 213 S. SECOND ST., SMITHFIELD, NC. 27577. (919)-989-8642. TWO BENCHMARKS SET BY BARBOUR SURVEYING AS SHOWN ON SHEET 2, OVERALL SITE PLAN.
14. FEMA FLOODWAY & FLOODPLAIN FOR BEAVERDAM & MOCCASIN CREEKS FROM NC FLOOD MAPPING PROGRAM WEB SITE SHAPE FILES DATED AUG. 2004.
15. S3 UNDEFINABLE NORTH OF ROADWAY DUE TO HIGH WATER.
16. WOLF CREEK NAMED FROM PREVIOUS LAND OWNER. LOCATION NOT FOUND ON ANY RECORDS.
17. WETLANDS LOCATED BY THE CATENA GROUP, INC., HILLSBOROUGH, NC, SEPTEMBER 2004.

CONSTRUCTION SEQUENCE

1. CONTRACTOR TO INSTALL ALL EROSION CONTROL MEASURES AND TREE PROTECTION FENCING AS SHOWN ON PLANS PRIOR TO BEGINNING CONSTRUCTION.
2. REMOVE DEBRIS FORM LARGE CULVERTS ON MOCCASIN CREEK TO LOWER WATER LEVEL UPSTREAM.
3. CONTRACTOR TO WORK FROM EASTERN MOST PORTION OF SITE TOWARDS THE WEST REMOVING THE ROADBED MATERIALS AND CULVERTS AS WORK PROCEEDS.
4. PLACE TEMPORARY CULVERTS IN S1.
5. REMOVE CULVERT AND ROAD IN WETLANDS S2.
6. REPAIR STREAM S1.
7. CONSTRUCT DITCH PLUGS AS SHOWN ON PLANS.
8. BEGIN CULVERT AND ROAD REMOVAL S4. CUT BYPASS CHANNEL LEAVING SOIL AT HEAD OF CHANNEL. STOCKPILE SUITABLE SOILS TO REFILL CHANNEL. REMOVE ROADBED MATERIAL AND DISPOSE OF IN DESIGNATED SPOIL AREAS OR OFF SITE.
9. SAND BAG STREAM AND REMOVE PLUG DIVERTING WATER TO BYPASS CHANNEL.
10. PUMP WORK AREA TO REMOVE WATER AS PIPE AND SOILS ARE REMOVED. PUMP WATER TO STABLE AREA AS DESIGNATED BY ENGINEER AWAY FORM CHANNEL.
11. REMOVE PIPE AND UNSUITABLE ROADBED SOILS AND DISPOSE OF PROPERLY.
12. REMOVE EARTH TO RECONSTRUCTED TYPICAL CHANNEL DIMENSIONS AND STABILIZE CHANNEL.
13. CUT SOD MATS OR SELECTED ON SITE VEGETATION IN AREAS IDENTIFIED ON PLAN OR BY ENGINEER AND PLACE ON TOP OF RECONSTRUCTED BANK AS SHOWN ON THE TYPICAL CHANNEL SECTIONS FOR WOLF CREEK AND STREAM S3.
14. RE-RELEASE WATER THROUGH RECONSTRUCTED STABLE CHANNEL.
15. CONSTRUCT CLAY PLUG IN BYPASS CHANNEL AND BACK FILL CHANNEL WITH STOCK PILED SUITABLE SOILS.
16. REPEAT PROCEDURE FOR CULVERTS 2, 3, AND 1 AS CONSTRUCTION MOVES WEST THROUGH THE SITE.
17. REMOVE UNSUITABLE SOILS TO DEPTH AND WIDTHS SHOWN ON PLANS. SHEET 3, ROAD FILL PLAN AND PROFILE AND AS SPECIFIED ON STREAM RESTORATION DETAIL SHEETS 4, 5, & 6.
18. SEED AND STABILIZE ALL DISTURBED AREAS.
19. PLANT AND MULCH VEGETATION AS SHOWN ON PLANTING PLAN.



SHEET SCHEDULE

SITE DATA TABLE

AREA:	APPROX. 84 ACRES WAKE COUNTY: 16.96 ACRES FRANKLIN COUNTY: 67 ACRES
PIN NO.	WAKE COUNTY - 2716-62-1607 FRANKLIN COUNTY - 2715-72-5839 0814-04-82-2915
DEED BOOK:	WAKE CO. 10809, FRANKLIN CO. 786
PAGE NUMBER:	WAKE CO. 1966, FRANKLIN CO. 503
DEED DATE:	MAY 6, 2004
ZONING: WAKE CO. FRANKLIN CO.	 HD R-40
OWNER:	STATE OF NORTH CAROLINA STATE PROPERTY OFFICE 1321 MAIL SERVICE CENTER RALEIGH, NC 27699-1321
PROPERTY PHYSICAL ADDRESS:	2412 NC 39 HIGHWAY ZEBULON, NC 27597
PROJECT SPONSORED BY:	NC ECOSYSTEM ENHANCEMENT PROGRAM PARKER LINCOLN BUILDING 2728 CAPITAL BLVD. SUITE 1H-103 RALEIGH, NC 27606 919-715-0476
TYPE OF PROJECT:	STREAM, BUFFER, & WETLAND RESTORATION ENHANCEMENT & PRESERVATION
DISTURBED AREA:	1.1 AC.

PROJECT RESTORATION/ENHANCEMENT AND PRESERVATION

TYPE	AREA (ACRES)	DISTANCE (FEET)
WETLAND ENHANCEMENT	5.30	N/A
WETLAND RESTORATION	0.42	N/A
WETLAND PRESERVATION	39.67	N/A
STREAM RESTORATION	N/A	180
STREAM BUFFER RESTORATION	3.72	N/A
STREAM BUFFER PRESERVATION	14.4	N/A

LEGEND

- PROPERTY LINE
- COUNTY LINE
- STREAM
- DITCH
- WETLAND LINE
- FLOODWAY
- 100 YR. FLOODPLAIN
- 500 YR. FLOODPLAIN
- 10 FT. CONTOUR
- 1' OR 2' FT. CONTOURS AS NOTED
- TREE LINE
- STREAM BUFFER LINE
- S1 STREAM IDENTIFICATION
- SANDBAG DIVERSION
- SILT FENCE
- TREE PROTECTION FENCING
- TEMPORARY GRAVEL CONSTRUCTION ENTRANCE
- VEGETATION HARVEST AREAS
- DITCH PLUG

WETLAND INVESTIGATION & DESIGN BY:
THE CATENA GROUP INC.
410-B MILLSTONE DRIVE
HILLSBORO, NC 27278
PH: 919-732-1300
FAX: 919-732-1303

MOCCASIN CREEK
TITLE SHEET

PRELIMINARY NOT FOR CONSTRUCTION

DATE: 11-11-04

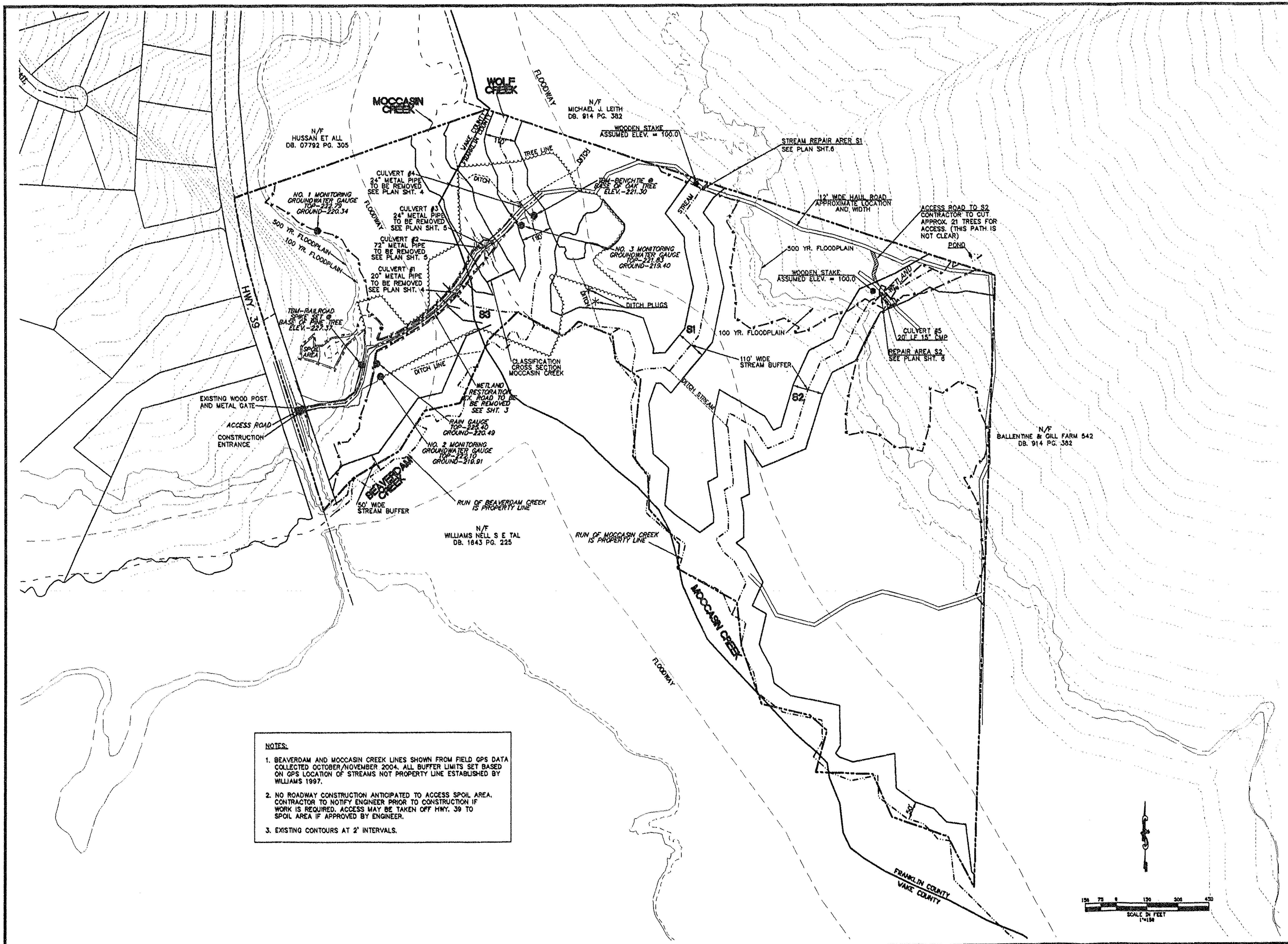
REVISIONS:

PROJECT NAME: MOCCASIN CREEK

DWG NAME: c-cover

SCALE: NTS

SHEET NO.


WOLF CREEK
MOCCASIN CREEK
FLOODWAY
N/F
MICHAEL J. LEITH
DB. 914 PG. 382
N/F
HUSSAN ET ALL
DB. 07792 PG. 305
WOODEN STAKE
ASSUMED ELEV. = 100.0
STREAM REPAIR ARER S1
SEE PLAN SHT.6
TREE LINE
DITCH
CULVERT #4
24" METAL PIPE
TO BE REMOVED
SEE PLAN SHT. 4
TBM-BENCHTIE @
BASE OF OAK TREE
ELEV.-221.30
12' WIDE HAUL ROAD
APPROXIMATE LOCATION
AND WIDTH
NO. 1 MONITORING
GROUNDWATER GAUGE
TOP-222.79
GROUND-220.34
CULVERT #3
24" METAL PIPE
TO BE REMOVED
SEE PLAN SHT. 5
ACCESS ROAD TO S2
CONTRACTOR TO CUT
APPROX. 21 TREES FOR
ACCESS. (THIS PATH IS
NOT CLEAR)
POND
500 YR. FLOODPLAIN
100 YR. FLOODPLAIN
CULVERT #2
72" METAL PIPE
TO BE REMOVED
SEE PLAN SHT. 5
NO. 3 MONITORING
GROUNDWATER GAUGE
TOP-221.83
GROUND-219.40
STREAM
WOODEN STAKE
ASSUMED ELEV. = 100.0
WETLAND
CULVERT #1
20" METAL PIPE
TO BE REMOVED
SEE PLAN SHT. 4
DITCH PLUGS
HWY. 39
TBM-RAILROAD
SPIKE SET @
BASE OF PINE TREE
ELEV.-227.37
SPOIL AREA
S3
S1
CULVERT #5
20' LF 15" CMP
REPAIR AREA S2
SEE PLAN SHT. 6
DITCH LINE
CLASSIFICATION
CROSS SECTION
MOCCASIN CREEK
110' WIDE
STREAM BUFFER
DITCH STREAM
S2
EXISTING WOOD POST
AND METAL GATE
WETLAND
RESTORATION
EX. ROAD TO BE
BE REMOVED
SEE SHT. 3
ACCESS ROAD
CONSTRUCTION
ENTRANCE
RAIN GAUGE
TOP-225.40
GROUND-220.49
NO. 2 MONITORING
GROUNDWATER GAUGE
TOP-222.10
GROUND-219.91
N/F
BALLENTINE & GILL FARM 542
DB. 914 PG. 382
BEAVERDAM CREEK
50' WIDE
STREAM BUFFER
RUN OF BEAVERDAM CREEK
IS PROPERTY LINE
N/F
WILLIAMS NELL S E TAL
DB. 1643 PG. 225
RUN OF MOCCASIN CREEK
IS PROPERTY LINE
MOCCASIN CREEK
FLOODWAY
FRANKLIN COUNTY
WAKE COUNTY
SCALE IN FEET
1"=150'

NOTES:

1. BEAVERDAM AND MOCCASIN CREEK LINES SHOWN FROM FIELD GPS DATA COLLECTED OCTOBER/NOVEMBER 2004. ALL BUFFER LIMITS SET BASED ON GPS LOCATION OF STREAMS NOT PROPERTY LINE ESTABLISHED BY WILLIAMS 1997.
2. NO ROADWAY CONSTRUCTION ANTICIPATED TO ACCESS SPOIL AREA. CONTRACTOR TO NOTIFY ENGINEER PRIOR TO CONSTRUCTION IF WORK IS REQUIRED. ACCESS MAY BE TAKEN OFF HWY. 39 TO SPOIL AREA IF APPROVED BY ENGINEER.
3. EXISTING CONTOURS AT 2' INTERVALS.

Ward Consulting Engineers, P.C.
Storm Water Management Engineering
1512 Eglantyne Court (919) 870-0526
Raleigh, NC 27613 FAX (919) 870-5359

ECOSYSTEM ENHANCEMENT PROGRAM
PARKER LINCON BUILDING
2728 CAPITAL BLVD, SUITE 1H-103
RALEIGH, NORTH CAROLINA 27608 - PH. 919-715-0476

SEAL:

MOCCASIN CREEK OVERALL SITE PLAN

PRELIMINARY NOT FOR CONSTRUCTION

DATE: 10-15-04

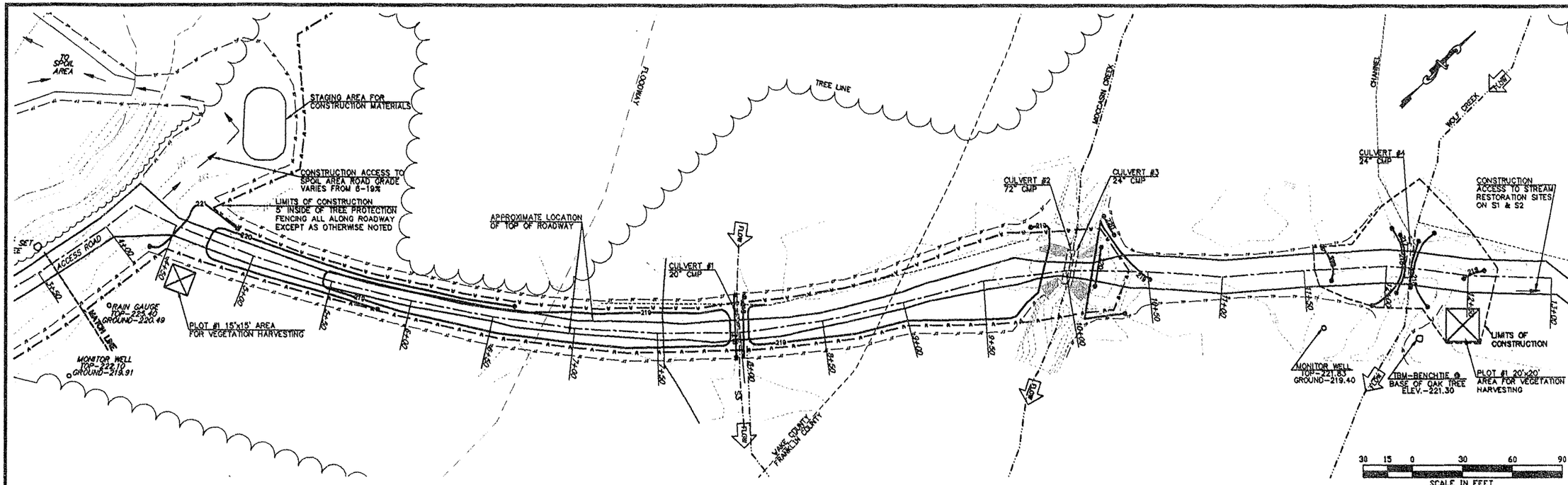
REVISIONS:

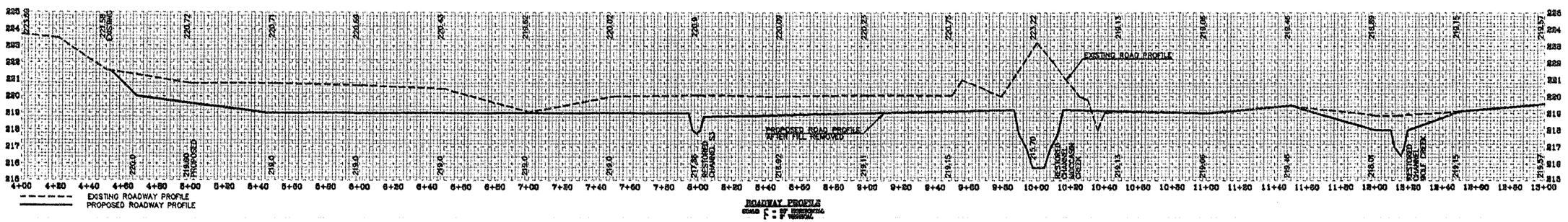
PROJECT NAME: MOCCASIN CREEK

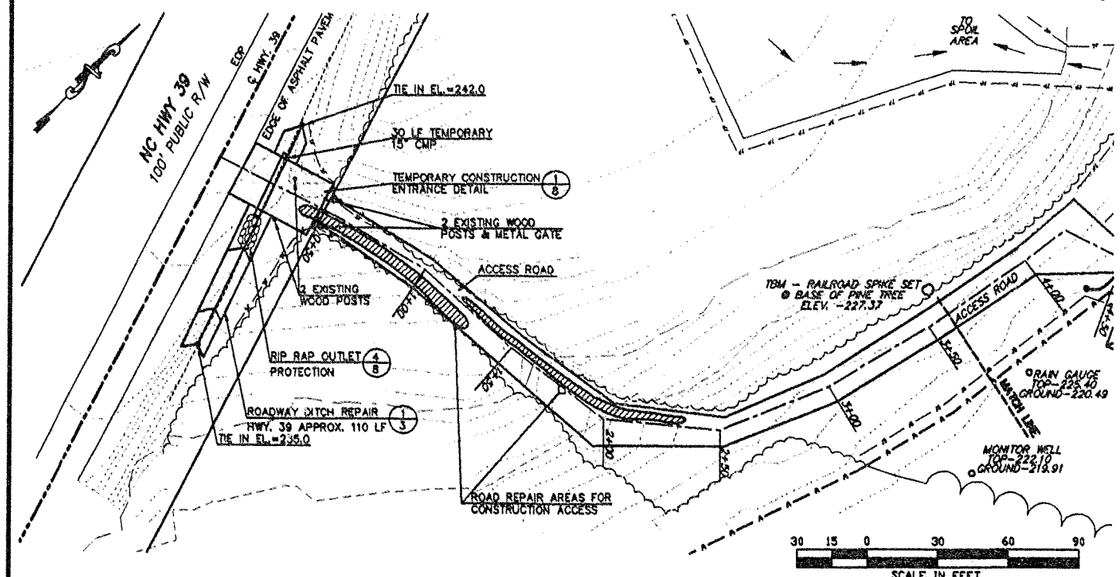
DWG NAME: c-full-site

SCALE: 1" = 150'

SHEET NO. 2 OF 8





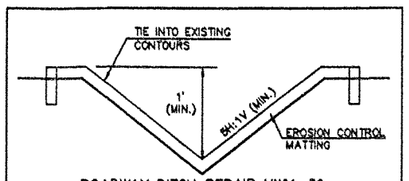


NOTES:

1. CONTRACTOR TO STAY WITHIN LIMITS OF CONSTRUCTION WITH EQUIPMENT AND CONSTRUCTION OPERATIONS. AREA OUTSIDE THE LIMITS OF CONSTRUCTION SHALL NOT BE DISTURBED.
2. CONTRACTOR SHALL CHECK ALL GRADES AND FINAL DIMENSIONS ON THE GROUND AND REPORT ANY DISCREPANCIES TO THE ENGINEER.
3. CONTRACTOR TO DISPOSE OF ALL SOILS AND STONE IN SPOIL AREA OR HAUL OFF SITE. NO WASTE MATERIALS ARE TO BE PLACED IN THE FLOODWAY OR FLOODPLAIN OF MOCCASIN CREEK.
4. ALL REMOVED CORRUGATED METAL PIPES TO BE DISPOSED OF IN A LICENSED LANDFILL.
5. CONTRACTOR TO STABILIZE THE SITE AS THE WORK PROCEEDS FROM EAST TO WEST.
6. PROTECT ANY SPOIL AREAS WITH SILT FENCE WHERE TOPO ADJACENT TO STOCK PILE DRAINS TOWARDS STREAMS.
7. THE EXISTING ROADWAY SHOULD NOT BE GRADED TO A UNIFORM ELEVATION. THE FINAL SURFACE SHALL BE RIPPED OR DISKED TO CREATE MICRO-TOPOGRAPHY.
8. CONTRACTOR TO MINIMIZE DISTURBANCE WITH EQUIPMENT IN WETLAND AND STREAM BUFFER ZONES UNLESS OTHERWISE DIRECTED BY ENGINEER.
9. NO CONSTRUCTION EQUIPMENT, ACTIVITIES, OR STORAGE OF MATERIALS ARE ALLOWED WITHIN DRIP LINE OF EXISTING TREES BEYOND ANY LIMITS OF CLEARING.
10. CONTRACTOR IS RESPONSIBLE FOR STAKING OF PROPOSED GRADES AND AS-BUILT SURVEYS. ALL GRADES SHALL BE REVIEWED AND APPROVED BY ENGINEER PRIOR TO EXCAVATION WORK. THE GRADING PLAN IS AVAILABLE ELECTRONICALLY TO THE CONTRACTOR AND HIS SURVEYOR.
11. CONTRACTOR TO REPAIR ACCESS ROAD FOR EQUIPMENT ACCESS TO THE SITE AS NECESSARY. ROAD REPAIR AREAS SHOWN ARE APPROXIMATE.
12. CONTRACTOR TO REMOVE 2 EXISTING WOODEN POST AT SITE ENTRANCE IF NEEDED DURING CONSTRUCTION.
13. CONTRACTOR TO REMOVE AND REINSTALL WOODEN POST AND METAL GATE AS NEEDED FOR CONSTRUCTION.
14. PLAN SHEET 3 CONTOURS 1' INTERVALS.

LEGEND

- LIMITS OF CONSTRUCTION
- PROPOSED CONTOURS
- EXISTING CONTOURS 1'
- EXISTING CONTOURS 10'
- TREE PROTECTION
- SILT FENCE



ROADWAY DITCH REPAIR HWY. 39
NTS

NOTES:
1. CONTRACTOR TO REGRADE DITCH AFTER REMOVAL OF CONSTRUCTION ENTRANCE AND TEMPORARY CMP.
2. DITCH GRADE APPROXIMATELY 6.4 %

DISTURBED AREA = 0.93 ACRES

Ward Consulting Engineers, P.C.
Storm Water Management Engineering
1512 Eglantyne Court
Raleigh, NC 27613
(919) 870-0526
FAX (919) 870-5359

ECOSYSTEM ENHANCEMENT PROGRAM
PARKER LINCON BUILDING
2728 CAPITAL BLVD, SUITE 1H-103
RALEIGH, NORTH CAROLINA 27606 - PH. 919-715-0476

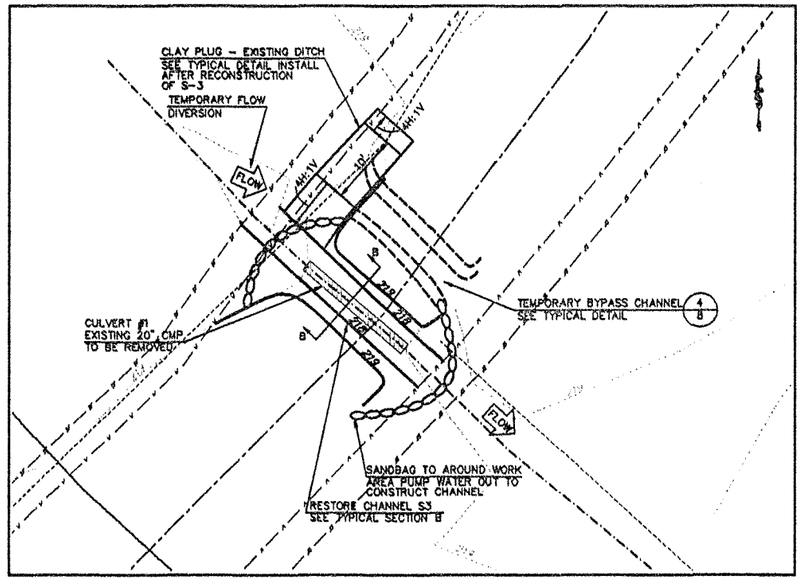
NORTH CAROLINA PROFESSIONAL SEAL 15504 ENGINEER BECKY LYNNE OWEN

SEAL

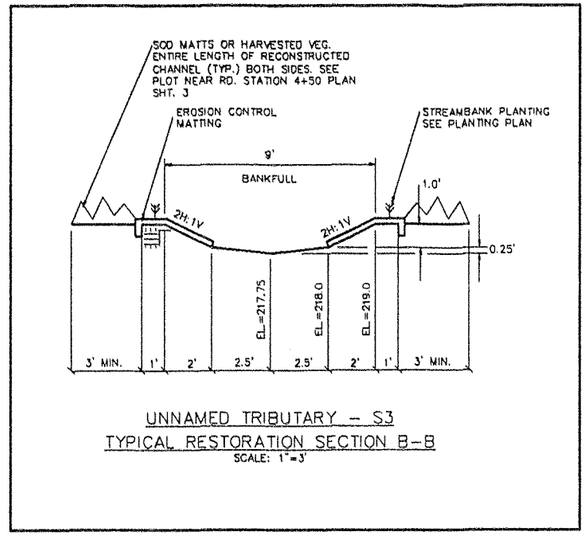
MOCCASIN CREEK
ROADFILL REMOVAL PLAN & PROFILE
PRELIMINARY NOT FOR CONSTRUCTION

DATE: 11-10-04
REVISIONS:
PROJECT NAME: MOCCASIN CREEK
DWG NAME: c-whole-road
SCALE: 1" = 30'
SHEET NO.

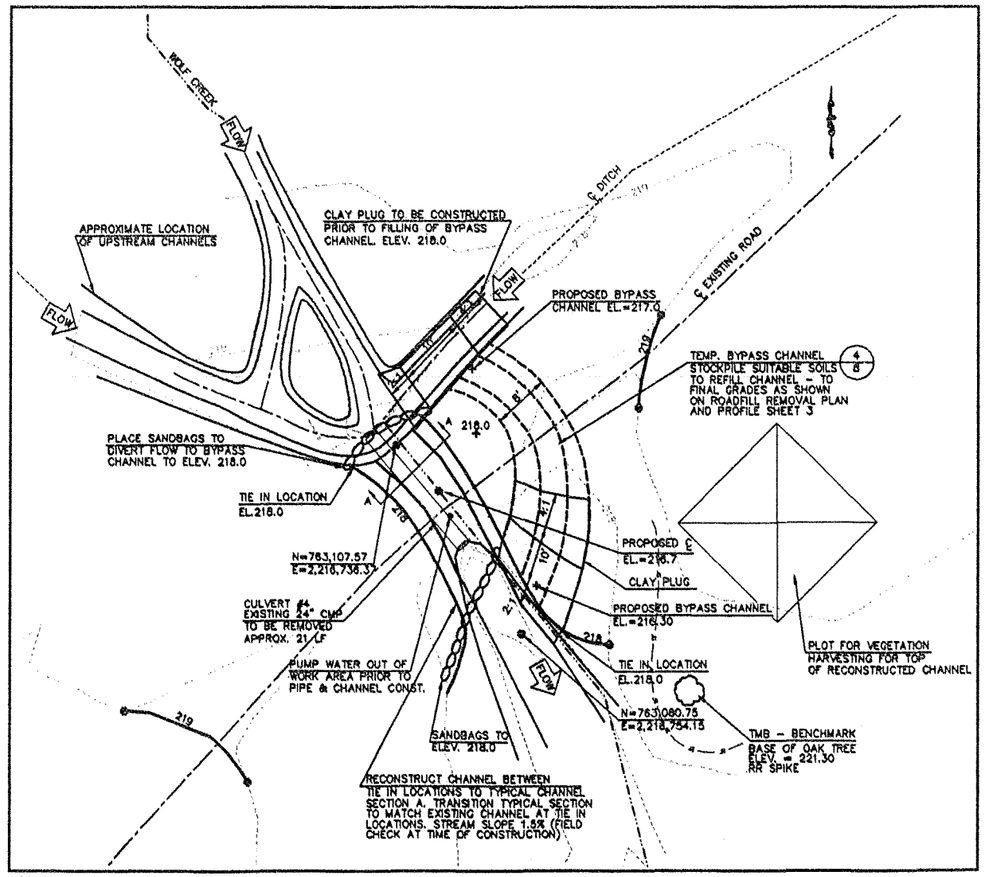
3 OF 8



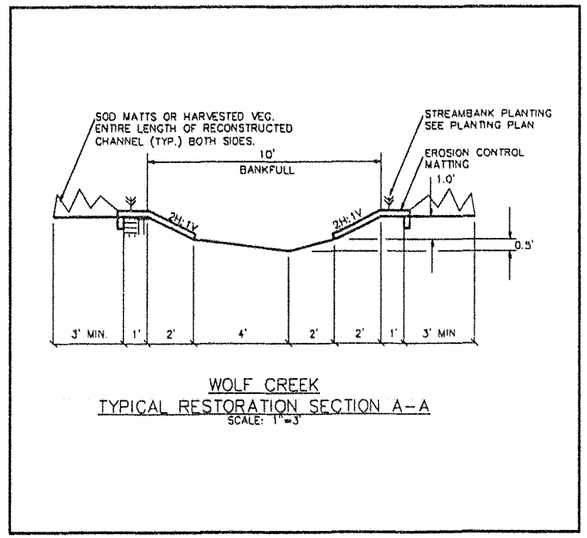
CULVERT #1 20" CMP REMOVAL UNNAMED TRIBUTARLY S-3



UNNAMED TRIBUTARY - S3
TYPICAL RESTORATION SECTION B-B
SCALE: 1"=3'



CULVERT #4 24" CMP REMOVAL WOLF CREEK



WOLF CREEK
TYPICAL RESTORATION SECTION A-A
SCALE: 1"=3'

NOTES:

1. CONTRACTOR TO PUMP OUT WORK AREA AND DISCHARGE PUMPED WATER TO STABLE AREA AS APPROVED BY THE ENGINEER.
2. CUT BYPASS CHANNEL PRIOR TO PIPE REMOVAL.
3. CONTRACTOR TO REMOVE PIPE, CONSTRUCT CHANNEL, AND STABILIZE PRIOR TO REMOVAL OF SANDBAGS AND RE-RELEASE OF WATER INTO NEWLY CONSTRUCTED CHANNEL.
4. CONTRACTOR TO REMOVE ROAD FILL SOILS AND CULVERTS AS SPECIFIED ON PLANS. CULVERTS TO BE DISPOSED OF PROPERLY AT A LICENSED LANDFILL.
5. ALL SOILS TO BE REMOVED FROM SITE OR PLACED ONLY IN DESIGNATED WASTE AREAS AS DESIGNATED ON PLANS. NO WASTE SOILS WILL BE ALLOWED TO BE PLACED IN THE FLOODWAY OR FLOODPLAIN OF MOCCASIN OR BEAVERDAM CREEKS.
6. EROSION CONTROL MATTING TO BE STAKED WITH FCO STAKES OR APPROVED EQUAL AS RECOMMENDED BY MANUFACTURER OR SPECIFIED IN THE CONTRACT SPECIFICATIONS.
7. ONE FOOT CONTOURS THIS PLAN SHEET.

LEGEND

- PROPOSED BYPASS CHANNEL
- PROPOSED CHANNEL
- EXISTING CONTOURS
- SILT FENCE
- TREE PROTECTION
- EXISTING PIPES
- LIMITS OF WETLANDS EXISTING
- SAND BAGS
- CLAY PLUGS

10 5 0 10 20 30
SCALE IN FEET
1"=30'

DISTURBED AREA INCLUDED IN AREA ON SHT. 3

Ward Consulting Engineers, P.C.
Storm Water Management Engineering
1512 Eglantyne Court
Raleigh, NC 27613
(919) 870-0526
FAX (919) 870-5358

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PARKER LINCON BUILDING
2728 CAPITAL BLVD., SUITE 1H-103
RALEIGH, NORTH CAROLINA 27606 - PH. 919-715-0476

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 15344 BECKY L. WARD

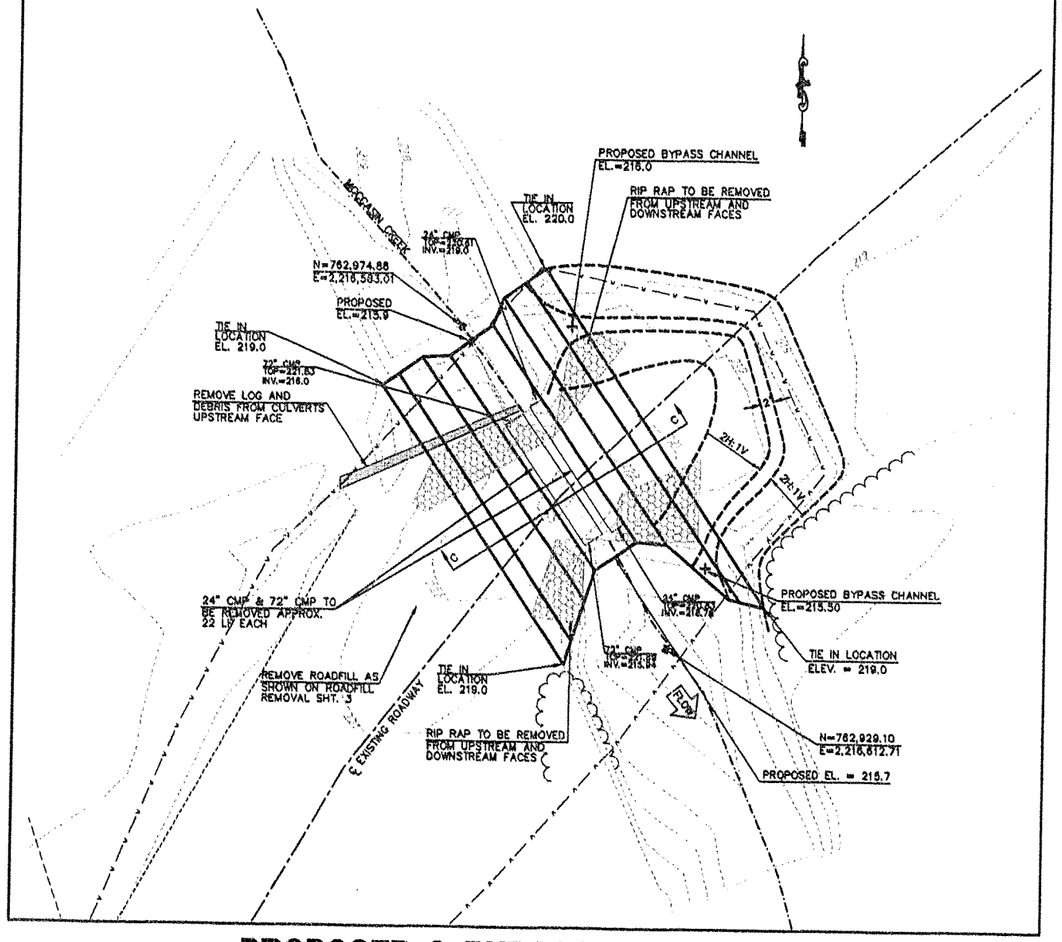
SEAL

MOCCASIN CREEK STREAM RESTORATION CULVERTS #1 & #4

PRELIMINARY NOT FOR CONSTRUCTION

DATE: 11-16-04
REVISIONS
PROJECT NAME: MOCCASIN CREEK
DWG NAME: c-culverts1-4
SCALE: 1" = 10'
SHEET NO.

4 OF 8

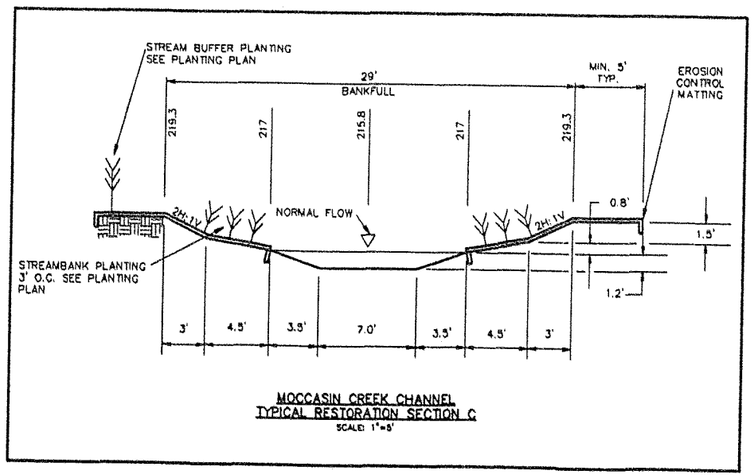


PROPOSED & BYPASS CHANNEL

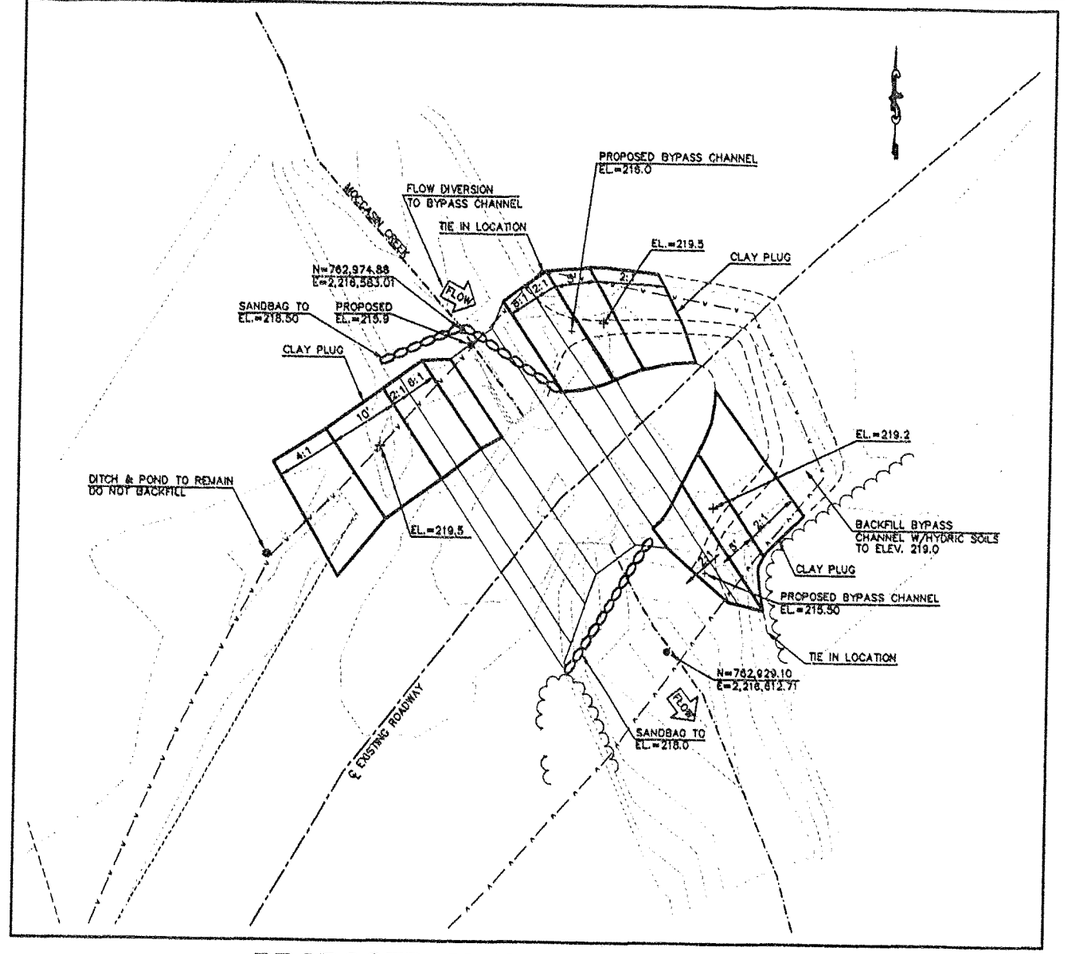
LEGEND
- PROPOSED BYPASS CHANNEL
- PROPOSED CHANNEL
- EXISTING CONTOURS
- EXISTING PIPES
- LIMITS OF WETLANDS EXISTING
- RIP RAP

NOTES:
1. CONTRACTOR TO PUMP OUT WORK AREA AND DISCHARGE PUMPED WATER TO STABLE AREA AS APPROVED BY THE ENGINEER.
2. CUT BYPASS CHANNEL PRIOR TO PIPE REMOVAL.
3. CONTRACTOR TO REMOVE PIPE, CONSTRUCT CHANNEL, AND STABILIZE PRIOR TO REMOVAL OF SANDBAGS AND RE-RELEASE OF WATER INTO NEWLY CONSTRUCTED CHANNEL.
4. CONTRACTOR TO REMOVE ROAD FILL SOILS AND CULVERTS AS SPECIFIED ON PLANS. CULVERTS TO BE DISPOSED OF PROPERLY AT A LICENSED LANDFILL.
5. ALL SOILS TO BE REMOVED FROM SITE OR PLACED ONLY IN WASTE AREAS AS DESIGNATED ON PLANS. NO WASTE SOILS WILL BE ALLOWED TO BE PLACED IN THE FLOODWAY OR FLOODPLAIN OF MOCCASIN OF BEAVERDAM CREEKS.
6. EROSION CONTROL MATTING TO BE STAKED WITH ECO STAKES OR APPROVED EQUAL AS RECOMMENDED BY MANUFACTURER OR SPECIFIED IN THE CONTRACT SPECIFICATIONS.
7. SEED ALL DISTURBED AREAS AND CLAY PLUGS PER SPECIFICATIONS.
8. INSTALL EROSION CONTROL MATTING & PLANT STREAM BANK AND BUFFER VEGETATION TO STABILIZE SITE.
9. ONE FOOT CONTOURS THIS PLAN SHEET.

10 5 0 10 20 30
SCALE IN FEET
1"=30'



MOCCASIN CREEK CHANNEL
TYPICAL RESTORATION SECTION C
SCALE: 1"=5'



PROPOSED CLAY PLUGS AND SANDBAG FLOW DIVERSION

LEGEND
- PROPOSED BYPASS CHANNEL
- PROPOSED CHANNEL
- CLAY PLUGS
- SAND BAGS
- EXISTING CONTOURS
- EXISTING PIPES
- LIMITS OF WETLANDS EXISTING
- RIP RAP

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ECOSYSTEM ENHANCEMENT PROGRAM
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2728 CAPITAL BLVD., SUITE 1H-103
RALEIGH, NORTH CAROLINA 27606 - PH. 919-715-0476

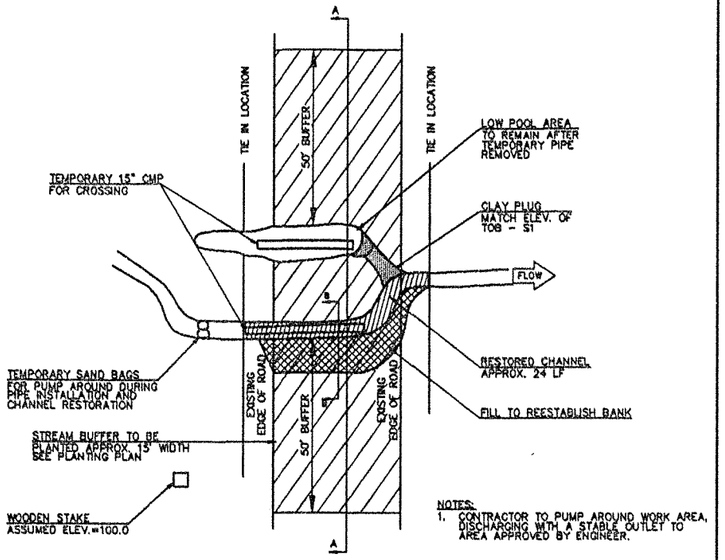
NORTH CAROLINA PROFESSIONAL SEAL 13341 ENGINEER BECKY LYNN WARD

SEAL:

MOCCASIN CREEK STREAM RESTORATION CULVERTS #2 & #3

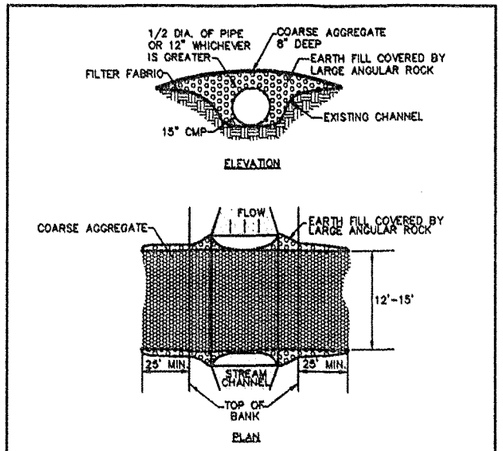
PRELIMINARY NOT FOR CONSTRUCTION

DATE: 10-15-04
REVISIONS:
PROJECT NAME: MOCCASIN CREEK
DWG NAME: c-culvert2-3
SCALE: 1" = 10'
SHEET NO.
5 OF 8

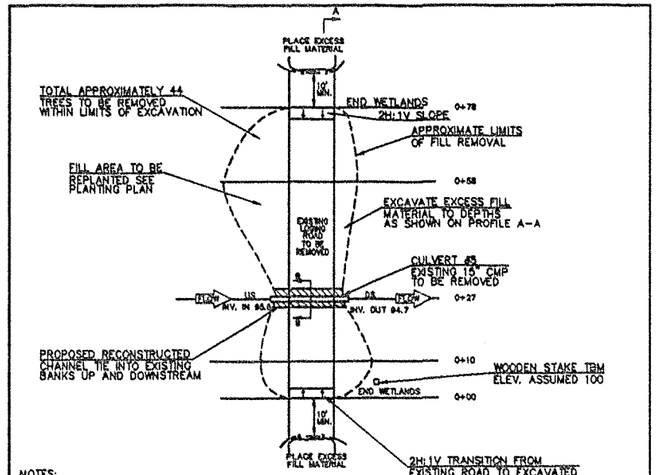


NOTES:
1. CONTRACTOR TO PUMP AROUND WORK AREA, DISCHARGING WITH A STABLE OUTLET TO AREA APPROVED BY ENGINEER.

PLAN VIEW RESTORATION AREA S1 SCHEMATIC
NTS

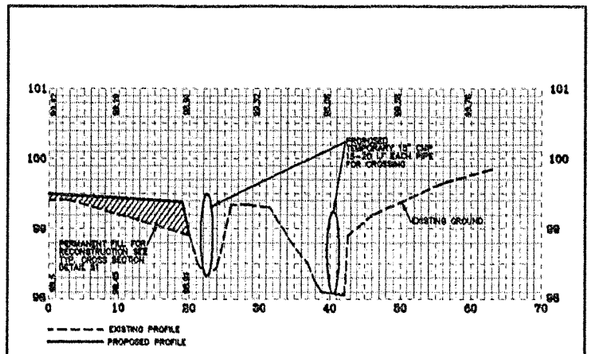


TEMPORARY STREAM CROSSING (1/6)
NTS

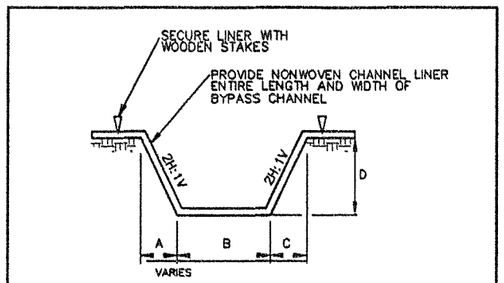


NOTES:
1. TREES REMOVED MAYBE LEFT ON SITE OUTSIDE OF WETLAND AREA AS APPROVED BY ENGINEER.
2. SEE PLAN SHT.2 FOR PROPOSED ACCESS TO SITE.
3. CONTRACTOR TO PUMP AROUND WORK AREA, DISCHARGING WITH A STABLE OUTLET TO AREA APPROVED BY ENGINEER.

PLAN VIEW RESTORATION AREA S2 SCHEMATIC
NTS

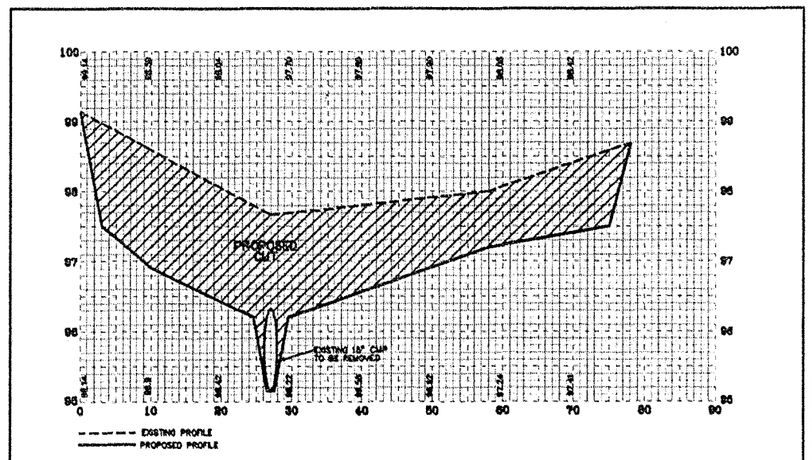


PROFILE REPAIR AREA S1 SECTION A-A
AS VIEWED LOOKING UPSTREAM
NTS

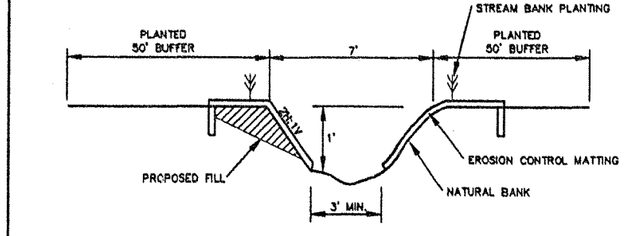


LOCATION	A (FT)	B (FT)	C (FT)	D (FT)
CULVERT #4 24" CMP PIPE REMOVAL WOLF CREEK	2'-4'	4'	2'-4'	1'-2'
CULVERT #1 20" CMP PIPE REMOVAL S3	2'-3'	3'	2'-3'	1'-1.5'

TEMPORARY BYPASS CHANNEL
NTS



PROFILE REPAIR AREA S2 SECTION A-A
NTS

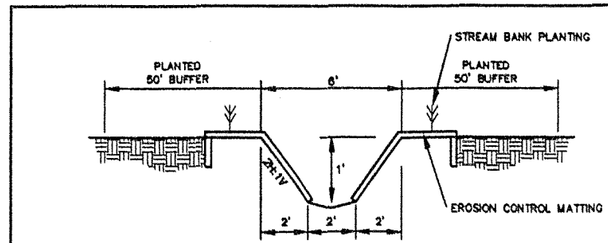


TYPICAL CHANNEL S1 SECTION B-B
AS VIEWED LOOKING UPSTREAM
NTS

GENERAL NOTES S1 & S2

1. CONTRACTOR TO PUMP AROUND WORK AREA AND DISCHARGE PUMPED WATER TO STABLE AREA AS APPROVED BY THE ENGINEER.
2. CONTRACTOR TO REMOVE ROAD FILL SOILS AND CULVERTS AS SPECIFIED ON PLANS. CULVERTS TO BE DISPOSED OF PROPERLY AT A LICENSED LANDFILL.
3. ALL SOILS TO BE REMOVED FROM SITE OR PLACED ONLY IN DESIGNATED WASTE AREAS AS DESIGNATED ON PLANS. NO WASTE SOILS WILL BE ALLOWED TO BE PLACED IN THE FLOODWAY OR FLOODPLAIN OF S1 OR S2.
4. EROSION CONTROL MATTING TO BE STAKED WITH ECO STAKES OR APPROVED EQUAL AS RECOMMENDED BY MANUFACTURER OR SPECIFIED IN THE CONTRACT SPECIFICATIONS.

DISTURBED AREA = 0.17 ACRES



TYPICAL CHANNEL S2 SECTION B-B
NTS

Ward Consulting Engineers, P.C.
Storm Water Management Engineering
1512 Eglantyne Court (919) 870-0526
Raleigh, NC 27613 FAX (919) 870-5359

ECOSYSTEM ENHANCEMENT PROGRAM
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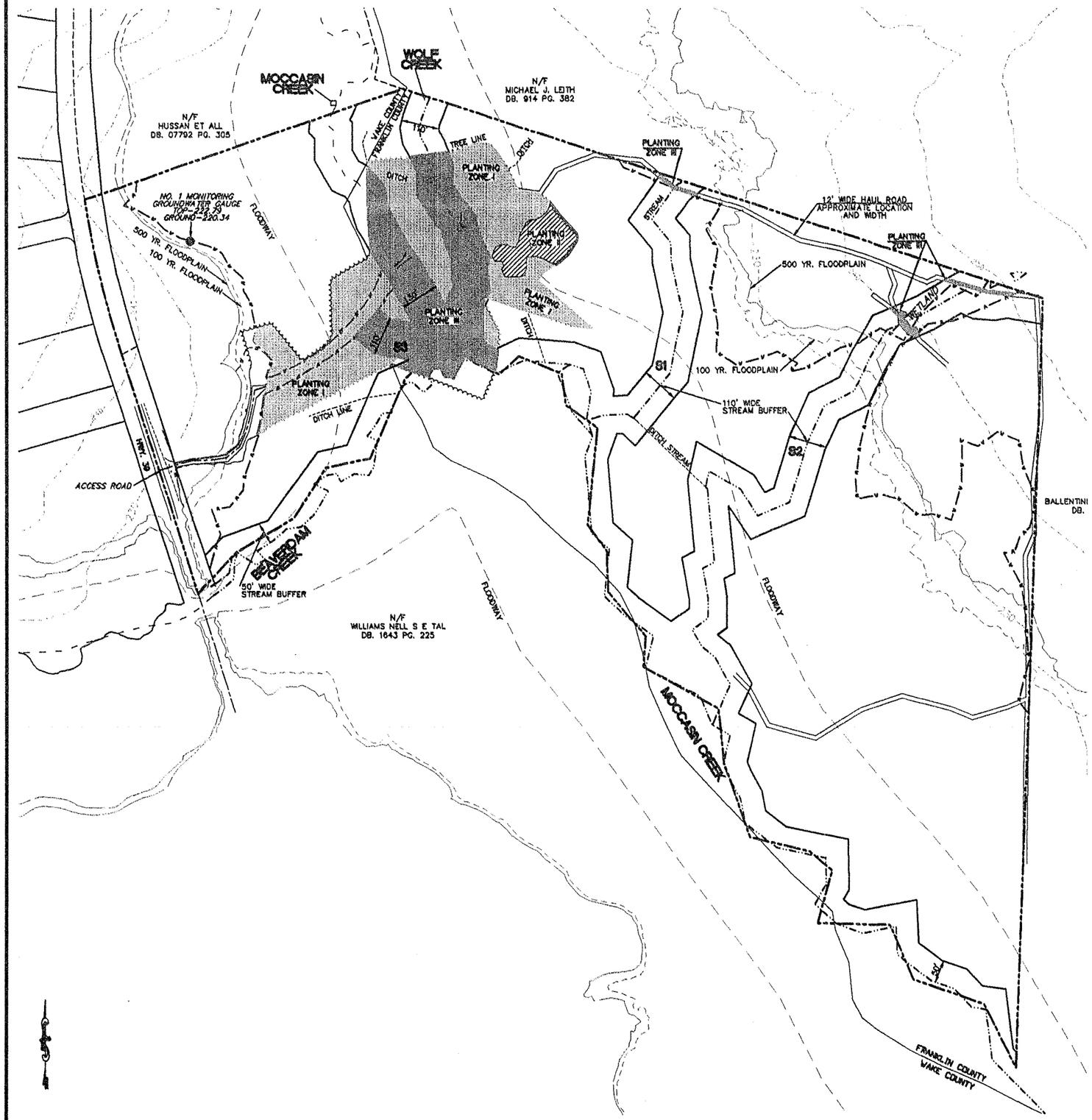
RALEIGH, NORTH CAROLINA 27606 - PH. 919-715-0476

SEAL

MOCCASIN CREEK STREAM RESTORATION S1 & S2

PRELIMINARY NOT FOR CONSTRUCTION

DATE: 11-16-04
REVISIONS:
PROJECT NAME: MOCCASIN CREEK
DWG NAME: c-s1-s2-channel
SCALE: NTS
SHEET NO.
6 OF 6



LEGEND

- PROPERTY LINE
- COUNTY LINE
- STREAM
- DITCH
- WETLAND LINE
- FLOODWAY
- 100 YR. FLOODPLAIN
- 500 YR. FLOODPLAIN
- 10 FT. CONTOUR
- 2' FT. CONTOUR
- TREE LINE
- STREAM BUFFER LINE
- S1 STREAM
- PLANTING ZONE I WETLANDS
- PLANTING ZONE II WETLANDS
- PLANTING ZONE III STREAM BUFFER

NOTES:

1. SUMMARY OF PLANT QUANTITIES CHART SIZE REFERS TO THE SIZE OF THE PLANTS AT INSTALLATION.
2. THE SPACING OF THE PLANTS SHALL BE 3' ON CENTER FOR SMALL PLANTS, WETLAND FORBES, AND ON STREAM BANK ZONE 3. FOR TREES AND SHRUBS SPACING SHALL BE 6' ALONG ROWS WITH 10' ROW SPACING FOR TREES AND SHRUBS. PLANTING DENSITY IS TO BE 726 PLANTS/ACRE. PLANTS WILL BE KEPT SHADED AND WELL WATERED TO MAINTAIN HEALTHY, VIGOROUS CONDITION PRIOR TO PLANTING.
3. PERMANENT SEED MIX DESCRIBED IN THE SPECIFICATIONS. SPECIAL RIPARIAN AND WETLAND MIX REQUIRES ADVANCE PRE-ORDER AND SHIPMENT.
4. PRIOR TO THE INSTALLATION OF PLANT MATERIAL, THE CONTRACTOR SHALL ACCURATELY LOCATE ALL EXISTING UNDERGROUND UTILITIES. THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE ENGINEER OF ANY CONFLICT WITH UTILITIES PRIOR TO PLANTING.
5. THE CONTRACTOR SHALL COORDINATE HIS WORK WITH ALL OTHER TRADES ON THE SITE. ANY PLANTING AREAS DISTURBED AS A RESULT OF CONSTRUCTION ACTIVITY SHALL BE REPAIRED/REPLACED BY THE LANDSCAPE CONTRACTOR AT NO ADDITIONAL EXPENSE TO THE OWNER.
6. ALL PLANT MATERIAL SHALL CONFORM TO OR EXCEED THE AMERICAN STANDARD FOR NURSERY STOCK (LATEST EDITION) AS PUBLISHED BY THE AMERICAN ASSOCIATION OF NURSERYMEN.
7. EXISTING TOPO AT 2' CONTOUR INTERVALS.

SUMMARY OF PLANT QUANTITIES

Quantity	Genus / Species	Common Name	Size	Remarks
Planting Zone 1 - Wetland Area (~5.12 acres)				
1000	Taxodium distichum	Bald Cypress	18" - 42"	Seedlings
1000	Nyssa sylvatica var biflo	Swamp Black Gum	18" - 42"	Seedlings
900	Quercus michauxii	Swamp Chestnut Oak	18" - 42"	Seedlings
800	Quercus lyrata	Overcup Oak	18" - 42"	Seedlings
Planting Zone 2 - Wetland Area (~0.6 acres)				
100	Betula nigra	River Birch	18" - 42"	Seedlings
150	Fraxinus pennsylvanica	Green Ash	18" - 42"	Seedlings
100	Platanus occidentalis	Sycamore	18" - 42"	Seedlings
100	Quercus phellos	Willow Oak	18" - 42"	Seedlings
Planting Zone 3 - Stream Buffer (~3.56 acres)				
300	Cephalanthus occidentalis	Button Bush	18" - 24"	Seedlings
300	Alnus serrulata	Hazel Alder	18" - 24"	Seedlings
200	Quercus lyrata	Overcup Oak	18" - 42"	Seedlings
900	Taxodium distichum	Bald Cypress	18" - 42"	Seedlings
900	Nyssa sylvatica var biflo	Swamp Black Gum	18" - 42"	Seedlings
Planting Zone 3 - Stream Bank S1				
6	Virburnum nudum	Possomhaw Viburnum	12"-24"	Rooted Plant Plugs
4	Sambucus canadensis	Elderberry	12"-24"	Rooted Plant Plugs
5	Alnus serrulata	Hazel Alder	12"-24"	Rooted Plant Plugs
Planting Zone 3 - Stream Bank S2				
8	Virburnum nudum	Possomhaw Viburnum	12"-24"	Rooted Plant Plugs
6	Sambucus canadensis	Elderberry	12"-24"	Rooted Plant Plugs
6	Alnus serrulata	Hazel Alder	12"-24"	Rooted Plant Plugs
Planting Zone 3 - Stream Bank S3				
10	Virburnum nudum	Possomhaw Viburnum	12"-24"	Rooted Plant Plugs
7	Sambucus canadensis	Elderberry	12"-24"	Rooted Plant Plugs
4	Salix nigra	Black Willow	12"-24"	Rooted Plant Plugs
Planting Zone 3 - Stream Bank Moccasin Creek				
130	Virburnum nudum	Possomhaw Viburnum	12"-24"	Rooted Plant Plugs
130	Alnus serrulata	Hazel Alder	12"-24"	Rooted Plant Plugs
70	Salix nigra	Black Willow	12"-24"	Rooted Plant Plugs
Planting Zone 3 - Stream Bank Wolf Creek				
11	Virburnum nudum	Possomhaw Viburnum	12"-24"	Rooted Plant Plugs
11	Sambucus canadensis	Elderberry	12"-24"	Rooted Plant Plugs
5	Salix nigra	Black Willow	12"-24"	Rooted Plant Plugs

* Stream bank plantings may be placed on the top of the stream bank for small streams (1ft to 1.5ft in depth) as determined by the Landscape Architect during planting operations. Live stakes may be substituted for rooted plant plugs as approved by the Engineer or Landscape Architect.

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RALEIGH, NORTH CAROLINA 27606 - PH. 919-715-0476

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 15304 BECKY LYNNE DAVIS

SEAL

MOCCASIN CREEK PLANTING PLAN

PRELIMINARY NOT FOR CONSTRUCTION

DATE: 11-16-04

REVISIONS:

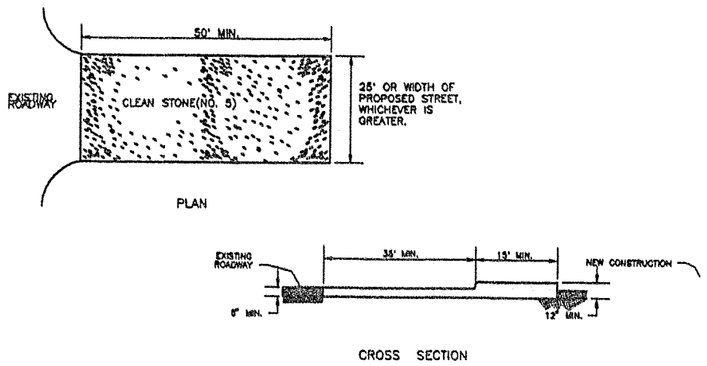
PROJECT NAME: MOCCASIN CREEK

DWG NAME: c-planting-plan

SCALE: 1" = 150'

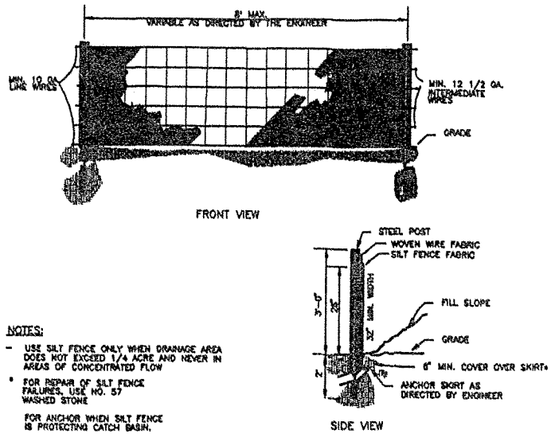
SHEET NO.

7 OF 8



1 CONSTRUCTION ENTRANCE

SCALE: NOT TO SCALE



NOTES:

- USE SILT FENCE ONLY WHEN DRAINAGE AREA DOES NOT EXCEED 1/4 ACRE AND NEVER IN AREAS OF CONCENTRATED FLOW
- FOR REPAIR OF SILT FENCE FAILURES, USE NO. 57 WASHED STONE

FOR ANCHOR WHEN SILT FENCE IS PROTECTING CATCH BASIN.

2 STANDARD TEMPORARY SILT FENCE

SCALE: NOT TO SCALE

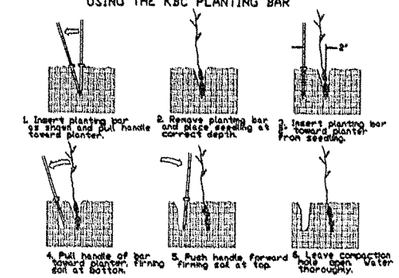
PLANTING DETAILS

SEEDLING / LINER BAREROOT PLANTING DETAIL

HEALING IN

1. Locate a heeling-in site in a shady, well protected area.
2. Excavate a flat bottom trench 12" deep and provide drainage.
3. Backfill the trench with 6" well rotted sawdust. Place a 6" layer of well rotted sawdust at a sloping angle at one end of the trench.
4. Place a single layer of plants against the sloping end so that the root collar is at ground level.
5. Place a 6" layer of well rotted sawdust over the roots maintaining a sloping angle.
6. Repeat layers of plants and sawdust as necessary and water thoroughly.

DIBBLE PLANTING METHOD USING THE KBC PLANTING BAR



PLANTING NOTES:

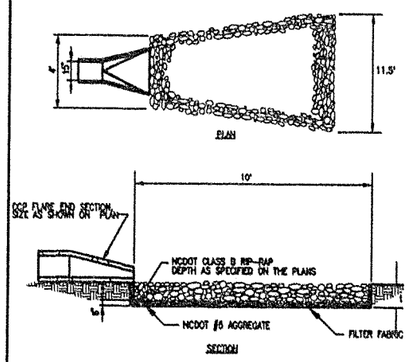
PLANTING BAG
During planting, seedlings shall be kept in a moist canvas bag or similar container to prevent the root systems from drying.

KBC PLANTING BAR
All seedlings shall have a blade with a triangular cross section and shall be 10" long at the end of which at center.

ROOT PRUNING
All seedlings shall be root pruned if necessary so that no roots extend more than 12 inches into below the root collar.

3 REFORESTATION DETAIL

SCALE: NOT TO SCALE

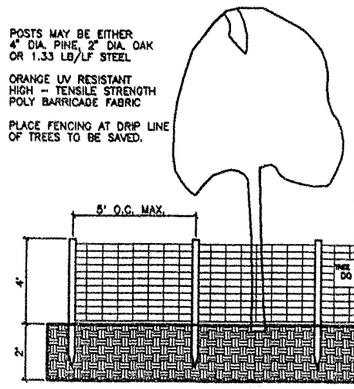


CONSTRUCTION SPECIFICATIONS

1. EXCAVATE BELOW CHANNEL OUTLET AND WIDEN CHANNEL TO THE REQUIRED RIP RAP THICKNESS FOR EACH APRON. FOUNDATION TO BE CUT TO ZERO GRADE AND SMOOTHED.
2. PLACE FILTER CLOTH ON BOTTOM AND SIDES OF PREPARED FOUNDATION. ALL JOINTS TO OVERLAP A MINIMUM OF 1.0'.
3. EXERCISE CARE IN RIP RAP PLACEMENT TO AVOID DAMAGE TO FILTER FABRIC.
4. PLACE RIP RAP ON ZERO GRADE - TOP OF RIP RAP TO BE LEVEL WITH EXISTING OUTLET - NO OVERFILL AT ENDS.
5. RIP RAP TO BE HARD, ANGULAR, WELL GRADED CLASS B EROSION CONTROL STONE.
6. IMMEDIATELY AFTER CONSTRUCTION, STABILIZE ALL DISTURBED AREAS WITH VEGETATION AS SHOWN IN THE VEGETATION PLAN.

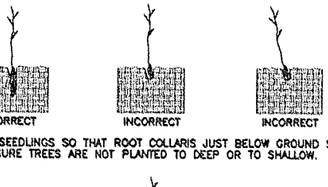
4 RIP RAP OUTLET PROTECTION

SCALE: NOT TO SCALE



5 TREE PROTECTION FENCE

SCALE: NOT TO SCALE

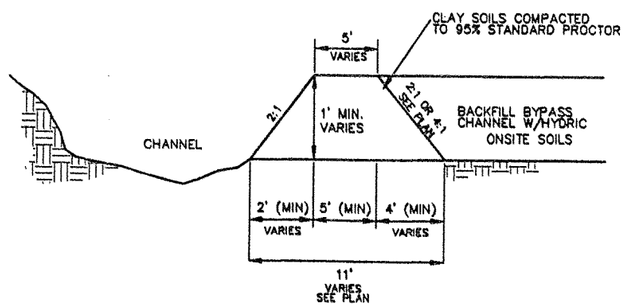


PLANT SEEDLINGS SO THAT ROOT COLLARIS JUST BELOW GROUND SURFACE. MAKE SURE TREES ARE NOT PLANTED TO DEEP OR TO SHALLOW.

ROOTS SHOULD BE STRAIGHT IN THE PLANTING HOLE. THEY SHOULD NOT BE "J" OR "U" SHAPED.

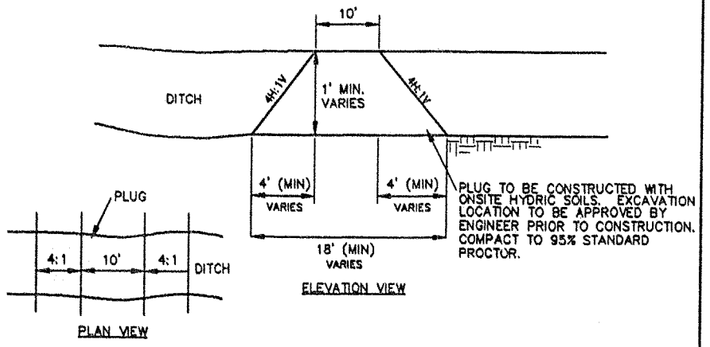
6 SEEDLING PLANTING

SCALE: NOT TO SCALE



7 CLAY PLUG

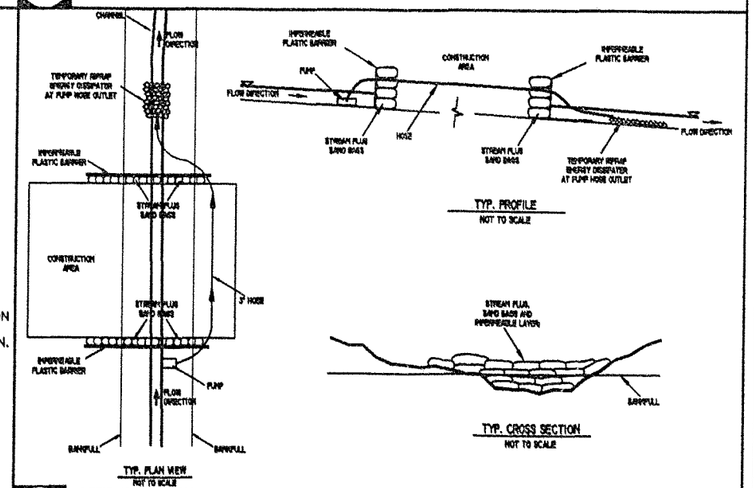
SCALE: NOT TO SCALE



PLUG TO BE CONSTRUCTED WITH ONSITE HYDRIC SOILS. EXCAVATION LOCATION TO BE APPROVED BY ENGINEER PRIOR TO CONSTRUCTION. COMPACT TO 95% STANDARD PROCTOR.

8 WETLAND DITCH PLUG

SCALE: NOT TO SCALE



9 STREAM PLUG, SANDBAGS, AND PUMP HOSE OUTLET

SCALE: NOT TO SCALE

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Raleigh, NC 27613 FAX (919) 870-5359

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PARKER LINCON BUILDING
2728 CAPITAL BLVD., SUITE 1H-103
RALEIGH, NORTH CAROLINA 27606 - PH. 919-715-0476

SEAL

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 15544 DAVID BECKLEY

MOCCASIN CREEK DETAILS

PRELIMINARY NOT FOR CONSTRUCTION

DATE: 10-15-04
REVISIONS:
PROJECT NAME: MOCCASIN CREEK
DWG NAME: c-details
SCALE: NTS
SHEET NO.

8 OF 8