MITIGATION PLAN

Devil's Racetrack Stream and Wetland Mitigation Site
Johnston County, North Carolina
EEP ID #95021

Neuse River Basin
HUC 03020201

Prepared for:

Ecosystem Enhancement PROGRAM

NC Department of Environment and Natural Resources
Ecosystem Enhancement Program
1652 Mail Service Center
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(January 2013)

EXECUTIVE SUMMARY

Wildlands Engineering, Inc. (WEI) proposes to restore and enhance a total of 15,512 existing linear feet (LF) of stream and restore 56.4 acres of wetlands on a full delivery mitigation site in Johnston County, NC. The streams proposed for restoration include five unnamed tributaries (UTs) to the Neuse River. The largest of these streams, referred to herein as Devil's Racetrack Creek, drains directly to the Neuse River. The other four streams are small headwaters tributaries to Devil's Racetrack Creek. The project will provide 18,216 stream mitigation units (SMUs) and 55.2 wetland restoration units (WMUs). Buffer restoration will also take place but is not intended for mitigation credit at this time.

The Devil's Racetrack Mitigation Project site is located near the town of Four Oaks in central Johnston County, NC. The site is in the eight-digit Cataloging Unit (CU) 03020201 in the Neuse River Basin, otherwise known as the Neuse 01 CU. The 14-digit Hydrologic Unit Code (HUC) is 03020201140010 which was identified as a Targeted Local Watershed in NCEEP's 2010 Neuse River Basin Restoration Priority (RBRP) Plan. The RBRP identified the following goals for the watershed:

- Wetland restoration and enhancement that contribute to the improvement of water quality downstream in the estuary and
- Implementation of buffer and stream projects in headwaters.

The proposed project will help meet both of those goals and will provide numerous additional ecological benefits within the Neuse 01 CU.
This mitigation plan has been written in conformance with the requirements of the following:

- Federal rule for compensatory mitigation project sites as described in the Federal Register Title 33 Navigation and Navigable Waters Volume 3 Chapter 2 Section § 332.8 paragraphs (c)(2) through (c)(14).
- NCDENR Ecosystem Enhancement Program In-Lieu Fee Instrument signed and dated July 28, 2010.

These documents govern EEP operations and procedures for the delivery of compensatory mitigation.

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1.0 Restoration Project Goals and Objectives

The Devil's Racetrack Mitigation Project site is located near the town of Four Oaks in Eastern Johnston County, NC. The site is in the eight-digit Cataloging Unit (CU) 03020201, in the Neuse River Basin, otherwise known as the Neuse 01 CU. The 14-digit hydrologic unit, or "Targeted Local Watershed," within the 03020201 CU that includes the project site is Neuse River Basin Hydrologic Unit Code (HUC) 03020201140010. The North Carolina Ecosystem Enhancement Program (NCEEP) follows the Compensation Planning Framework based on these hydrologic units when targeting mitigation sites for implementation. The first planning stage is the development of River Basin Restoration Priority Plans (RBRPs) to prioritize specific watersheds within the 8-digit CUs in which to implement mitigation projects. Through the development of RBRPs, NCEEP develops restoration goals and priorities for the 14-digit Targeted Local Watersheds. All Full Delivery Procurement projects must be located within a Targeted Local Watershed. The next phase of planning is the development of Local Watershed Plans to identify and prioritize specific mitigation projects. To date, no local watershed plan has been developed that includes the Devil's Racetrack project site watershed. The most detailed restoration goals in this case are identified in the RBRP.

Restoration goals for the Targeted Local Watershed in the 2010 Neuse River Basin Restoration Priorities (RBRP) document (http://www.nceep.net/services/restplans/FINAL%20RBRP%20Neuse%2020111207%20CORRECTED.pdf) include the following:

- Wetlands restoration and enhancement that contribute to the improvement of water quality downstream in the estuary and
- Implementation of buffer and stream projects in headwaters.

The Devil's Racetrack Creek Mitigation Project was identified as a stream and wetland mitigation project that will improve water quality and aquatic and riparian habitat within the CU. The project will contribute to meeting both restoration goals for the Targeted Local Watershed described above. The overall primary goals of the project include:

- Restore a large wetland complex to a naturally occurring community to improve riparian habitat and water quality;
- Restore a network of badly degraded stream channels, including multiple headwaters streams, to create aquatic habitat and further improve water quality to receiving waters; and
- Restore riparian buffers along stream corridors for additional habitat and water quality benefits.

A secondary goal of the project will be to restore fish passage from the Neuse River to Devil's Racetrack Creek. This is a secondary goal because success will not be measured.

The primary project goals will be addressed through the following project objectives:

- Promote wetland hydrology by raising channelized stream beds and filling drainage ditches;
- Plant wetland areas with native tree species to restore a Coastal Plain Small Stream Swamp – Blackwater Subtype community;
- Reconstruct stream channels to have the appropriate slope, planform, and cross-sectional geometry for the region of the Coastal Plain in which the project is located;
- Size reconstructed stream channels to flood floodplains and wetlands frequently;

- Stabilize stream banks using bioengineering, natural channel design techniques, and grading to reduce bank angles and bank height;
- Install in-stream structures and woody debris to promote aeration of water, create habitat, and influence the creation of bed forms commonly found in sand bed channels;
- Restore riparian buffer areas with native tree species to stabilize channels, filter flood flows and runoff, and supplement wetland plantings; and
- Remove project area from agricultural production further improving water quality.

2.0 Project Site Location and Selection

2.1 Directions to Project Site

The proposed stream and wetland mitigation site is located in central Johnston County along Devil's Racetrack Road just east of its intersection with U.S. Highway 701 and approximately one mile east of Interstate 95 (Figure 1). To access the site, drive east along Devil's Racetrack Road approximately 1.2 miles from the Highway 701 intersection. Both portions of the site can be accessed on either side of Devil's Racetrack Road.

2.2 Site Selection and Project Components

This proposed mitigation project includes the restoration and enhancement of 18,744 linear feet (LF) of stream and restoration of 56.4 acres of riparian wetlands (Figure 2). No jurisdictional wetlands currently exist on the site. The site was selected for restoration because the streams have been relocated and channelized and the surrounding wetland complex has been drained for agricultural purposes. The portion of the site west of Devil's Racetrack Road is currently used for row crop agriculture and the eastern portion is currently used for timber production. The streams proposed for restoration and enhancement include five unnamed tributaries to the Neuse River. The largest of these streams, referred to herein as Devil's Racetrack Creek, discharges directly to the Neuse River. The other streams included in the proposed project are tributaries to Devil's Racetrack Creek.

In the current configuration of channels, Devil's Racetrack Creek flows eastward from US Hwy 701 along the north and east boundaries of the property to the Neuse River on the east side of Devil's Racetrack Road. On the west side of Devil's Racetrack Road, four tributaries referred to as Southwest Branch, Middle Branch, Southeast Branch, and North Branch flow into Devil's Racetrack Creek. The project also includes restoration of degraded wetlands located adjacent to the streams. Photographs of the project site are included in Appendix 1.

As a result of the proposed restoration activities, total stream length within the project area will be increased from approximately 15,512 LF to 18,744 LF. The proposed stream restoration designs for Devil's Racetrack Creek and North Branch will primarily be a Priority 1 approach and the stream types for the restored streams will be similar to E or C channels under the Rosgen classification system. Devil's Racetrack Creek will be rerouted back through its original valley and floodplain on the western portion of the site. North Branch and Southeast Branch will both join Devil's Racetrack Creek near Devil's Racetrack Road. This alignment of the streams is very similar to the historic, natural configuration (see historic aerial photographs in Appendix 2). Priority 1 restoration will continue to the portion of Devil's Racetrack Creek east of Devil's Racetrack Road. The lower portion of Devil's Racetrack Creek will transition to a relatively short section of Priority 2 restoration. The stream will be connected into an existing stream channel immediately above its confluence with the Neuse River resulting in a short Enhancement II section. Southwest Branch, Middle Branch, and Southeast Branch will be reconstructed as small, steep streams that flatten in gradient as they near Devil's Racetrack Creek.

A headwater wetland feature will be constructed as a portion of the stream restoration where a pond currently exists on the upstream end of Middle Branch. The majority of the streams will be built as Priority 1 restoration with the exception of the upper section of Southwest Branch which will have short sections of both Enhancement I and Enhancement II. The original valleys of Middle and Southeast Branch will be reconstructed near the upstream end of these reaches resulting in short sections of Priority 2 restoration. The wetland restoration designs will be based on reference conditions and will restore Coastal Plain small stream swamp communities. Based on the proposed mitigation effort, the project will result in 18,216 stream mitigation units (SMUs) and 55.2 riparian wetland mitigation units (WMUs).

3.0 Site Protection Instrument

The Devil's Racetrack Mitigation Site is located on two parcels owned by the Nell Howell Revocable Trust. An option to purchase a conservation easement, to be held by the State of North Carolina, has been recorded for 75.92 and 24.09 acres for a total of 100.01 acres. The land required for construction, management, and stewardship of the mitigation project includes portions of the parcel(s) listed in Table 1. Copies of the option agreements are included in the Appendix 3. Figure 2 depicts the proposed conservation easement.

Table 1. Site Protection Instrument
Devil's Racetrack Mitigation Site

Landowner	PIN	County	Site Protection Instrument	Deed Book and Page Number	Acreage Protected
Nell Howell Revocable Trust	168100-48-4293	Johnston	Conservation Easement	TBD	TBD
Nell Howell Revocable Trust	168100-28-6055	Johnston	Conservation Easement	TBD	TBD

All site protection instruments require 60-day advance notification to the Corps and the State prior to any action to void, amend, or modify the document. No such action shall take place unless approved by the State.

4.0 Baseline Information –Project Site and Watershed Summary

Table 2 presents the project information and baseline watershed information.

Table 2. Project and Watershed Information
Devil's Racetrack Creek Mitigation Site

Project County	Johnston County
Physiographic Region	Upper Coastal Plain
Ecoregion	Southeastern Plains
River Basin	Neuse
USGS HUC (14 digit)	03020201140010
NCDWQ Sub-basin	03-04-02
Within NCEEP Watershed Plan?	No, but is within targeted local watershed
WRC Class	Warm

Percent of Easement Fenced or Demarcated	The easement has not been recorded and is proposed to be demarcated post construction.					
Beaver Activity Observed During Design Phase?	No					
Reaches	**Southwest Branch**	**Middle Branch**	**Southeast Branch**	**North Branch**	**Devil's Racetrack Creek (west)**	**Devil's Racetrack Creek (east)**
Drainage Area (acres)	20.6	10.8	69.9	49.9	493.5	831.4
Watershed Land Use						
Developed	0%	0%	0%	15%	5%	3%
Forested/Scrubland	64%	40%	23%	43%	51%	59%
Agriculture/Managed Herb.	36%	60%	77%	42%	44%	38%
Open Water	0%	0%	0%	0%	0%	0%
Watershed Impervious Cover	<1%	<1%	<1%	<1%	<1%	<1%

4.1 Watershed Historical Land Use and Development Trends

The Neuse 03020201 CU is one of the most developed and continues to be one of the most rapidly developing areas of the state. The CU includes portions of Orange, Durham, Wake, and Johnston Counties, all of which are among the fastest growing counties in the state and are part of the Raleigh-Durham-Cary combined statistical area, also known as "the Triangle." Population growth and associated rapid development create a significant need for mitigation projects in this CU.

Targeted local watershed HUC 03020201140010 is located in the south central portion of the basin in central Johnston County. The watershed includes a large, mostly forested segment of the Neuse River and many tributaries including Polecat Branch and Miry Branch. The 53 square mile HUC is very rural overall with 62 percent of the land use comprised by forest or wetland and 34 percent farm land.

The project watershed (Figure 3) is also primarily agricultural lands and forest. The only significant development in the watershed is a campground adjacent to Devil's Racetrack Creek on the western portion of the project site, a middle school in the upper portion of the watershed, a low-density subdivision with single family homes, and a small section of I-95. Land uses for each subwatershed are described in Table 2.

4.2 Watershed Assessment

During the site assessment portion of the project, Wildlands Engineering, Inc. (WEI) reviewed available aerial photography of the project watershed and conducted a ground reconnaissance of the watershed. Aerial photographs of the area were obtained for a number of different time periods in order to characterize the development and land cover changes within the watershed. Aerial images from 1949, 1959, 1993, 1999, 2006, and 2009 were reviewed. The ground reconnaissance was performed to verify

land uses observed from the aerial photography, identify potential sediment sources, and develop a more detailed understanding of the hydrology of the project streams.

Review of the aerial photographs indicates that, in general, there has been little change in the amount of forested area within the watershed within the last 60 years. The major exception to that is the project site itself which appears on aerial photos to have been cleared for farming sometime between the early 1960's and the early 1990's. Some forested area was cleared in the 1950's for the construction of the Interstate 95 corridor and a few other small parcels were cleared during the time period covered by the aerials. Some of the areas that were cleared for farming prior to 1949 were developed for other uses during the period. A plant nursery was established in the northwestern portion of the watershed just east of I-95 prior to 1993. That operation now appears defunct and the site is over-grown with weeds. The Smithfield KOA campground adjacent to the project site was established prior to 1993 on land that was previously cleared farmland. A small subdivision was built along Heath Road in the southwestern portion of the watershed between 1993 and 1999. Four Oaks Middle School was built on farmland around 2005 at the far western edge of the watershed. There have been virtually no changes in watershed land use since 2005 and the only significant change since the 1990's was the construction of the middle school.

The only channel upstream of the project site is the upper extent of what is now referred to as Devil's Racetrack Creek. This channel connects to Devil's Racetrack Creek through a culvert under U.S. Highway 701. Upstream of the culvert, the channel runs through a wooded area southeast of the old nursery site. This area has been completely wooded at least as far back as the earliest aerial photo reviewed – 1949. Field review of this stream revealed a straight channel with a well-defined cross section. The stream appears to have been channelized at some point in the past. Despite this, the stream is very stable and it is not overly deep. It does not appear to be eroding and there is no evidence that it is supplying excessive sediment to downstream reaches. Small deposits of sand on the channel bed were observed at irregular intervals but it appears that very little bed deposition has occurred over quite a long period of time. It seems likely that this channel does not have enough flow and sediment load to drive morphologic changes. Even though the channel appears to have been constructed at some point in the past, due to its long-term stability, WEI collected cross-sectional geometry data and channel gradient data and used this stream as one of multiple reference sites.

No recent watershed disturbances were identified during the ground reconnaissance and all of the land use visible in the latest aerial was confirmed. No significant sources of sediment were identified during the aerial photo review or ground reconnaissance. Neither the channel upstream of the project site nor the project streams appear to have significant deposition. The watershed appears to be stable and there are no indications of new disturbances that would affect the project that are likely occur within the near future.

4.3 Physiography, Geology, and Soils

The Devil's Racetrack Mitigation Site is located in the western portion of the upper or Inner Coastal Plain Physiographic Province. The landscape of the Inner Coastal Plain is characterized by flat lands to gently-rolling hills and valleys. Elevations range from 25 to 600 feet above sea level. The Coastal Plain largely consists of marine sedimentary rocks including sand, clay, and limestone. This area is the largest geologic belt in the State and formed through the deposition of estuarine and marine sediments approximately 100 to 140 million years ago. Specifically, the project site is located in the Cape Fear Formation (Kc – sandstone and sandy mudstone) of the Coastal Plain. The formation is described as indurate and graded with laterally continuous bedding. In addition, blocky clay, faint cross-bedding, feldspar and mica are commonly found within this formation type (NCGS, 2009).

The floodplain areas of the proposed project are mapped by the Johnston County Soil Survey (SCS, 1994). Soils in the project area floodplain are primarily mapped as Altavista fine sandy loam, Bibb sandy

loam, Cecil loam, Goldsboro sandy loam, Leaf silt loam, Lynchburg sandy loam, Nason silt loam, Norfolk loamy sand, and Rains sandy loam. These soils are described below in Table 3. A soils map is provided in Figure 4.

Table 3. Floodplain Soil Types and Descriptions
Devil's Racetrack Mitigation Site

Soil Name	Location	Description
Altavista fine sandy loam, 0-2% slopes	Small portion of Devil's Racetrack Creek (east)	Altavista soils are found on valleys and stream terraces. These soils are very deep, moderately well drained soils and exhibit moderate permeability. They are occasionally flooded and not ponded.
Bibb sandy loam, 0-2% slopes	Majority of Southwest Branch and upper Devil's Racetrack Creek (west)	The Bibb series consists of very deep, poorly drained, moderately permeable soils that formed in stratified loamy and sandy alluvium. These soils are typically found on floodplains and coastal plains and are frequently flooded.
Cecil loam, 2-6% slopes	Upper Southwest Branch	The Cecil series consists of very deep, well drained moderately permeable soils on ridges and side slopes of the Piedmont uplands. These soils are typically not flooded or ponded.
Goldsboro loamy sand, 0-2% slopes	Lower portion of Middle Branch	Goldsboro soils are typically found on flats on marine terraces and coastal plains. These soils are very deep, moderately well drained soils exhibiting moderate permeability.
Leaf silt loam, 0-2% slopes	Majority of Devils Racetrack Creek (east) and lower Southeast Branch	The Leaf series consists of very deep, poorly drained, very slowly permeable soils on flood plains, low terraces along streams, coastal plains, and flats on broad interstream divides.
Lynchburg sandy loam, 8-15% slopes	Upper portion of Southeast Branch	Lynchburg soils are found on flats on marine terraces and coastal plains. They are very deep, somewhat poorly drained soils and exhibit moderate permeability. These soils typically do not flood or pond.
Nason silt loam, 8-15% slopes	Upper portion of Southwest Branch	Nason soils are found on hillslopes on ridges and upland areas. They are deep well drained soils and exhibit moderately high water movement through the most restrictive layer.
Norfolk loamy sand, 2-6% slopes	Upper portion of Middle Branch	Norfolk soils are found on coastal plains and on broad interstream divides on marine terraces. They are very deep, well drained soils and exhibit moderate permeability. These soils are typically not flooded or ponded.
Rains sandy loam, 0-2% slopes	Majority of open agricultural fields between Southeast Branch and Middle Branch	Rains soils are found on flats on marine terraces, coastal plains, and Carolina bays. They are very deep, poorly drained soils that are typically not flooded or ponded.
Source: Johnston County Soil Survey, USDA-NRCS, http://efotg.nrcs.usda.gov		

4.4 Valley Classification

The Devil's Racetrack project area is located in the Inner Coastal Plain physiographic province and the surrounding fluvial landforms are typical of this region. The portion of the site east of Devil's Racetrack

Road has little topography and lies on a flat terrace that was previously a portion of the Neuse River floodplain. This portion of the site includes Devil's Racetrack Creek (East) and is most similar to a valley type X – very broad and gentle slopes associated with extensive floodplains – according to the Rosgen (1996) valley classification. The portion of the site west of Devil's Racetrack Road has steeper slopes and a dendritic drainage pattern related to fluvial dissection. This portion of the site is on a gradual slope that decreases as it approaches the Neuse River floodplain terrace. The original, natural valley of Devil's Racetrack Creek is a fairly broad flat floodplain. However, it is not located on an extensive plain, has no terraces, and is not located in a steep, mountainous setting. It is more typical of the North Carolina Piedmont and none of the Rosgen valley classifications accurately describe this valley. The valleys of the tributaries to Devil's Racetrack Creek have been regraded in some locations but are very discernible in others. Like Devil's Racetrack Creek, there is no appropriate classification for them in the Rosgen valley classifications.

4.5 Surface Water Classification and Water Quality

On February 8, 2011, and February 23, 2012, WEI investigated and assessed on-site jurisdictional Waters of the United States using the U.S. Army Corps of Engineers (USACE) Routine On-Site Determination Method. This method is defined in the Corps of Engineers Wetlands Delineation Manual (USACE, 1987) and the subsequent Atlantic and Gulf Coastal Plain Regional Supplement. Determination methods included stream classification utilizing the North Carolina Division of Water Quality (NCDWQ) Stream Identification Form and the USACE Stream Quality Assessment Worksheet. Potential jurisdictional wetland areas as well as typical upland areas were classified using the USACE Routine Wetland Determination Data Form. On-site jurisdictional wetland areas were also assessed using the North Carolina Wetland Assessment Method (NCWAM). All USACE and NCWAM wetland forms are included in Appendix 4. The stream and wetland jurisdictional determination was approved by Thomas Brown with the USACE Raleigh Field Office in an approval letter dated June 13, 2012 (included in Appendix 4).

The results of the on-site field investigation indicate that there are four jurisdictional stream channels within the property including Devil's Racetrack Creek and three unnamed tributaries to Devil's Racetrack Creek (Figure 2). In the current site configuration, a tributary referred to as North Branch is not on the property but flows into Devil's Racetrack Creek on the north side of the property boundary. North Branch was investigated in the field and also determined to be jurisdictional. Devil's Racetrack Creek and four of the tributaries are included in the project. An additional channel, an unnamed tributary to Southeast Branch, will be connected to the new alignment of Southeast Branch but no credit will be claimed for this tributary. No other perennial or intermittent tributaries have been identified on the site. No existing jurisdictional wetland areas were identified within the project site during this on-site investigation.

The project site is in NCDWQ subbasin 03-04-02. None of the tributaries on the project site, including Devil's Racetrack Creek, are classified by NCDWQ. Therefore they all are, by default, required to meet the standards for Class C waters which are waters protected for secondary recreation, fishing, wildlife and aquatic life, maintenance of biotic integrity, and agriculture. Devil's Racetrack Creek discharges into a section of the Neuse River (NCDWQ AU# 27-(41.7)) that is classified as Class WS-V; NSW. Class WS-V waters are water supplies which are generally upstream and draining to Class WS-IV waters or waters used by industry to supply their employees with drinking water or waters that were formerly used as water supply. These waters are also protected for Class C uses. The Nutrient Sensitive Waters (NSW) classification is a supplemental classification for waters needing additional nutrient management due to excessive growth of microscopic or macroscopic vegetation (NCDWQ, 2011). This section of the Neuse River, which extends from the City of Smithfield water supply intake to a point 1.7 miles upstream of the

confluence of Bawdy Creek, is listed as impaired for aquatic life on the North Carolina 303(d) list (NCDWQ, 2009).

All NCDWQ Stream Classification Forms are included in Appendix 4. All of the streams included in the restoration project will be protected under the conservation easement that will be placed on the property.

5.0 Baseline Information – Stream Reach Summary

On-site existing conditions assessments were conducted by WEI between September 2011 and March 2012. The assessments were performed on each of the streams listed in Table 4. All of the streams were determined to be perennial except for the upper reach of Southeast Branch which is intermittent. The locations of the project reaches and surveyed cross sections are shown in Figure 5. Existing geomorphic survey data is included in Appendix 5.

Table 4. Reach Summary Information
Devil's Racetrack Mitigation Site

	Southwest Branch	Middle Branch	Southeast Branch	North Branch	Devil's Racetrack Creek (west)	Devil's Racetrack Creek (east)
Restored Length (LF)[1]	1,155	1,900	2,892	2,034	5,212	5,540
Valley Type	---	---	---	---	X	X
Valley Slope (feet/ foot)	0.022	0.024	0.021	---	0.005	0.00024
Drainage Area (acres)	20.6	10.8	69.9	49.9	493.5	831.4
NCDWQ stream ID score	34.5 - 37	30	29 - 30.75	32	38	37.5
Perennial or Intermittent	P	P	P/I	P	P	P
NCDWQ Classification	C/NSW	C/NSW	C/NSW	C/NSW	C/NSW	C/NSW
Existing Conditions Rosgen Classification	G5	G5	G/F5	---	Gc5	Gc5
Simon Evolutionary Stage	---	---	---	---	---	---
FEMA classification	None	None	None	None	None	None

1. Restoration length includes restoration and enhancement components.

5.1 Existing Stream and Vegetation Condition

The streams located within the Devil's Racetrack Mitigation Site have been channelized and comprise a network of deep drainage ditches for the surrounding farm land. The fields are currently drained for cultivation of soybeans, corn, wheat, and timber. The channels have been dug very deep for drainage, straightened, and in some cases redirected away from their original flow paths. The riparian buffers were entirely removed decades ago when the sites were cleared for agricultural use. There is a farm pond on the site that impounds the upper portion of one of the smaller tributaries – Middle Branch. Review of historic aerial photos indicates that the land cover patterns on the project site have remained essentially the same at least as far back as the early 1990's.

To gain a clearer understanding of the previous condition of the site, WEI staff conducted an interview with a local farmer whose operation included the west side of the project site back to the early 1980's. During this discussion, he described alterations of the site including ditching and grading of the fields to prepare for row crop cultivation when he began farming the site. He was not present when the pond was built or when the largest ditch on the north edge of the property was dug. These features were built prior to clearing the land, but not long before row crop farming began in the early 1980's. However, he was present during channelization of Southwest Branch, Middle Branch, and Southeast Branch. He described how a dragline was used to dig the ditches and additional grading was done to fill low areas. Among the areas filled were valleys along Southwest and Southeast Branches and a low area that "stayed wet" along Middle Branch. This practice of "land leveling" is common in agricultural settings and has historically been encouraged by local NRCS offices to address Highly Erodible Lands (HEL). The upland areas on the site were mapped as HEL land by the NRCS (Appendix 6) and terracing is evident throughout the upland fields providing further evidence of significant land manipulation on the site. WEI staff attempted to determine historic valley grades through analysis of soil cores excavated to a depth of approximately six feet. The soil profile is highly disturbed as is common in situations where large scale land leveling has been conducted. Due to the disturbed nature of the soil profile, WEI was unable to locate historic A horizons or other evidence of the exact elevations of these valleys prior to land disturbance activities.

The history of the east side of the site is less clear but the site is used for timber production and it is obvious that the original stream channel has been straightened and dredged to convey the drainage from the east side of the property to the Neuse River and to drain adjacent wetlands to improve timber production. Review of aerial photos indicates that the road along the existing canal appears to have been constructed between 1959 and 1971. This is the most likely time when the dredging was conducted.

The existing vegetation communities within the proposed project area are predominately disturbed row crop agriculture covered seasonally by temporary fescue grasses with adjacent forested areas. Due to heavy agricultural activities and vegetation management over the past several decades, several major strata are completely absent from this area resulting in a dominant herbaceous layer with no mature trees or understory growth. Upstream headwater areas exhibit more mature forest coverage and include mature canopy species such as sweetgum (*Liquidambar styraciflua*), red maple (*Acer rubrum*), loblolly pine (*Pinus taeda*), longleaf pine (*Pinus palustris*), winged elm (*Ulmus alata*), green ash (*Fraxinus pennsylvanica*), and black jack oak (*Quercus marilandica*). Shrub species are dominated by Chinese privet (*Ligustrum sinense*) with vine species of catbriar (*Smilax rotundifolia*) and Japanese honeysuckle (*Lonicera japonica*). The shrub layer also contains young tree species such as red maple, green ash, and winged elm. The downstream portion of the project site from Devil's Racetrack Road to the Neuse River includes areas dominated by planted evergreen species including longleaf and loblolly pines. Common understory growth includes sweetgum, red maple, black jack oak, red bay (*Persea borbonia*), and giant river cane (*Arundinaria gigantea*).

5.2 Stream Geomorphology

Existing conditions channel morphology surveys were performed to document the current condition of the streams on the Devil's Racetrack site and to provide a basis for the design. The existing conditions assessment of the project reaches included surveying channel morphology, reviewing aerial photography, performing a visual channel stability assessment, and collecting and analyzing bulk bed material samples. The channels on the Devil's Racetrack site were extensively modified to provide drainage for farming and timber production, most likely during the 1970's and early 1980's. A dragline was used to deepen and straighten the channels, which, in some cases, were relocated out of the natural valleys. Some of the spoil was used to build a berm and a road along the eastern side of Devil's Racetrack Creek. Like many farm sites in eastern North Carolina, the channels are now very straight with no remaining sinuosity. The channels on the site are also very deep with bank height ratios as high as 10.7.

The channel gradients on the site are quite variable between reaches. Devil's Racetrack Creek has slopes ranging from 0.0041 ft/ft on the western portion of the site to 0.0003 ft/ft on the eastern portion of the site. The smaller tributaries on the western portion of the site have higher slopes (0.022 ft/ft to 0.032 ft/ft) due to the topography in that area and the small, headwaters nature of those streams.

Bulk samples of bed materials were collected at one or more locations on each reach. All of the reaches have beds comprised of sand and silt with few particles in the gravel size range. These streams all classify as sand bed channels. The bed forms in the channels consist primarily of plain bed or ripples with some small scour pools. There is vegetation growing on the channel beds in many locations which impedes the formation of ripples or dunes.

The streams on the project site have all been channelized and remain very straight and very deep. In this unnatural condition, reliable bankfull features were difficult to identify. An estimate of bankfull stage was made for each reach based on potential field indicators (if available) and comparison to channel dimensions predicted by the rural Coastal Plain regional curves. WEI classified the streams based on the Rosgen classification system to the degree possible using these best estimates of bankfull stage. These channels are mostly classified as G5 stream types. All of these streams were most likely originally E stream types (or Eb depending on slope) but have been deepened to the point at which they now classify as G streams which have low entrenchment ratios because of the deep, confining channels. Cross-sectional surveys were conducted on each of the project reaches for assessment purposes. Figure 5 shows the cross sectional survey locations and the individual cross section plots are included in Appendix 5. Existing geomorphic conditions for each reach included in the project are summarized below in Tables 5a and 5b.

The existing channel alignment of Devil's Racetrack Creek has been altered and the stream does not follow its natural valley any longer. The stream flows eastward from its headwaters near the intersection of Highway 96 and Heath Road, first through an open field and then a forested parcel, before entering a culvert under Highway 701. The stream enters the project site on the east side of 701. From this point, it runs along the perimeter of the Howell property west of Devil's Racetrack Road. This 4,975 LF portion of the stream – referred to as Devil's Racetrack Creek (West) – was relocated to the perimeter of the property to maximize the arable land available for row crops. The constructed channel is unusually deep (over 10 feet in some locations) even for a drainage canal. There is essentially no woody vegetation in the riparian zone of this channel and crops are planted nearly to the top edge of the right bank. There is some herbaceous vegetation growing on the channel banks but that has not prevented significant erosion from occurring at various locations along the channel. When bankfull stage is estimated in this channel it results in a width to depth ratio ranging from 4.0-10.5 and entrenchment ratios ranging from 1.6 to 2.2. The channel is very flat with a slope of 0.0041 ft/ft and has no natural sinuosity. The classification that

most nearly describes this stream is a Gc5. This portion of Devil's Racetrack Creek has entrenchment ratios that vary significantly; in places they are within the typical range of E stream types. However, the bank height ratios range from 1.9 to 4.5, indicating that the channel is significantly incised throughout its length. The entrenchment ratio calculations (made for a few locations only) are an artifact of the small channel size and moderate bench formation at the base of mass wasting stream banks. Floodplain function is significantly impaired meaning that the channel functions most similarly to a G channel type.

Southwest Branch is a small, spring-fed stream that has been channelized and flows due north for approximately 1,100 LF and discharges into Devil's Racetrack Creek just east of where it enters the property under Highway 701. The entire channel is within the property boundaries. It has been constructed as a deep, very straight, v-shaped channel to provide drainage for the adjacent fields. Even though the watershed is small (20.6 acres), the spring-fed stream maintains frequent flows and is classified as perennial. The downstream end of the channel has significant erosion and mass wasting on the channel banks. There is no vegetation in the riparian zone and crops are planted nearly to the top of both banks. There is some herbaceous vegetation on the channel banks. Estimates of bankfull stage resulted in width to depth ratios of 10 to 14 and entrenchment ratios of 1.5 to 1.9. The overall slope of the channel is 3.2% although it becomes much less steep by the downstream end (1.0%). The sinuosity of the reach is essentially 1.0. The classification that most nearly describes this stream is a G5. Although this portion of Southwest Branch has moderate entrenchment ratios, the measured bank height ratios are greater than 10, meaning that the channel is significantly incised. The moderate entrenchment ratio calculations are an artifact of the small channel size and occasional bench formation where mass wasting has occurred. Floodplain function is significantly impaired meaning that the channel functions most similarly to a G channel type.

Middle Branch is similar to Southwest Branch in that it is a small spring-fed stream that has been straightened and deepened to promote drainage. This channel has an even smaller drainage area than Southwest Branch (10.8 ac). There is a small pond at the headwaters of this channel that is the only pond on the property. From the outlet of the pond, the channel flows northeastward for approximately 1,650 LF before turning to the northwest about 150 LF before joining Devil's Racetrack Creek. The pond is buffered by 75 to 100 feet of loblolly pine trees but the channel downstream of the pond has no riparian buffer. There is some herbaceous vegetation on the channel banks, but like the other streams on the site that drain agricultural fields, row crops are planted nearly to the top of the banks. The classification that most nearly describes this stream is a G5. Although this portion of Middle Branch has entrenchment ratios of 2.0 to 3.8, the bank height ratios range from 5.3 to 6.5 meaning that the channel is significantly incised. Along portions of the channel entrenchment ratios are moderate. This is related to the small channel size and occasional bench formation at the base of high stream banks. Floodplain function is significantly impaired meaning that the channel functions most similarly to a G channel type.

Southeast Branch is a fairly long reach (2,967 LF) that begins in a forested area on the south edge of the property and flows eastward through agricultural fields before joining Devil's Racetrack Creek just upstream of Devil's Racetrack Road. Southeast Branch has a larger drainage area than Middle and Southwest Branches (70 ac). Like the other channels that run through the row-cropped fields, the stream has been straightened and deepened, and all woody riparian vegetation has been removed. Considering the best estimates of bankfull stage, the stream has a width to depth ratio ranging from 6.8 to 24.3 and an entrenchment ratio ranging from 1.5 to 4.2. The overall slope of the channel is 2.3%. Although the constructed channel curves in two locations, these turns appear to be driven by the valley and the sinuosity has been estimated as nearly 1.0. The classification that most nearly describes this stream is a G/F5. Although Southeast Branch has entrenchment ratios that are moderate to high, the bank height ratios range from 2.1 to 6.2 meaning that the channel is significantly incised. The moderate entrenchment ratio calculations are an artifact of the small channel size and moderate bench formation at the base of

high stream banks. Floodplain function is significantly impaired meaning that the channel functions most similarly to a G/F channel type.

A design reach called North Branch will join the new alignment of Devil's Racetrack Creek approximately 150 LF upstream from Devil's Racetrack Road. North Branch currently flows into the existing alignment of Devil's Racetrack Creek on the north edge of the property from offsite. The proposed drainage configuration will be much more similar to the original drainage pattern of the site and includes relocating Devil's Racetrack Creek to the south of its current location through its natural valley. Once restored, North Branch will follow a pattern similar to its original path on the project site and join Devil's Racetrack Creek upstream of Devil's Racetrack Road. Currently, the drainage of the North Creek watershed and the Devils Racetrack watershed flow through the existing channel on the north perimeter of the property. In short, the restored drainage pattern includes a proposed channel on the project site for both Devil's Racetrack Creek and North Branch while currently there is only one channel. Therefore, there are no existing conditions data for North Branch on the project site.

There is only one channel, the downstream portion of the mainstem of Devil's Racetrack Creek, on the project site east of Devil's Racetrack Road. The reach – referred to as Devil's Racetrack Creek (East) – flows through managed timberland and discharges into the Neuse River approximately 4,500 feet east of Devil's Racetrack Road. The channel has been straightened and deepened like the other channels on the project site. Spoil piles and levees run along much of the top of the channel banks. The channel and valley are essentially flat except for the very downstream end where the channel discharges into a drop structure down to its outlet into the Neuse River. The drop structure is 95 feet of 36-inch corrugated metal pipe that drops 10.5 feet from the invert of Devil's Racetrack Creek (East) to the Neuse River. A gravel and dirt road parallels the channel all the way from Devil's Racetrack Road to the Neuse River. This maintained road has resulted in significant degradation of the riparian buffer for much of the right bank of the channel. The left bank of the entire reach is buffered. There is some herbaceous vegetation on the channel banks with density varying by location. Like the other channels on the project site, bankfull indicators were difficult to identify along this reach. With an estimate of bankfull stage, the channel has a width to depth ratio ranging from 5.0 to 7.8 and an entrenchment ratio ranging from 1.6 to 1.8. The slope is near zero and the sinuosity is essentially 1. The classification that most closely represents this channel is a Gc5. Although this portion of Devil's Racetrack Creek has moderate entrenchment ratios, the bank height ratios range from 2.6 to 4.3 meaning that the channel is significantly incised. The moderate entrenchment ratios are indicative of the small channel size with a moderate bench formation at the base of high stream banks. Floodplain function is significantly impaired meaning that the channel functions most similarly to a G channel type.

There is an existing culvert under Devil's Racetrack Road that connects the streams on the western portion of the project site to Devil's Racetrack Creek (East). The current alignments of Devil's Racetrack Creek (West) and Southeast Branch join just upstream of the culvert. The existing culvert is a 36 inch reinforced concrete pipe that is 46 feet long and has a slope of 0.0067 ft/ft. The culvert will be replaced with an adequate sized culvert during construction of this project (see Section 11.1).

Table 5a. Existing Stream Conditions[1]
Devil's Racetrack Mitigation Site

	Notation	Units	Southwest Branch		Middle Branch		Southeast Branch	
			Min	Max	Min	Max	Min	Max
stream type			G5		G5		G/F5	
drainage area	DA	sq mi	0.032		0.017		0.109	
bankfull cross-sectional area	A_{bkf}	SF	0.8	0.9	0.4	0.5	1.1	1.4
average bankfull velocity	v_{bkf}	fps	1.8	1.9	1.4	1.5	1.8	2.2
width at bankfull	w_{bkf}	feet	2.8	3.4	1.8	2.3	2.7	5.7
max. bankfull depth	d_{max}	feet	0.3	0.9	0.3	0.6	0.4	1.4
mean bankfull depth	d_{bkf}	feet	0.2	0.3	0.2	0.3	0.2	0.4
bankfull width/ depth ratio	w_{bkf}/d_{bkf}		10	14	6.9	12	6.8	24.3
low bank height		feet	3.2	8.5	1.6	3.9	2.4	3
bank height ratio	BHR		10.0	10.7	5.3	6.5	2.2	6
floodprone area width	w_{fpa}	feet	4.9	6.2	4.6	6.8	8.6	11.4
entrenchment ratio	ER		1.5	1.9	2	3.8	1.5	4.2
valley slope*	S_{valley}	ft/ft	0.022		0.024		0.021	
channel slope	$S_{channel}$	ft/ft	0.032		0.024		0.023	
shallow slope	$S_{shallow}$	ft/ft	---		---		---	
shallow slope ratio	$S_{shallow}/S_{channel}$		---		---		---	
pool slope	S_{pool}	ft/ft	---		---		---	
pool slope ratio	$S_{pool}l/S_{channel}$		---		---		---	

	Notation	Units	Southwest Branch		Middle Branch		Southeast Branch	
			Min	Max	Min	Max	Min	Max
pool-to-pool spacing	L_{p-p}	feet	---		---		---	
pool spacing ratio	L_{p-p}/w_{bkf}		---		---		---	
sinuosity	K		1		1		1	
belt width	w_{blt}	feet	---		---		---	
meander width ratio	w_{blt}/w_{bkf}		---		---		---	
linear meander length	L_m	feet	---		---		---	
linear meander length ratio	L_m/w_{bkf}		---		---		---	
radius of curvature	R_c	feet	---		---		---	
radius of curvature ratio	R_c/ w_{bkf}		---		---		---	
Particle Size Distribution from Bulk Sample								
d_{50} Description			Fine Sand		Fine Sand		Fine Sand	
	d_{16}	mm	---		---		0.084	
	d_{35}	mm	0.065		---		0.275	
	d_{50}	mm	0.105		0.083		0.409	
	d_{84}	mm	0.336		0.498		0.939	
	d_{95}	mm	0.4		0.9		1.6	
	d_{100}	mm	9.6		9.6		9.6	

1. Locations of cross sections surveyed during existing conditions assessments are shown on Figure 5.

Table 5b. Existing Stream Conditions[1]
Devil's Racetrack Mitigation Site

	Notation	Units	North Branch		Devil's Racetrack Creek (West)		Devil's Racetrack Creek (East)	
			Min	Max	Min	Max	Min	Max
stream type			---		Gc5		Gc5	
drainage area	DA	sq mi	0.078		0.771		1.3	

	Notation	Units	North Branch		Devil's Racetrack Creek (West)		Devil's Racetrack Creek (East)	
			Min	Max	Min	Max	Min	Max
bankfull cross-sectional area	A_{bkf}	SF	---	---	5.7	6.3	14.2	19.1
average bankfull velocity	v_{bkf}	fps	---	---	1.5	1.8	0.3	0.4
width at bankfull	w_{bkf}	feet	---	---	4.8	8	8.1	10.4
max. bankfull depth	d_{max}	feet	---	---	1.3	1.6	2.1	2.8
mean bankfull depth	d_{bkf}	feet	---	---	0.8	1.2	1	1.8
bankfull width/ depth ratio	w_{bkf}/d_{bkf}		---	---	4	10.5	5	7.8
low bank height		feet	---	---	2.5	7.5	6.2	9
bank height ratio	BHR		---	---	1.9	4.5	2.6	4.3
floodprone area width	w_{fpa}	feet	---	---	7.8	18	14.2	18.6
entrenchment ratio	ER		---	---	1.6	2.2	1.6	1.8
valley slope*	S_{valley}	ft/ft	---		0.005		0.00024	
channel slope	$S_{channel}$	ft/ft	---		0.0041		0.0003	
shallow slope	$S_{shallow}$	ft/ft	---		---		---	
shallow slope ratio	$S_{shallow}/S_{channel}$		---		---		---	
pool slope	S_{pool}	ft/ft	---		---		---	
pool slope ratio	$S_{pool}/S_{channel}$		---		---		---	
pool-to-pool spacing	L_{p-p}	feet	---		---		---	

	Notation	Units	North Branch		Devil's Racetrack Creek (West)		Devil's Racetrack Creek (East)	
			Min	Max	Min	Max	Min	Max
pool spacing ratio	L_{p-p}/w_{bkf}		---		---		---	
sinuosity	K		---		1		1	
belt width	w_{blt}	feet	---		---		---	
meander width ratio	w_{blt}/w_{bkf}		---		---		---	
linear meander length	L_m	feet	---		---		---	
linear meander length ratio	L_m/w_{bkf}		---		---		---	
radius of curvature	R_c	feet	---		---		---	
radius of curvature ratio	R_c/ w_{bkf}		---		---		---	
Particle Size Distribution from Bulk Sample								
d_{50} Description			---		Medium Sand		Fine Sand	
	d_{16}	mm	---		0.168		---	
	d_{35}	mm	---		0.33		---	
	d_{50}	mm	---		0.464		0.179	
	d_{84}	mm	---		1.23		0.642	
	d_{95}	mm	---		2		1	
	d_{100}	mm	---		9.6		9.6	

1. Locations of cross sections surveyed during existing conditions assessments are shown on Figure 5.

5.3 Channel Evolution

A review of aerial photos for the project area covering multiple time periods and discussions with landowners indicates that the streams were channelized and the riparian buffers were cleared during the 1970s and 1980's. During that time the morphology of the channels was changed completely from small headwaters streams into the straight, deep canals that exist on the site today. It does not appear that there have been significant changes to the channels over the decades since the alterations were completed except for bank erosion and mass wasting along some of the channel banks. It is doubtful that the channel gradients or bed elevations have changed since channelization. The current state of these channels is completely unnatural and maintained and no model of channel evolution driven by fluvial processes applies to this situation.

5.4 Channel Stability Assessment

WEI utilized a modified version of the Rapid Assessment of Channel Stability as described in Hydrologic Engineering Circular (HEC)-20 (Lagasse, 2001). The method is semi-quantitative and incorporates thirteen stability indicators that are evaluated in the field. In a 2007 publication, the Federal Highway Administration (FHWA) updated the method for HEC-20 by modifying the metrics included in the assessment and incorporating a stream type determination. The result is an assessment method that can be rapidly applied on a variety of stream types in different physiographic settings with a range of bed and bank materials.

The Channel Stability Assessment protocol was designed to evaluate 13 parameters: watershed land use, status of flow, channel pattern, entrenchment/channel confinement, bed substrate material, bar development, presence of obstructions and debris jams, bank soil texture and coherence, average bank angle, bank vegetation, bank cutting, mass wasting/bank failure, and upstream distance to bridge. Once all parameters are scored, the stability of the stream is then classified as Excellent, Good, Fair, or Poor. As the protocol was designed to assess stream channel stability near bridges, two minor modifications were made to the methodology to make it more applicable to project specific conditions. The first modification involved adjusting the scoring so that naturally meandering streams score lower (better condition) than straight and/or engineered channels. Because straight, engineered channels are hydraulically efficient and necessary for bridge protection, they score low (excellent to good rating) with the original methodology. Secondly, the last assessment parameter – upstream distance to bridge – was removed from the protocol because it relates directly to the potential effects of instability on a bridge and should not influence stability ratings for the streams assessed for this project. The final scores and corresponding ratings were based on the twelve remaining parameters. The rating adjectives were assigned to the streams based on the FHWA guidelines for pool-riffle stream types.

The HEC-20 manual also describes both lateral and vertical components of overall channel stability which can be separated with this assessment methodology. Some of the 12 parameters described above relate specifically to either vertical or horizontal stability. When all parameter scores for the vertical category or all parameter scores for the horizontal category are summed and normalized by the total possible scores for their respective categories, a vertical or horizontal fraction is produced. These fractions may then be compared to one another determine if the channel is more vertically or horizontally unstable.

The assessment results for the streams on the Devil's Racetrack site indicate that all of the streams are rated in the second to the lowest category – fair. For every stream assessed, the lateral fraction was greater than the vertical fraction. This indicates that lateral instability is a greater problem for these streams than vertical instability. Total scores, stability ratings, and vertical and horizontal fractions are provided in Table 6.

Table 6. Existing Conditions Channel Stability Assessment Results
Devil's Racetrack Mitigation Project

Parameter	Southwest Branch	Middle Branch	Southeast Branch	Devil's Racetrack Creek (Upstream)	Devil's Racetrack Creek (Downstream)
1. Watershed characteristics	7	5	5	7	7
2. Flow habit	3	3	3	3	3
3. Channel pattern	9	9	9	10	8

Parameter	Southwest Branch	Middle Branch	Southeast Branch	Devil's Racetrack Creek (Upstream)	Devil's Racetrack Creek (Downstream)
4. Entrenchment	9	8	8	9	8
5. Bed material	10	10	10	9	10
6. Bar development	4	4	4	4	5
7. Obstructions	5	5	5	5	5
8. Bank soil texture and coherence	7	7	7	7	7
9. Average bank slope angle	11	9	10	11	11
10. Bank protection	10	10	10	10	8
11. Bank cutting	7	6	6	7	7
12. Mass wasting or bank failure	9	5	5	9	7
Score	**91**	**75**	**82**	**91**	**86**
Ranking	**Fair**	**Fair**	**Fair**	**Fair**	**Fair**
Lateral Score	44	37	38	44	40
Vertical Score	23	22	22	22	23
Lateral Fraction	0.73	0.62	0.63	0.73	0.67
Vertical Fraction	0.64	0.61	0.61	0.61	0.64

5.5 Bankfull Verification

Bankfull stage indicators on the project streams were few and difficult to identify due to the deep channelization of the streams. However, during the existing conditions assessment, WEI staff identified the best available bankfull indicators and surveyed cross sections at those locations. Bank features considered to be potential bankfull indicators included flat depositional features and prominent breaks in slope. There are no nearby USGS gauging stations of comparable size that would be useful to develop a calibrated estimate of bankfull discharge and channel geometry at a local site. Bankfull data for the surveyed project reaches were compared with both sets of NC rural Coastal Plain (Doll et al., 2003 and Sweet and Geratz, 2003) regional curves and are shown overlaid with the regional curves for area and discharge in Figure 6. Three of the five project reaches for which existing conditions cross sections were surveyed are lower in drainage area (independent variable) than the lower extent of the regional curves. The estimated bankfull cross-sectional areas of each of the project reaches plot below both cross-sectional area regional curves except for Devil's Racetrack Creek below Devil's Racetrack Road which plots above both curves. Discharges for the two project reaches with drainage areas within the range covered by the regional curves plot above the discharge regional curves while the three project reaches with lower drainage areas appear as if they would plot above the Doll et al. curve. Visually the estimated bankfull discharges of the project reaches appear to plot within the range of the Coastal Plain curves while the majority of the estimated cross-sectional areas for the project reaches appear to plot below the curves. This is not surprising given the steeper slopes of many of the project reaches compared to those of the regional curves reaches. However, it remains unclear whether reliable bankfull field indicators were present or could have been identified. Bankfull discharges for project reaches were not chosen based on existing site conditions but on a variety of data as described in section 5.6 below.

5.6 Design Discharge

Multiple methods were used to approximate the bankfull discharge for the project streams and to choose a design discharge for each of the separate design reaches. Due to the agricultural and forest land cover within the watershed, discharge estimates were made using methods intended for rural watersheds.

Two different published regional bankfull discharge regression curves (regional curves) relating bankfull discharge to drainage area for rural watersheds in the Coastal Plain region of North Carolina (Doll, et al., 2003 and Sweet and Geratz, 2003) were used to estimate the bankfull discharge for each reach. WEI also created a project-specific bankfull discharge regional curve based on data collected for seven reference streams near the project site (including two completed stable mitigation sites) and used the relation to estimate bankfull discharge for each project reach. In addition, the U.S. Geological Survey (USGS) flood frequency equations for rural watersheds in the North Carolina Coastal Plain (USGS, 2009) were used to estimate peak discharges for each reach for flows with a recurrence interval of two years. The two-year discharge provides a reasonable approximation of bankfull discharge, but is generally slightly larger than the discharge predicted by the discharge regional curves. To provide additional information, historic gauge data were collected from four nearby stream gauges operated by the USGS. These gauge data were used to develop a regional flood frequency curve (Dalrymple, 1960) for the area near the project site. A regional flood frequency curve uses multiple gauges (which are tested for regional homogeneity) to produce a statistical relation that can be used to estimate the magnitude of discharges of a large range of recurrence intervals for any ungaged site within the region. This relation was used to estimate 1.2-year and 1.5-year discharges for each of the project reaches. It should be noted that the USGS gauges used in these analyses were on reaches with much larger drainage areas than the project site. No nearby gauges for similar sized watersheds were available.

To support the statistical analyses described above, a continuous discharge monitoring station was installed on each of the small tributaries on the project site including Southeast Branch, Middle Branch, and Southwest Branch (Figure 5). The discharge monitoring stations consisted of a v-notched weir across the channel with a gauge staff plate and a pressure transducer housed in PVC on the upstream side of the weir. The depth of water flowing through each v-notch was monitored by the transducer at regular intervals from November 16, 2011 to March 7, 2012. For the first portion of the monitoring period flow depth was measured twice per day. This interval was increased to every 15 minutes beginning on December 7, 2012. The depth of flow was used to calculate a discharge over the weir for each monitored depth. These data were compiled to produce a 112 day discharge record for each of the small tributaries. The hydrographs of each discharge monitor are included in Appendix 7. A tipping bucket rain gauge was also installed on the project site allowing streamflows in the small tributaries to be compared with rainfall data. A 61-year record of daily rainfall at the nearby Smithfield weather station (NOAA Station 317994) was used to develop a rainfall frequency curve for 24-hour annual maximum storms for comparison to the 24-hour rainfall totals collected onsite. Although this station is 5.1 miles from the project site, it provides the best data for analyzing long term rainfall patterns for the area surrounding the site. The largest daily rainfall recorded on the project site during the period when the discharge monitoring stations were collecting data was 0.86 inches. Based on the Smithfield station record, this would represent a 24-hour rainfall with a recurrence interval of approximately 0.55 years. While many factors not measured (e.g. antecedent moisture, seasonal differences in uptake by vegetation, etc.) have significant effects on the relationship between precipitation and streamflow, the discharge data collected on the project site and comparison to the Smithfield rainfall frequency curve provide an additional qualitative line of evidence to support selection of design discharges for the small streams. The main outcome of this analysis is that the largest discharges recorded on the weir gauges likely represents discharges much below a one-year recurrence interval.

Each of the statistical methods described above was used to estimate a bankfull discharge or discharge with a recurrence interval approximating bankfull for each design reach. The monitored discharge data and rainfall data were used to provide additional information about the discharge regime of the small streams. A design discharge was selected for each reach based on comparison of the results of these analyses. Use of the regional curves provides the only bankfull discharge estimates based on a dataset that includes streams with comparable drainage areas to the project sites. The regional flood frequency curves are based on actual gauge discharge records and use rigorous statistical methods to reduce the variability and potential error inherent in using a single gauge record for similar purposes. These methods produced generally similar results. The discharge monitoring data and rainfall data provide a check that the selected discharges are in the appropriate range. The design discharges were chosen to be on the low end of the range of the bankfull or 1.0- to1.2-year discharges predicted by the three sets of regional curves and the regional flood frequency curve. The selected design discharges are significantly lower than the estimates made from the reference reach regional curve and the regional flood frequency curve. Out-of-bank flow events are expected to occur on the proposed channels one or more times per year. Table 7 summarizes the results of each of the discharge analyses described in this section.

Two of the small tributaries, Southwest Branch and Middle Branch, are spring-fed streams and respond less to rainfall-runoff events. This can be seen on the hydrograph plots for these reaches (Appendix 7) as the discharge appears more constant over time for both when compared to the discharge of Southeast Branch, which is more influenced by rainfall-runoff hydrology. The standard deviation of the discharge values for Southeast and Middle branches are both 0.02 cfs while the standard deviation of the discharge values of Southeast Branch is 0.06 cfs. This indicates more variability in the discharge of Southeast Branch over time. The designs have been developed for Southwest and Middle Branches such that the springs feeding the systems will continue to supply water to them. However, due to the hydrology of these two streams, it is expected that they will flood less frequently than the other design reaches.

Table 7. Design Discharge Analysis Summary
Devil's Racetrack Mitigation Site

Reach	Drainage Area (ac)	Drainage Area (sq. mi.)	Regional Curve Q_{bkf} (Doll et. Al, 2003)[1]	Regional Curve Q_{bkf} (Sweet and Geratz, 2003)[2]	Reference Reach Regional Curve Q_{bkf}[3]	USGS NFF Rural Q_{2yr}[4]	Regional Flood Frequency $Q_{1.2\ yr}$[6]	Regional Flood Frequency $Q_{1.5\ yr}$[5]	Highest Peak Flow (Weir Data)[7]	Design Q_{bkf}[8]
Devil's Racetrack Creek (West)US of SE Branch	384	0.6	8.8	7.0	12.4	43.3	16.9	23.8	---	10
Devil's Racetrack Creek (West)DS of SE Branch	449	0.7	10.8	9.4	16.2	57.0	22.6	30.38	---	13
Devil's Racetrack Creek (East) upstream of Neuse River	729.5	1.14	14.7	10.3	19.1	65.7	26.8	37.8	---	16
Devil's Racetrack Creek (East) at Confluence to Neuse River	831.4	1.3	16.3	11.1	20.8	71.5	29.5	41.5	---	17
Middle Branch	8.6	0.01	0.4	0.7	1.0	3.7	1.1	1.5	0.44	2
North Branch	118.8	0.19	3.5	3.4	5.7	20.2	7.2	10.2	---	5
Southeast Branch Upstream	16.72	0.03	0.8	1.2	1.7	5.7	1.8	2.5	---	1.5
Southeast Branch Middle	41.8	0.07	1.5	1.8	2.8	10.3	3.4	4.8	1.11	2
Southeast Branch Downstream	65.1	0.1	2.2	2.4	3.8	13.7	4.7	6.6	---	3

Reach	Drainage Area (ac)	Drainage Area (sq. mi.)	Regional Curve Q_{bkf} (Doll et. Al, 2003)[1]	Regional Curve Q_{bkf} (Sweet and Geratz, 2003)[2]	Reference Reach Regional Curve Q_{bkf}[3]	USGS NFF Rural Q_{2yr}[4]	Regional Flood Frequency $Q_{1.2\ yr}$[6]	Regional Flood Frequency $Q_{1.5\ yr}$[5]	Highest Peak Flow (Weir Data)[7]	Design Q_{bkf}[8]
Southwest Branch	14.6	0.02	0.7	1.0	1.4	5.2	1.6	2.2	0.97	1.5

1. Bankfull discharge estimates based on North Carolina Coastal plain Regional Curve (Doll et al., 2003)
2. Bankfull discharge estimates based on North Carolina Coastal Plain Regional Curve (Sweet and Geratz, 2003)
3. Bankfull discharge estimates based on regional curve regression developed from reference reach data collected for this project and other nearby projects.
4. Two-year discharge estimate calculated from USGS NFF regional regression equations (Weaver et al., 2009).
5. 1.5-year discharge estimate developed through a regional flood frequency analysis of four nearby gauges
6. 1.2-year discharge estimate developed through a regional flood frequency analysis of four nearby gauges.
7. Highest recorded peak measured from weirs installed on certain project streams during November 2011 to March 2012.
8. Chosen design bankfull discharge.

6.0 Baseline Information – Wetland Summary

Table 8 presents the baseline wetland information.

Table 8. Wetland Summary Information
Underwood Mitigation Project

	West	East
Size of Wetland (acres)	N/A	N/A
Wetland Type (non-riparian, riparian riverine, or riparian non-riverine)	Riparian	Riparian
Mapped Soil Series	Bibb and Rains	Leaf
Drainage Class	Poorly drained	Poorly drained
Soil Hydric Series	Bibb and Rains	Leaf
Source of Hydrology	Hillslope runoff, springs, overbank flooding	Hillslope runoff, overbank flooding
Hydrologic Impairment	Ditching	Ditching
Native vegetation community	Coastal Plain Small Stream Swamp – Blackwater Subtype community	Coastal Plain Small Stream Swamp – Blackwater Subtype community
% exotic invasive vegetation	0%	0%

6.1 Jurisdictional Wetlands

On February 23, 2012, WEI delineated jurisdictional waters of the U.S. within the project easement area. Potential jurisdictional areas were delineated using the USACE Routine On-Site Determination Method. This method is defined by the 1987 Corps of Engineers Wetlands Delineation Manual and subsequent Atlantic and Gulf Coastal Plain Regional Supplement. Routine On-Site Data Forms have been included in Appendix 4. The results of the on-site jurisdictional determination indicate that there are no jurisdictional wetlands located within the project easement. The stream and wetland jurisdictional determination was approved by Thomas Brown with the USACE Raleigh field office in an approval letter dated June 13, 2012 (included in Appendix 4).

6.2 Hydrologic Characterization

In order to develop a wetland restoration design for the Devil's Racetrack Site, an analysis of the existing and proposed conditions for groundwater hydrology was necessary. DrainMod (version 6.0) was used to model existing and proposed groundwater hydrology at the site. DrainMod simulates water table depth over time and produces statistics describing long term water table characteristics and an annual water budget. DrainMod was selected for this application because it is a well-documented modeling tool for assessing wetland hydrology (NCSU, 2010) and is commonly used in wetland creation and restoration projects. For more information on DrainMod and its application to high water table soils see Skaggs (1980).

6.2.1 Groundwater Modeling

For the Devil's Racetrack wetlands, eight total models were developed and calibrated to represent the existing and proposed conditions at eight different groundwater monitoring gauge locations across the

site. The locations of the monitoring wells are shown in Figure 5. Resulting model output was used to validate the wetland restoration plan and to develop a water budget for the site. The modeling procedures are described below.

Data Collection

DrainMod models are built using site hydrology, soil, climate, and crop data. Prior to building the models, soil cores were taken to validate existing mapped soils across the site. Further explanation of the site soils can be found in Section 6.3 of this report. Rainfall and temperature data were obtained from nearby weather station Smithfield (Station 317994) operated by the National Oceanic and Atmospheric Administration (NOAA) National Weather Service. The data set for this station was obtained from the North Carolina State Climate Office from January of 1960 through December of 2011. These data were used to calibrate the models and perform the long term simulations. Information to develop model inputs for crops currently grown onsite was obtained through site observations.

Existing Conditions Base Model Set up and Calibration

Models were created to represent eight monitoring gauge locations on the site at as shown on Figure 5. The models were developed using the conventional drainage water management option to best simulate the drainage of the site. Each of the eight gauges was installed in August 2011 and recorded groundwater depth twice per day with In-situ Level TROLL® 100 or 300 pressure transducers through early March 2012. This period was used as the calibration period for the groundwater models.

The first step in developing the model was to prepare input files from various data sources. A soil input file obtained from N.C. State University, which has similar characteristics to the soils on the site, was used as a base soil input file for each model. The soil files were refined by adjusting certain parameters for each of the mapped soils found on-site using published soil survey data (NRCS, 2011) and in-situ soil profiles and characterization. Temperature and precipitation data from a nearby weather station, described above, were used to produce weather input files for each model. The precipitation data files were calibrated with on-site rain gauge data for the monitoring period.

Once the necessary input files were created, the project settings were adjusted for this application and then calibration runs were conducted. To calibrate the model, soil parameters not measured in the field were adjusted within the limits typically encountered under similar soil and geomorphic conditions until model simulation results were similar to observed gauge data. Also, the models were calibrated by adjusting crop conditions to reflect the site conditions of the calibration period. After calibration of each of the models was complete, the calibrated models were used as the basis for the proposed conditions models. Plots showing the calibration results are included in Appendix 8.

Trends in the observed data are well-represented by the calibration simulations. Although hydrograph peaks between plots of observed and simulated data do not match exactly, relative changes in water table hydrology as a result of precipitation events correspond well between observed data and model results.

Proposed Conditions Model Setup

The proposed conditions models were developed based on the calibrated existing conditions models to predict whether wetland criteria would be met over a long period of recorded climate

data. Proposed plans for the site include relocating the streams and raising the stream bed inverts. In addition, the existing ditches that currently help drain the site will be filled. The proposed wetland areas will be disked and planted with native wetland plants. Settings for the proposed conditions model were altered to reflect these changes to the site. To account for changes to stream alignments, the ditch spacing values and the lateral seepage conditions in the models were altered. To simulate proposed site grading conditions, the ground surface elevations were decreased by the depth of ground to be graded at groundwater monitoring gauge 8. Grading will be done in this location to remove fill material only. No grading is proposed in the area surrounding any of the other wells that are used for modeling purposes. The only other wetland area that includes any proposed grading is the area around Middle Branch. Grading in this area is discussed in Section 10.2. Changes in the vegetation on the site were simulated by altering the rooting depth of plants on the site from variable shallow depths for crops (varying by time of year) to consistent and deeper values for hardwood tree species. Surface storage values were increased at all gauges to account for proposed disking to the site. Once the proposed conditions models were developed, each model was run for a 52-year period from January 1960 through March 2012 using the weather data from the Smithfield weather station and on-site rain gauge data to perform the long term simulation.

Modeling Results and Conclusions

DrainMod was used to compare calibrated existing conditions models with proposed conditions scenarios to determine the effect of proposed practices onsite hydrology. Each gauge location was evaluated to establish how often annual wetland criteria would be met over the 52-year simulation period. Wetland criteria are defined as free water within 12 inches of the ground surface for a specified consecutive percent of the growing season. Model simulations were run starting at a 5% consecutive standard and increasing the consecutive standard by ½ percent increments with subsequent model runs. This process was used to establish a percent consecutive performance standard and a target hydroperiod for monitoring purposes. The performance standard is defined for this purpose as the minimum threshold for evaluating monitoring gauge success during the post construction monitoring period. The target hydroperiod is not a threshold for success, but rather the estimated average hydroperiod that will be observed for the monitoring gauges.

The model run simulations indicate that all of the gauges on the western side of the site function very similarly with the exception of gauge 3 which is affected by lateral seepage to the open ditch that will remain along the northern boundary of the site. Model simulations were analyzed at individual gauge locations and also as a group on the western side of the site. For the purposes of establishing a performance standard and target hydroperiod, 75% and 50% success rates, respectively, were identified as the appropriate break points. In other words, the performance standard was chosen at the point at which on average all gauges would meet the performance standard a minimum of 75% of the model years ($\geq$ 39 out of the 52 years simulated). Using this approach, a performance standard of 8.5% and a target hydroperiod of 11.0% were chosen.

The wetland performance standard is that the water table must be within 12 inches of the ground surface at each gauge for a minimum of 8.5% (20 consecutive days) of the growing season (March 21 through November 16). The modeling results show that all gauges, except for gauge 3, would meet the performance standard if the site is restored by raising the stream bed and removing the existing on-site ditches. The target hydroperiod is that the water table will be within 12 inches of the ground surface at each gauge for 11.0% (24 consecutive days) or more of the growing season. Table 9 shows the modeling results depicting the number of years out of the

52 year monitoring period that each gauge is expected to meet the performance standard and the target hydroperiod.

The hydrology of a small area around gauge number 3 will be affected in the post construction condition by leaving a section of open channel adjacent to the proposed wetlands. The channel must remain open to allow for positive drainage from the KOA campground that is immediately to the north of the project along Hwy 701. The drainage impact on the area around gauge 3 was modeled by incrementally increasing and decreasing the ditch spacing to mimic conditions closer to and farther from the drainage effect of the open channel. Model simulations indicate that the furthest extent of hydrologic impact is 200 LF from the channel. This area has been removed from credit generation. WEI will coordinate with the campground to determine whether an agreement can be reached to relocate this section of open channel away from the project area. If an agreement can be reached, the revised wetland acreage will be accounted for in the Baseline Monitoring Document.

Table 9. Modeling Results Showing Expected Performance by Gauge Location
Devil's Racetrack Mitigation Site

Gauge ID	Number of Years Meeting Performance Standard (8.5%)	Performance Standard Success Rate	Number of Years Meeting Target Hydroperiod (11.0%)	Performance Standard Success Rate
1	45	87%	38	73%
2	42	81%	29	56%
3	15	29%	4	8%
4	42	81%	28	54%
5	37	71%	23	44%
6	35	67%	23	44%
7	37	71%	26	50%
8	35	67%	21	40%

6.2.2 Surface Water Modeling at Restoration Site

The surface water runoff contributions are minimal therefore the wetland models were simulated as precipitation only contributions. The site will benefit from overbank flooding (not modeled) as a result of the raised stream beds and modified stream dimensions.

6.2.3 Hydrologic Budget for Restoration Site

DrainMod computes daily water balance information and outputs summaries that describe the loss pathways for rainfall over the model simulation period. Tables 10a – 10h summarize the average annual amount of rainfall, infiltration, drainage, runoff, and evapotranspiration estimated for the eight modeled locations onsite. Infiltration represents the amount of water that percolates into the soil. Drainage is the loss of infiltrated water that travels through the soil profile and is discharged to the drainage ditches or to underlying aquifers. Runoff is water that flows overland and reaches the drainage ditches before infiltration. Evapotranspiration is water that is lost by the direct evaporation of water from the soil or through the transpiration of plants. From the water balance results provided in the tables it can be seen that, in all cases evapotranspiration is larger in the proposed condition when compared to the existing condition. The drainage is lower from proposed conditions as compared to existing conditions. The reduction of the drainage through site modification is the

primary reason the proposed conditions meet the wetland success criteria. As a result of increased saturated soil conditions, infiltration decreases and runoff increases in the proposed conditions.

Table 10a. Summary Water Balance for Gauge 1
Devils Racetrack Mitigation Site

Hydrologic Parameter	Existing Conditions		Proposed Conditions	
	Average Annual Amount (cm of water)	Average Annual Amount (% of precip + runon)	Average Annual Amount (cm of water)	Average Annual Amount (% of precip + runon)
Precipitation	119.79	100.0%	119.79	100.0%
Runon	0.00	0.0%	0.00	0.0%
Precip + Runon	119.79	100.0%	119.79	100.0%
Infiltration	119.53	99.8%	117.36	98.0%
Evapotranspiration	72.74	60.7%	79.60	66.4%
Drainage	46.57	38.9%	40.21	33.6%
Runoff	0.27	0.2%	2.43	2.0%

Table 10b. Summary Water Balance for Gauge 2
Devil's Racetrack Mitigation Site

Hydrologic Parameter	Existing Conditions		Proposed Conditions	
	Average Annual Amount (cm of water)	Average Annual Amount (% of precip + runon)	Average Annual Amount (cm of water)	Average Annual Amount (% of precip + runon)
Precipitation	119.79	100.0%	119.79	100.0%
Runon	0.00	0.0%	0.00	0.0%
Precip + Runon	119.79	100.0%	119.79	100.0%
Infiltration	119.54	99.8%	117.87	98.4%
Evapotranspiration	71.98	60.1%	79.49	66.4%
Drainage	47.11	39.3%	40.32	33.7%
Runoff	0.26	0.2%	1.93	1.6%

Table 10c. Summary Water Balance for Gauge 3
Devil's Racetrack Mitigation Site

Hydrologic Parameter	Existing Conditions		Proposed Conditions	
	Average Annual Amount (cm of water)	Average Annual Amount (% of precip + runon)	Average Annual Amount (cm of water)	Average Annual Amount (% of precip + runon)
Precipitation	119.79	100.0%	119.79	100.0%
Runon	0.00	0.0%	0.00	0.0%
Precip + Runon	119.79	100.0%	119.79	100.0%
Infiltration	119.45	99.7%	118.50	98.9%
Evapotranspiration	73.93	61.7%	78.44	65.5%
Drainage	45.28	37.8%	41.37	34.5%
Runoff	0.35	0.3%	1.30	1.1%

Table 10d. Summary Water Balance for Gauge 4
Devil's Racetrack Mitigation Site

Hydrologic Parameter	Existing Conditions		Proposed Conditions	
	Average Annual Amount (cm of water)	Average Annual Amount (% of precip + runon)	Average Annual Amount (cm of water)	Average Annual Amount (% of precip + runon)
Precipitation	119.79	100.0%	119.79	100.0%
Runon	0.00	0.0%	0.00	0.0%
Precip + Runon	119.79	100.0%	119.79	100.0%
Infiltration	119.34	99.6%	117.91	98.4%
Evapotranspiration	75.01	62.6%	80.15	66.9%
Drainage	43.99	36.7%	39.66	33.1%
Runoff	0.45	0.4%	1.88	1.6%

Table 10e. Summary Water Balance for Gauge 5
Devil's Racetrack Mitigation Site

Hydrologic Parameter	Existing Conditions		Proposed Conditions	
	Average Annual Amount (cm of water)	Average Annual Amount (% of precip + runon)	Average Annual Amount (cm of water)	Average Annual Amount (% of precip + runon)
Precipitation	119.79	100.0%	119.79	100.0%
Runon	0.00	0.0%	0.00	0.0%
Precip + Runon	119.79	100.0%	119.79	100.0%
Infiltration	119.10	99.4%	117.52	98.1%
Evapotranspiration	75.05	62.7%	80.27	67.0%
Drainage	43.97	36.7%	39.55	33.0%
Runoff	0.70	0.6%	2.27	1.9%

Table 10f. Summary Water Balance for Gauge 6
Devil's Racetrack Mitigation Site

Hydrologic Parameter	Existing Conditions		Proposed Conditions	
	Average Annual Amount (cm of water)	Average Annual Amount (% of precip + runon)	Average Annual Amount (cm of water)	Average Annual Amount (% of precip + runon)
Precipitation	119.79	100.0%	119.79	100.0%
Runon	0.00	0.0%	0.00	0.0%
Precip + Runon	119.79	100.0%	119.79	100.0%
Infiltration	119.19	99.5%	117.38	98.0%
Evapotranspiration	75.30	62.9%	80.43	67.1%
Drainage	43.81	36.6%	39.39	32.9%
Runoff	0.60	0.5%	2.40	2.0%

Table 10g. Summary Water Balance for Gauge 7
Devil's Racetrack Mitigation Site

Hydrologic Parameter	Existing Conditions		Proposed Conditions	
	Average Annual Amount (cm of water)	Average Annual Amount (% of precip + runon)	Average Annual Amount (cm of water)	Average Annual Amount (% of precip + runon)
Precipitation	119.79	100.0%	119.79	100.0%
Runon	0.00	0.0%	0.00	0.0%
Precip + Runon	119.79	100.0%	119.79	100.0%
Infiltration	119.01	99.3%	117.31	97.9%
Evapotranspiration	77.42	64.6%	80.54	67.2%
Drainage	41.46	34.6%	39.23	32.7%
Runoff	0.79	0.7%	2.47	2.1%

Table 10h. Summary Water Balance for Gauge 8
Devil's Racetrack Mitigation Site

Hydrologic Parameter	Existing Conditions		Proposed Conditions	
	Average Annual Amount (cm of water)	Average Annual Amount (% of precip + runon)	Average Annual Amount (cm of water)	Average Annual Amount (% of precip + runon)
Precipitation	119.79	100.0%	119.79	100.0%
Runon	0.00	0.0%	0.00	0.0%
Precip + Runon	119.79	100.0%	119.79	100.0%
Infiltration	119.28	99.6%	117.43	98.0%
Evapotranspiration	73.23	61.1%	79.77	66.6%
Drainage	46.01	38.4%	40.03	33.4%
Runoff	0.52	0.4%	2.36	2.0%

6.3 Soil Characterization

An investigation of the existing soils within the wetland restoration areas was performed by WEI staff and a licensed soil scientist (LSS) on February 22 and 23, 2012. Soil cores were analyzed at locations across the site to provide data to refine NRCS soils mapping units and establish areas suitable for wetland restoration. Forty-seven (47) soil cores were analyzed at approximately 200- to 300-foot grid spacing in

key wetland areas across the site by the LSS. Soil texture, Munsell chart hue, chroma and value, and hydric soil characteristics were recorded for each core. The depth to hydric indicators was then measured as well. A map of the boring locations and the data for each core is included in Appendix 9.

6.3.1 Taxonomic Classification

Analysis of the soil core samples collected from the project site along with consideration of site topography indicated that soil classifications largely agreed with the mapped soil units in nearly all locations. Soil classifications of the core samples are discussed below.

Bibb Sandy Loam

Soils within the western portion of the project area are predominately mapped as Bibb sandy loam, which is listed on the NC Hydric Soil List. This map unit is comprised of two units including the undrained Bibb component and the undrained Johnston component, both of which exhibit water tables at depths of one foot or less during the growing season. The Johnston component of this feature is also shown to exhibit frequent flooding for long or very long durations during the growing season. Soil cores 1-10 (Appendix 9) indicate chroma values of 1 and 2 throughout the matrix to a depth of 18 inches and greater. The chroma 2 matrices typically showed distinct mottling of around 20% while the lower chroma 1 matrices showed mottling of less than 2%. The soil mapping unit was confirmed to be correct in this area.

Rains Sandy Loam

Soils within the central portion of the western project area are predominately mapped as Rains sandy loam, which is listed on the NC Hydric Soil List. Both the drained and undrained components of this map unit exhibit a water table at a depth of one foot or less during the growing season. Soil cores 11-18, 21-32, 34, and 45-47 indicate chroma values of 1 and 2 to depths of 18-20 inches and greater with mottling ranging from 2% to 20% of the matrix. These cores show that the soils throughout the central portion of the row crop fields match the Rains series description.

Leaf Silt Loam

Soils within the eastern portion of the project area are predominately mapped as Leaf silt loam. This soil type is listed on the NC Hydric Soil List and both the drained and undrained components of this map unit exhibit a water table at a depth of one foot or less during the growing season. Soil cores 33 and 35-44 indicate chroma values of 1 and 2 to depths of 18 inches and greater. Mottling within these profiles was shown within the pore linings and ranged from 2% to 20% of the soil matrix. The soils throughout the eastern portion of the project largely match the mapped Leaf soil unit.

6.3.2 Profile Description

The floodplain areas of the proposed project are mapped by the Johnston County Soil Survey (SCS, 1994). Soils along the downstream portion of the Devil's Racetrack Creek floodplains are primarily mapped as Leaf silt loam. The upstream portion of Devil's Racetrack Creek and Southwest Branch are primarily mapped as Bibb sandy loam. Middle Branch is located between a pocket of Goldsboro sandy loam and Rains sandy loam. The upstream reach of Southeast Branch is located primarily within the Lynchburg sandy loam, transitioning to the Rains sandy loam at the downstream reach. These soils are described above in Table 3. A soils map is provided in Figure 4.

6.3.3 Hydraulic Conductivity

The Bibb series has a moderate permeability and consists of deep, poorly-drained soils. Saturated hydraulic conductivity for this series is 14-42 micro m/sec in the upper 6 inches of the soil with conductivity increasing to 14-141 micro m/sec to a depth of 6-80 inches. The Goldsboro series is a very deep, moderately well-drained with moderate permeability. Hydraulic conductivity for this soil ranges from 14-42 micro m/sec in the upper 15 inches of the profile and decreases to a range of 4-14 micro m/sec at depths of 15-80 inches. The Leaf series is a very deep, poorly-drained soil type with very slow permeability. Hydraulic conductivity ranges from 4-14 micro m/sec in the upper 6 inches of the profile and drops to a very slow 0.01-0.42 micro m/sec at depths of 6-80 inches. Lynchburg soils are very deep, somewhat poorly-drained, and exhibit moderate permeability. Hydraulic conductivity of this series is comparable to Goldsboro, which ranges from 14-42 micro m/sec in the upper 10 inches of the profile and drops to a range of 4-14 micro m/sec at depths of 10-80 inches. The Rains series is a very deep, poorly-drained soil type that exhibits moderate permeability. Hydraulic conductivity ranges from 14-42 micro m/sec in the upper 12 inches of the profile and decreases to 4-14 micro m/sec at depths of 12-85 inches.

6.4 Vegetation Community Types Descriptions and Disturbance History

The existing vegetation communities within the proposed project area are predominately disturbed row crop agriculture covered seasonally by temporary fescue grasses with adjacent forested areas. Based on historical aerials, row crop agriculture has been the predominant land use on this property since between 1949 and 1971. Due to heavy agricultural activities and vegetation management over the past several decades, several major strata are completely absent from this area resulting in a dominant herbaceous layer with no mature trees or understory growth. Dominant species in these areas include fescue (*Festuca* spp.) with some of the stream banks exhibiting Chinese privet and soft stem rush (*Juncus effuses*). Upstream headwater areas exhibit more mature forest coverage and include mature canopy species such as sweetgum, red maple, loblolly pine, longleaf pine, and black jack oak. Common shrub species include winged elm, red maple, green ash, and Chinese privet with vine species of catbriar, and Japanese honeysuckle. The downstream portion of the project site from Devils Racetrack Road to the Neuse River has been largely maintained as an evergreen forest for timber production and includes longleaf and loblolly pines. Common understory growth includes sweetgum, red maple, black jack oak, red bay, and giant river cane. Portions of the undergrowth in this area have been heavily maintained through recent controlled burning.

7.0 Baseline Information - Regulatory Considerations

Table 11 presents the project information and baseline wetland information.

Table 11. Regulatory Considerations
Devil's Racetrack Mitigation Site

	Applicable?	Resolved?	Supporting Documentation
Waters of the US – Section 404	Yes	In progress	404 permit (in progress)
Waters of the US – Section 401	Yes	In progress	401 certification (in progress)
Endangered Species Act	Yes	Yes	None
Historic Preservation Act	Yes	Yes	Letter from SHPO
Coastal Zone Management Act/Coastal Area Management	No	N/A	N/A

	Applicable?	Resolved?	Supporting Documentation
Act			
FEMA Floodplain Compliance	Yes	In progress	In progress
Essential Fisheries Habitat	No	N/A	N/A

7.1 401/404

As discussed in Section 4.5, the results of the onsite field investigation indicate that four channels are jurisdictional within the project limits. There are no jurisdiction al wetlands on the site. Impacts to portions of on-site jurisdictional features are anticipated as part of the development of the Devils Racetrack Mitigation Project. WEI will acquire written approval for these impacts through submittal of the appropriate Section 404 Nationwide Permit and 401 Water Quality Certification. A Nationwide Permit No. 27 is expected to be approved by the USACE and a Water Quality Certification No. 3885 is expected be approved by the NCDWQ; these permits authorize activities for aquatic habitat restoration, establishment, and enhancement activities.

7.2 Endangered and Threatened Species

7.2.1 Site Evaluation Methodology

The Endangered Species Act (ESA) of 1973, amended (16 U.S.C. 1531 et seq.), defines protection for species with the Federal Classification of Threatened (T) or Endangered (E). An "Endangered Species" is defined as "any species which is in danger of extinction throughout all or a significant portion of its range" and a "Threatened Species" is defined as "any species which is likely to become an Endangered Species within the foreseeable future throughout all or a significant portion of its range" (16 U.S.C. 1532).

The US Fish and Wildlife Service (USFWS) and NC Natural Heritage Program (NHP) databases were searched for federally listed threatened and endangered plant and animal species for Johnston County, NC. Five (5) federally listed species, the bald eagle (Haliaeetus leucocephalus), red-cockaded woodpecker (Picoides borealis), dwarf wedgemussel (Alasmidonta heterodon), Tar River spinymussel (Elliptio steinstansana), and Michaux's sumac (Rhus michauxii) are currently listed in Johnston County (Table 12).

Table 12. Listed Threatened and Endangered Species in Person County, NC Devil's Racetrack Mitigation Site

Species	Federal Status	Habitat	Biological Conclusion
Vertebrate			
Bald eagle (*Haliaeetus leucocephalus*)	BGEPA	Near large open water bodies: lakes, marshes, seacoasts, and rivers	No effect
Red-cockaded woodpecker (*Picoides borealis*)	E	Open stands of mature pines	No effect
Invertebrate			
Dwarf wedgemussel (*Alasmidonta heterodon*)	E	Slow to moderate stream currents; sand, gravel, muddy bottom.	No effect
Tar River spinymussel	E	Fast-flowing, well	No effect

Species	Federal Status	Habitat	Biological Conclusion
(*Elliptio steinstansana*)		oxygenated, silt-free streams.	
Vascular Plants			
Michaux's sumac (*Rhus michauxii*)	E	Sandy or rocky open woods with some form of disturbance.	No effect
E = Endangered; T=Threatened; BGEPA = Bald and Golden Eagle Protection Act			

7.2.2 Threatened and Endangered Species Descriptions

Bald Eagle

The bald eagle is a very large raptor species, typically 28 to 38 inches in length. Adult individuals are brown in color with a very distinctive white head and tail. Bald eagles typically live near large bodies of open water with suitable fish habitat including: lakes, marshes, seacoasts, and rivers. This species generally requires tall, mature tree species for nesting and roosting. Bald eagles were de-listed from the Endangered Species List in June 2007; however, this species remains under the protection of the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act (BGEPA). This species is known to occur in every U.S. state except Hawaii.

Red-Cockaded Woodpecker

The red-cockaded woodpecker is a medium-sized woodpecker species (8 to 9 inches in length). Distinctive coloration includes black and white feathers with a large white cheek patch and a black back with a white barred pattern. This species is typically found year-round in large open stands of pines with mature trees of 60+ years in age. The foraging habitat for this species may include pine hardwood stands of longleaf and southern pine, 30+ years in age.

Dwarf Wedgemussel

The dwarf wedgemussel is a relatively small freshwater mussel with a yellowish brown shell approximately 1 inch in length. This species typically inhabits creeks and rivers with slow to moderate current and sand, gravel or muddy substrate. Typical threats to this species include common pollutants from municipal and industrial wastewater discharges as well as sedimentation and runoff from agricultural and forestry operations. This species is known to occur in stream reaches along the Atlantic Coast, including North Carolina.

Tar River Spinymussel

The Tar River spinymussel is a medium-sized freshwater mussel and is one of only three mussels in the world with spines. This species grows to approximately 2.5 inches in length and typically inhabits creeks with fast moving, well-oxygenated, silt-free water. Ideal stream substrates include uncompacted gravel and/or coarse sand. Typical threats to this species include common pollutants from municipal and industrial wastewater discharges as well as sedimentation and runoff from agricultural and forestry operations. Known occurrences of this species have been observed in Johnston County within the last 20 years.

Michaux's Sumac

Michaux's sumac is a densely hairy shrub with serrated compound leaves that grows from 1 to 3 meters in height. These plants are found in disturbed, sandy or rocky open woods with basic soil types. Typical habitat may also include road rights-of-way and edges of artificially-maintained clearings. This plant is threatened by habitat destruction from residential and industrial development as well as fire suppression. This species is currently listed as historic for Johnston County.

7.2.3 Biological Conclusion

A pedestrian survey of the site was performed on January 8, 2011 and February 23, 2012. On-site habitats include agricultural row crop fields, early successional woodlands, and young established pine forests. The on-site streams provide poor quality potential habitat for the Tar River spinymussel and the dwarf wedgemussel. Active runoff from adjacent agriculture fields and sedimentation degrades any potential on-site habitat quality for these species. Artificially maintained clearings have been entirely cleared of all vegetation strata other than herbaceous species and provide no habitat for the presence of Michaux's sumac. No habitat for red-cockaded woodpecker occurs onsite as they require 60+ year old pine trees. There is no suitable nesting or breeding habitat for bald eagles located within the site, as they require tall, mature trees, although potential suitable feeding habitat for bald eagles does exist within close proximity to the Neuse River. As a result of the pedestrian survey, no individual species were found to exist on the site.

WEI requested review and comment from the USFWS on June 30, 2011, regarding the results of the site investigation of the Devils Racetrack Mitigation Site and its potential impacts on threatened or endangered species. Since no response was received from the USFWS within a 30-day time frame, it is assumed that the site determination is correct and that no additional, relevant information is available for this site. A further review of the North Carolina Natural Heritage Program's (NCNHP) element occurrence GIS data layer shows that no natural heritage elements for Federally-listed species occur within 1 mile of the proposed project area. All correspondence is included in Appendix 10.

7.3 Cultural Resources

7.3.1 Site Evaluation Methodology

The National Historic Preservation Act (NHPA) of 1966, amended (16 U.S.C. 470), defines the policy of historic preservation to protect, restore, and reuse districts, sites, structures, and objects significant in American history, architecture, and culture. Section 106 of the NHPA mandates that federal agencies take into account the effect of an undertaking on any property, which is included in, or eligible for inclusion in, the National Register of Historic Places. A letter was sent to the North Carolina State Historic Preservation Office (SHPO) on July 8, 2011 requesting review and comment for the potential of cultural resources to be affected by the Devil's Racetrack Mitigation Project.

7.3.2 SHPO/THPO Concurrence

A request for records search was submitted on July 8, 2011 to the NC State Historic Preservation Office (SHPO) to determine the presence of any areas of architectural, historic, or archaeological significance that would be affected by the project. In a letter dated July 20, 2011 (see Appendix 10) the SHPO stated that they have reviewed the project and are "aware of no historic resources which would be affected by the project."

7.4 FEMA Floodplain Compliance and Hydrologic Trespass

The project stream channels do not have an associated regulatory floodplain; however, the downstream end of Devil's Racetrack Creek is located within the floodway and flood fringe of the Neuse River (Figure 7). The Neuse River was performed as a detailed study including 100-year base flood elevations and mapped floodway. The Neuse River is mapped as FEMA Zone AE on floodplain FIRM panel 1680. No mapped cross-sections from the Neuse River exist within our project work area. No net fill is proposed in the mapped section of Neuse River floodplain. A detailed grading plan and evaluation of the proposed effects on hydrology will be submitted for approval by the Johnston County floodplain administrator. The EEP Floodplain Requirements Checklist is included in Appendix 11 and has been submitted to the Johnston County floodplain administrator.

The project will be designed so that any increase in flooding will be contained on the project site and will not extend upstream to adjacent parcels, so hydrologic trespass will not be a concern. The proposed restoration has been designed to transition back to the existing boundary conditions in a gradual manner.

7.5 Essential Fisheries Habitat

7.5.1 Habitat Description

The USFWS does not list any Critical Habitat areas for Johnston County. Agency correspondence received for the project contains no mention of essential fisheries or requests for additional information related to essential fisheries

7.5.2 Biological Conclusion

WEI requested review and comment from the USFWS on June 30, 2011, regarding the results of the site investigation of the Devils Racetrack Mitigation Site and its potential impacts on essential fisheries habitat. Since no response was received from the USFWS within a 30-day time frame, it is assumed that the site determination is correct and that no additional, relevant information is available for this site.

7.6 Utilities and Site Access

There is a 100-foot wide power transmission line easement that runs southwest to northeast from U.S. Highway 701 through a small portion of the site before it exits the site near the confluence of Middle Branch and Devil's Racetrack Creek. This easement crosses both Southwest Branch and Devil's Racetrack Creek (west). Two farm road crossings will be relocated near the upstream end of Southeast Branch and near the middle of Devil's Racetrack Creek (East). Mitigation credit will not be claimed for these areas. The site is split by Devil's Racetrack Road where Devil's Racetrack Creek flows through a culvert. This culvert will be replaced as part of project construction in order to establish an appropriate invert elevation for Devil's Racetrack Creek (East) allowing for Priority 1 restoration in this reach. There are no other road crossings or utility easements that cross the project streams or wetlands on the site.

The project area of the project includes two parcels – one west of Devil's Racetrack Road and one east of Devil's Racetrack Road. There are two likely access points for the western parcel – one on the west side off of U.S. Highway 701 and one on the east side off of Devil's Racetrack Road. The access for the eastern parcel is also off of Devil's Racetrack Road directly across the road from the western parcel access. All of the access points are existing, gated driveways. Existing farm roads and open fields will permit easy movement of construction equipment within the properties. Site access is provided by the conservation easement agreement that will be recorded.

8.0 Reference Sites

8.1 Reference Streams

Due to the range of stream gradients on the Devil's Racetrack site, multiple reference reaches were necessary and WEI investigated multiple sources for potential reference information. To begin, existing reference reaches and completed mitigation sites near the project site were reviewed. Multiple sites were visited by WEI staff and a reference reach very near the project site, Johanna Creek, was selected as a reference for this project. The site has been surveyed by members of WEI's staff for past projects. Design parameter information was also gathered from two nearby mitigation projects well known to WEI staff – the Cox Site and the Westbrook Site. In addition, a database of reference reach and design parameters from six other Coastal Plain mitigation projects was assembled by WEI to provide additional plan and profile reference information. WEI reviewed mitigation plans, as-built documents, and monitoring reports for these projects. For each, the monitoring reports (two through Year 5) indicate that the cross sections and longitudinal profiles have shown little change since construction. One of the reference sites included in this group, Jarman Oak reference reach, was assessed in the field by WEI staff. The site was found to be a stable stream with characteristics similar to the other references and was used as a source of pattern data for the low-gradient design reaches. Finally, a large property with multiple small, reference quality streams was identified ten miles southeast of the project site. This site is owned by the Tuscarora Council of the Boy Scouts of America and is part of Camp Tuscarora. Four separate streams on the scout camp site were surveyed to provide reference information. Two of them are very small, steep headwater streams referred to as Scout West 1 and Scout East 1. The other two are somewhat larger streams with flatter gradients into which Scout West 1 and Scout East 1 flow. These larger streams are referred to as Scout West 2 and Scout East 2.

The purpose of all of the reference data derived from the sites described above was to support the design of the project reaches. The primary high gradient reference reach used to inform the designs was Scout West 1 and the primary low gradient references were Scout West 2, Johanna Creek, and Jarman Oak reference reach. The data compiled from the other mitigation sites and reference reaches was primarily used to provide additional information on pattern and profile characteristics of stable Coastal Plain streams. Reference reaches can be used as a basis for design or, more appropriately, as one source of information on which to base a stream restoration design. Most reference reaches, including the ones used for this project, are located in heavily wooded areas and the mature vegetation contributes greatly to their stability. Design parameters for this project were also developed based on the design discharge and hydraulic and sediment transport modeling. Figure 8 shows the locations of the main reference sites used for this project (not including the Coastal Plain reference reach database sites that were not surveyed either for this project or previously by WEI staff).

8.1.1 Reference Streams Channel Morphology and Classification

The Scout Camp reference site (including four surveyed streams) is a wooded area located in southeastern Johnston County near Bentonville in the Mill Creek watershed. It is situated in a similar landscape to the Devil's Racetrack site and is similar in position relative to an especially broad, flat, and low-lying zone of the Neuse River floodplain and surrounding wetlands. The small headwaters streams on the site are similar in gradient to the upper portions of the small tributaries on the project site with slopes up to 2.6%. The larger streams are much less steep (Scout West 2 has a gradient of 0.4%) and are similar in gradient to Devil's Racetrack Creek and the downstream portions of the headwaters streams when they reach the Devil's Racetrack Creek floodplain. The Johanna Creek site is also located near Bentonville as are both the Cox and Westbrook mitigation sites. Johanna Creek flows through a mature forest and was previously used as a reference for the Cox site. Johanna Creek

is a low slope (0.22%), meandering channel similar to but larger than Scout West 2. The Johanna Creek gradient and drainage area are comparable to Devil's Racetrack Creek (East).

Collectively, the reference reaches surveyed for this project represent the range of stream morphology planned for the Devil's Racetrack site from steep, straight channels with gradient drops over woody structure to larger, flatter meandering streams. Scout West 1 is a very small, sand bed stream that is very steep for most of its length with an overall gradient of 2.6%. It has a width to depth ratio ranging from 5.4 in the upper sections to 19.4 in the lower, less steep reaches. Its sinuosity is 1.1 and its entrenchment ratio is high – greater than 2.2 throughout. It is most closely represented by an E/C5b according the Rosgen classification system (Rosgen, 1994) although for most of its length it is not a meandering riffle-pool stream. Much of the energy dissipation, gradient, and pool formation are controlled by sudden drops over woody structure (logs and tree roots).

Scout East 2 is a similar but larger sand bed stream with an overall slope of 1.7%, a width to depth ratio of 3.6 to 5.4, an entrenchment ratio of greater than 2.2, and a sinuosity of 1.2. It meanders more than Scout West 1 but also has a lot of energy loss and pool formation over woody structure. It is most similar to a Rosgen E5 stream.

Scout West 2 is a larger, flatter stream with a width to depth ratio range of 5.7 to 11.0, a very large entrenchment ratio much greater than 2.2, and a sinuosity of 1.1 to 1.2. It is most similar to a Rosgen E5 stream type and functions more like an E5 as described by Rosgen with pool formations in meander bends and less drop in gradient over woody structure.

Johanna Creek is the largest of the primary reference reaches and has the lowest slope. Its width to depth ratio is 10.1 to 19.7, its entrenchment ratio is as large as nearly 10, and its sinuosity is 1.2. Johanna Creek is most similar to an E5/C5 stream type and fits the Rosgen classification system as well or better than Scout West 2 in that it is a meandering stream with pool formation and energy dissipation in meander bends. Summaries of geomorphic parameters for the reference reaches analyzed for this project are included in Tables 13a and 13b.

All of the reaches described above were used to compile a reference reach database for this project. The database includes a dataset to support the design of the low-gradient reaches and a separate dataset to support the design of the higher-gradient reaches. The design parameters for a specific design stream reach were chosen from either the high- or low-gradient dataset but minor adjustments were made to meet design goals or specific site conditions. In these cases the designers' judgment and knowledge of successful design parameters from past projects were used. In addition, the Coastal Plain reference reach database compiled by WEI for this project was used to supply additional pattern and profile design parameters derived from a larger number of available streams in similar physiographic conditions. This was important to the design because short reaches surveyed for many of the reference streams were not long enough to obtain an accurate measure of sinuosity and other pattern and profile features, which are more variable along a reach than cross-sectional dimensions. Annotated tables of the composite high-gradient and low-gradient design parameters and the Coastal Plain reference reach database compiled by WEI for this project are included in Appendix 12.

8.1.2 Reference Streams Vegetation Community Types Descriptions

Stream vegetation communities for the Devil's Racetrack Mitigation Site will be similar to those of Johanna Creek and the Scout Camp reference reaches. Both of those streams are surrounded by mature hardwood forests composed of typical Coastal Plain bottomland riparian forest tree species. The mature trees within the riparian buffers provide significant bank reinforcement to maintain

channel pattern and keep the streams from eroding horizontally. Johanna Creek, Scout East 2, and Scout West 2 are classified as Coastal Plain small stream swamp and bottomland forest types (Schafale & Weakley, 1990). Dominant species include swamp chestnut oak (*Quercus michauxii*), laurel oak (*Quercus laurifolia*), red maple (*Acer rubrum*), sweetbay (*Magnolia virginiana*), river birch (*Betula nigra*), tulip poplar (*Liriodendron tulipifera*), sweetgum (*Liquidambar styraciflua*), green ash (*Fraxinus pennsylvanica*), and sycamore (*Platanus occidentalis*). Common understory vegetation includes ironwood (*Carpinus caroliniana*), American holly (*Ilex opaca*), leucothoe (*Leucothoe axillaris*), sweet pepperbush (*Clethra alnifolia*), and swamp titi (*Cyrilla racemiflora*). The herbaceous stratum consists of microstegium (*Microstegium vimineum*), false nettle (*Boehmeria cylindrica*), jewel-weed (*Impatiens capensis*), cinnamon fern (*Osmunda cinnamomea*), sensitive fern (*Onoclea sensibilis*), green-briar (*Smilax* spp.), Virginia creeper (*Parthenocissus quinquefolia*), grape (*Vitis* spp.), poison ivy (*Toxicodendron radicans*), and honeysuckle (*Lonicera japonica*). Scout West 1 does not fit any natural community classification specifically due to the high valley slope but the vegetation community is similar to the other reference reaches.

Table 13a. Summary of Reference Reach Geomorphic Parameters
Devil's Racetrack Mitigation Site

			Scout West 1		Scout East 2		Scout West 2	
Parameter	**Notation**	**Units**	**min**	**max**	**min**	**max**	**min**	**max**
stream type			E/C5b		E5		E5	
drainage area	DA	sq mi	0.06		0.67		0.34	
bankfull discharge	Q_{bkf}	cfs	2.6		17.5		6.4	
bankfull cross-sectional area	A_{bkf}	SF	1.3	2	6	6.9	5.3	5.4
average bankfull velocity	v_{bkf}	fps	1.3	2	2.5	2.9	1.2	1.2
width at bankfull	w_{bkf}	feet	2.6	6.3	4.7	6.1	5.6	7.6
maximum depth at bankfull	d_{max}	feet	0.5	0.7	1.7	1.8	1.2	1.3
mean depth at bankfull	d_{bkf}	feet	0.3	0.5	1.1	1.3	0.7	1
bankfull width to depth ratio	w_{bkf}/d_{bkf}		5.4	19.4	3.6	5.4	5.7	11
depth ratio	d_{max}/d_{bkf}		1.5	1.9	1.4	1.5	1.5	1.6

			Scout West 1		Scout East 2		Scout West 2	
Parameter	**Notation**	**Units**	**min**	**max**	**min**	**max**	**min**	**max**
bank height ratio	BHR		1.1	1.3	1		1.1	1.2
floodprone area width	w_{fpa}	feet	>20		>50		>50	
entrenchment ratio	ER		>2.2		>2.2		>2.2	
valley slope	S_{valley}	ft/ft	0.029		0.02		0.005	
channel slope	$S_{channel}$	ft/ft	0.026		0.017		0.004	
sinuosity	K		1.1		1.2		1.2	
shallow slope	$S_{shallow}$	ft/ft	0.026	0.047	---		0.033	0.051
shallow slope ratio	$S_{shallow}/S_{channel}$		1	1.8	---		8.8	13.4
pool slope	S_{pool}	ft/ft	0.0125	0.027	---		0.003	0.0031
pool slope ratio	$S_{pool}/S_{channel}$		0.5	1.1	---		0.795	0.816
pool-to-pool spacing	L_{p-p}	feet	27	67	---		20.7	27.4
pool spacing ratio	L_{p-p}/w_{bkf}		4.9	12.2	---		3.7	4.9
maximum pool depth at bankfull	d_{pool}	feet	0.6		---		1.7	1.9
pool depth ratio	d_{pool}/d_{bkf}		1		---		2.4	2.7
pool width at bankfull	w_{pool}	feet	6.7		---		6.5	8.8
pool width ratio	w_{pool}/w_{bkf}		1.2		---		1.2	1.6
pool cross-sectional area at bankfull	A_{pool}	SF	2.2		---		5.9	8.2
pool area ratio	A_{pool}/A_{bkf}		1.3		---		1.1	1.5

			Scout West 1		Scout East 2		Scout West 2	
Parameter	**Notation**	**Units**	**min**	**max**	**min**	**max**	**min**	**max**
belt width	w_{blt}	feet	8.7	14.3	7.2	16.2	9.1	9.8
meander width ratio	w_{blt}/w_{bkf}		1.6	2.6	1.3	3	1.4	1.5
linear wavelength length	L_m	feet	39.8	84.8	36.5	63.2	32.5	36.9
linear wavelength ratio	L_m/w_{bkf}		7.2	15.4	6.8	11.7	4.9	4.9
radius of curvature	R_c	feet	3.1	9	5.5	16	5.4	6.8
radius of curvature ratio	R_c/ w_{bkf}		0.6	1.6	1	3	0.8	1

Table 13b. Summary of Reference Reach Geomorphic Parameters
Devil's Racetrack Mitigation Site

	Johanna Creek		Jarman Oak Reference	
Parameter	**min**	**max**	**min**	**max**
stream type	E5/C5		E6	
drainage area	0.9		1.27	
bankfull discharge	14		11	
bankfull cross-sectional area	7.2	7.8	11.6	
average bankfull velocity	1.8	1.9	0.95	
width at bankfull	9.7		9.3	
maximum depth at bankfull	1.1		2.3	
mean depth at bankfull	0.8		1.2	

	Johanna Creek		Jarman Oak Reference	
Parameter	**min**	**max**	**min**	**max**
bankfull width to depth ratio	10.1	19.7	7.4	
depth ratio	1.4	1.8	1.9	
bank height ratio	1		1	
floodprone area width	>2.2		>150	
entrenchment ratio	8	9.6	16.1	26.9
valley slope	0.0027		0.0055	
channel slope	0.0022		0.004	
sinuosity	1.2		1.4	
shallow slope	---		0.0129	
shallow slope ratio	---		3.2	
pool slope	0.0005		0.0029	
pool slope ratio	0.2		0.7	
pool-to-pool spacing	16	59	32	55
pool spacing ratio	1.6	6.1	3.4	5.9
maximum pool depth at bankfull	1.5		3.1	
pool depth ratio	1.9		2.5	
pool width at bankfull	8	10	8.7	9.0
pool width ratio	1		0.9	1.0

	Johanna Creek		Jarman Oak Reference	
Parameter	**min**	**max**	**min**	**max**
pool cross-sectional area at bankfull	---		16.2	
pool area ratio	---		1.4	
belt width	14	20	21	36
meander width ratio	1.4	2.1	2.3	2.9
linear wavelength length	50		---	
linear wavelength ratio	4	5.9	---	
radius of curvature	15	27	13.7	18.6
radius of curvature ratio	1.5	2.8	1.5	2.0

8.2 Reference Wetlands

Two reference wetlands that have been monitored for periods of greater than five years were identified for the Devil's Racetrack project. Both sites are within 10 miles of the project site and are in similar geomorphic settings within the floodplain of small coastal plain streams. The first is the Johanna Creek reference wetland site, initially identified in 2001 by Buck Engineering. Hydrology at the site has been continuously monitored for over 10 years. The second site is the Cox Mitigation Site developed by Environmental Banc & Exchange in 2005. Although this is a constructed stream and wetland mitigation site and not a mature reference site, the project has been closed out and approved as a functional wetland site by the USACE and DWQ. WEI has discussed the use of this site in combination with the Johanna Creek site with the USACE and all parties have agreed that the use of the two sites in combination provides an appropriate range of vegetative and hydrologic comparison data.

The Johanna Creek reference site is located in the transition area between the Coastal Plain and Piedmont physiographic regions of North Carolina adjacent to the Westbrook and Cox sites completed by Environmental Banc & Exchange in 2003 and 2005, respectively. It is located within the floodplain of Johanna Creek, a tributary to Mill Creek (Figure 8). The site is an example of a Coastal Plain small stream swamp, as described by Schafale and Weakley (1990). The Cox Mitigation Site is located in the valley adjacent to Johanna Creek and is also classified as a Coastal Plain small stream swamp. These systems exist as the floodplains of small blackwater and brownwater streams in which separate fluvial features and associated vegetation are too small or poorly developed to distinguish. It is difficult to define whether the site is of the brownwater or blackwater subtype, since the site exhibits features of both subtypes. Schafale and Weakley characterize the brownwater subtype as having its headwater originating in the Piedmont, while the blackwater subtype originates in the Coastal Plain. Hydrology of these

systems is palustrine, intermittently, temporarily, or seasonally flooded. Flows tend to be highly variable, with floods of short duration, and periods of very low flow.

8.2.1 Hydrological Characterization

Climatic conditions of the Johanna Creek and Cox reference sites are the same as those described for the project site. Site hydrology is controlled by the main stream channel that flows through the site, as well as several small drainages that flow onto the site and provide additional water to the floodplain areas during wet periods. Due to the shallow, unincised condition of the main streams through the sites and drainage from upland side slopes, high water table conditions are sustained across the active floodplain.

Groundwater monitoring wells were installed in the Johanna Creek reference site and monitoring data were collected from June 2001 to the present. Monitoring wells were installed at the Cox site following construction in the winter of 2005/2006 and data were collected for the monitoring period from 2006 to 2010. Table 14 presents the results for the 2006 to 2010 growing seasons as reported in the Cox Site annual monitoring reports prepared by WK Dickson and Co., Inc. The hydrology results reported are the percent consecutive period of the growing season during which the water table was within 12 inches of the soil surface. Annual results are averaged over the five year period to provide a range of anticipated conditions for comparison to the restoration site.

Table 14. Reference Wetland Hydrology Results 2006-2010
Devil's Racetrack Mitigation Site

Max Hydroperiod by Year (Growing Season 17-Mar through 5-Nov, 232 days)						
Reach	**2006**	**2007**	**2008**	**2009**	**2010**	**Average**
Johanna Ref MW1	8	3	2	3	18	6.8
Johanna Ref MW2	8	8	8	15	14	10.6
Johanna Ref AW3	29	19	22	17	18	21.0
Johanna Ref MW4	9	19	16	16	13	14.6
Johanna Ref MW5	0	1	0	0	13	2.8
Cox AW1	43	20	30	38	22	30.6
Cox MW2	29	18	27	31	15	24.0
Cox AW3	0	17	7	10	9	8.6
Cox MW4	2	2	7	11	9	6.2
Cox AW5	9	5	17	17	14	12.4
Cox MW6	29	4	8	12	5	11.6
Cox AW7	58	28	32	45	20	36.6
Cox MW8	13	8	25	19	18	16.6
Cox MW9	7	8	26	16	14	14.2
Cox AW10	6	4	22	17	13	12.4
Cox AW11	n/a	4	27	18	12	15.3
Cox AW12	n/a	0	4	3	2	2.3

8.2.2 Soil Characterization and Taxonomic Classification

The Johanna Creek reference site is located in the transition area between the Coastal Plain and Piedmont physiographic regions of North Carolina and is adjacent to the Cox and Westbrook sites completed by Environmental Banc & Exchange in 2005 and 2003, respectively. Soils located within the wetland areas of the reference site are mapped as the Bibb and Pantego series (SCS, 1994). Soils located within the wetland areas of the Cox reference site are mapped as the Pantego series (SCS, 1994). The Bibb series consists of poorly drained soils typically found on floodplains along streams in the Coastal Plain. Permeability is moderate, and the seasonal high water table is within 0.5 to 1.5 feet of the soil surface. The Pantego series consists of poorly drained soils typically found on broad stream terraces on the Coastal Plain. In the undrained condition, permeability is moderate, and the seasonal high water table is within one foot of the soil surface in winter and spring.

WEI conducted a soil analysis at both reference sites to confirm earlier findings and to verify soil information obtained from the Johnston County soil survey maps. These tests revealed that the soils on both reference sites are correct and match the Bibb and Pantego soil series. The Bibb soil series is one of the soil types found on the Devil's Racetrack site while the Pantego series is very similar to the Rains and Leaf soil types found on the Devil's Racetrack site. The reference site soils have a deep, dark loamy layer to a depth of approximately two to three feet, underlain by a layer of sandy clay loam material to a depth of approximately 4.5 feet. At a depth of approximately 4.5 feet, a layer of sand begins and extends to an undetermined depth.

8.2.3 Vegetation Community Types Descriptions and Disturbance History

Historical aerials reveal that the Johanna Creek reference wetland area has not been cleared since 1939. The reference wetland area is within the floodplain of the Johanna Creek reference stream and the vegetation community is described above in section 8.1.2. The Cox reference wetland was planted in the winter of 2005/2006. A forestry management plan was implemented resulting in accelerated tree growth and an average tree height of approximately 20-30 feet as of April 2012. The planting plan for the site included sycamore, black gum (*Nyssa sylvatica*), black walnut (*Juglans nigra*), swamp chestnut oak, overcup oak (*Quercus lyrata*), and river birch.

9.0 Determination of Credits

Mitigation credits presented in Table 15 are projections based upon site design. Upon completion of site construction the project components and credits data will be revised to be consistent with the as-built condition.

Table 15. Determination of Credits
Devil's Racetrack Mitigation Site

Mitigation Credits									
	Stream		Riparian Wetland		Non-riparian Wetland		Buffer	Nitrogen Nutrient Offset	Phosphorus Nutrient Offset
Type	R	RE	R	RE	R	RE			
Totals	18,104	112	55.2	---	---	---	---	---	---

Project Components							
Project Component or Reach ID	Stationing / Location	Existing Footage / Acreage	Approach (PI, PII, etc.)	Restoration or Restoration Equivalent	Restoration Footage or Acreage	Mitigation Ratio	Credits
Devil's Racetrack Creek (West) (DOT ROW)	0+00 to 0+20	20 LF	P1	Restoration (No Credit)	20 LF	---	---
Devil's Racetrack Creek (West)	0+20 to16+26 & 17+50 to 52+05	4,755 LF	P1	Restoration	5,061 LF	1:1	5,061
Devil's Racetrack Creek (West) (Power Line Easement)	16+26 to 17+50	196 LF	P1	Restoration (Partial Credit)	124 LF	4:1[1]	31
Devil's Racetrack Creek (West) (DOT ROW)	52+05 to 52+11	5 LF	P1	Restoration (No Credit)	6 LF	---	---
Devil's Racetrack (East) (DOT ROW)	52+59 to 52+65	5 LF	P1	Restoration (No Credit)	6 LF	---	---
Devil's Racetrack (East)	52+65 to 70+73 & 71+03 to 88+00 & 88+31 to 106+85	4,778 LF	P1/2	Restoration	5,359 LF	1:1	5,363

Devil's Racetrack (East) (Easement Break)	70+73 to 71+03	30 LF	P1/2	Restoration (No Credit)	31 LF	---	---
Devil's Racetrack (East) (Easement Break)	88+00 to 88+31	31 LF	P1/2	Restoration (No Credit)	31 LF	---	---
Devil's Racetrack (East)	106+85 to 107+97	0 LF	P1/2	Restoration (No Credit)	112 LF	---	---
Southwest Branch	500+00 to 501+31 & 600+00 to 600+23	154 LF	EII	Enhancement	154 LF	2.5:1	62
Southwest Branch	501+31 to 502+06	75 LF	EI	Enhancement	75 LF	1.5:1	50
Southwest Branch	502+06 to 504+85 & 505+99 to 511+32	740 LF	P1/2	Restoration	812 LF	1:1	812
Southwest Branch (Power Line Easement)	504+85 to 505+99	111 LF	P1/2	Restoration (Partial Credit)	114 LF	4:1[1]	29
Middle Branch	200+00 to 204+10	410 LF	Headwater Wetland		410 LF	1:1	410
Middle Branch	204+10 to 219+06	1,326 LF	P1/2	Restoration	1,496 LF	1:1	1,496
Southeast Branch	300+00 to 305+03 & 305+35 to 328+92	2,946 LF	P1	Restoration	2,860 LF	1:1	2,860
Southeast Branch (Easement Break)	305+03 to 305+35	30 LF	P1	Restoration (No Credit)	32 LF	---	---
North Branch	403+76 to 424+18	---	P1	Restoration	2,042 LF	1:1	2,042
Riparian Wetlands (West)	---	51.4 ac	---	Restoration	51.4 ac	1:1	51.4 ac
Riparian Wetlands (West) (Power Line Easement)	---	1.6 ac	---	Restoration (Partial Credit)	1.6 ac	4:1	0.4 ac
Riparian Wetlands (East)	---	3.4 ac	---	Restoration	3.4 ac	1:1	3.4 ac

Component Summation						
Restoration Level	Stream (linear feet)	Riparian Wetland (acres)		Non-Riparian Wetland (acres)	Buffer (acres)	Upland (acres)
		Riverine	Non-Riv.			
Restoration	18,515	56.4	---	---	---	---
Enhancement	229	---	---	---	---	---
Enhancement I	75	---	---	---	---	---
Enhancement II	154	---	---	---	---	---
Creation	---	---	---	---	---	---
Preservation	---	---	---	---	---	---
High Quality Preservation	---	---	---	---	---	---

1. Ratio of 4:1 based on an expected 75% reduction in credits for stream restoration with shrub buffer zone in power line easements.

10.0 Project Site Mitigation Plan

The design streams and wetlands will be restored to the appropriate type based on the surrounding landscape, climate, and natural vegetation communities but also with thorough consideration to existing watershed conditions and trajectory. The project includes stream restoration and enhancement as well as wetland restoration (Figures 9 and 10). The specific proposed stream and wetland types are described below.

10.1 Designed Channel Classification

The stream restoration portion of this project includes six reaches:

- Southwest Branch from 131 feet below its headwaters to the confluence with Devil's Racetrack Creek;
- Middle Branch from its headwaters to the confluence with Devil's Racetrack Creek;
- Southeast Branch from its headwaters to the confluence with Devil's Racetrack Creek;
- North Branch from the northeast corner of the property to its confluence with Devil's Racetrack Creek;
- Devil's Racetrack Creek (west) from U.S. Highway 701 to Devil's Racetrack Creek Road; and
- Devil's Racetrack Creek (east) from Devil's Racetrack Creek Road to its confluence with the Neuse River.

The upper 530 LF of Middle Branch will be designed as a headwater wetland feature. Stream restoration credit will be generated by construction of this feature and will be calculated as valley length through the feature.

The project also includes one stream Enhancement II reach and one Enhancement I reach. The Enhancement II reach consists of the upper 131 feet of Southwest Branch along with 23 feet of a channel connecting the spring head to Southwest Branch. The Southwest Branch design includes 75 feet of Enhancement I in the transition between enhancement II and restoration.

The site design has been developed based on similar reference conditions representing small inner Coastal Plain stream and wetland complexes with low gradient, meandering streams and straighter, higher-gradient zero- to first-order tributaries. The streams on the site are all sand bed channels and the designs will incorporate abundant woody structures that will drive scour pool formation and provide aquatic habitat. While the larger meandering streams will also have some pool formation in the bends, the bed profile of the steeper streams will be completely controlled by the woody structures. The streams will be small in cross section and shallow so that multiple out-of-bank flow events occur annually and hydrology of the adjacent riparian wetlands is maximized. The lower-slope, meandering channels will be constructed with side channels and meander scrolls which will fill at higher flows and provide additional habitat. The wetlands and riparian buffers will be planted with native tree species which will be managed throughout the monitoring period to maximize recovery of the site ecology.

The stream restoration components of the project are all Priority 1 restoration except for a few short sections of Middle Branch and Southeast Branch and the downstream end of Devil's Racetrack Creek (east). Research on the history of the site indicates that the valleys of Middle and Southeast Branches were filled in and these will be excavated to return the site to a close approximation of its historic condition. The valleys will be sculpted into a natural valley shape rather than typical Priority 2 benching. Devil's Racetrack (east) will include two sections of Priority 2 restoration with different depths of

floodplain grading necessary. The Priority 2 designs are necessary to connect Devil's Racetrack Creek with the Neuse River without the need to construct a very steep section at the downstream end of the project. Instead, a more gradual slope will be constructed to provide the potential for fish migration from the river up the Devil's Racetrack Creek and back.

The streams have been designed based on nearby reference conditions rather than particular stream types included in the Rosgen classification system. In general, the larger, meandering streams would be most similar to a Rosgen type C with width-to-depth ratios of 12 to 14, entrenchment ratios of greater than 10, slopes of 0.05% to 1%, and sinuosity values of 1.2 to 1.55. The higher sinuosity values are based on streams in the Coastal Plain reference reach database developed for this project (Appendix 12). The downstream reach of Devil's Racetrack Creek (east) includes a steep section (2.5% slope) in order to drop down to the elevation of the Neuse River. The smaller, higher gradient streams would be most similar to the E stream type in cross section with fairly low width-to-depth ratios (10 to 12) and high entrenchment ratios (greater than 10). However, unlike E channels, these streams will be fairly steep with slopes ranging from 1% to 2.5% and fairly straight with sinuosity values of 1.05 to 1.1. These channels designs are based on reference reaches from a similar landscape. The downstream reach of Southwest Branch, Middle Branch, and Southeast Branch all flatten in slope as they near Devil's Racetrack Creek. A summary of the design parameters for each project reach is included in Tables 16a to 16c.

The headwater wetland feature will be designed on the upper 530 linear feet of Middle Branch. There is currently a pond and earthen embankment in this area. The pond will be drained and the wetland feature will be constructed in the area that is now the pond. Stream restoration credit will be generated by this feature as it is an alternative preferred by the Interagency Review Team (IRT) to designing a stream channel through the pond bottom.

Table 16a. Design Morphologic Parameters
Devil's Racetrack Mitigation Site

	Notation	Units	Southwest Branch – Reaches 1 to 3		Southwest Branch – Reach 4		Middle Branch – Reach 1		Middle Branch – Reach 2	
			Min	Max	Min	Max	Min	Max	Min	Max
Stream Type[1]			---		E/C5		---		E/C5	
Drainage Area[2]	DA	Sq. mi.	0.023		0.023		0.013		0.013	
Bankfull Design Discharge	Qbkf	cfs	1.5		1.5		1		1	
Cross-Section Features										
Bankfull Cross-Sectional Area	Abkf	SF	1.0		1.0		0.9		1.5	
Average Bankfull Velocity	vbkf	fps	1.7		1.3		1.3		0.8	
Bankfull Width	wbkf	feet	3.0		3.3		3.0		4.0	

	Notation	Units	Southwest Branch – Reaches 1 to 3		Southwest Branch – Reach 4		Middle Branch – Reach 1		Middle Branch – Reach 2	
			Min	Max	Min	Max	Min	Max	Min	Max
Mean Depth at Bankfull	dbkf	feet	0.3		0.3		0.3		0.3	
Bankfull Width to Depth Ratio	wbkf/dbkf		9.0	10.0	10.0	12.0	10.0	10.5	10.0	12.0
Maximum Depth at Bankfull	dmax	feet	0.5	0.6	0.4	0.5	0.4	0.5	0.5	0.6
Maximum Depth Ratio	dmax/dbkf		1.4	1.7	1.3	1.7	1.3	1.7	1.3	1.7
Bank Height Ratio	BHR		1.0	1.1	1.0	1.1	1.0	1.1	1.0	1.1
Floodprone Area Width	wfpa	feet	40	60	100	300	40	60	100	300
Entrenchment Ratio	ER		13.3	20.0	30.3	90.9	33.3	100.0	22.2	66.7
Slope										
Valley Slope	Svalley	feet/ foot	0.0400	0.0400	0.0101	0.0101	0.0207	0.0207	0.0113	0.0113
Channel Slope	Schannel	feet/ foot	0.0171	0.0216	0.0078	0.0096	0.0096	0.0163	0.0024	0.0077
Shallow Features										
Shallow Slope	Sriffle	feet/ foot	0.0257	0.0648	0.0109	0.0308	0.0144	0.0489	0.0002	0.0074
Shallow Slope Ratio	Srif/Schan		1.5	3.0	1.4	3.2	1.5	3.0	1.4	3.2
Pool Features										
Pool Slope	Spool	feet/ foot	0.0000	0.0086	0.0000	0.0038	0.0010	0.0065	0.0002	0.0031
Pool Slope Ratio	Spool/ Schan		0.10	0.40	0.10	0.40	0.10	0.40	0.10	0.40
Pool-to-Pool Spacing	Lp-p	feet	15	24	5	23	15	24	5	22
Pool Spacing Ratio	Lp-p/wbkf		4.9	8.0	1.6	7.0	4.9	8.0	1.6	7.0
Maximum Pool Depth at Bankfull	dpool	feet	0.5	1.1	0.4	1.0	0.4	1.0	0.5	1.0
Pool Depth Ratio	dpool/dbkf		1.3	3.3	1.3	3.3	1.3	3.3	1.3	3.3
Pool Width at Bankfull	wpool	feet	3.0	4.5	3.3	5.0	3.0	4.2	4.5	5.8

	Notation	Units	Southwest Branch – Reaches 1 to 3		Southwest Branch – Reach 4		Middle Branch – Reach 1		Middle Branch – Reach 2	
			Min	Max	Min	Max	Min	Max	Min	Max
Pool Width Ratio	wpool/wbkf		1.0	1.5	1.0	1.5	1.0	1.5	1.0	1.5
Pool Cross-Sectional Area at Bankfull	Apool	SF	1.3	2.0	1.2	2.1	1.0	1.6	1.1	2.0
Pool Area Ratio	Apool/Abkf		1.3	2.0	1.1	2.0	1.3	2.0	1.1	2.0
Pattern Features										
Sinuosity	K		1.05	1.18	1.05	1.45	1.05	1.18	1.15	1.45
Belt Width	wblt	feet	4	9	4	26	4	9	6	36
Meander Width Ratio	wblt/wbkf		1.3	3.0	1.3	8.0	1.3	3.0	1.3	8.0
Linear Wavelength	LW	feet	20	46	9	50	20	46	12	68
Linear Wavelength Ratio	LW/wbkf		6.8	15.4	2.7	15.0	6.8	15.4	2.7	15.0
Meander Length	Lm	feet	24	51	10	56	24	51	14	77
Meander Length Ratio	Lm/wbkf		8.0	17.0	3.0	17.0	8.0	17.0	3.0	17.0
Radius of Curvature	Rc	feet	5	14	5	16	5	14	7	22
Radius of Curvature Ratio	Rc/ wbkf		1.7	4.5	1.5	4.8	1.7	4.5	1.5	4.8

1. High slope reaches were not classified according to the Rosgen classification system
2. Drainage areas of proposed channel differ from those of existing channels due to changes in alignment of receiving streams. Drainage areas were determined for multiple locations on proposed channels where reach breaks are designed.

Table 16b. Design Morphologic Parameters
Devil's Racetrack Mitigation Site

	Notation	Units	Southeast Branch – Reach 1		Southeast Branch – Reach 2		Southeast Branch – Reach 3		North Branch	
			Min	Max	Min	Max	Min	Max	Min	Max
Stream Type[1]			---		---		E/C5		E/C5	
Drainage Area[2]	DA	sq. mi.	0.026		0.065		0.102		0.186	
Bankfull Design Discharge	Qbkf	cfs	1.5		2		3		5	

	Notation	Units	Southeast Branch – Reach 1		Southeast Branch – Reach 2		Southeast Branch – Reach 3		North Branch	
			Min	Max	Min	Max	Min	Max	Min	Max
Cross-Section Features										
Bankfull Cross-Sectional Area	Abkf	SF	1.0		1.5		2.5		5.9	
AverageBankfull Velocity	vbkf	fps	1.7		1.4		1.4		0.9	
Bankfull Width	wbkf	feet	3.0		4.0		5.4		9.2	
Mean Depth at Bankfull	dbkf	feet	0.3		0.4		0.5		0.6	
Bankfull Width to Depth Ratio	wbkf/dbkf		9.0	10.0	10.0	12.0	11.0	12.0	14.0	14.5
Maximum Depth at Bankfull	dmax	feet	0.4	0.6	0.5	0.7	0.5	0.8	0.9	1.1
Maximum Depth Ratio	dmax/dbkf		1.4	1.7	1.3	1.7	1.2	1.7	1.4	1.7
Bank Height Ratio	BHR		1.0	1.1	1.0	1.1	1.0	1.2	1.0	1.1
Floodprone Area Width	wfpa	feet	25	35	50	70	100	300	100	300
Entrenchment Ratio	ER		8.3	11.7	12.5	17.5	18.5	55.6	10.9	32.6
Slope										
Valley Slope	Svalley	feet/ foot	0.0322	0.0322	0.0273	0.0273	0.0066	0.0066	0.0012	0.0023
Channel Slope	Schannel	feet/ foot	0.0108	0.0227	0.0096	0.0128	0.0025	0.0089	0.0007	0.0020
Shallow Features										
Shallow Slope	Sriffle	feet/ foot	0.0162	0.0681	0.0144	0.0384	0.0035	0.0285	0.0010	0.0065
Shallow Slope Ratio	Srif/Schan		1.5	3.0	1.5	3.0	1.4	3.2	1.4	3.2
Pool Features										
Pool Slope	Spool	feet/ foot	0.0000	0.0091	0.000	0.0051	0.0000	0.0036	0.0001	0.0008
Pool Slope Ratio	Spool/ Schan		0.10	0.40	0.10	0.40	0.10	0.40	0.10	0.40
Pool-to-Pool Spacing	Lp-p	feet	15	24	20	32	9	38	15	64
Pool Spacing Ratio	Lp-p/wbkf		4.9	8.0	4.9	8.0	1.6	7.0	1.6	7.0

	Notation	Units	Southeast Branch – Reach 1		Southeast Branch – Reach 2		Southeast Branch – Reach 3		North Branch	
			Min	Max	Min	Max	Min	Max	Min	Max
Maximum Pool Depth at Bankfull	dpool	feet	0.5	1.1	0.4	1.2	0.5	1.5	0.9	2.1
Pool Depth Ratio	dpool/dbkf		1.4	3.3	1.0	3.3	1.0	3.3	1.0	3.3
Pool Width at Bankfull	wpool	feet	3.0	4.5	4.0	6.0	5.4	8.1	9.2	13.8
Pool Width Ratio	wpool/wbkf		1.0	1.5	1.0	1.5	1.0	1.5	1.0	1.5
Pool Cross-Sectional Area at Bankfull	Apool	SF	1.3	2.0	2.0	3.0	2.8	5.0	6.4	11.7
Pool Area Ratio	Apool/Abkf		1.3	2.0	1.3	2.0	1.1	2.0	1.1	2.0
Pattern Features										
Sinuosity	K		1.05	1.18	1.05	1.18	1.15	1.55	1.15	1.55
Belt Width	wblt	feet	4	9	5	12	7	43	12	74
Meander Width Ratio	wblt/wbkf		1.3	3.0	1.3	3.0	1.3	8.0	1.3	8.0
Linear Wavelength	LW	feet	20	46	27	62	15	81	25	138
Linear Wavelength Ratio	LW/wbkf		6.8	15.4	6.8	15.4	2.7	15.0	2.7	15.0
Meander Length	Lm	feet	24	51	32	68	16	92	28	156
Meander Length Ratio	Lm/wbkf		8.0	17.0	8.0	17.0	3.0	17.0	3.0	17.0
Radius of Curvature	Rc	feet	5	14	6	18	8	26	14	44
Radius of Curvature Ratio	Rc/ wbkf		1.5	4.5	1.5	4.5	1.5	4.8	1.5	4.8

1.High slope reaches were not classified according to the Rosgen classification system
2. Drainage areas of proposed channel differ from those of existing channels due to changes in alignment of receiving streams. Drainage areas were determined for multiple locations on proposed channels where reach breaks are designed.

Table 16c. Design Morphologic Parameters
Devil's Racetrack Mitigation Site

	Notation	Units	Devil's Racetrack Creek (West) – Reach 1		Devil's Racetrack Creek (West) – Reach 2		Devil's Racetrack Creek(East) – Reach 1		Devil's Racetrack Creek (East) – Reach 2	
			Min	Max	Min	Max	Min	Max	Min	Max
Stream Type[1]			E/C5		E/C5		E/C5		E/C5	
Drainage Area[2]	DA	sq. mi.	0.60		0.70		1.14		1.30	
Bankfull Design Discharge	Qbkf	cfs	10		13		16		17	
Cross-Section Features										
Bankfull Cross-Sectional Area	Abkf	SF	5.8		9.5		12.8		4.8	
AverageBankfull Velocity	vbkf	fps	1.7		1.2		1.2		3.5	
Bankfull Width	wbkf	feet	9.0		11.5		13.0		8.0	
Mean Depth at Bankfull	dbkf	feet	0.6		0.8		1.0		0.6	
Bankfull Width to Depth Ratio	wbkf/dbkf		14.0	14.5	14		13.0	13.5	14.0	14.5
Maximum Depth at Bankfull	dmax	feet	0.9	1.1	1.1	1.5	1.4	1.8	0.8	1.0
Maximum Depth Ratio	dmax/dbkf		1.4	1.7	1.4	1.7	1.4	1.7	1.3	1.7
Bank Height Ratio	BHR		1.0	1.1	1.0	1.1	1.0	1.1	1.0	1.1
Floodprone Area Width	wfpa	feet	100	300	100	300	100	500	100	500
Entrenchment Ratio	ER		11.1	33.3	8.7	26.1	7.7	38.5	12.5	62.6
Slope										
Valley Slope	Svalley	feet/ foot	0.0039	0.010	0.0025	0.0025	0.0004	0.0008	0.0264	0.0264
Channel Slope	Schannel	feet/ foot	0.0025	0.0087	0.0016	0.0022	0.0004	0.0008	0.0224	0.0251
Shallow Features										
Shallow Slope	Sriffle	feet/ foot	0.0036	0.0277	0.0023	0.0072	0.0007	0.0025	0.0377	0.0671
Shallow Slope Ratio	Srif/Schan		1.4	3.2	1.4	3.2	1.4	3.2	1.5	3.0
Pool Features										
Pool Slope	Spool	feet/ foot	0.0003	0.0035	0.0002	0.0009	0.0001	0.0003	0.0025	0.0089

	Notation	Units	Devil's Racetrack Creek (West) – Reach 1		Devil's Racetrack Creek (West) – Reach 2		Devil's Racetrack Creek(East) – Reach 1		Devil's Racetrack Creek (East) – Reach 2	
			Min	Max	Min	Max	Min	Max	Min	Max
Pool Slope Ratio	Spool/ Schan		0.10	0.40	0.10	0.40	0.10	0.40	0.10	0.40
Pool-to-Pool Spacing	Lp-p	feet	14	63	18	81	21	91	39	64
Pool Spacing Ratio	Lp-p/wbkf		1.6	7.0	1.6	7.0	1.6	7.0	4.9	8.0
Maximum Pool Depth at Bankfull	dpool	feet	0.9	2.1	1.1	2.5	1.4	3.2	0.8	2.0
Pool Depth Ratio	dpool/dbkf		1.0	3.3	1.0	3.3	1.0	3.3	1.0	3.3
Pool Width at Bankfull	wpool	feet	9.0	13.5	11.5	17.3	13.0	19.5	8.0	12.0
Pool Width Ratio	wpool/wbkf		1.0	1.5	1.0	1.5	1.0	1.5	1.0	1.5
Pool Cross-Sectional Area at Bankfull	Apool	SF	6.2	11.3	10.4	19.0	14.0	25.5	6.2	9.5
Pool Area Ratio	Apool/Abkf		1.1	2.0	1.1	2.0	1.1	2.0	1.3	2.0
Pattern Features										
Sinuosity	K		1.15	1.55	1.15	1.55	1.05	1.25	1.05	1.18
Belt Width	wblt	feet	12	72	15	92	17	65	10	40
Meander Width Ratio	wblt/wbkf		1.3	8.0	1.3	8.0	1.3	5.0	1.3	5.0
Linear Wavelength	LW	feet	24	135	31	173	35	195	54	132
Linear Wavelength Ratio	LW/wbkf		2.7	15.0	2.7	15.0	2.7	15.0	6.8	15.4
Meander Length	Lm	feet	27	153	35	196	39	221	64	136
Meander Length Ratio	Lm/wbkf		3.0	17.0	3.0	17.0	3.0	17.0	8.0	17.0
Radius of Curvature	Rc	feet	14	43	17	55	20	62	12	36
Radius of Curvature Ratio	Rc/ wbkf		1.5	4.8	1.5	4.8	1.5	4.8	1.5	4.5

1. High slope reaches were not classified according to the Rosgen classification system
2. Drainage areas of proposed channel differ from those of existing channels due to changes in alignment of receiving streams. Drainage areas were determined for multiple locations on proposed channels where reach breaks are designed.

10.2 Designed Wetland Type

The proposed stream and wetland restoration project includes two distinct riparian wetland restoration zones. This does not include a headwater wetland feature planned for the impounded area at the top of Middle Branch for which no wetland credit is proposed. All areas proposed for wetland restoration are mapped as Prior Converted Wetlands by the NRCS (Appendix 6). The majority of the wetland restoration will occur adjacent to the stream restoration reaches on the west side of the property. This portion of the wetland restoration will account for 54.5 acres of wetlands restoration. The other zone includes 3.5 acres in a narrow corridor immediately adjacent to the mainstem of Devil's Racetrack Creek on the east side of the project. These two zones are depicted on Figures 9 and 10. Soil investigations for the wetland areas are described in detail in Section 6.3.

The west riparian wetlands are adjacent to the mainstem of Devil's Racetrack Creek and the lower portions of Southwest Branch, Middle Branch, and Southeast Branch. There are three areas of delineated hydric soils immediately adjacent to one another on this portion of the site. The streams in this area are highly incised – existing bank height ratios range from 2.2 to 10.7 – which, in combination with extensive ditching across the site (Figure 2), increases the drainage effect on the surrounding historic wetlands. The ditches are variable in depth – A and B are the deepest with typical depths up to seven feet while typical depths for C, D, and E are two to three feet. The current plan for the site does not include filling ditch E due to adjacent landowners' objections. The drainage effect from the ditches and incised streams and the lack of surface water retention in the fields has impaired wetland hydrology and function. The bed elevation of each of these streams will be raised to restore the natural water table elevation and a natural over-bank flooding regime. The streams will be reconstructed in their most probable original valleys. Other drainage ditches on the site will also be filled (Figure 11) to eliminate their effect on draining the wetlands. These wetlands will be planted with native tree species appropriate for the mosaic of Coastal Plain small stream swamp and bottomland hardwood type of wetland ecosystems planned for the site. The groundwater modeling described in Section 6.2.1 indicates that the wetlands in this area will meet wetland criteria most years after the project is constructed.

The wetland zone adjacent to Middle Branch is mapped as hydric soil however, as described in Section 5.1, the valley along much of this stream was filled and graded out flat in the early1980's to increase the farmable land on the property. The Middle Branch valley will be graded to match the most probable historic elevations based on information provided by a farmer who worked on the site during the time it was modified and review of the surveyed profile of the pond, dam, and channel downstream of the dam. The downstream portion of the graded valley includes a small section of the wetland restoration adjacent to Middle Branch. Although this small portion of the wetland zone will involve more significant grading than is typical with wetland restoration projects, the entire zone is considered to be restoration as the intent is to return this valley to historic conditions. Approximately 2.4 acres of wetlands will be graded along Middle Branch.

The east riparian wetlands are also adjacent to an incised stream. The existing Devil's Racetrack Creek has bank height ratios of 2.6 to 4.3, indicating severe incision. This incised channel drains the adjacent historic wetlands. As part of the stream restoration, the channel bed in this area will be raised significantly so that the stream will have access to its floodplain and out-of-bank floods will occur fairly frequently. This activity will also serve to raise the water table significantly. The higher water table and frequent floods will provide the hydrology to maintain wetland conditions. The corridor through which the stream and wetlands will be restored has been highly manipulated within the past 100 years. The stream was drag-lined and spoil was used to create a berm along both side of the stream. Additional fill material, including a surface gravel layer, was used to construct a raised road bed extending from Devil's Racetrack Road to the Neuse River. Fill material will be removed from the roadway and existing dredge spoil berms and used to fill the existing stream. Grading depths have been designed to return the site to pre-disturbance elevations and uncover historic hydric soil surface layers. Soils analysis and modeling

results indicate that wetlands will be restored for approximately 1,200 feet extending downstream from Devil's Racetrack Road as shown on Figure 10. These wetlands will be planted with native tree species appropriate for the mosaic of Coastal Plain small stream swamp and bottomland hardwood type of wetland ecosystems planned for the site. The groundwater modeling described in Section 6.2.1 indicates that the wetlands in this area will meet wetland criteria most years after the project is constructed.

10.3 Target Buffer Communities

The target communities for the restored and created wetlands and riparian buffer zones will be based on reference conditions, existing mature trees throughout the project area, comparison to vegetation listed for these community types in Shafale and Weakley (1990), and through consultation with native tree suppliers. The reference sites are the Johanna Creek stream and wetland reference site and the Scout Camp stream reference sites described in more detail in Section 8. Existing mature trees within the project area are described in Section 5.9. Bare root trees specified for planting are detailed in the construction plan set.

10.4 Stream Project and Design Justification

Based on investigations of the project site watershed, the landscape surrounding the project, and nearby reference conditions in similar landscapes it is very likely that a small stream/wetland complex (Coastal Plain small stream swamp and bottomland hardwood ecosystem type) originally existed on this property. The property has been used for agriculture and timber production for decades. WEI staff interviewed a local farmer who once farmed the western side of the site. The farmer explained the dredging and filling activities that were conducted to prepare the site for agricultural use in the early 1980's. The details of the interview are explained in Section 5.1. The canal that is the mainstem of Devil's Racetrack Creek was excavated earlier. Aerial photos show that the road along the existing canal on the eastern portion of the site was constructed between 1959 and 1971. This is the most likely time when the dredging was conducted.

The channelization of streams on the Devil's Racetrack site resulted in severely over-enlarged channels that are extremely deep in many locations. As can be clearly seen on aerial photos (Appendix 2), they have been relocated or redirected to maximize land available for row crop production. Stream valleys and other low areas were filled to raise wet areas and even out the fields. At the same time, the streams were straightened and the riparian vegetation was removed. The alterations of the site to promote farming resulted in complete elimination of the ecological function of this small stream/wetland complex. Specifically, functional losses at the site include degraded aquatic habitat, altered hydrology (related to loss of floodplain connection and lowered water table), and reduction of quality and amount of riparian wetland habitats and related water quality benefits. Ongoing bank erosion is occurring at some locations due to high, overly steep banks and lack of bank vegetation.

The objectives described in Section 1 were partially developed to deal with the issues described in the paragraphs above. The key factors driving the need for this intervention are:

- This site presents an opportunity to restore a large stream/wetland complex directly adjacent to the Neuse River to a naturally occurring community to create riparian and wetland habitat and improve water quality;
- The stream channels, including multiple headwaters streams, are badly degraded and restoration will create aquatic habitat and further improve water quality to receiving waters;
- Riparian buffers along stream corridors need reforestation for additional habitat and water quality benefits; and

- Devil's Racetrack Creek currently drops 10.5 ft over the drop inlet structure at the confluence with the Neuse River representing a significant barrier to passage of anadromous and other fish for spawning. Restoration will remove this barrier and restore natural migration patterns.

These project goals are commensurate with the primary restoration goals for the Targeted Local Watershed in the 2010 Neuse River Basin Restoration Priorities (RBRP) document:

- Wetlands restoration that contributes to the improvement of water quality downstream in the Neuse River estuary and
- Implementation of buffer and stream projects in headwaters.

10.5 Sediment Transport Analysis

A sediment transport analysis was performed for representative restoration reaches including Southeast Branch, Devil's Racetrack Creek (West), and Devil's Racetrack (East). In general, sediment transport analysis for stream restoration projects is performed to answer two questions:

1) What size bed material particles will become entrained at flows at or near the bankfull discharge (competence) and
2) Does the stream have the ability to pass the sediment load supplied to it (capacity).

However, in sand bed channels the entire bed mobilizes at flows near and often well below bankfull, with the grains moving together as migrating bedforms such as ripples and dunes (Knighton, 1998). The more important question in regard to sediment transport in sand bed streams is that of capacity. Therefore, the focus of the sediment transport analysis for this project was to determine if the designed channels have the capacity to pass the sediment load supplied by their watersheds.

A capacity analysis is much more difficult to perform and is prone to error. In order to perform the analysis, an estimate of sediment supply must be developed and compared with computation of the stream's ability or capacity to move the load. This analysis was performed for representative project reaches as described below.

To begin an analysis of sediment supply a watershed assessment was performed (as described in Section 4.2). WEI staff performed a ground-based watershed reconnaissance, reviewed GIS land cover data, and analyzed a series of aerial photographs dating from 2009 back to the 1930's. The goal of the assessment was to determine the current condition of the watersheds and identify time periods when the watersheds underwent changes that would affect the sediment load such as development or land clearing. As described in Section 4.2, land cover within the watersheds has remained essentially the same for the last 60 or more years. The only exception to this is the project site itself which, according to available information, was cleared in the early 1980's. The only other development in the project watershed within the last 20 years includes the construction of the KOA campground adjacent to the site and a small plant nursery in the northwestern portion of the watershed prior to 1993, a small subdivision in the southwestern portion of the watershed between 1993 and 1999, and Four Oaks Middle School on the western edge of the watershed around 2005. Overall the watershed is only about 4% developed. The majority of land cover in the watershed is agricultural (40%) and forest (39%). The remaining 17% is managed herbaceous or shrubland. WEI staff also walked the mainstem of Devil's Racetrack Creek upstream of the project site. That portion of the stream is surrounded by woods for most of its length. It appears to have been straightened in the past but is stable. There do not appear to be any significant sediment accumulations in the channel. Because of the rural nature of the watershed, the stable land use,

and the lack of sediment accumulation in the streams on the site or upstream of the project area, the sediment load to the project streams is expected to be low.

Because no sources of sediment were identified, a threshold channel design approach (Shields et al., 2003) will be used for each of the project reaches. This design approach is based on the concept that the morphology of the channels is not sensitive to sediment supply and channel migration and changes in slopes are not expected or desired. To validate the threshold design approach, a sediment modeling analysis was performed for representative design reaches.

The sediment load of any watershed is difficult to determine and estimates are fraught with error. Load calculations performed with models such as the universal soil loss equation typically generate annual load estimates (e.g. tons per year) which are then difficult to use with a design discharge or a range of discharges. Therefore a sediment load estimate for the project watersheds was not developed with this type of model. Instead, the capacity of existing representative streams on the site (maximum load if channels are moving sediment through) was compared to the capacity of the proposed designs for the same representative streams. The rationale for this approach is: because sediment accumulation in the existing channels was not observed to be a problem, the existing streams are supply-limited or have the capacity to transport the loads coming to them. If the design reaches have the capacity to transport sediment equal or greater to the existing reaches, there is no reason to believe capacity would be insufficient for the design reaches.

A HEC-RAS model was developed for three existing reaches and used to perform a sediment transport capacity analysis for the design bankfull discharges. Models of the proposed designs for the same project reaches were also developed and the results of the capacity analysis were compared. The reaches selected to represent the site include:

- Devil's Racetrack (west) sta. 14+78 to sta. 35+03
- Devil's Racetrack (east) sta. 64+92 to sta. 85+12
- Southeast Branch sta. 311+95 to sta. 326+05.

These reaches represent the range of stream sizes and slope conditions for the site and provide ample information on the mainstem of Devil's Racetrack Creek.

The hydraulic design sediment transport analysis module was used to analyze sediment transport capacity in the existing and proposed channels. This module of HEC-RAS allows the user to input flow data, bed material data, and cross section and slope data and then choose from a variety of transport functions to analyze transport capacity. For this analysis, the three equations most appropriate for sand bed streams were selected: Engelund-Hanson, Larsen (Copeland), and Yang. While these equations are not expected to produce precise results, they provide an estimate of the existing channels' capacity that can be compared to that of the proposed channels calculated through the same methods. The results of the HEC-RAS capacity analysis for each existing and proposed design reach are summarized in Table 17.

Table 17. Summary of Mean Sediment Transport Capacity of Design Reaches Devil's Racetrack Mitigation Site

Reach	Function	Existing	Proposed		
		Reachwide	Shallow	Pool	Reachwide
Southeast Branch	Engelund-Hansen (g/sec)	2,273	5,700	183	3,881
	Laursen (Copeland) (g/sec)	2,436	2,315	71	1,575

Reach	Function	Existing	Proposed		
		Reachwide	Shallow	Pool	Reachwide
	Yang (g/sec)	1,574	2,482	87	1,692
Devil's Racetrack Creek (west)	Engelund-Hansen (g/sec)	4,291	8,706	1,889	5,350
	Laursen (Copeland) (g/sec)	17,137	27,603	6,151	17,042
	Yang (g/sec)	11,348	23,081	4,921	14,141
Devil's Racetrack Creek (east)	Engelund-Hansen (g/sec)	49	74	7	40
	Laursen (Copeland) (g/sec)	1,297	4,349	343	2,346
	Yang (g/sec)	583	1,750	61	905

As expected, the results of the sediment transport analysis summarized in Table 17 show that the different equations produce highly variable results. In all cases, the sediment transport in the shallows is much greater than in the pools (where more setting is expected). In general, the transport capacity of the proposed streams is equal to or slightly more than that of the existing channels, although in a few cases it is slightly less. Though these values are rough estimates, the results indicate that the proposed channels have the capacity to move at least as much sediment at the design bankfull discharge as the existing channels. Therefore, the proposed channels will move their sediment loads and any bed adjustments will most likely be in the form of scour. Grade control structures will be incorporated into the design to prevent scour. For more information on grade control, see Section 11.1. According to the results in Table 17, Devil's Racetrack Creek (east) has a significantly lower transport capacity than Devil's Racetrack (west). This is due to the lower slope of the east reach (both existing and proposed). The existing east reach has finer bed material than the west, indicating that more fines settle out on the east side. This is to be expected with the lower slope. While some accumulations of fine sediments have occurred along this reach, aggradation has not been observed to be a significant problem.

11.0 Project Implementation Summary

The stream and wetland restoration will be constructed as described in this section. A full set of preliminary (60%) design plans are included with this mitigation plan for review.

11.1 Site Grading, Structure Installation, and Other Project Related Construction

The majority of the stream restoration elements of the project will be constructed as Priority 1 restoration in which the stream bed is raised so that the bankfull elevation will coincide with the existing floodplain. The cross sections will be constructed so that they are sized for the design discharge to fill the channels to the floodplain elevation. The cross sections of the larger, low-gradient reaches (North Branch, Devil's Racetrack Creek, and the downstream ends of Southwest Branch, Middle Branch, and Southeast Branch) will be well-defined. The cross sections of the higher-gradient reaches (the majority of Southwest Branch, Middle Branch, and Southeast Branch) will be less well-defined linear depressions on the floodplain. The sinuosity of each stream will be increased and the streams will meander through the floodplain to varying degrees. The low gradient streams will have a moderate to high sinuosity and will have irregular meander patterns similar to natural coastal plain streams. These reaches will also have natural Coastal Plain floodplain features including oxbows and meander scrolls. The higher-gradient reaches will have low sinuosity and meander patterns similar to the Scout East 1 and West 1 surveys. As described in Sections 5.1 and 10.2, some floodplain excavation will be performed to restore the expected original valley of Southeast and Middle Branch. The upper 131 feet of Southwest Branch will be Enhancement II and construction will include bank treatments and stabilization

only. Southwest Branch will transition from enhancement II to restoration through a 75 foot enhancement I zone where structures will be used to raise the grade of the channel in order to meet a Priority 1 restoration downstream.

The streambed of the low gradient channels will vary between pools and shallow zones. Pools will be constructed in some meander bends, but unlike gravel bed channels, pools are not expected to form in every bend. Pools will also be constructed downstream of woody structures in straight sections of the channels. In the higher-gradient reaches, pools will be constructed at irregular intervals downstream of woody structures. Nearly all of the grade drop in these small channels will occur on the downstream end of these structures.

As a result of the project, the floodplain will be more frequently inundated. Wetland hydrology will be improved by raising the channel beds. Wetland restoration is proposed in areas adjacent to the stream channels.

As previously mentioned in Sections 5.1 and 10.2, sections of floodplain grading will be necessary on Southeast Branch and Middle Branch to restore the probable historic valley elevations. As previously discussed, WEI was unable to determine exact elevations of the historic valleys for these two reaches through soil core analyses. Grading depths to restore the natural valley elevations were determined through analysis of longitudinal profiles along the valley. For example, the original valley of Middle Branch was filled downstream of the pond to support the embankment. The grading depths in this area were determined by extending the downstream valley slope up-valley to the upstream limits of grading. Grading of these valleys will be completed in such a manner as to create a natural valley shape as opposed to a floodplain bench with consistent side slopes. The grading will vary in depth as needed but generally range from one to two feet. Creation of the headwater wetland feature will reduce the need to cut downstream of the embankment on Middle Branch (compared to restoring a stream channel through the pond bottom) so that only 2 feet of valley cut will be necessary. Less than one foot of cut will be excavated on downstream portions of Middle Branch and two feet to less than one foot on Southeast Branch. The deepest grading on Middle Branch is immediately downstream of the existing pond embankment which will be partially removed. In areas requiring the removal of topsoil, the topsoil will be stockpiled. These areas will be undercut by 6 inches and the topsoil will be replaced to achieve final grades and to create a suitable planting medium.

Construction of Devil's Racetrack (East) will require the removal of spoil berms along both sides of the existing channel and removal of the raised roadbed throughout the work corridor including the Priority 1 section. In order to achieve the correct grades to avoid additional floodplain excavation on the upstream section of Devil's Racetrack (East), the existing 36-inch reinforced concrete culvert under Devil's Racetrack Road will be replaced at a higher invert. The preliminary plan is to replace that culvert with four 30-inch by 19-inch elliptical reinforced concrete pipes.

Floodplain grading will be necessary on a portion of Devil's Racetrack (East) and will result in Priority 2 restoration. For two sections, different depths of floodplain grading will be necessary. Beginning at station 65+00 and extending downstream to station 101+00, a moderate depth of floodplain grading will be necessary. The floodplain through this section will be excavated approximately one to three feet in depth from existing ground elevation and will be shaped into a wide valley with low side slopes similar to natural streams in the area. Beginning at station 101+00, the slope will be increased to meet the grade of the channel that will connect Devil's

Racetrack Creek to the Neuse River. Floodplain excavation will be greater in this section with cut depths ranging from four to ten feet.

No grading will be required to achieve the wetland restoration outside of the small stream valley restoration. Wetland hydrology will be restored by raising the inverts of the adjacent stream channels and filling drainage ditches. Wetland areas will be disked to increase surface roughness and better capture rainfall which will improve connection with the water table for groundwater recharge. Furrows will not exceed 6" to 9" in depth.

Woody debris structures are common in small Coastal Plain streams and will be an important element of the stream restoration components of this project. Log and brush structures will be installed throughout all of the channels and will provide grade control, energy dissipation, and habitat. Log sill structures will be placed at all drops in the high-gradient channels. Log sills and brush will also be used as grade control in the low-gradient channels, although the drops in the streambeds of those channel will be more gradual throughout the alignment rather than at log sill structures only. Sections of the channel bed on the low-gradient, meandering streams will be seeded with native bed material to jump start the process of bed load movement through the system and provide a natural substrate from the completion of construction that otherwise might take months or years to form. The channel banks will also be armored with native materials from the site including root wads and brush toe features. These structures and revetments are shown on the preliminary design plans.

11.2 Natural Plant Community Restoration

As a final stage of construction, riparian stream buffers and wetlands will be planted and restored with native trees and herbaceous plants. The target communities for the restored and created wetlands and riparian buffer zones will be based on reference conditions, existing mature trees throughout the project area, comparison to vegetation listed for these community types in Shafale and Weakley (1990), and through consultation with native tree suppliers. Stream banks will be stabilized with sod matting grown specifically for the purpose of establishing native grasses on the Devil's Racetrack site. The sod mats will be grown at a nearby location and will consist of a non-native Bermuda grass overseeded with a mix of native seed appropriate for the target community types. The purpose of the Bermuda is to bind the native seed together with a turf grass that will create a sod layer that can be harvested, rolled, transported to the site, and installed without breaking apart. Bermuda was selected over other turf grasses due to the fact that it is a low growing, non-allelapathic species and is relatively shade intolerant. This combination means that the Bermuda is unlikely to shade out the native species and will quickly disappear from the site as trees grow and shade this grass out. Permanent herbaceous seed will be placed on all other disturbed areas within the project easement. The stream banks will be planted with live stakes. Proposed permanent herbaceous species are shown in the plan set.

Bare root trees will be planted throughout the project easement from the top of stream bank out through all riparian buffer and wetland zones. Species planted as bare roots will be spaced at an initial density of 520 plants per acre on a 12-foot by 7-foot spacing. The tree spacing will be established to allow for site maintenance for the purpose of increasing tree survival and growth rates. The site will be bush-hogged twice annually for the first three monitoring years through the 12-foot spacing gap between the tree rows. Additionally, a band spray technique will be used to conduct one annual application of a pre-emergent herbicide along the tree rows. This maintenance approach will decrease herbaceous competition with the planted bare root seedlings allowing for improved tree survival and vigor. Bare root trees specified for planting are detailed in the construction plan set.

Live stakes will be planted on channel banks at 2-foot to 3-foot spacing on the outside of meander bends and 6-foot to 8-foot spacing on tangent sections. Point bars will not be planted with live stakes. Live stake species are detailed in the Construction plan set.

12.0 Maintenance Plan

The site shall be monitored on a regular basis and a physical inspection of the site shall be conducted a minimum of once per year throughout the post-construction monitoring period until performance standards are met. These site inspections may identify site components and features that require routine maintenance. Routine maintenance should be expected most often in the first two years following site construction and may include the items included in Table 18.

Table 18. Maintenance Plan
Devil's Racetrack Mitigation Site

Component/Feature	Maintenance through project close-out
Stream	Routine channel maintenance and repair activities may include chinking of in-stream structures to prevent piping, securing of loose coir matting, and supplemental installations of live stakes and other target vegetation along the channel. Areas where storm water and floodplain flows intercept the channel may also require maintenance to prevent bank failures and head-cutting.
Vegetation	Vegetation shall be maintained to ensure the health and vigor of the targeted community. Annual mowing between tree rows and band sprays of pre-emergent along tree rows will be conducted for the first three monitoring years to control herbaceous competition. Routine vegetation maintenance and repair activities may include supplemental planting, pruning, mulching, and fertilizing. Exotic invasive plant species shall be controlled by mechanical and/or chemical methods. Any vegetation control requiring herbicide application will be performed in accordance with NC Department of Agriculture (NCDA) rules and regulations.
Site boundary	Site boundaries shall be identified in the field to ensure clear distinction between the mitigation site and adjacent properties. Boundaries may be identified by fence, marker, bollard, post, tree-blazing, or other means as allowed by site conditions and/or conservation easement. Boundary markers disturbed, damaged, or destroyed will be repaired and/or replaced on an as-needed basis.
Utility Right-of-Way	Utility right-of-way within the site may be maintained only as allowed by Conservation Easement or existing easement, deed restrictions, rights of way, or corridor agreements.
Ford Crossing	The ford crossing is outside of the easement area and not subject to maintenance.
Road Crossing	The road crossing is outside of the easement area and not subject to maintenance.
Storm Water Management Device	There are no stormwater management devices on the site.

13.0 Performance Standards

The stream restoration performance criteria for the project site will follow approved performance criteria presented in the EEP Mitigation Plan Template (version 2.1, 09/01/2011), the EEP Monitoring Requirements and Performance Standards for Stream and/or Wetland Mitigation (11/7/2011), and the Stream Mitigation Guidelines issued in April 2003 by the USACE and NCDWQ. Annual monitoring and bi-annual site visits will be conducted to assess the condition of the finished project. The stream and wetland restoration and enhancement sections of the project will be assigned specific performance criteria components for hydrology, vegetation, and morphology (streams only). Performance criteria will be evaluated throughout the seven year post-construction monitoring. If all performance criteria have been successfully met and two bankfull events have occurred during separate years, WEI may propose to terminate stream and/or vegetation monitoring. An outline of the performance criteria components follows.

13.1 Streams

13.1.1 Dimension

Shallow section cross-sections on the restoration reaches should be stable and should show little change in bankfull area, maximum depth ratio and width-to-depth ratio. Shallow cross-sections should fall within the parameters defined for channels of the appropriate Rosgen stream type (when applicable). If any changes do occur, these changes will be evaluated to assess whether the stream channel is showing signs of instability. Indicators of instability include a vertically incising thalweg or eroding channel banks. Changes in the channel that indicate a movement toward stability or enhanced habitat include a decrease in the width-to-depth ratio in meandering channels or an increase in pool depth. Remedial action would not be taken if channel changes indicate a movement toward stability.

In order to monitor the channel dimension, two permanent cross-sections will be installed per 1,000 linear feet of stream restoration work, with shallow and pool sections in proportion to EEP guidance. Each cross-section will be permanently marked with pins to establish its location. An annual cross-section survey will include points measured at all breaks in slope, including top of bank, bankfull, edge of water, and thalweg. It is important to note that in sand bed channels pools and bed forms (ripples, dunes, etc.) may migrate over time as a natural function of the channel hydraulics. These sorts of bed changes do not constitute a problem or indicate a need for remedial actions.

13.1.2 Pattern and Profile

Longitudinal profile surveys will not be conducted during the seven year monitoring period unless other indicators during the annual monitoring indicate a trend toward vertical and lateral instability. As mentioned above, migration of pools and bed forms are expected and do not require remedial action. Stream pattern and profile will be assessed visually as described below.

13.1.3 Photo Documentation

Photographs should illustrate the site's vegetation and morphological stability on an annual basis. Cross-section photos should demonstrate no excessive erosion or degradation of the banks. Longitudinal photos should indicate the absence of persistent bars within the channel or vertical incision. Grade control structures should remain stable. Deposition of sediment on the bank side of vane arms is preferable. Maintenance of scour pools on the channel side of vane arms is expected. Reference photos will also be taken for each of the vegetation plots.

Photographs will be taken once a year to visually document stability for seven years following construction. Permanent markers will be established so that the same locations and view directions on the site are monitored each year. Photos will be used to monitor restoration and enhancement stream reaches as well as vegetation plots.

Lateral reference photos should show a stable cross-section with no excessive erosion or degradation of the banks. The reference photo transects will be taken of both banks at each permanent cross-section. A survey tape pulled across the section will be centered in the photographs of the bank. The photographer will make every effort to maintain the same area in each photo over time.

Longitudinal photos should indicate the absence of developing bars within the channel or vertical incision. The photographer will make every effort to consistently maintain the same area in each photo over time.

Grade control structures should remain stable. Deposition of sediment on the bank side of vane arms is preferable. Maintenance of scour pools on the channel side of vane arms is expected. Photographs will be taken at representative grade control structures along the restored stream. The photographer will make every effort to consistently maintain the same area in each photo over time.

Reference photos will also be taken for each of the vegetation plots. One representative digital photo of each vegetation plot will be taken on the same day vegetative cover estimates are conducted.

13.1.4 Substrate

Pebble count procedures will not be conducted for this project due to the sand bed nature of the streams.

13.1.5 Stream Hydrology

Two bankfull flow events must be documented on the restoration and enhancement reaches within the seven-year monitoring period. The two bankfull events must occur in separate years. Stream monitoring will continue until success criteria in the form of two bankfull events in separate years have been documented. Consistent flow must be documented in the smaller drainage area streams on the project site including Southwest Branch, Middle Branch, and Southeast Branch. Under normal circumstances stream flow must be documented to occur every year for at least 30 consecutive days during the seven year monitoring period. Stream flow must also be documented to occur intermittently in all months other than July through September of each monitoring year.

13.1.6 Macroinvertebrates

Macroinvertebrates will be assessed prior to beginning restoration activities to establish a baseline for population diversity and abundance. The final performance standard will be an increase in diversity and abundance by the end of the seventh year of monitoring.

13.2 Vegetation

The final vegetative success criteria will be the survival of 210 planted stems per acre in the riparian corridor along restored and enhanced reaches and within the wetland restoration areas at the end of the required monitoring period (year seven). The interim measure of vegetative success for the site will be the survival of at least 320 planted stems per acre at the end of the third monitoring year and at least 260 stems per acre at the end of the fifth year of monitoring. Planted vegetation must average 10 feet in height in each plot at the end of the seventh year of monitoring. If this performance standard is met by

year five and stem density is trending towards success (i.e., no less than 260 five year old stems/acre), monitoring of vegetation on the site may be terminated provided written approval is provided by the USACE in consultation with the NC Interagency Review Team. The extent of invasive species coverage will also be monitored and controlled as necessary throughout the required monitoring period (year five or seven).

It is expected that vegetation in the power line easements will be controlled by the power company. Therefore, vegetation in these areas is not expected to meet performance criteria. As shown in Table 15, mitigation credits for these areas will be reduced by 75% due to the expectation of maintenance by the power company.

13.3 Wetlands

The final performance standard for wetland hydrology will be a free groundwater surface within 12 inches of the ground surface for 8.5 percent of the growing season, which is measured on consecutive days under typical precipitation conditions. This performance standard was determined through model simulations of post restoration conditions and comparison to reference wetland systems. A detailed discussion of the modeling approach to determining this performance standard as well as definitions and determinations of a target hydroperiod are included in section 6.2 of this report. If a particular gauge does not meet the performance standard for a given monitoring year, rainfall patterns will be analyzed and the hydrograph will be compared to that of the reference wetlands to assess whether atypical weather conditions occurred during the monitoring period. Figure 12 shows the proposed post-construction locations of groundwater monitoring gauges across the project site.

14.0 Monitoring Plan

Annual monitoring data will be reported using the EEP Monitoring Report template (version 1.3, 01/15/2010). The monitoring report shall provide a project data chronology that will facilitate an understanding of project status and trends, population of EEP databases for analysis, research purposes, and assist in decision making regarding close-out. The monitoring period will extend seven years for stream and hydrology assessments beyond completion of construction or until performance criteria have been met. Project monitoring requirements are listed in more detail in Table 19. All survey will be tied to grid.

Table 19. Monitoring Requirements
Devils Racetrack Creek Mitigation Site

Parameter	Monitoring Feature	Quantity/ Length by Reach								Frequency	Notes
		SW Br.	Middle Br.	SE Br.	North Br.	DRC West	DRC East	RW West	RW East		
Dimension	Riffle Cross Sections	1	2	3	2	5	6	n/a	n/a	Annual	1
	Pool Cross Section	1	1	3	2	5	5	n/a	n/a	Annual	
Pattern	Pattern	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	Annual	2
Profile	Longitudinal Profile	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	Annual	
Substrate	Reach wide (RW), Riffle (RF) 100 pebble count	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	Annual	
Hydrology	Crest Gage	1	1	1	1	1	1	n/a	n/a	Annual	3

Parameter	Monitoring Feature	Quantity/ Length by Reach								Frequency	Notes
		SW Br.	Middle Br.	SE Br.	North Br.	DRC West	DRC East	RW West	RW East		
Hydrology	Transducer	1	1	1	n/a	n/a	n/a	n/a	n/a	Annual	4
Hydrology	Groundwater Gages	n/a	n/a	n/a	n/a	n/a	n/a	26	2	Quarterly	
Vegetation	CVS Level 2	2	2	3	3	6	7	25	3	Annual	5
Macroinvertebrates	DWQ Standard	1	1	1	1	1	1	n/a	n/a	Years 2, 4, & 7	6
Exotic and nuisance vegetation										Annual	7
Project Boundary										Annual	8
Reference Photos	Photographs	6	9	14	11	26	28	n/a	n/a	Annual	9

1. Cross-sections will be permanently marked with rebar to establish location. Surveys will include points measured at all breaks in slope, including top of bank, bankfull, edge of water, and thalweg.
2. Pattern and profile will be assessed visually during bi-annual site visits.
3. Device will be inspected quarterly or semi-annually, evidence of bankfull will be documented with a photo.
4. Device will set to record stage once every hour. Device will be inspected and downloaded semi-annually.
5. Vegetation monitoring will follow CVS protocols.
6. Sampling will be performed using NCDWQ Standard Operating Procedures for Benthic Macroinvertebrates, July 2006.
7. Locations of exotic and nuisance vegetation will be mapped.
8. Locations of fence damage, vegetation damage, boundary encroachments, etc. will be mapped.
9. Permanent markers will be established so that the same locations and view directions on the site are monitored.

14.1 Additional Monitoring Details

Vegetation

Vegetation monitoring plots will be installed and evaluated within the restoration and enhancement areas to measure the survival of the planted trees. The number of monitoring quadrants required is based on the EEP monitoring guidance documents (version 1.3, 11/15/2010). The size of individual quadrants will be 100 square meters for woody tree species and shrubs. Vegetation assessments will be conducted following the Carolina Vegetation Survey (CVS) Level 2 Protocol for Recording Vegetation (2006).

The initial baseline survey will be conducted within 21 days from completion of site planting and used for subsequent monitoring year comparisons. The first annual vegetation monitoring activities will commence at the end of the first growing season, during the month of September. The restoration and enhancement sites will then be evaluated each subsequent year between June 1 and September 31. Species composition, density, and survival rates will be evaluated on an annual basis by plot and for the entire site. Individual plot data will be provided and will include diameter, height, density, vigor, damage (if any), and survival. Planted woody stems will be marked annually as needed and given a coordinate, based off of a known origin, so they can be found in succeeding monitoring years. Mortality will be determined from the difference between the previous year's living planted stems and the current year's living planted stems.

15.0 Long-Term Management Plan

Upon approval for close-out by the Interagency Review Team (IRT) the site will be transferred to the NCDENR Division of Natural Resource Planning and Conservation's Stewardship Program. This party shall be responsible for periodic inspection of the site to ensure that restrictions required in the

conservation easement or the deed restriction document(s) are upheld. Endowment funds required to uphold easement and deed restrictions shall be negotiated prior to site transfer to the responsible party.

The Division of Natural Resource Planning and Conservation's Stewardship Program currently houses NCEEP stewardship endowments within the non-reverting, interest-bearing Conservation Lands Stewardship Endowment Account. The use of funds from the Endowment Account is governed by North Carolina General Statue GS 113A-232(d)(3). Interest gained by the endowment fund may be used only for the purpose of stewardship, monitoring, stewardship administration, and land transaction costs, if applicable. The NCDENR Stewardship Program intends to manage the account as a non-wasting endowment. Only interest generated from the endowment funds will be used to steward the compensatory mitigation sites. Interest funds not used for those purposes will be re-invested in the Endowment Account to offset losses due to inflation.

16.0 Adaptive Management Plan

Upon completion of site construction WEI will implement the post-construction monitoring protocols previously defined in this document. Project maintenance will be performed as described previously in this document. If, during the course of annual monitoring it is determined the site's ability to achieve site performance standards are jeopardized, WEI will notify the NCEEP of the need to develop a Plan of Corrective Action. Once the Corrective Action Plan is prepared and finalized WEI will:

1. Notify the USACE as required by the Nationwide 27 permit general conditions.
2. Revise performance standards, maintenance requirements, and monitoring requirements as necessary and/or required by the NCEEP and/or USACE.
3. Obtain other permits as necessary.
4. Implement the Corrective Action Plan.
5. Provide the NCEEP a Record Drawing of Corrective Actions. This document shall depict the extent and nature of the work performed.

17.0 Financial Assurances

Pursuant to Section IV H and Appendix III of the Ecosystem Enhancement Program's In-Lieu Fee Instrument dated July 28, 2010, the North Carolina Department of Environment and Natural Resources has provided the US Army Corps of Engineers Wilmington District with a formal commitment to fund projects to satisfy mitigation requirements assumed by NCEEP. This commitment provides financial assurance for all mitigation projects implemented by the program.

18.0 References

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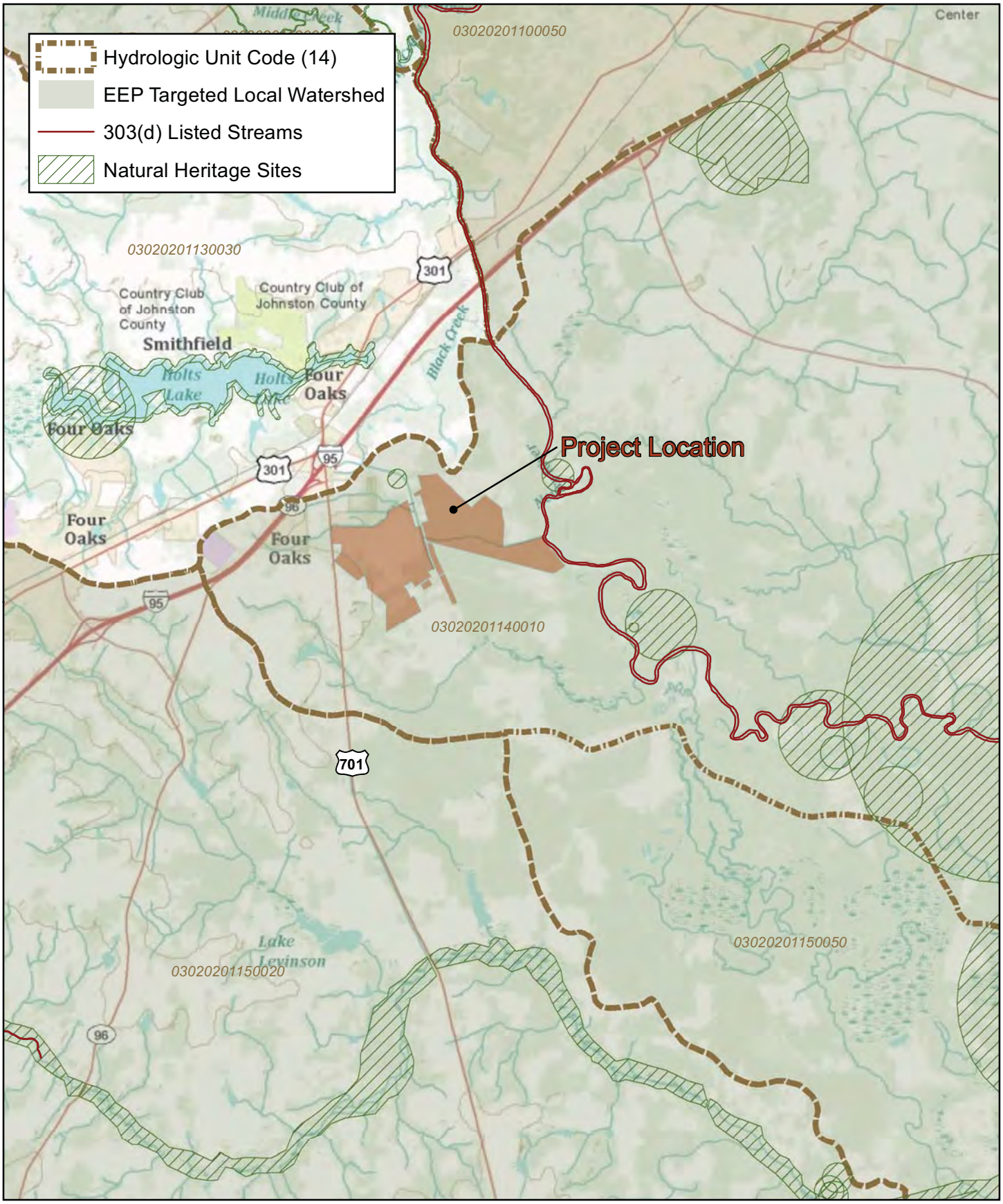
Figures

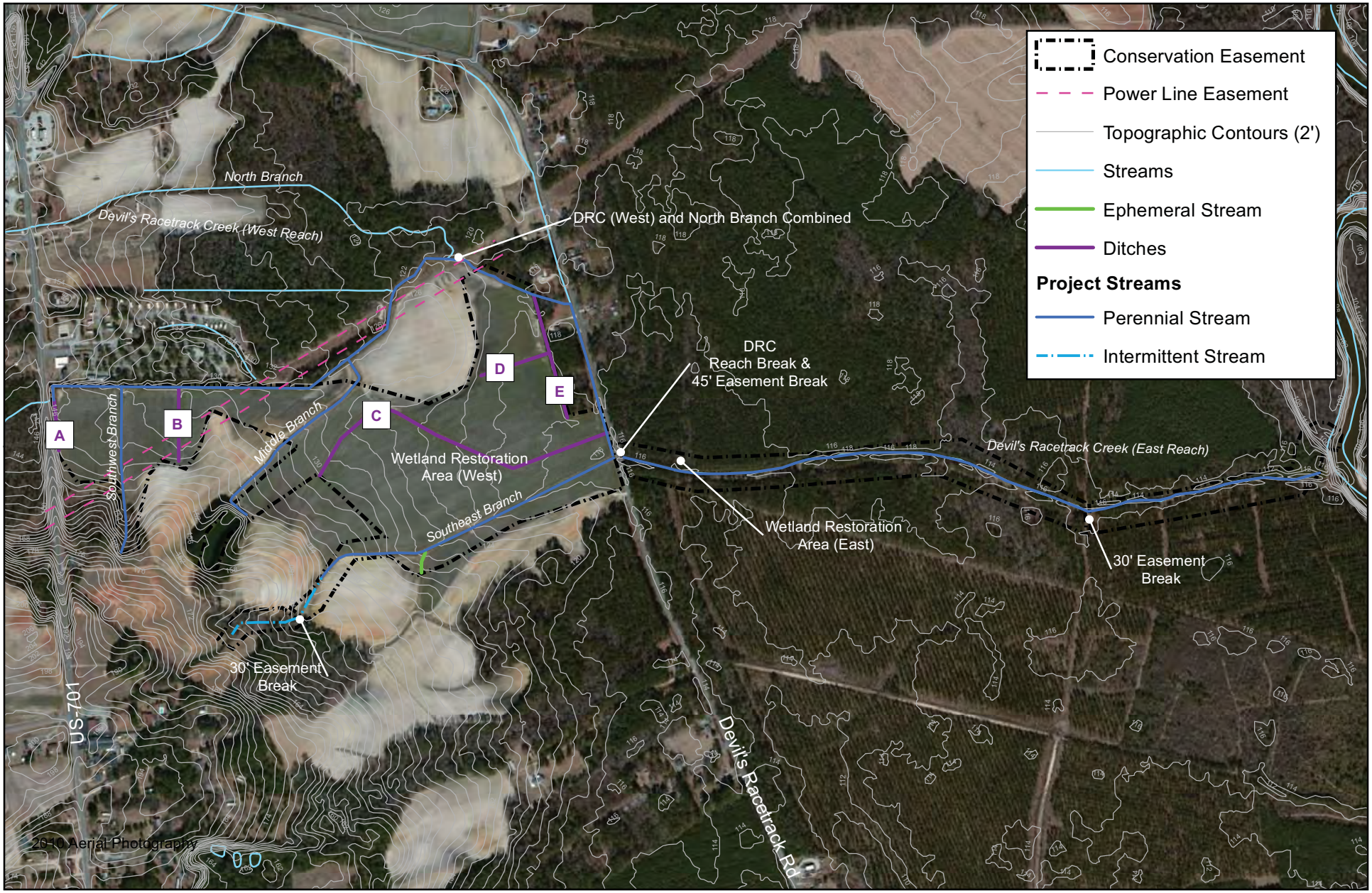


WILDLANDS ENGINEERING

0 0.5 1 Miles

N

Figure 1 Vicinity Map
Devil's Racetrack Mitigation Site
Mitigation Plan
Neuse River Basin (03020201)
Johnston County, NC



WILDLANDS ENGINEERING

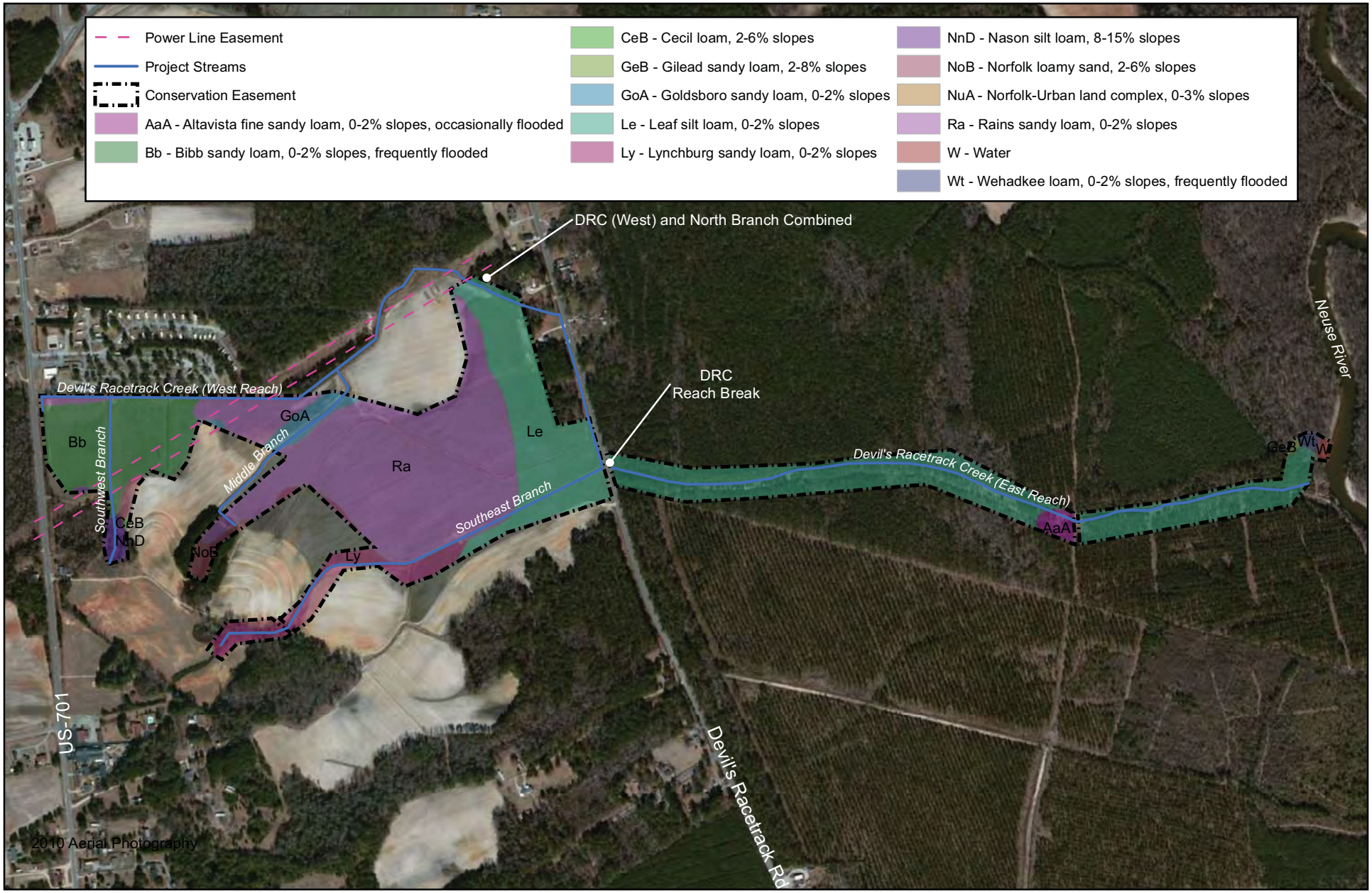
Figure 2 Site Map with LIDAR Created Topographic Contours
Devil's Racetrack Mitigation Site
Mitigation Plan
Neuse River Basin (03020201)
Johnston County, NC

WILDLANDS ENGINEERING

0 750 1,500 Feet

N

Figure 3 Watershed Map
Devil's Racetrack Mitigation Site
Mitigation Plan
Neuse River Basin (03020201)
Johnston County, NC

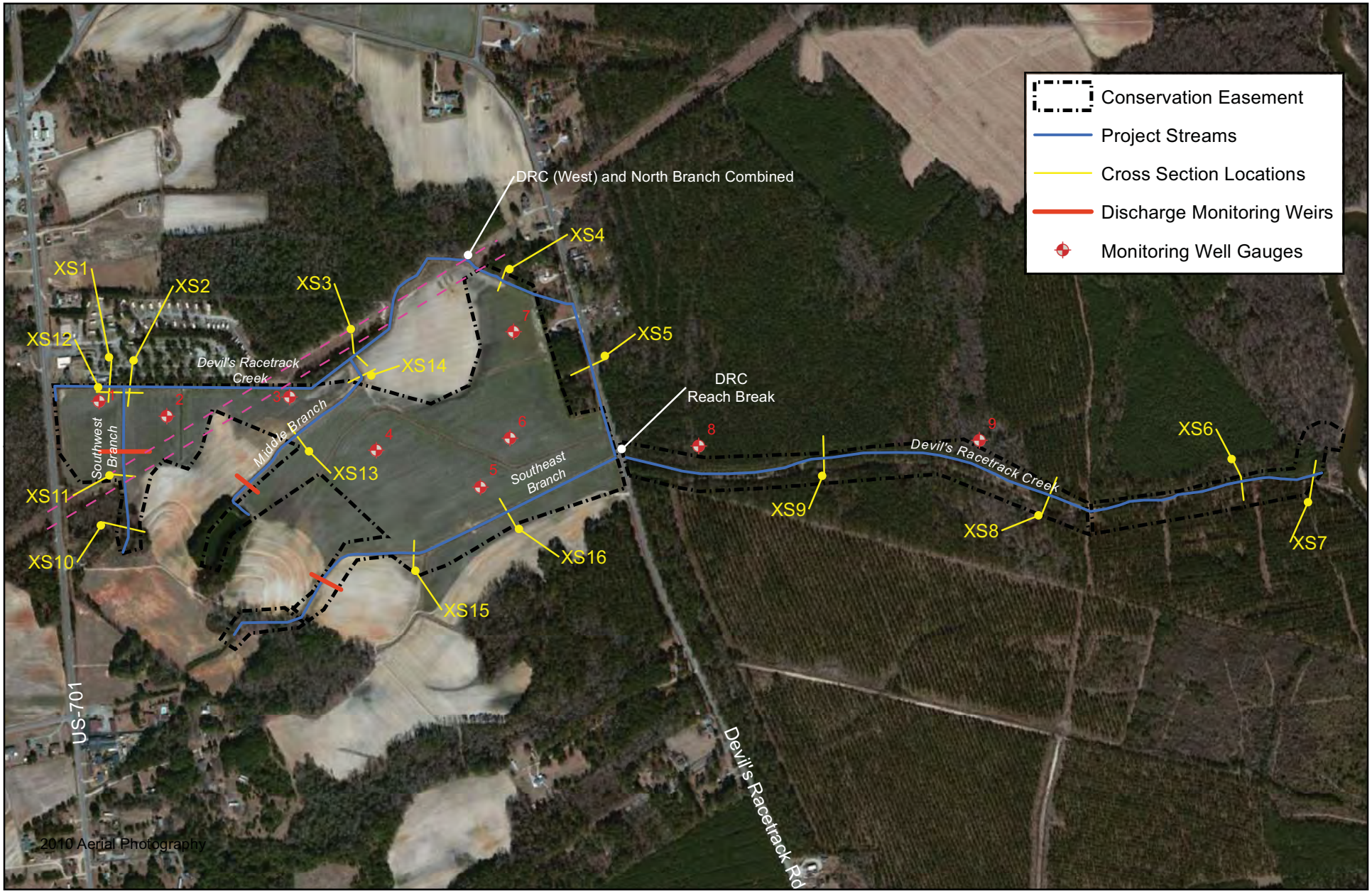


WILDLANDS ENGINEERING

0 450 900 Feet

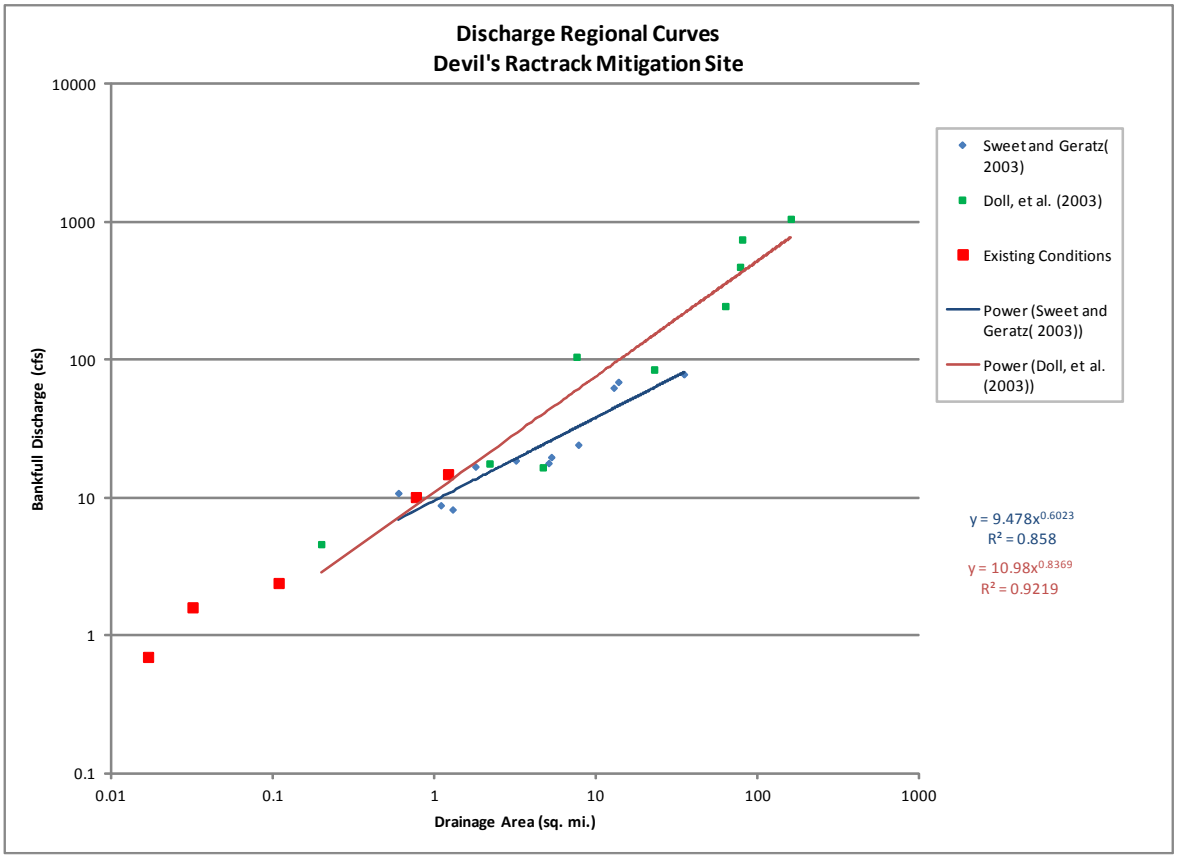
N

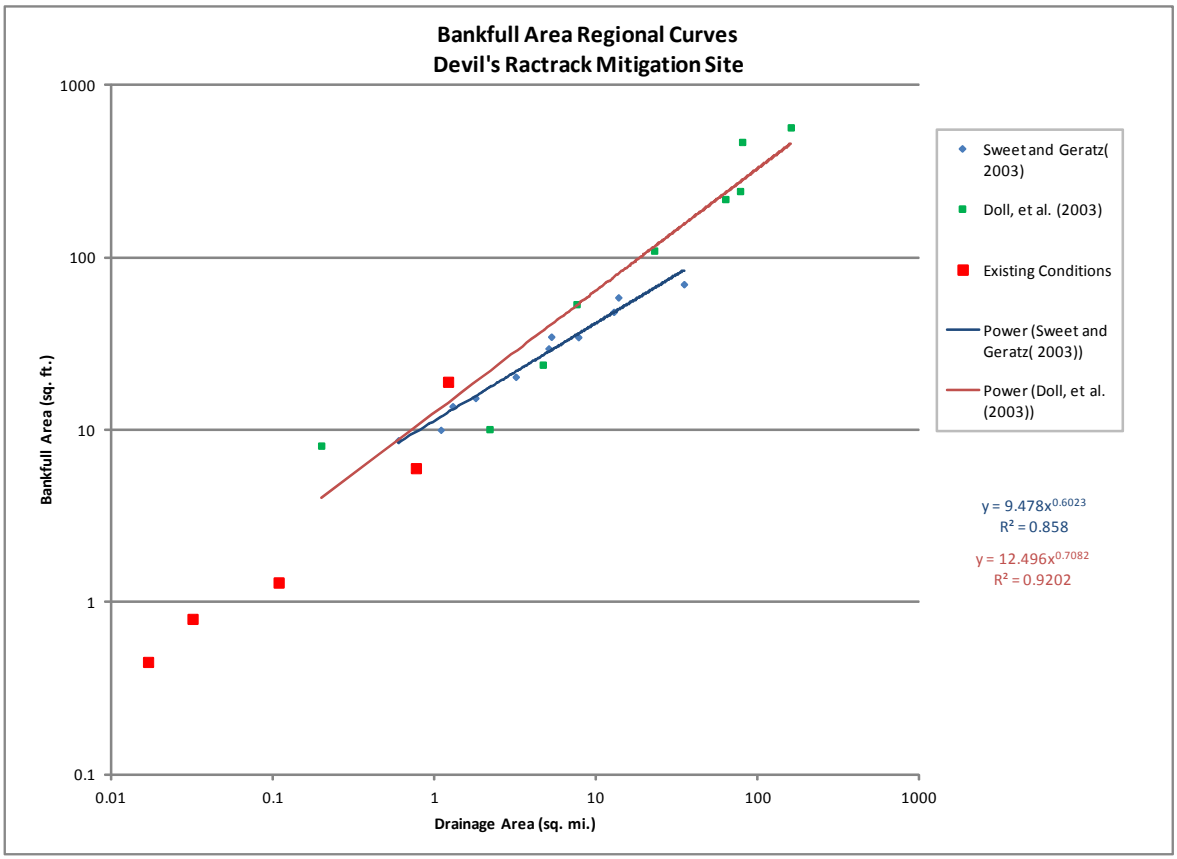
Figure 4 Soils Map
Devil's Racetrack Mitigation Site
Mitigation Plan
Neuse River Basin (03020201)
Johnston County, NC



WILDLANDS ENGINEERING

Figure 5 Hydrologic Features Map
Devil's Racetrack Mitigation Site
Mitigation Plan
Neuse River Basin (03020201)
Johnston County, NC

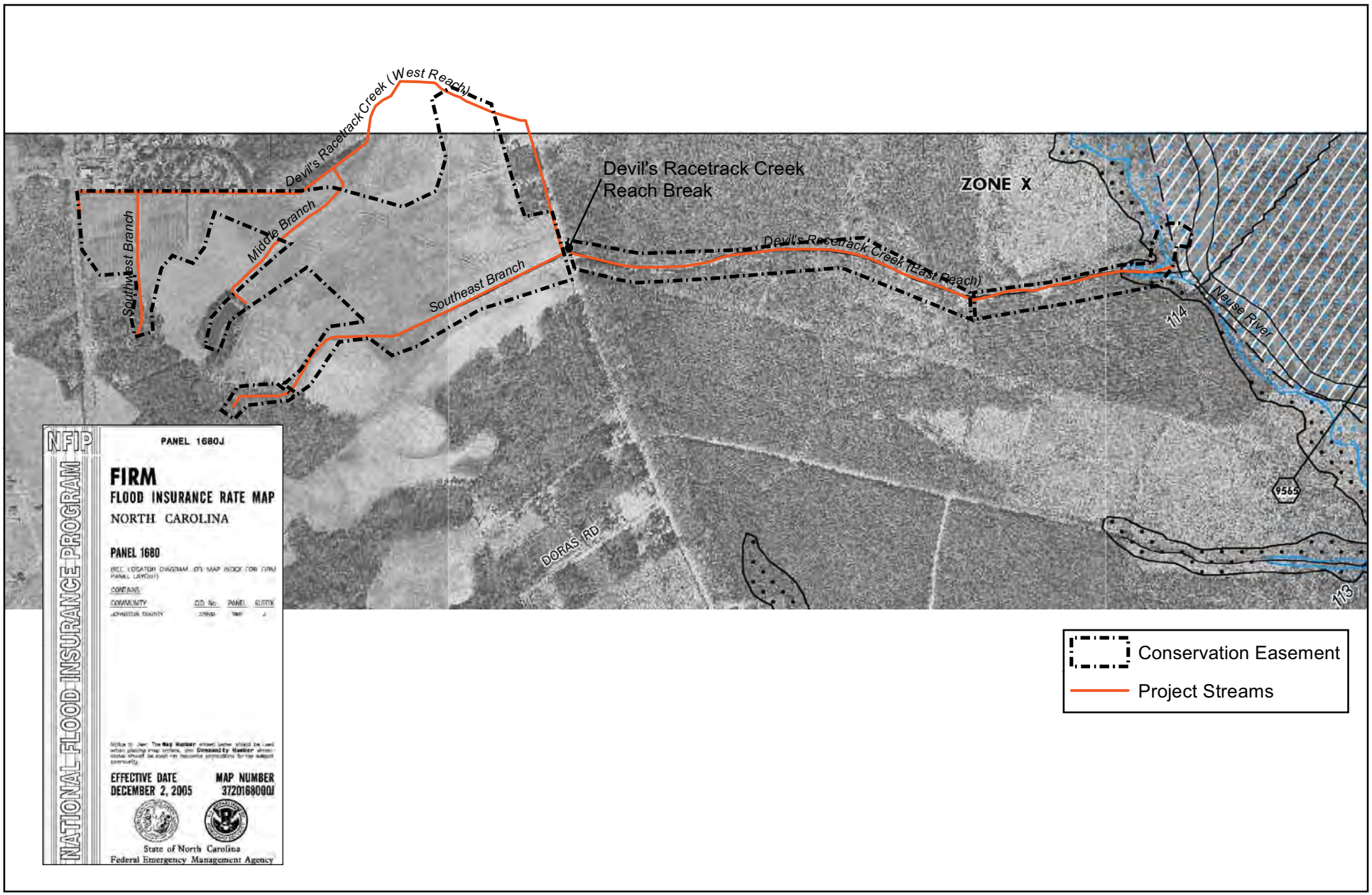




WILDLANDS ENGINEERING

Figure 6 Regional Curve
Devil's Racetrack Mitigation Site
Mitigation Plan
Neuse River Basin (03020201)

Johnston County, NC

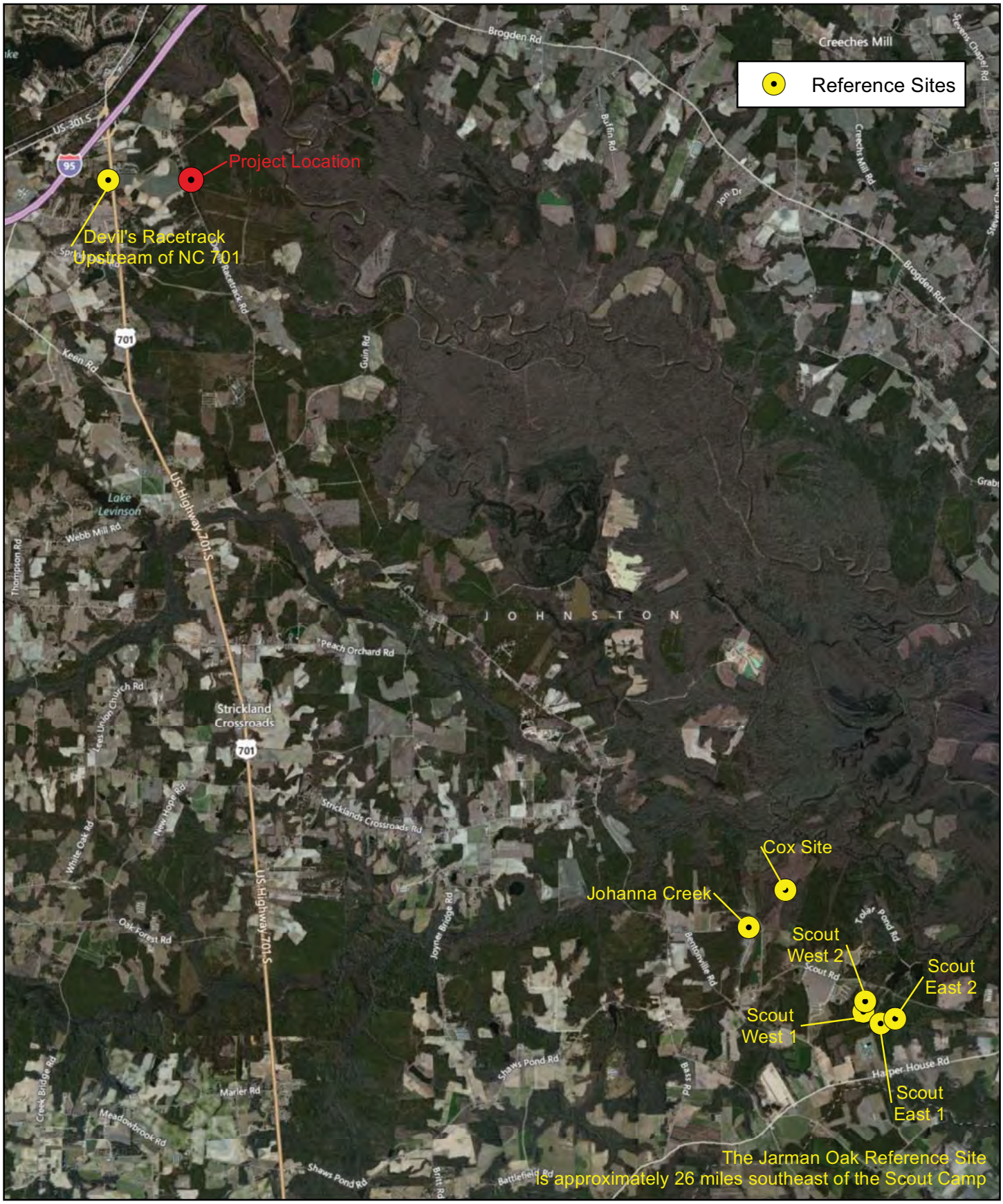


WILDLANDS ENGINEERING

0 500 1,000 Feet

N

Figure 7 FEMA Flood Map
Devil's Racetrack Mitigation Site
Mitigation Plan
Neuse River Basin (03020201)
Johnston County, NC



WILDLANDS ENGINEERING

0 0.625 1.25 Miles

N

Figure 8 Reference Sites Vicinity Map
Devil's Racetrack Mitigation Site
Mitigation Plan
Neuse River Basin (03020201)
Johnston County, NC

WILDLANDS ENGINEERING

0 250 500 Feet

N

Figure 9 Stream and Wetland Design - West
Devil's Racetrack Mitigation Site
Mitigation Plan
Neuse River Basin (03020201)

Johnston County, NC

WILDLANDS ENGINEERING

0 250 500 Feet

N

Figure 10 Stream Design - East
Devil's Racetrack Mitigation Site
Mitigation Plan
Neuse River Basin (03020201)
Johnston County, NC

Appendix 1: Site Photos

Devil's Racetrack Mitigation Site Photos

Existing Conditions of wetland restoration area on west side of Howell property

Existing conditions of Southeast Branch

Existing conditions of downstream end of Southwest Branch

Existing conditions of upstream end of Southwest Branch

Existing conditions of upstream end of Middle Branch

Existing conditions of downstream end of Middle Branch

Existing conditions of Devil’s Racetrack Creek (West)

Existing conditions of Devil’s Racetrack Creek (West)

Existing conditions of Devil's Racetrack Creek (East)

Streamflow monitoring weir on Southwest Branch

Culvert under U.S. Highway 701

Inlet of Drop Structure at Downstream End of Project

Outlet of Drop Structure at Downstream End of Project

Johanna Branch reference reach

Scout West 1 reference reach

Scout West 2 reference reach

Scout East 1 reference reach

Scout East 2 reference reach

Scout East 2 reference reach

Appendix 2: Historic Aerial Photos

WILDLANDS ENGINEERING

N

1939 Aerial
Devil's Racetrack Mitigation Site
Mitigation Plan
Neuse River Basin (03020201)
Johnston County, NC

WILDLANDS ENGINEERING

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1949 Aerial
Devil's Racetrack Mitigation Site
Mitigation Plan
Neuse River Basin (03020201)
Johnston County, NC

WILDLANDS ENGINEERING

N

1959 Aerial
Devil's Racetrack Mitigation Site
Mitigation Plan
Neuse River Basin (03020201)
Johnston County, NC

WILDLANDS ENGINEERING

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1971 Aerial
Devil's Racetrack Mitigation Site
Mitigation Plan
Neuse River Basin (03020201)
Johnston County, NC

WILDLANDS ENGINEERING

N

1988 Aerial
Devil's Racetrack Mitigation Site
Mitigation Plan
Neuse River Basin (03020201)
Johnston County, NC

Appendix 3: Easement Information

NC DOT Encroachment Agreement

The NC DOT encroachment agreement will be added when the document is obtained by Wildlands Engineering, Inc.

Filed in JOHNSTON COUNTY, NC CRAIG OLIVE, Register of Deeds Filed 2/11/2011 3:36:31 PM DEED BOOK 3951 PAGE 678 - 681 INSTRUMENT # 2011308980 Real Estate Excise Tax: $0.00 Deputy/Assistant Register of Deeds: L KIRBY

RECORDING REQUESTED BY AND WHEN RECORDED MAIL TO:

Wildlands Engineering, Inc.
1430 South Mint Street, Suite 104
Charlotte, NC 28203
Attention: Andrea Spangler Eckardt

SPACE ABOVE THIS LINE FOR RECORDER'S USE

MEMORANDUM OF OPTION

THIS MEMORANDUM OF OPTION (this **"Memorandum"**) is made and entered into as of the date of the last execution, which date is the 25th day of January, 2011, by and between **Nell M. Howell, Trustee of the Nell M. Howell Revocable Trust ("Optionor")**, and **WILDLANDS ENGINEERING, INC.**, a North Carolina corporation **("Optionee")**.

WITNESSETH:

WHEREAS, Optionor and Optionee have entered into that certain Agreement for Option to Purchase Conservation Easement dated as of an even date with this Memorandum (the **"Option Agreement"**);

WHEREAS, the Option Agreement pertains to certain premises containing two tracts of approximately 465 acres and 15 acres located in Johnston County, North Carolina, said premises being more specifically described on Attachment A, attached hereto and made a part hereof (the **"Property"**); and

WHEREAS, Optionor and Optionee desire to create notice of the Option Agreement in the Public Records of Johnston County by the recitations contained in this Memorandum.

NOW, THEREFORE, for good and valuable consideration, the receipt and adequacy of which are hereby acknowledged, Optionor does hereby grant unto Optionee an option **("Option")** to purchase a Conservation Easement on the Property upon the following the terms and conditions:

1. The Term of the Option shall expire on July 31, 2012.

2. This Memorandum is subject to all conditions, terms and provisions of the Option Agreement, which is hereby adopted and made a part hereof by reference to the same in the same manner as if all the provisions of the Option Agreement were copied herein in full.

3. In the event of a conflict between the terms of the Option Agreement and this Memorandum, the Option Agreement shall prevail. Reference should be made to the Option Agreement for a more detailed description of all matters contained in this Memorandum.

4. The Option Agreement and the terms and conditions contained herein and within the Option Agreement shall be binding upon the heirs, successors and assigns of the Optionor and Optionee.

[EXECUTION PAGES TO FOLLOW]

IN WITNESS WHEREOF, Optionor and Optionee have executed this Memorandum effective as of the date first written above.

OPTIONEE:

WILDLANDS ENGINEERING, INC., a North Carolina corporation

By: John W. Hutton

Print Name: John W. Hutton

Title: Vice President

Date: 1-31-11

OPTIONOR:

Nell M. Howell

By: Nell M. Howell

Print Name: NELL M. HOWELL

Title: _____

Date: 2/3/11

STATE OF NORTH CAROLINA

COUNTY OF WAKE

I certify that the following person(s) personally appeared before me this day, each acknowledging to me that he or she voluntarily signed the foregoing document for the purpose stated therein and in the capacity indicated: JOHN W. HUTTON

name(s) of principal(s)

Date: 1-31-11

Daniel M. Taylor

(official signature of Notary)

DANIEL M. TAYLOR, Notary Public

(Notary's printed or typed name)

(Official Seal)

DANIEL M TAYLOR NOTARY PUBLIC WAYNE COUNTY, N.C.

My commission expires: 10-4-14

STATE OF NORTH CAROLINA

COUNTY OF Wake

I certify that the following person(s) personally appeared before me this day, each acknowledging to me that he or she voluntarily signed the foregoing document for the purpose stated therein and in the capacity indicated: Nell M. Howell, Optionor

name(s) of principal(s)

Date: 2-3-11

(official signature of Notary)

Patricia S. Horne, Notary Public

(Notary's printed or typed name)

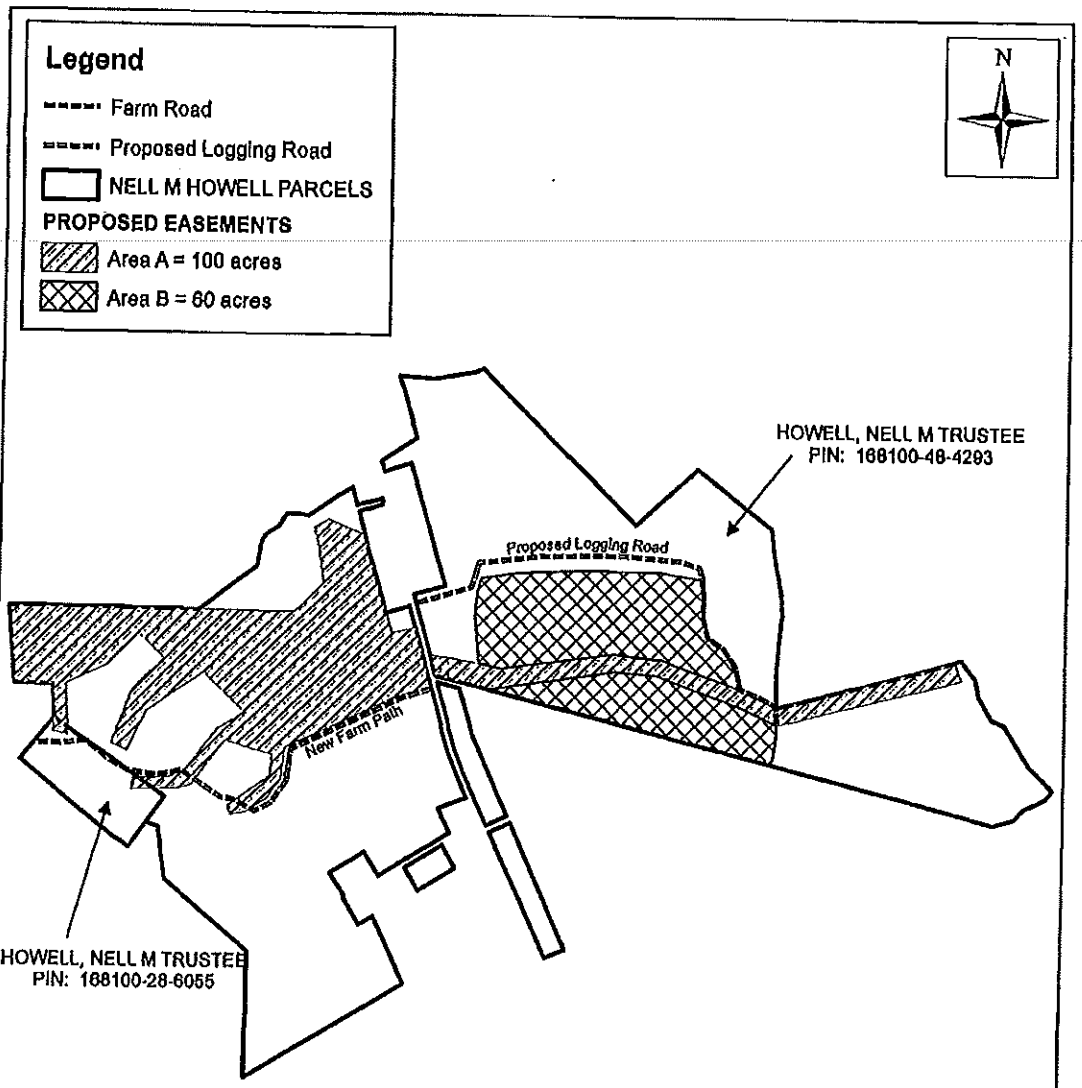
(Official Seal)

PATRICIA S. HORNE NOTARY *** PUBLIC WAKE COUNTY, N.C.

My commission expires: 9-9-13

EXHIBIT A

DESCRIPTION OF PROPERTY



This map is not a survey and has not been reviewed by a local government agency for compliance with any applicable land development regulations.

0 600 1,200 2,400 Feet

WILDLANDS

HOWELL PROPERTY
Neuse 03020201
JOHNSTON COUNTY, NC

Exhibit A
Site Map

RECORDING REQUESTED BY AND WHEN RECORDED MAIL TO:

Mr. Shawn Wilkerson
Wildlands Engineering, Inc.
1430 South Main Street – Suite 104
Charlotte, NC 28203

Filed in JOHNSTON COUNTY, NC
CRAIG OLIVE, Register of Deeds
Filed 2/14/2011 10:28:07 AM
BOOK 3951 PAGE 899 - 904
INSTRUMENT # 2011309039
Real Estate Excise Tax: $0
Deputy/Assistant Register of Deeds: L KIRBY

SPACE ABOVE THIS LINE FOR RECORDER'S USE

AGREEMENT FOR

PERMANENT WAIVER OF RIPARIAN RIGHTS

(DEVIL'S RACETRACK ROAD – New Stream Alignment)

This Agreement for Permanent Waiver of Riparian Rights (**"Agreement"**), dated for reference purposes only as February 10, 2011, is entered into by and between **JOSEPH STEWART ADAMS** (the **"Grantor**, and **WILDLANDS ENGINEERING, INC.,** a North Carolina corporation (**"Grantee"**).

Recitals

A. Grantor is the owner of that certain real property (**"Grantor's Parcel"**) consisting of approximately 1.50 acres, located at 696 Devil's Racetrack Road, Four Oaks, NC 27524 in Johnston County, North Carolina, as recorded in Book 3151 Page 0765 in the Johnston County Registry. The Grantor's Parcel is also identified as Tax Parcel Number 168100-59-4911.

B. Grantor's Parcel is located immediately adjacent and to and North of that certain real property, (the **"Adjacent Parcel"**) consisting of approximately 465.10 acres, located at 747 Devils Racetrack Road, Four Oaks, NC 27524 in the county of Johnston, State of North Carolina, as recorded in Book 3334 Page 0883 in the Johnston County Registry. The Adjacent Parcel is also identified as Tax Parcel Number 168100-48-4293.

C. An un-named non-navigable stream proceeds from parallel to Devils Racetrack Road across the eastern boundary of the Grantor's Parcel, as shown on the map attached hereto as

Exhibit A and incorporated herein by this reference.

D. Grantee is in the business of preparing, designing, and obtaining conservation easements from landowners for the purposes of submitting a proposal to the North Carolina Ecosystem Enhancement Program (NCEEP) to restore and enhance riparian, stream and wetland habitats and water quality and then maintain and monitor the success of these restoration efforts in the future.

E. Grantee believes that the un-named non-navigable stream referenced above and certain portions of the Adjacent Parcel satisfy the site criteria established by the United States Army Corps of Engineers and the North Carolina Department of Water Quality for a successful stream restoration project (the **"Stream Restoration Project"**). The Stream Restoration Project will require that the water flow from the un-named non-navigable stream be relocated from Grantor's Parcel to the Adjacent Parcel, as generally shown as the existing stream alignment on the map attached hereto as Exhibit A. The existing stream channel will be plugged upstream from the Grantor's Parcel just after it flows through the CP&L easement and will be diverted south through the proposed new stream alignment on the Adjacent Parcel over 100' away from the western property line of the Grantor's Parcel. The existing stream channel will remain unchanged and will serve as a storm water ditch.

G. Grantor desires to waive any and all riparian or water rights of whatsoever nature relating to the diversion of water flow away from Grantor's Parcel in the above referenced un-named non-navigable stream, as more fully set out below.

NOW, THEREFORE, for valuable consideration, the parties hereby agree as follows:

Agreement

1. Waiver of Riparian Rights. Grantor permanently and irrevocably, for all time, hereby completely waives, releases, abandons any and all claims of every nature whatsoever related to or connected with (and any and all rights related to or connected with) the presence of, use of, access to or control over any water present in or flowing in the above-referenced un-named non-navigable stream, intentionally waiving any and all water rights, riparian rights or any other rights or claims whatsoever in connection therewith by operation of this provision. Furthermore, Grantor expressly acknowledges that Grantee makes no representation or warranty or guarantee as to whether or not future weather events or land surface alterations or the present Stream Restoration Project Activities will not result in the return of water temporarily or otherwise to the un-named non-navigable stream or that there will be no future flooding events. It is the express intention of the Grantor that this Agreement for Permanent Waiver of Riparian Rights will be a covenant running with the land and binding upon any and all subsequent owners, their successors, heirs, and or assigns of the above-referenced tract and parcel of land.

2. Purchase Price. Concurrently with the execution of this Agreement for the Permanent Waiver of Riparian Rights, Grantee shall pay to Grantor the amount of One Hundred and No/100ths Dollars ($100.00) as consideration for executing the Agreement. Grantee waives any rights to this payment now or in the future and shall become the Grantors property upon execution of this document.

3. Termination. This Permanent Waiver of Riparian Rights shall terminate only in the event that Grantee's proposal to the NCEEP for a Stream Restoration Project is not selected for contracting by the NCEEP. In such a case, within 30 days of notification of non-selection, Grantee shall prepare a notice of termination for Grantor's review and execution and shall then record the notice in the Johnston County Registry. Furthermore, should Grantee's proposal not be accepted by the NCEEP, it is understood by both parties that the Grantee shall not be responsible for doing any work contained herein.

4. Performance of Stream Restoration Project Activities. Prior to commencing the Stream Restoration Project activities, Grantee shall have obtained all permits and approvals necessary from the North Carolina Department of Water Quality, the United States Army Corps of Engineers and any other agencies with jurisdiction over the Stream Restoration Project activities (collectively, the **"Regulatory Agencies"**). Grantee shall cause the Stream Restoration Project activities to be performed in compliance with plans and specifications approved by the Regulatory Agencies and in accordance with all applicable laws, statutes and ordinances.

5. Agreement not to trespass. Nothing contained in this Agreement shall allow or cause Grantor to trespass or alter the Grantor's Parcel in any way other than the redirection of water flow as described in this Agreement.

6. Agreement not to negatively impact drainage. Grantee hereby agrees that Stream Restoration Project activities performed associated with this agreement shall not negatively impact any drainage or back up additional water on Grantor's Parcel in any way.

7. Property Boundary. In no case shall Grantee's Stream Restoration Project activities change or alter the Grantor's property boundary.

8. Recordation. This Agreement shall be recorded in the Official Records of Johnston County, North Carolina.

9. Entire Agreement. This Agreement and all matters referenced herein (including all Exhibits attached hereto) is the final expression of, and contains the entire agreement between, the parties with respect to the subject matter hereof and supersedes all prior understandings with respect thereto.

10. Governing Law. The parties hereto acknowledge that this Agreement has been negotiated and entered into in the State of North Carolina. The parties hereto expressly agree that this Agreement shall be governed by, interpreted under, and construed and enforced in accordance with the laws of the State of North Carolina.

11. Amendment. This Agreement may not be modified, changed, supplemented, superseded, canceled or terminated, nor may any obligations hereunder be waived, except by written instrument signed by both parties.

12. Relationship of Parties. Nothing contained in this Agreement shall be deemed or construed by the parties to create the relationship of principal and agent, a partnership, joint venture or any other association between the parties hereto.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement as of the date first written above.

GRANTEE:

WILDLANDS ENGINEERING, INC.,
a North Carolina corporation

By: _____

Its: Vice President

Date: 02/10/11

GRANTOR:

JOSEPH STEWART ADAMS

By: _____

Date: 2-11-11

STATE OF NORTH CAROLINA

COUNTY OF WAKE

I certify that the following person(s) personally appeared before me this day, each acknowledging to me that he or she voluntarily signed the foregoing document for the purpose stated therein and in the capacity indicated: John W. Hutton
name(s) of principal(s)

Date: 2/10/11

(official signature of Notary)

(Official Seal) DANIEL M TAYLOR NOTARY PUBLIC WAYNE COUNTY, N. C.

Daniel M. Taylor, Notary Public
(Notary's printed or typed name)

My commission expires: 10/04/2014

STATE OF NORTH CAROLINA

COUNTY OF JOHNSTON

I certify that the following person(s) personally appeared before me this day, each acknowledging to me that he or she voluntarily signed the foregoing document for the purpose stated therein and in the capacity indicated: JOSEPH STEWART ADAMS
name(s) of principal(s)

Date: 2/11/11

(official signature of Notary)

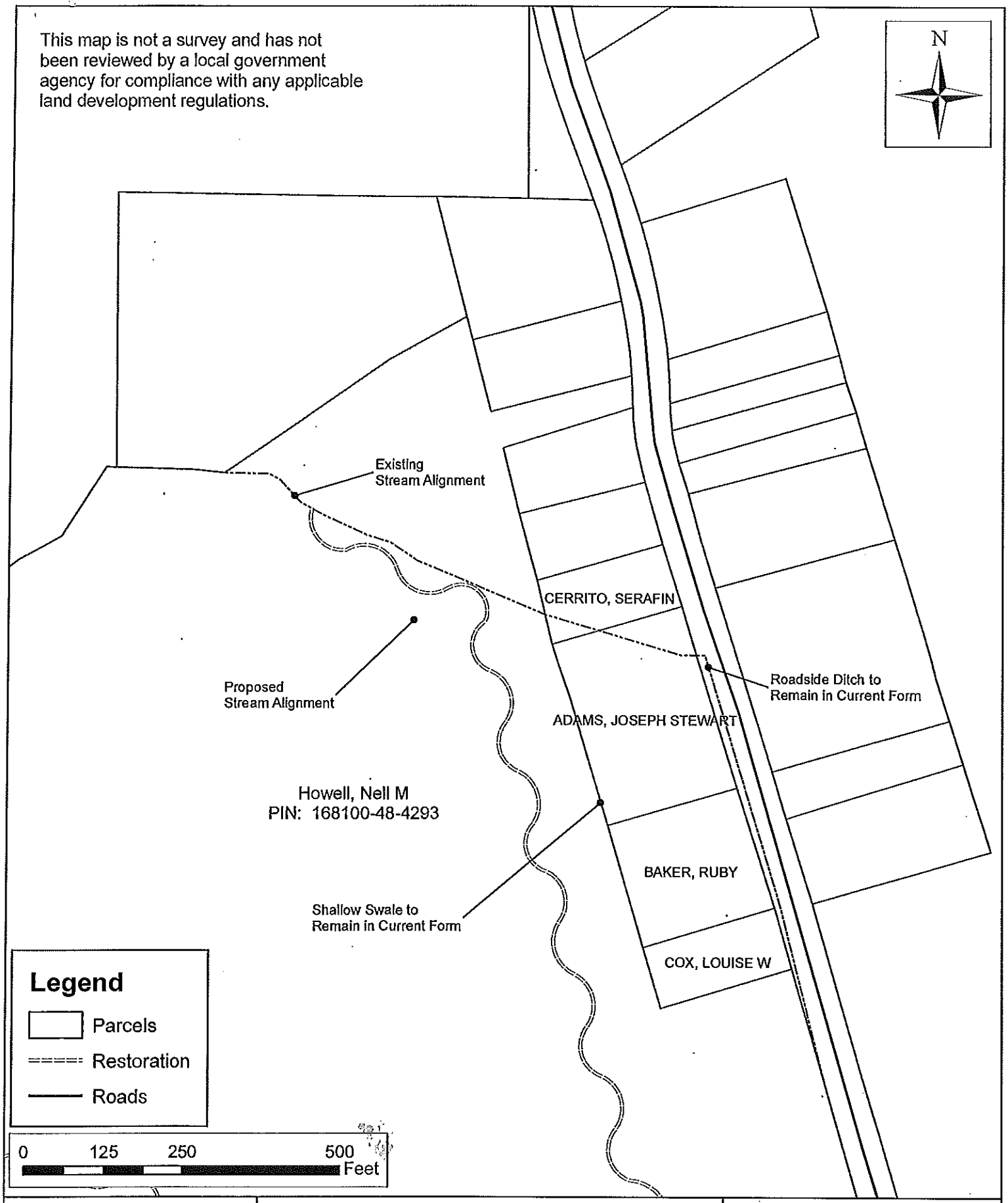
(Official Seal) DANIEL M TAYLOR NOTARY PUBLIC WAYNE COUNTY, N. C.

Daniel M. Taylor, Notary Public
(Notary's printed or typed name)

My commission expires: 10/04/2014

List of Exhibits

Exhibit A - Map Showing Grantor's Parcel, the Adjacent Parcels, and the Existing Location of the un-named non-navigable stream.



WILDLANDS

Devil's Racetrack Properties
Neuse 03020201
JOHNSTON COUNTY, NC

Exhibit A
Site Map

RECORDING REQUESTED BY AND WHEN RECORDED MAIL TO:

Mr. Shawn Wilkerson
Wildlands Engineering, Inc.
1430 South Main Street – Suite 104
Charlotte, NC 28203

Filed in JOHNSTON COUNTY, NC
CRAIG OLIVE, Register of Deeds
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BOOK 3951 PAGE 911 - 916
INSTRUMENT # 2011309041
Real Estate Excise Tax: $0
Deputy/Assistant Register of Deeds: L KIRBY

SPACE ABOVE THIS LINE FOR RECORDER'S USE

AGREEMENT FOR

PERMANENT WAIVER OF RIPARIAN RIGHTS

(DEVIL'S RACETRACK ROAD – New Stream Alignment)

This Agreement for Permanent Waiver of Riparian Rights (**"Agreement"**), dated for reference purposes only as February 10, 2011, is entered into by and between **RUBY BAKER** (the **"Grantor**, and **WILDLANDS ENGINEERING, INC.,** a North Carolina corporation (**"Grantee"**).

Recitals

A. Grantor is the owner of that certain real property (**"Grantor's Parcel"**) consisting of approximately 1.01 acres, located between 696 and 748 Devil's Racetrack Road, Four Oaks, NC 27524 in Johnston County, North Carolina, as recorded in Book 0689 Page 0562 in the Johnston County Registry. The Grantor's Parcel is also identified as Tax Parcel Number 168100-59-4687.

B. Grantor's Parcel is located immediately adjacent and to and North of that certain real property, (the **"Adjacent Parcel"**) consisting of approximately 465.10 acres, located at 747 Devils Racetrack Road, Four Oaks, NC 27524 in the county of Johnston, State of North Carolina, as recorded in Book 3334 Page 0883 in the Johnston County Registry. The Adjacent Parcel is also identified as Tax Parcel Number 168100-48-4293.

C. An un-named non-navigable stream proceeds from parallel to Devils Racetrack Road across the eastern boundary of the Grantor's Parcel, as shown on the map attached hereto as Exhibit A and incorporated herein by this reference.

D. Grantee is in the business of preparing, designing, and obtaining conservation easements from landowners for the purposes of submitting a proposal to the North Carolina Ecosystem Enhancement Program (NCEEP) to restore and enhance riparian, stream and wetland habitats and water quality and then maintain and monitor the success of these restoration efforts in the future.

E. Grantee believes that the un-named non-navigable stream referenced above and certain portions of the Adjacent Parcel satisfy the site criteria established by the United States Army Corps of Engineers and the North Carolina Department of Water Quality for a successful stream restoration project (the **"Stream Restoration Project"**). The Stream Restoration Project will require that the water flow from the un-named non-navigable stream be relocated from Grantor's Parcel to the Adjacent Parcel, as generally shown as the existing stream alignment on the map attached hereto as Exhibit A. The existing stream channel will be plugged upstream from the Grantor's Parcel just after it flows through the CP&L easement and will be diverted south through the proposed new stream alignment on the Adjacent Parcel over 100' away from the western property line of the Grantor's Parcel. The existing stream channel will remain unchanged and will serve as a storm water ditch.

G. Grantor desires to waive any and all riparian or water rights of whatsoever nature relating to the diversion of water flow away from Grantor's Parcel in the above referenced un-named non-navigable stream, as more fully set out below.

NOW, THEREFORE, for valuable consideration, the parties hereby agree as follows:

Agreement

1. Waiver of Riparian Rights. Grantor permanently and irrevocably, for all time, hereby completely waives, releases, abandons any and all claims of every nature whatsoever related to or connected with (and any and all rights related to or connected with) the presence of, use of, access to or control over any water present in or flowing in the above-referenced un-named non-navigable stream, intentionally waiving any and all water rights, riparian rights or any other rights or claims whatsoever in connection therewith by operation of this provision. Furthermore, Grantor expressly acknowledges that Grantee makes no representation or warranty or guarantee as to whether or not future weather events or land surface alterations or the present Stream Restoration Project Activities will not result in the return of water temporarily or otherwise to the un-named non-navigable stream or that there will be no future flooding events. It is the express intention of the Grantor that this Agreement for Permanent Waiver of Riparian Rights will be a covenant running with the land and binding upon any and all subsequent owners, their successors, heirs, and or assigns of the above-referenced tract and parcel of land.

2. Purchase Price. Concurrently with the execution of this Agreement for the Permanent Waiver of Riparian Rights, Grantee shall pay to Grantor the amount of One Hundred and No/100ths Dollars ($100.00) as consideration for executing the Agreement. Grantee waives any rights to this payment now or in the future and shall become the Grantors property upon execution of this document.

3. Termination. This Permanent Waiver of Riparian Rights shall terminate only in the event that Grantee's proposal to the NCEEP for a Stream Restoration Project is not selected for contracting by the NCEEP. In such a case, within 30 days of notification of non-selection, Grantee shall prepare a notice of termination for Grantor's review and execution and shall then record the notice in the Johnston County Registry. Furthermore, should Grantee's proposal not be accepted by the NCEEP, it is understood by both parties that the Grantee shall not be responsible for doing any work contained herein.

4. Performance of Stream Restoration Project Activities. Prior to commencing the Stream Restoration Project activities, Grantee shall have obtained all permits and approvals necessary from the North Carolina Department of Water Quality, the United States Army Corps of Engineers and any other agencies with jurisdiction over the Stream Restoration Project activities (collectively, the **"Regulatory Agencies"**). Grantee shall cause the Stream Restoration Project activities to be performed in compliance with plans and specifications approved by the Regulatory Agencies and in accordance with all applicable laws, statutes and ordinances.

5. Agreement not to trespass. Nothing contained in this Agreement shall allow or cause Grantor to trespass or alter the Grantor's Parcel in any way other than the redirection of water flow as described in this Agreement.

6. Agreement not to negatively impact drainage. Grantee hereby agrees that Stream Restoration Project activities performed associated with this agreement shall not negatively impact any drainage or back up additional water on Grantor's Parcel in any way.

7. Property Boundary. In no case shall Grantee's Stream Restoration Project activities change or alter the Grantor's property boundary.

8. Recordation. This Agreement shall be recorded in the Official Records of Johnston County, North Carolina.

9. Entire Agreement. This Agreement and all matters referenced herein (including all Exhibits attached hereto) is the final expression of, and contains the entire agreement between, the parties with respect to the subject matter hereof and supersedes all prior understandings with respect thereto.

10. Governing Law. The parties hereto acknowledge that this Agreement has been negotiated and entered into in the State of North Carolina. The parties hereto expressly agree that this Agreement shall be governed by, interpreted under, and construed and enforced in accordance with the laws of the State of North Carolina.

11. Amendment. This Agreement may not be modified, changed, supplemented, superseded, canceled or terminated, nor may any obligations hereunder be waived, except by written instrument signed by both parties.

12. Relationship of Parties. Nothing contained in this Agreement shall be deemed or construed by the parties to create the relationship of principal and agent, a partnership, joint venture or any other association between the parties hereto.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement as of the date first written above.

GRANTEE:

WILDLANDS ENGINEERING, INC.,
a North Carolina corporation

By: _____

Its: Vice President

Date: 02/10/11

GRANTOR:

RUBY BAKER

By: _____

Date: RUBY BAKER 2/13/11

STATE OF NORTH CAROLINA

COUNTY OF WAKE

I certify that the following person(s) personally appeared before me this day, each acknowledging to me that he or she voluntarily signed the foregoing document for the purpose stated therein and in the capacity indicated: John W. Hutton
name(s) of principal(s)

Date: 2/10/11

(official signature of Notary)

(Official Seal) DANIEL M TAYLOR NOTARY PUBLIC WAYNE COUNTY, N. C.

Daniel M. Taylor, Notary Public
(Notary's printed or typed name)

My commission expires: 10/04/2014

STATE OF NORTH CAROLINA

COUNTY OF JOHNSTON

I certify that the following person(s) personally appeared before me this day, each acknowledging to me that he or she voluntarily signed the foregoing document for the purpose stated therein and in the capacity indicated: RUBY BAKER
name(s) of principal(s)

Date: 2/13/11

(official signature of Notary)

(Official Seal) DANIEL M TAYLOR NOTARY PUBLIC WAYNE COUNTY, N. C.

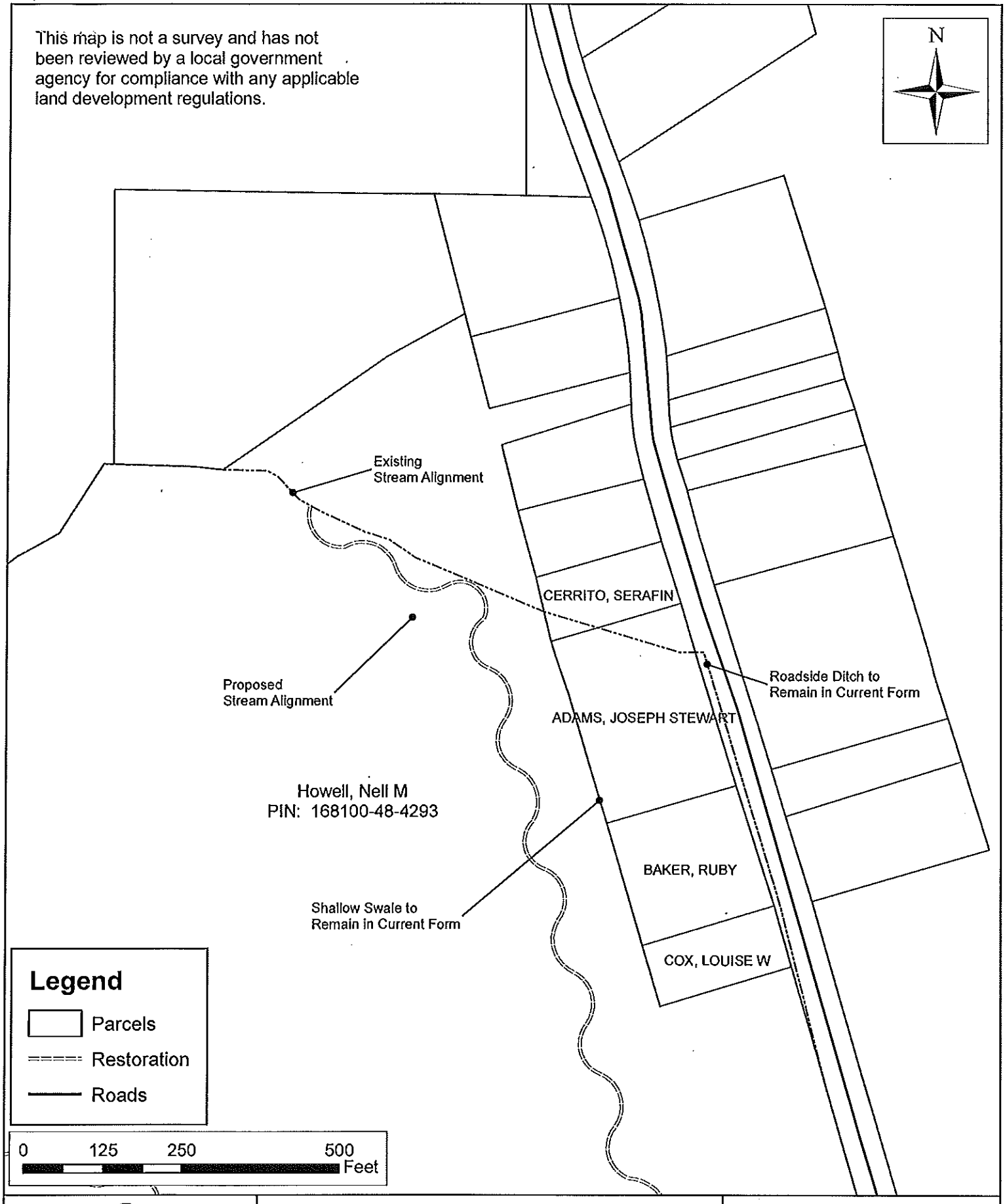
Daniel M. Taylor, Notary Public
(Notary's printed or typed name)

My commission expires: 10/04/2014

DMT

List of Exhibits

Exhibit A	-	Map Showing Grantor's Parcel, the Adjacent Parcels, and the Existing Location of the un-named non-navigable stream.



WILDLANDS

Devil's Racetrack Properties
Neuse 03020201
JOHNSTON COUNTY, NC

Exhibit A
Site Map

RECORDING REQUESTED BY AND WHEN RECORDED MAIL TO:

Mr. Shawn Wilkerson
Wildlands Engineering, Inc.
1430 South Main Street – Suite 104
Charlotte, NC 28203

Filed in JOHNSTON COUNTY, NC
CRAIG OLIVE, Register of Deeds
Filed 2/14/2011 10:28:08 AM
BOOK 3951 PAGE 905 - 910
INSTRUMENT # 2011309040
Real Estate Excise Tax: $0
Deputy/Assistant Register of Deeds: L KIRBY

SPACE ABOVE THIS LINE FOR RECORDER'S USE

AGREEMENT FOR

PERMANENT WAIVER OF RIPARIAN RIGHTS

(DEVIL'S RACETRACK ROAD – New Stream Alignment)

This Agreement for Permanent Waiver of Riparian Rights (**"Agreement"**), dated for reference purposes only as February 10, 2011, is entered into by and between **SERAFIN CERRITO and ROSA FRANCO** (collectively the **"Grantor**, and **WILDLANDS ENGINEERING, INC.,** a North Carolina corporation (**"Grantee"**).

Recitals

A. Grantor is the owner of that certain real property (**"Grantor's Parcel"**) consisting of approximately .51 acres, located at 658 Devil's Racetrack Road, Four Oaks, NC 27524 in Johnston County, North Carolina, as recorded in Book 3382 Page 0037 in the Johnston County Registry. The Grantor's Parcel is also identified as Tax Parcel Number 168200-50-3140.

B. Grantor's Parcel is located immediately adjacent and to and North of that certain real property, (the **"Adjacent Parcel"**) consisting of approximately 465.10 acres, located at 747 Devils Racetrack Road, Four Oaks, NC 27524 in the county of Johnston, State of North Carolina, as recorded in Book 3334 Page 0883 in the Johnston County Registry. The Adjacent Parcel is also identified as Tax Parcel Number 168100-48-4293.

C. An un-named non-navigable stream proceeds from parallel to Devils Racetrack Road across the eastern boundary of the Grantor's Parcel, as shown on the map attached hereto as

Exhibit A and incorporated herein by this reference.

D. Grantee is in the business of preparing, designing, and obtaining conservation easements from landowners for the purposes of submitting a proposal to the North Carolina Ecosystem Enhancement Program (NCEEP) to restore and enhance riparian, stream and wetland habitats and water quality and then maintain and monitor the success of these restoration efforts in the future.

E. Grantee believes that the un-named non-navigable stream referenced above and certain portions of the Adjacent Parcel satisfy the site criteria established by the United States Army Corps of Engineers and the North Carolina Department of Water Quality for a successful stream restoration project (the **"Stream Restoration Project"**). The Stream Restoration Project will require that the water flow from the un-named non-navigable stream be relocated from Grantor's Parcel to the Adjacent Parcel, as generally shown as the existing stream alignment on the map attached hereto as Exhibit A. The existing stream channel will be plugged upstream from the Grantor's Parcel just after it flows through the CP&L easement and will be diverted south through the proposed new stream alignment on the Adjacent Parcel over 100' away from the western property line of the Grantor's Parcel. The existing stream channel will remain unchanged and will serve as a storm water ditch.

G. Grantor desires to waive any and all riparian or water rights of whatsoever nature relating to the diversion of water flow away from Grantor's Parcel in the above referenced un-named non-navigable stream, as more fully set out below.

NOW, THEREFORE, for valuable consideration, the parties hereby agree as follows:

Agreement

1. Waiver of Riparian Rights. Grantor permanently and irrevocably, for all time, hereby completely waives, releases, abandons any and all claims of every nature whatsoever related to or connected with (and any and all rights related to or connected with) the presence of, use of, access to or control over any water present in or flowing in the above-referenced un-named non-navigable stream, intentionally waiving any and all water rights, riparian rights or any other rights or claims whatsoever in connection therewith by operation of this provision. Furthermore, Grantor expressly acknowledges that Grantee makes no representation or warranty or guarantee as to whether or not future weather events or land surface alterations or the present Stream Restoration Project Activities will not result in the return of water temporarily or otherwise to the un-named non-navigable stream or that there will be no future flooding events. It is the express intention of the Grantor that this Agreement for Permanent Waiver of Riparian Rights will be a covenant running with the land and binding upon any and all subsequent owners, their successors, heirs, and or assigns of the above-referenced tract and parcel of land.

2. Purchase Price. Concurrently with the execution of this Agreement for the Permanent Waiver of Riparian Rights, Grantee shall pay to Grantor the amount of One Hundred and No/100ths Dollars ($100.00) as consideration for executing the Agreement. Grantee waives any rights to this payment now or in the future and shall become the Grantors property upon execution of this document.

3. Termination. This Permanent Waiver of Riparian Rights shall terminate only in the event that Grantee's proposal to the NCEEP for a Stream Restoration Project is not selected for contracting by the NCEEP. In such a case, within 30 days of notification of non-selection, Grantee shall prepare a notice of termination for Grantor's review and execution and shall then record the notice in the Johnston County Registry. Furthermore, should Grantee's proposal not be accepted by the NCEEP, it is understood by both parties that the Grantee shall not be responsible for doing any work contained herein.

4. Performance of Stream Restoration Project Activities. Prior to commencing the Stream Restoration Project activities, Grantee shall have obtained all permits and approvals necessary from the North Carolina Department of Water Quality, the United States Army Corps of Engineers and any other agencies with jurisdiction over the Stream Restoration Project activities (collectively, the **"Regulatory Agencies"**). Grantee shall cause the Stream Restoration Project activities to be performed in compliance with plans and specifications approved by the Regulatory Agencies and in accordance with all applicable laws, statutes and ordinances.

5. Agreement not to trespass. Nothing contained in this Agreement shall allow or cause Grantor to trespass or alter the Grantor's Parcel in any way other than the redirection of water flow as described in this Agreement.

6. Agreement not to negatively impact drainage. Grantee hereby agrees that Stream Restoration Project activities performed associated with this agreement shall not negatively impact any drainage or back up additional water on Grantor's Parcel in any way.

7. Property Boundary. In no case shall Grantee's Stream Restoration Project activities change or alter the Grantor's property boundary.

8. Recordation. This Agreement shall be recorded in the Official Records of Johnston County, North Carolina.

9. Entire Agreement. This Agreement and all matters referenced herein (including all Exhibits attached hereto) is the final expression of, and contains the entire agreement between, the parties with respect to the subject matter hereof and supersedes all prior understandings with respect thereto.

10. Governing Law. The parties hereto acknowledge that this Agreement has been negotiated and entered into in the State of North Carolina. The parties hereto expressly agree that this Agreement shall be governed by, interpreted under, and construed and enforced in accordance with the laws of the State of North Carolina.

11. Amendment. This Agreement may not be modified, changed, supplemented, superseded, canceled or terminated, nor may any obligations hereunder be waived, except by written instrument signed by both parties.

12. Relationship of Parties. Nothing contained in this Agreement shall be deemed or construed by the parties to create the relationship of principal and agent, a partnership, joint venture or any other association between the parties hereto.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement as of the date first written above.

GRANTEE:

WILDLANDS, ENGINEERING, INC.,
a North Carolina corporation

By: _____

Its: Vice President

Date: 02/10/11

GRANTOR:

SERAPHIN CERRITO and ~~ROSE~~ ROSA FRANCO R. F S.C

By: Seraphin Cerrito R

Date: 2/11/11

By: Rosa Franco

Date: 2/11/11

STATE OF NORTH CAROLINA

COUNTY OF WAKE

I certify that the following person(s) personally appeared before me this day, each acknowledging to me that he or she voluntarily signed the foregoing document for the purpose stated therein and in the capacity indicated: John W. Hutton
name(s) of principal(s)

Date: 2/10/11

(Official Seal)

DANIEL M TAYLOR NOTARY PUBLIC WAYNE COUNTY, N. C.

_____
(official signature of Notary)

Daniel M. Taylor, Notary Public
(Notary's printed or typed name)

My commission expires: 10/04/2014

STATE OF NORTH CAROLINA

COUNTY OF JOHNSTON

I certify that the following person(s) personally appeared before me this day, each acknowledging to me that he or she voluntarily signed the foregoing document for the purpose stated therein and in the capacity indicated: SERAFIN CERRITO and ROSA FRANCO
name(s) of principal(s)

Date: 2/11/11

(Official Seal)

DANIEL M TAYLOR NOTARY PUBLIC WAYNE COUNTY, N. C.

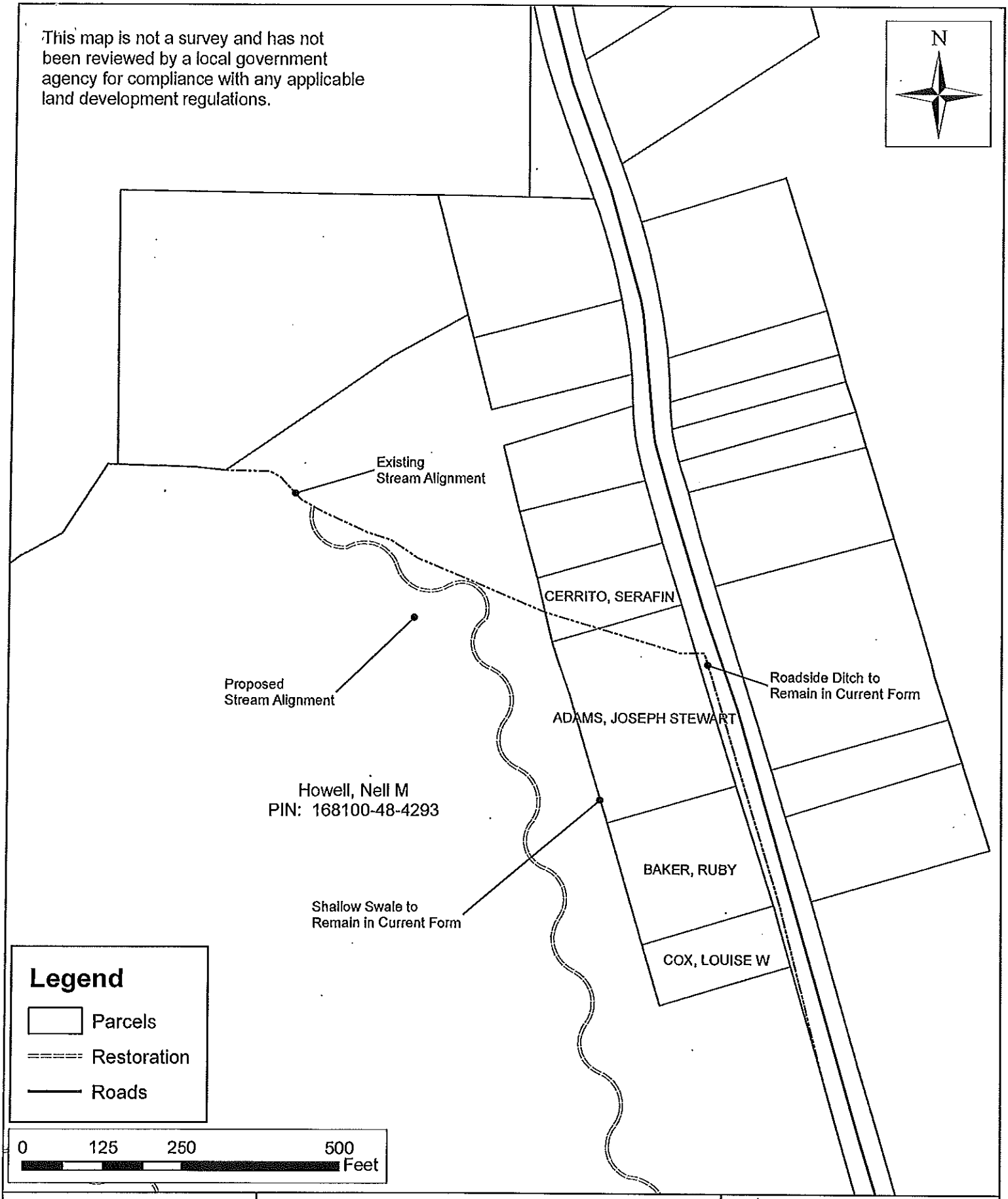
_____
(official signature of Notary)

Daniel M. Taylor, Notary Public
(Notary's printed or typed name)

My commission expires: 10/04/2014

List of Exhibits

Exhibit A	-	Map Showing Grantor's Parcel, the Adjacent Parcels, and the Existing Location of the un-named non-navigable stream.



WILDLANDS

Devil's Racetrack Properties
Neuse 03020201
JOHNSTON COUNTY, NC

Exhibit A
Site Map

RECORDING REQUESTED BY AND WHEN RECORDED MAIL TO:

Mr. Shawn Wilkerson
Wildlands Engineering, Inc.
1430 South Main Street – Suite 104
Charlotte, NC 28203

Filed in JOHNSTON COUNTY, NC
CRAIG OLIVE, Register of Deeds
Filed 2/14/2011 10:28:06 AM
BOOK 3951 PAGE 893 - 898
INSTRUMENT # 2011309038
Real Estate Excise Tax: $0
Deputy/Assistant Register of Deeds: L KIRBY

SPACE ABOVE THIS LINE FOR RECORDER'S USE

AGREEMENT FOR

PERMANENT WAIVER OF RIPARIAN RIGHTS

(DEVIL'S RACETRACK ROAD – New Stream Alignment)

This Agreement for Permanent Waiver of Riparian Rights (**"Agreement"**), dated for reference purposes only as February 10, 2011, is entered into by and between **Louise W. Cox** (the **"Grantor**, and **WILDLANDS ENGINEERING, INC.,** a North Carolina corporation (**"Grantee"**).

Recitals

A. Grantor is the owner of that certain real property (**"Grantor's Parcel"**) consisting of approximately .51 acres, located at 748 Devil's Racetrack Road, Four Oaks, NC 27524 in Johnston County, North Carolina, as recorded in Book 0727 Page 0061 in the Johnston County Registry. The Grantor's Parcel is also identified as Tax Parcel Number 168100-59-5532.

B. Grantor's Parcel is located immediately adjacent and to and North of that certain real property, (the **"Adjacent Parcel"**) consisting of approximately 465.10 acres, located at 747 Devils Racetrack Road, Four Oaks, NC 27524 in the county of Johnston, State of North Carolina, as recorded in Book 3334 Page 0883 in the Johnston County Registry. The Adjacent Parcel is also identified as Tax Parcel Number 168100-48-4293.

C. An un-named non-navigable stream proceeds from parallel to Devils Racetrack Road across the eastern boundary of the Grantor's Parcel, as shown on the map attached hereto as Exhibit A and incorporated herein by this reference.

D. Grantee is in the business of preparing, designing, and obtaining conservation easements from landowners for the purposes of submitting a proposal to the North Carolina Ecosystem Enhancement Program (NCEEP) to restore and enhance riparian, stream and wetland habitats and water quality and then maintain and monitor the success of these restoration efforts in the future.

E. Grantee believes that the un-named non-navigable stream referenced above and certain portions of the Adjacent Parcel satisfy the site criteria established by the United States Army Corps of Engineers and the North Carolina Department of Water Quality for a successful stream restoration project (the **"Stream Restoration Project"**). The Stream Restoration Project will require that the water flow from the un-named non-navigable stream be relocated from Grantor's Parcel to the Adjacent Parcel, as generally shown as the existing stream alignment on the map attached hereto as Exhibit A. The existing stream channel will be plugged upstream from the Grantor's Parcel just after it flows through the CP&L easement and will be diverted south through the proposed new stream alignment on the Adjacent Parcel over 100' away from the western property line of the Grantor's Parcel. The existing stream channel will remain unchanged and will serve as a storm water ditch.

G. Grantor desires to waive any and all riparian or water rights of whatsoever nature relating to the diversion of water flow away from Grantor's Parcel in the above referenced un-named non-navigable stream, as more fully set out below.

NOW, THEREFORE, for valuable consideration, the parties hereby agree as follows:

Agreement

1. Waiver of Riparian Rights. Grantor permanently and irrevocably, for all time, hereby completely waives, releases, abandons any and all claims of every nature whatsoever related to or connected with (and any and all rights related to or connected with) the presence of, use of, access to or control over any water present in or flowing in the above-referenced un-named non-navigable stream, intentionally waiving any and all water rights, riparian rights or any other rights or claims whatsoever in connection therewith by operation of this provision. Furthermore, Grantor expressly acknowledges that Grantee makes no representation or warranty or guarantee as to whether or not future weather events or land surface alterations or the present Stream Restoration Project Activities will not result in the return of water temporarily or otherwise to the un-named non-navigable stream or that there will be no future flooding events. It is the express intention of the Grantor that this Agreement for Permanent Waiver of Riparian Rights will be a covenant running with the land and binding upon any and all subsequent owners, their successors, heirs, and or assigns of the above-referenced tract and parcel of land.

2. Purchase Price. Concurrently with the execution of this Agreement for the Permanent Waiver of Riparian Rights, Grantee shall pay to Grantor the amount of One Hundred and No/100ths Dollars ($100.00) as consideration for executing the Agreement. Grantee waives any rights to this payment now or in the future and shall become the Grantors property upon execution of this document.

3. Termination. This Permanent Waiver of Riparian Rights shall terminate only in the event that Grantee's proposal to the NCEEP for a Stream Restoration Project is not selected for contracting by the NCEEP. In such a case, within 30 days of notification of non-selection, Grantee shall prepare a notice of termination for Grantor's review and execution and shall then record the notice in the Johnston County Registry. Furthermore, should Grantee's proposal not be accepted by the NCEEP, it is understood by both parties that the Grantee shall not be responsible for doing any work contained herein.

4. Performance of Stream Restoration Project Activities. Prior to commencing the Stream Restoration Project activities, Grantee shall have obtained all permits and approvals necessary from the North Carolina Department of Water Quality, the United States Army Corps of Engineers and any other agencies with jurisdiction over the Stream Restoration Project activities (collectively, the **"Regulatory Agencies"**). Grantee shall cause the Stream Restoration Project activities to be performed in compliance with plans and specifications approved by the Regulatory Agencies and in accordance with all applicable laws, statutes and ordinances.

5. Agreement not to trespass. Nothing contained in this Agreement shall allow or cause Grantor to trespass or alter the Grantor's Parcel in any way other than the redirection of water flow as described in this Agreement.

6. Agreement not to negatively impact drainage. Grantee hereby agrees that Stream Restoration Project activities performed associated with this agreement shall not negatively impact any drainage or back up additional water on Grantor's Parcel in any way.

7. Property Boundary. In no case shall Grantee's Stream Restoration Project activities change or alter the Grantor's property boundary.

8. Recordation. This Agreement shall be recorded in the Official Records of Johnston County, North Carolina.

9. Entire Agreement. This Agreement and all matters referenced herein (including all Exhibits attached hereto) is the final expression of, and contains the entire agreement between, the parties with respect to the subject matter hereof and supersedes all prior understandings with respect thereto.

10. Governing Law. The parties hereto acknowledge that this Agreement has been negotiated and entered into in the State of North Carolina. The parties hereto expressly agree that this Agreement shall be governed by, interpreted under, and construed and enforced in accordance with the laws of the State of North Carolina.

11. Amendment. This Agreement may not be modified, changed, supplemented, superseded, canceled or terminated, nor may any obligations hereunder be waived, except by written instrument signed by both parties.

12. Relationship of Parties. Nothing contained in this Agreement shall be deemed or construed by the parties to create the relationship of principal and agent, a partnership, joint venture or any other association between the parties hereto.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement as of the date first written above.

GRANTEE:

WILDLANDS, ENGINEERING, INC.,
a North Carolina corporation

By: _____

Its: Vice President

Date: 02/10/11

GRANTOR:

LOUISE W. COX

By: Vickie Peters

Its: Executor of estate

Date: 2-12-11

STATE OF NORTH CAROLINA

COUNTY OF WAKE

I certify that the following person(s) personally appeared before me this day, each acknowledging to me that he or she voluntarily signed the foregoing document for the purpose stated therein and in the capacity indicated: John W. Hutton
name(s) of principal(s)

Date: 2/10/11

(official signature of Notary)

(Official Seal) DANIEL M TAYLOR NOTARY PUBLIC WAYNE COUNTY, N.C.

Daniel M. Taylor, Notary Public
(Notary's printed or typed name)

My commission expires: 10/04/2014

STATE OF NORTH CAROLINA

COUNTY OF WAKE

I certify that the following person(s) personally appeared before me this day, each acknowledging to me that he or she voluntarily signed the foregoing document for the purpose stated therein and in the capacity indicated: Vickie Peters, executor of estate
name(s) of principal(s)

Date: 2/20/2011

Michelle R. Wawrzyniak
(official signature of Notary)

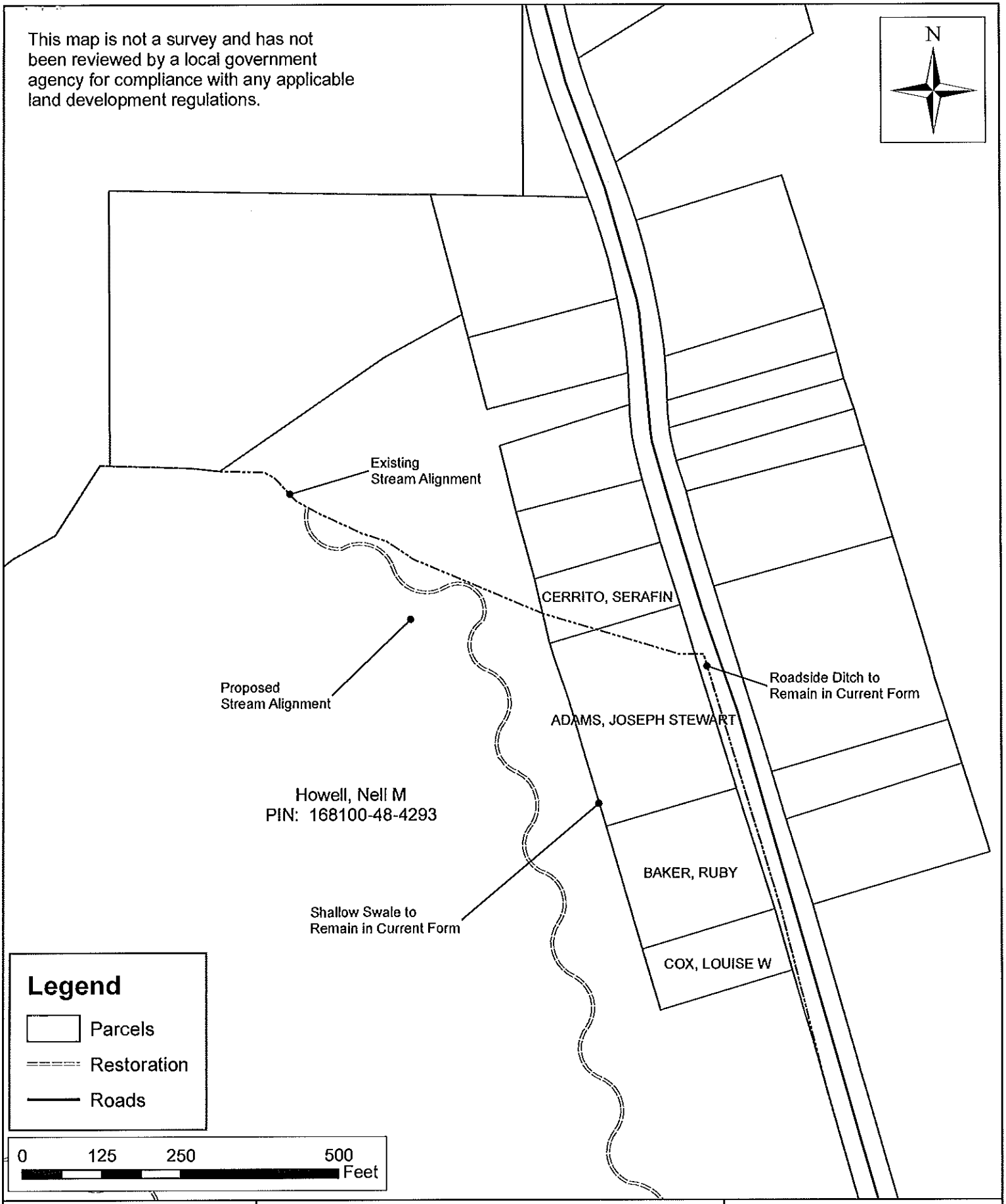
(Official Seal) MICHELLE R. WAWRZYNIAK NOTARY PUBLIC WAKE COUNTY, NC

MICHELLE R WAWRZYNIAK, Notary Public
(Notary's printed or typed name)

My commission expires: 8.21.2012

List of Exhibits

Exhibit A	-	Map Showing Grantor's Parcel, the Adjacent Parcels, and the Existing Location of the un-named non-navigable stream.



WILDLANDS

Devil's Racetrack Properties
Neuse 03020201
JOHNSTON COUNTY, NC

Exhibit A
Site Map

Filed in JOHNSTON COUNTY, NC CRAIG OLIVE, Register of Deeds Filed 2/11/2011 3:36:30 PM DEED BOOK 3951 PAGE 669 - 677 INSTRUMENT # 2011308979 Real Estate Excise Tax: $0.00 Deputy/Assistant Register of Deeds: L KIRBY

RECORDING REQUESTED BY AND WHEN RECORDED MAIL TO:

Wildlands Engineering, Inc.
1430 South Mint Street, Suite 104
Charlotte, NC 28203
Attention: Shawn Wilkerson

SPACE ABOVE THIS LINE FOR RECORDER'S USE

AGREEMENT FOR TEMPORARY CONSTRUCTION EASEMENT

This Agreement for Temporary Construction Easement ("**Agreement**"), dated for reference purposes only as February 7, 2011, is entered into by and between **Smithfield Campground, LLC**, a North Carolina limited liability company (collectively, the "**Grantor**"), and **WILDLANDS ENGINEERING, INC.**, a North Carolina corporation ("**Grantee**").

Recitals

A. Grantor is the owner of that certain real property ("**Grantor's Parcel**") consisting of approximately 27.39 acres, located at 497 US Highway 701 South, Four Oaks, NC 27524 in the county of Johnson, State of North Carolina, as recorded in Book 2764 Page 0254 in the Johnston County Registry as shown on the map attached hereto as Exhibit A and incorporated herein by this reference. The Grantor's Parcel is also identified as Tax Parcel Number **168100-29-9707.**

B. Grantor's Parcel is located immediately adjacent and to and North of that certain real property, (the "**Adjacent Parcel**") consisting of approximately 465.10 acres, located at 747 Devils Racetrack Road, Four Oaks, NC 27524 in the county of Johnson, State of North Carolina, as recorded in Book 3334 Page 0883 in the Johnston County Registry. The Adjacent Parcel is also identified as Tax Parcel Number **168100-48-4293.**

C. An Unnamed Tributary to the Neuse River is situated along the common boundary of

Grantor's Parcel and the Adjacent Parcel, as shown on the map attached hereto as Exhibit A.

D. Grantee is in the business of preparing, designing, and obtaining conservation easements and temporary construction easements from landowners for the purposes of submitting a proposal to the North Carolina Ecosystem Enhancement Program ("NCEEP") to restore and enhance riparian, stream and wetland habitats and water quality and then maintain and monitor the success of these restoration efforts in the future.

E. Grantee believes that Unnamed Tributary to the Neuse River and certain portions of the Adjacent Parcel satisfy the site criteria established by the United States Army Corps of Engineers and the North Carolina Department of Water Quality for a successful stream restoration project (the **"Stream Restoration Project"**).

F. The Stream Restoration Project will require that the Unnamed Tributary to the Neuse River be relocated from Grantor's Parcel to the Adjacent Parcel, as generally shown on the map attached hereto as Exhibit A.

G. In order to relocate the Unnamed Tributary to the Neuse River from Grantor's Parcel to the Adjacent Parcel, Grantee will need to obtain access to portions of Grantor's Parcel.

H. Grantor desires to grant and Grantee desires to obtain a temporary construction easement over those portions of Grantor's Parcel that are reasonably necessary (the **"Easement Area"**) to enable Grantee to relocate Unnamed Tributary to the Neuse River to the Adjacent Parcel pursuant to the terms and conditions of this Agreement. The Easement Area of Grantor's Parcel shall be limited to the first 100' along the southern border with the Adjacent Parcel and the right of egress and ingress through the Grantor's Parcel from US-701. In the event Grantee reasonably needs access to additional portions of Grantor's Parcel for the purposes described in this Agreement, Grantee shall request and Grantor shall not unreasonably deny such additional access areas on the Grantor's Parcel; and, at Grantee's sole cost, the parties will execute and record an amendment to this Agreement in the Johnson County Registry to describe the additional access areas.

NOW, THEREFORE, for valuable consideration, the parties hereby agree as follows:

Agreement

1. Grant of Easement. Grantor hereby grants to Grantee, and Grantee hereby accepts from Grantor, a non-exclusive temporary construction easement (**"Easement"**) over the Easement Area to enable Grantee to relocate Unnamed Tributary to the Neuse River to the Adjacent Parcel.

2. Character, Use and Description of Easement. The Easement is an easement in gross in favor of Grantee consisting of a temporary right to enter upon the Easement Area in connection with and to the extent reasonably necessary for the relocation of the Unnamed Tributary to the Neuse River to the Adjacent Parcel, including, without limitation, filling portions of the Unnamed Tributary to the Neuse River and performing related stream restoration activities (collectively the **"Stream Restoration Activities"**). Once commenced, Grantee shall diligently

and continuously proceed in a workmanlike manner until completion of the Stream Restoration Activities.

3. Purchase Price. Concurrently with the execution of this Agreement by Grantor and Grantee, Grantee shall pay to Grantor the amount of One Hundred and No/100ths Dollars ($100.00) as consideration for the granting of the Easement.

4. Performance of Stream Restoration Activities. Prior to commencing the Stream Restoration Activities, Grantee shall have obtained all permits and approvals necessary from the North Carolina Department of Water Quality, the United States Army Corps of Engineers and any other agencies with jurisdiction over the Stream Restoration Activities (collectively, the "**Regulatory Agencies**"). Grantee shall cause the Stream Restoration Activities to be performed in compliance with plans and specifications approved by the Regulatory Agencies and in accordance with all applicable laws, statutes and ordinances.

5. Liens. Grantee shall not permit any mechanics or other liens to be filed against Grantor's Parcel as a result of labor or materials furnished in connection with the Stream Restoration Activities. If any such lien is filed against Grantor's Parcel, Grantee shall cause the same to be discharged of record within thirty (30) days after receipt of written demand from Grantor. Grantee shall indemnify, defend and hold harmless Grantor from and against any such lien.

6. Record of Survey. In no event shall the southern boundary of Grantor's Parcel be adjusted as a result of the relocation of Unnamed Tributary to the Neuse River. If in the event Grantee disrupts any property stake or survey iron, Grantee, at Grantee's expense shall reset said property stake or survey iron in the exact same position. In conjunction with performing the Stream Restoration Activities, Grantee, at Grantee's sole cost and expense, shall cause to be prepared and recorded a record of survey ("**Record of Survey**") showing the southern boundary of Grantor's Parcel in its current location. The Record of Survey shall be subject to Grantor's review and approval. Upon Grantor's approval of the Record of Survey, Grantor agrees to execute and acknowledge such Record of Survey promptly upon Grantee's request.

7. Termination. The Easement shall terminate and be of no further force and effect on the earlier of (a) the date on which Grantee notifies Grantor that the Stream Restoration Activities have been completed in compliance with Section 4 and the Record of Survey has been recorded, or (b) five (5) years after the date of recordation of this Agreement, or (c) immediately upon any notification from the NCEEP that Grantee's proposal for stream restoration has not been accepted. Within 30 days of termination, Grantee shall prepare a notice of termination for Grantor's review, and upon Grantor's review and execution, Grantee will record the notice in the Johnson County Registry.

8. Indemnification. Grantee shall indemnify Grantor, its agents and assigns against, and hold Grantor, its agents and assigns harmless from, any and all claims, obligations, demands, causes of action, damages, losses, liabilities and expenses incurred in connection with or arising from: (a) the use of the Easement by Grantee and/or Grantee's agents, contractors, subcontractors, materialmen or employees or anyone else claiming under Grantee; (b) any activity, work, or thing done or permitted in or about Grantor's Parcel by Grantee and/or

Grantee's agents, contractors, subcontractors, materialmen or employees or anyone else claiming under Grantee; (c) any acts, omissions, or negligence of Grantee and/or Grantee's agents, contractors, subcontractors, materialmen or employees or any other person claiming under Grantee; or (d) any breach by Grantee and/or Grantee's agents, contractors, subcontractors, materialmen or employees or any other person claiming under Grantee of any term or covenant of this Agreement. Nothwithstanding the foregoing, any damages resulting to Grantor's Parcel from the uses, acts, or breaches described above shall be promptly repaired by Grantee at its expense. Grantee agrees that the use of the Easement Area shall be conducted in a manner so as not to unreasonably interfere with or impede the ongoing business or recreational activities being conducted on the Grantor's Parcel by Grantor, its successors or assigns, and/or its invitees.

9. Insurance. Prior to commencing the Stream Restoration Activities, Grantee, at its sole cost and expense, shall procure and maintain throughout the term of the Easement a commercial general liability insurance policy with a financially responsible insurance company reasonably acceptable to Grantor, covering the Stream Restoration Activities. Grantee shall deliver to Grantor a certificate of insurance for Grantee's commercial general liability insurance policy prior to commencing the performance of the Stream Restoration Activities. Such insurance policy shall have a per occurrence limit of at least One Million and No/100 Dollars ($1,000,000.00) and an aggregate limit of at least Three Million and No/100 Dollars ($3,000,000.00), and shall name Grantor as an additional insured.

10. Remedies Cumulative. In the event of a breach or attempted or threatened breach of any part of this Agreement by either party, the other party shall be entitled forthwith to full and adequate relief by injunction and all other available legal and equitable remedies. The remedies permitted at law or equity of each party specified herein shall be cumulative as to each.

11. Recordation. This Agreement shall be recorded in the Official Records of Johnson County.

12. Assignment of Easement Rights. Grantee shall not assign this Agreement without the prior written consent of Grantor, which shall not be unreasonably withheld. Grantee shall have the right to assign this Agreement to any entity that is owned and/or controlled by Wildlands Engineering, Inc. and/or any of the principals of Wildlands Engineering, Inc. without the consent of Grantor. No assignment shall be effective, however, unless the assignee has delivered to Grantor a written assumption of Grantee's obligations under this Agreement. Grantor hereby releases Grantee from any obligations under this Agreement arising after the effective date of any assignment of this Agreement by Grantee, but only so long as any such assignment has been made in accordance with the terms and conditions of this Section 12.

13. Construction. Headings at the beginning of each paragraph and subparagraph are solely for the convenience of the parties and are not a part of the Agreement. This Agreement shall not be construed as if it had been prepared by one of the parties, but rather as if both parties had prepared the same.

14. Attorney's Fees. If any action or proceeding is instituted to (a) enforce or interpret any provision of this Agreement or (b) as a result of the breach by a party to any of the terms

hereof, then the prevailing party therein shall be entitled to recover its attorneys' fees and costs from the losing party.

15. No Public Dedication. Nothing contained in this Agreement shall be deemed to be a gift or dedication of Grantor's Parcel or any other property to the general public or for any public use or purpose whatsoever, it being the intention of the parties hereto that this Agreement be for the exclusive benefit of the parties hereto and their successors and assigns.

16. Entire Agreement. This Agreement and all matters referenced herein (including all Exhibits attached hereto) is the final expression of, and contains the entire agreement between, the parties with respect to the subject matter hereof and supersedes all prior understandings with respect thereto.

17. Relationship of Parties. Nothing contained in this Agreement shall be deemed or construed by the parties to create the relationship of principal and agent, a partnership, joint venture or any other association between the parties hereto.

18. Recitals/Exhibits. The Recitals herein, and any exhibits to this Agreement, are hereby incorporated by reference into this Agreement. The parties warrant that the Recitals are true and correct.

19. Governing Law. The parties hereto acknowledge that this Agreement has been negotiated and entered into in the State of North Carolina. The parties hereto expressly agree that this Agreement shall be governed by, interpreted under, and construed and enforced in accordance with the laws of North Carolina.

20. Amendment. This Agreement may not be modified, changed, supplemented, superseded, canceled or terminated, nor may any obligations hereunder be waived, except by written instrument signed by the party to be charged.

21. Further Assurances. Each of the parties shall execute and deliver any and all additional papers, documents, and other assurances, and shall do any and all acts and things reasonably necessary in connection with the performance of their obligations hereunder and to carry out the intent of this Agreement.

22. Additional Provisions: As outlined on the attached Exhibit A, Grantee shall at Grantee's expense perform the following additional construction activities to assure that the Grantor's Parcel shall not be negatively impacted by the Stream Restoration Activities on either the Grantor's Parcel and/or the Adjacent Parcel:

i.) Starting approximately 200' South of the South-Western corner of the Grantor's Parcel on the Eastern side of US-701, Grantee shall fill in the existing stream leaving a shallow drainage swale. This shallow swale shall continue North along US-701 and then East approximately 1200' across the Southern boundary between the Grantor's Parcel and the Adjacent parcel where it shall transition from a shallow swale back to the existing deep ditch.

ii.) The existing deep ditch shall remain in its current form along the Southern and Western boundaries of the Grantor's Parcel after the convergence of the stream/ditch which runs South East through the Grantor's Parcel.

iii.) The existing drop inlet shall be removed and replaced with a swale designed to drain storm water on to the existing stream.

1) IN WITNESS WHEREOF, the parties hereto have executed this Agreement as of the date first written above.

GRANTEE:

WILDLANDS, ENGINEERING INC., a North Carolina corporation.

By: _____

Its: Vice President

Date: 2/7/11

GRANTOR:

SMITHFIELD CAMPGROUND, LLC, a North Carolina limited liability company.

By: _____

Its: Member/Manager

Date: 2/4/11

STATE OF NORTH CAROLINA

COUNTY OF New Hanover

I certify that the following person(s) personally appeared before me this day, each acknowledging to me that he or she voluntarily signed the foregoing document for the purpose stated therein and in the capacity indicated: Joel Tomaselli for Smithfield Campground, LLC

name(s) of principal(s)

Date: 2/4/11

_____

(official signature of Notary)

MERYL FELDS, Notary Public

(Notary's printed or typed name)

(Official Seal)

My commission expires: 1/18/15

STATE OF NORTH CAROLINA

COUNTY OF WAKE

I certify that the following person(s) personally appeared before me this day, each acknowledging to me that he or she voluntarily signed the foregoing document for the purpose stated therein and in the capacity indicated: JOHN W. HUTTON

name(s) of principal(s)

Date: 2-7-11

_____

(official signature of Notary)

DANIEL M. TAYLOR, Notary Public

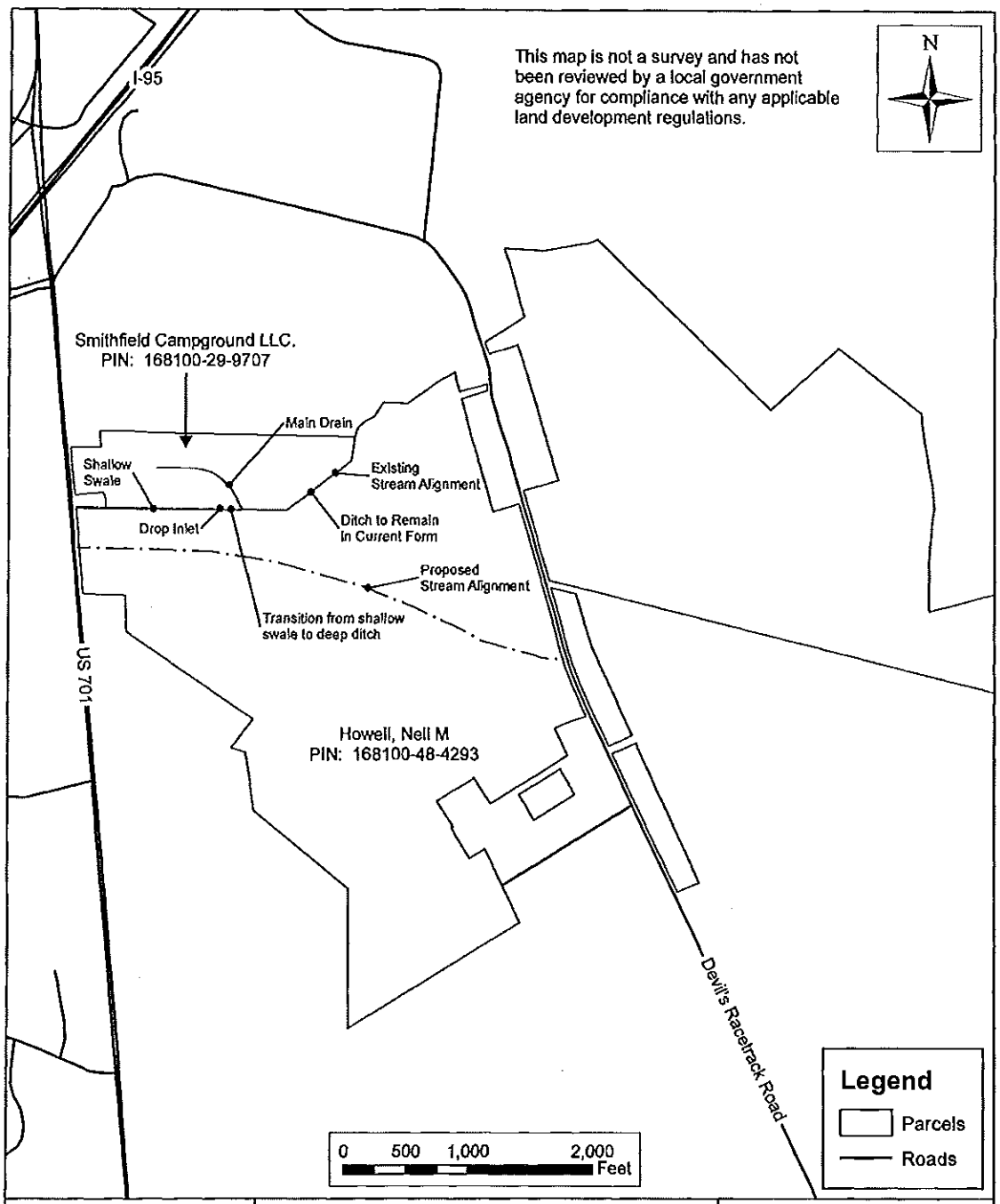
(Notary's printed or typed name)

(Official Seal)

My commission expires: 10-4-14

List of Exhibits

Exhibit A	Map showing Grantor's Parcel, the Adjacent Parcel, and tbe existing and proposed stream alignment of the Unnamed Tributary to the Neuse River.


This map is not a survey and has not been reviewed by a local government agency for compliance with any applicable land development regulations.
N
I-95
Smithfield Campground LLC.
PIN: 168100-29-9707
Main Drain
Shallow Swale
Existing Stream Alignment
Drop Inlet
Ditch to Remain In Current Form
Proposed Stream Alignment
Transition from shallow swale to deep ditch
US 701
Howell, Nell M
PIN: 168100-48-4293
Devil's Racetrack Road
Legend
Parcels
Roads
0 500 1,000 2,000
Feet
WILDLANDS
SMITHFIELD CAMPGROUND
Neuse 03020201
JOHNSTON COUNTY, NC
Exhibit A
Site Map

RECORDING REQUESTED BY AND WHEN RECORDED MAIL TO:

Mr. Shawn Wilkerson
Wildlands Engineering, Inc.
1430 South Main Street – Suite 104
Charlotte, NC 28203

Filed in JOHNSTON COUNTY, NC
CRAIG OLIVE, Register of Deeds
Filed 2/14/2011 10:28:05 AM
BOOK 3951 PAGE 887 - 892
INSTRUMENT # 2011309037
Real Estate Excise Tax: $0
Deputy/Assistant Register of Deeds: L KIRBY

SPACE ABOVE THIS LINE FOR RECORDER'S USE

AGREEMENT FOR

PERMANENT WAIVER OF RIPARIAN RIGHTS

(DEVIL'S RACETRACK ROAD – New Stream Alignment)

This Agreement for Permanent Waiver of Riparian Rights (**"Agreement"**), dated for reference purposes only as February 10, 2011, is entered into by and between **STEWART 1996 FAMILY LIMITED PARTNERSHIP** (the **"Grantor**, and **WILDLANDS ENGINEERING, INC.,** a North Carolina corporation (**"Grantee"**).

Recitals

A. Grantor is the owner of that certain real property (**"Grantor's Parcel"**) consisting of approximately 35.97 acres, located at 272 Devil's Racetrack Road, Four Oaks, NC 27524 in Johnston County, North Carolina, as recorded in Book 1449 Page 0921 in the Johnston County Registry. The Grantor's Parcel is also identified as Tax Parcel Number 168218-41-4002.

B. Grantor's Parcel is located immediately adjacent and to and North of that certain real property, (the **"Adjacent Parcel"**) consisting of approximately 465.10 acres, located at 747 Devils Racetrack Road, Four Oaks, NC 27524 in the county of Johnston, State of North Carolina, as recorded in Book 3334 Page 0883 in the Johnston County Registry. The Adjacent Parcel is also identified as Tax Parcel Number 168100-48-4293.

C. An un-named non-navigable stream proceeds from parallel to Devils Racetrack Road across the eastern boundary of the Grantor's Parcel, as shown on the map attached hereto as

Exhibit A and incorporated herein by this reference.

D. Grantee is in the business of preparing, designing, and obtaining conservation easements from landowners for the purposes of submitting a proposal to the North Carolina Ecosystem Enhancement Program (NCEEP) to restore and enhance riparian, stream and wetland habitats and water quality and then maintain and monitor the success of these restoration efforts in the future.

E. Grantee believes that the un-named non-navigable stream referenced above and certain portions of the Adjacent Parcel satisfy the site criteria established by the United States Army Corps of Engineers and the North Carolina Department of Water Quality for a successful stream restoration project (the **"Stream Restoration Project"**). The Stream Restoration Project will require that the water flow from the un-named non-navigable stream be relocated from Grantor's Parcel to the Adjacent Parcel, as generally shown as the existing stream alignment on the map attached hereto as Exhibit A. The existing stream channel will be plugged upstream from the Grantor's Parcel just after it flows through the CP&L easement and will be diverted south through the proposed new stream alignment on the Adjacent Parcel over 100' away from the western property line of the Grantor's Parcel. The existing stream channel will remain unchanged and will serve as a storm water ditch.

G. Grantor desires to waive any and all riparian or water rights of whatsoever nature relating to the diversion of water flow away from Grantor's Parcel in the above referenced un-named non-navigable stream, as more fully set out below.

NOW, THEREFORE, for valuable consideration, the parties hereby agree as follows:

Agreement

1. Waiver of Riparian Rights. Grantor permanently and irrevocably, for all time, hereby completely waives, releases, abandons any and all claims of every nature whatsoever related to or connected with (and any and all rights related to or connected with) the presence of, use of, access to or control over any water present in or flowing in the above-referenced un-named non-navigable stream, intentionally waiving any and all water rights, riparian rights or any other rights or claims whatsoever in connection therewith by operation of this provision. Furthermore, Grantor expressly acknowledges that Grantee makes no representation or warranty or guarantee as to whether or not future weather events or land surface alterations or the present Stream Restoration Project Activities will not result in the return of water temporarily or otherwise to the un-named non-navigable stream or that there will be no future flooding events. It is the express intention of the Grantor that this Agreement for Permanent Waiver of Riparian Rights will be a covenant running with the land and binding upon any and all subsequent owners, their successors, heirs, and or assigns of the above-referenced tract and parcel of land.

2. Purchase Price. Concurrently with the execution of this Agreement for the Permanent Waiver of Riparian Rights, Grantee shall pay to Grantor the amount of One Hundred and No/100ths Dollars ($100.00) as consideration for executing the Agreement. Grantee waives any rights to this payment now or in the future and shall become the Grantors property upon execution of this document.

3. Termination. This Permanent Waiver of Riparian Rights shall terminate only in the event that Grantee's proposal to the NCEEP for a Stream Restoration Project is not selected for contracting by the NCEEP. In such a case, within 30 days of notification of non-selection, Grantee shall prepare a notice of termination for Grantor's review and execution and shall then record the notice in the Johnston County Registry. Furthermore, should Grantee's proposal not be accepted by the NCEEP, it is understood by both parties that the Grantee shall not be responsible for doing any work contained herein.

4. Performance of Stream Restoration Project Activities. Prior to commencing the Stream Restoration Project activities, Grantee shall have obtained all permits and approvals necessary from the North Carolina Department of Water Quality, the United States Army Corps of Engineers and any other agencies with jurisdiction over the Stream Restoration Project activities (collectively, the **"Regulatory Agencies"**). Grantee shall cause the Stream Restoration Project activities to be performed in compliance with plans and specifications approved by the Regulatory Agencies and in accordance with all applicable laws, statutes and ordinances.

5. Agreement not to trespass. Nothing contained in this Agreement shall allow or cause Grantor to trespass or alter the Grantor's Parcel in any way other than the redirection of water flow as described in this Agreement.

6. Agreement not to negatively impact drainage. Grantee hereby agrees that Stream Restoration Project activities performed associated with this agreement shall not negatively impact any drainage or back up additional water on Grantor's Parcel in any way.

7. Property Boundary. In no case shall Grantee's Stream Restoration Project activities change or alter the Grantor's property boundary.

8. Recordation. This Agreement shall be recorded in the Official Records of Johnston County, North Carolina.

9. Entire Agreement. This Agreement and all matters referenced herein (including all Exhibits attached hereto) is the final expression of, and contains the entire agreement between, the parties with respect to the subject matter hereof and supersedes all prior understandings with respect thereto.

10. Governing Law. The parties hereto acknowledge that this Agreement has been negotiated and entered into in the State of North Carolina. The parties hereto expressly agree that this Agreement shall be governed by, interpreted under, and construed and enforced in accordance with the laws of the State of North Carolina.

11. Amendment. This Agreement may not be modified, changed, supplemented, superseded, canceled or terminated, nor may any obligations hereunder be waived, except by written instrument signed by both parties.

12. Relationship of Parties. Nothing contained in this Agreement shall be deemed or construed by the parties to create the relationship of principal and agent, a partnership, joint venture or any other association between the parties hereto.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement as of the date first written above.

GRANTEE:

WILDLANDS, ENGINEERING, INC.,
a North Carolina corporation

By: _____

Its: Vice President

Date: 02/10/11

GRANTOR:

STEWART 1996 FAMILY LIMITED PARTNERSHIP

By: Elmer Wayne Stewart

Its: General Partner

Date: February 12, 2011

STATE OF NORTH CAROLINA

COUNTY OF WAKE

I certify that the following person(s) personally appeared before me this day, each acknowledging to me that he or she voluntarily signed the foregoing document for the purpose stated therein and in the capacity indicated: John W. Hutton
name(s) of principal(s)

Date: 2/10/11

_____
(official signature of Notary)

(Official Seal)

DANIEL M TAYLOR NOTARY PUBLIC WAYNE COUNTY, N. C.

Daniel M. Taylor, Notary Public
(Notary's printed or typed name)

My commission expires: 10/04/2014

STATE OF NORTH CAROLINA

COUNTY OF WAKE

I certify that the following person(s) personally appeared before me this day, each acknowledging to me that he or she voluntarily signed the foregoing document for the purpose stated therein and in the capacity indicated: ELMER WAYNE STEWART
name(s) of principal(s)

Date: 02.12.2011

Michelle R. Wawrzyniak
(official signature of Notary)

(Official Seal)

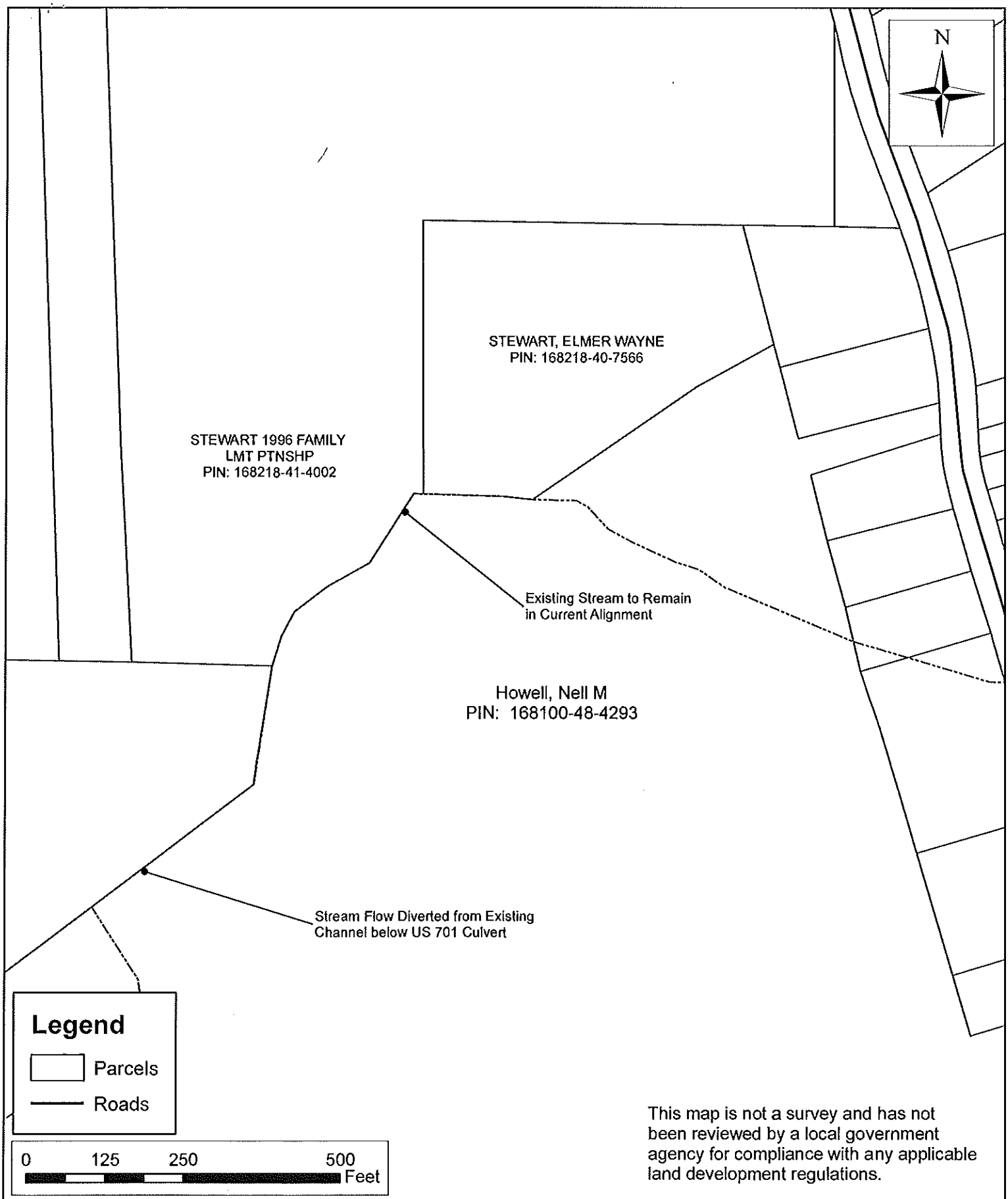
MICHELLE R. WAWRZYNIAK NOTARY PUBLIC WAKE COUNTY, NC

Michelle R. Wawrzyniak, Notary Public
(Notary's printed or typed name)

My commission expires: ~~10/04/2014~~ 08.26.2012

List of Exhibits

Exhibit A	-	Map Showing Grantor's Parcel, the Adjacent Parcels, and the Existing Location of the un-named non-navigable stream.



This map is not a survey and has not been reviewed by a local government agency for compliance with any applicable land development regulations.

WILDLANDS

Stewart Properties
Neuse 03020201
JOHNSTON COUNTY, NC

Exhibit A
Site Map

RECORDING REQUESTED BY AND WHEN RECORDED MAIL TO:

Mr. Shawn Wilkerson
Wildlands Engineering, Inc.
1430 South Main Street – Suite 104
Charlotte, NC 28203

Filed in JOHNSTON COUNTY, NC
CRAIG OLIVE, Register of Deeds
Filed 2/14/2011 10:28:04 AM
BOOK 3951 PAGE 881 - 886
INSTRUMENT # 2011309036
Real Estate Excise Tax: $0
Deputy/Assistant Register of Deeds: L KIRBY

SPACE ABOVE THIS LINE FOR RECORDER'S USE

AGREEMENT FOR

PERMANENT WAIVER OF RIPARIAN RIGHTS

(DEVIL'S RACETRACK ROAD – New Stream Alignment)

This Agreement for Permanent Waiver of Riparian Rights (**"Agreement"**), dated for reference purposes only as February 10, 2011, is entered into by and between **ELMER WAYNE STEWART AND JULIA WOMMACK STEWART** (collectively the **"Grantor,** and **WILDLANDS ENGINEERING, INC.,** a North Carolina corporation (**"Grantee"**).

Recitals

A. Grantor is the owner of that certain real property (**"Grantor's Parcel"**) consisting of approximately 4.39 acres, located at 370 Devil's Racetrack Road, Four Oaks, NC 27524 in Johnston County, North Carolina, as recorded in Book 1445 Page 0910 in the Johnston County Registry. The Grantor's Parcel is also identified as Tax Parcel Number 168218-40-7566.

B. Grantor's Parcel is located immediately adjacent and to and North of that certain real property, (the **"Adjacent Parcel"**) consisting of approximately 465.10 acres, located at 747 Devils Racetrack Road, Four Oaks, NC 27524 in the county of Johnston, State of North Carolina, as recorded in Book 3334 Page 0883 in the Johnston County Registry. The Adjacent Parcel is also identified as Tax Parcel Number 168100-48-4293.

C. An un-named non-navigable stream proceeds from parallel to Devils Racetrack Road across the eastern boundary of the Grantor's Parcel, as shown on the map attached hereto as Exhibit A and incorporated herein by this reference.

D. Grantee is in the business of preparing, designing, and obtaining conservation easements from landowners for the purposes of submitting a proposal to the North Carolina Ecosystem Enhancement Program (NCEEP) to restore and enhance riparian, stream and wetland habitats and water quality and then maintain and monitor the success of these restoration efforts in the future.

E. Grantee believes that the un-named non-navigable stream referenced above and certain portions of the Adjacent Parcel satisfy the site criteria established by the United States Army Corps of Engineers and the North Carolina Department of Water Quality for a successful stream restoration project (the **"Stream Restoration Project"**). The Stream Restoration Project will require that the water flow from the un-named non-navigable stream be relocated from Grantor's Parcel to the Adjacent Parcel, as generally shown as the existing stream alignment on the map attached hereto as Exhibit A. The existing stream channel will be plugged upstream from the Grantor's Parcel just after it flows through the CP&L easement and will be diverted south through the proposed new stream alignment on the Adjacent Parcel over 100' away from the western property line of the Grantor's Parcel. The existing stream channel will remain unchanged and will serve as a storm water ditch.

G. Grantor desires to waive any and all riparian or water rights of whatsoever nature relating to the diversion of water flow away from Grantor's Parcel in the above referenced un-named non-navigable stream, as more fully set out below.

NOW, THEREFORE, for valuable consideration, the parties hereby agree as follows:

Agreement

1. Waiver of Riparian Rights. Grantor permanently and irrevocably, for all time, hereby completely waives, releases, abandons any and all claims of every nature whatsoever related to or connected with (and any and all rights related to or connected with) the presence of, use of, access to or control over any water present in or flowing in the above-referenced un-named non-navigable stream, intentionally waiving any and all water rights, riparian rights or any other rights or claims whatsoever in connection therewith by operation of this provision. Furthermore, Grantor expressly acknowledges that Grantee makes no representation or warranty or guarantee as to whether or not future weather events or land surface alterations or the present Stream Restoration Project Activities will not result in the return of water temporarily or otherwise to the un-named non-navigable stream or that there will be no future flooding events. It is the express intention of the Grantor that this Agreement for Permanent Waiver of Riparian Rights will be a covenant running with the land and binding upon any and all subsequent owners, their successors, heirs, and or assigns of the above-referenced tract and parcel of land.

2. Purchase Price. Concurrently with the execution of this Agreement for the Permanent Waiver of Riparian Rights, Grantee shall pay to Grantor the amount of One Hundred and No/100ths Dollars ($100.00) as consideration for executing the Agreement. Grantee waives any rights to this payment now or in the future and shall become the Grantors property upon execution of this document.

3. Termination. This Permanent Waiver of Riparian Rights shall terminate only in the event that Grantee's proposal to the NCEEP for a Stream Restoration Project is not selected for contracting by the NCEEP. In such a case, within 30 days of notification of non-selection, Grantee shall prepare a notice of termination for Grantor's review and execution and shall then record the notice in the Johnson County Registry. Furthermore, should Grantee's proposal not be accepted by the NCEEP, it is understood by both parties that the Grantee shall not be responsible for doing any work contained herein.

4. Performance of Stream Restoration Project Activities. Prior to commencing the Stream Restoration Project activities, Grantee shall have obtained all permits and approvals necessary from the North Carolina Department of Water Quality, the United States Army Corps of Engineers and any other agencies with jurisdiction over the Stream Restoration Project activities (collectively, the **"Regulatory Agencies"**). Grantee shall cause the Stream Restoration Project activities to be performed in compliance with plans and specifications approved by the Regulatory Agencies and in accordance with all applicable laws, statutes and ordinances.

5. Agreement not to trespass. Nothing contained in this Agreement shall allow or cause Grantor to trespass or alter the Grantor's Parcel in any way other than the redirection of water flow as described in this Agreement.

6. Agreement not to negatively impact drainage. Grantee hereby agrees that Stream Restoration Project activities performed associated with this agreement shall not negatively impact any drainage or back up additional water on Grantor's Parcel in any way.

7. Property Boundary. In no case shall Grantee's Stream Restoration Project activities change or alter the Grantor's property boundary.

8. Recordation. This Agreement shall be recorded in the Official Records of Johnston County, North Carolina.

9. Entire Agreement. This Agreement and all matters referenced herein (including all Exhibits attached hereto) is the final expression of, and contains the entire agreement between, the parties with respect to the subject matter hereof and supersedes all prior understandings with respect thereto.

10. Governing Law. The parties hereto acknowledge that this Agreement has been negotiated and entered into in the State of North Carolina. The parties hereto expressly agree that this Agreement shall be governed by, interpreted under, and construed and enforced in accordance with the laws of the State of North Carolina.

11. Amendment. This Agreement may not be modified, changed, supplemented, superseded, canceled or terminated, nor may any obligations hereunder be waived, except by written instrument signed by both parties.

12. Relationship of Parties. Nothing contained in this Agreement shall be deemed or construed by the parties to create the relationship of principal and agent, a partnership, joint venture or any other association between the parties hereto.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement as of the date first written above.

GRANTEE:

WILDLANDS, ENGINEERING, INC.,
a North Carolina corporation

By: _____

Its: Vice President

Date: 02/10/11

GRANTOR:

ELMER WAYNE STEWART AND JULIA WOMMACK STEWART

By: Elmer Wayne Stewart

Date: February 12, 2011

By: Julia Wommack Stewart

Date: 2/12/11

STATE OF NORTH CAROLINA

COUNTY OF WAKE

I certify that the following person(s) personally appeared before me this day, each acknowledging to me that he or she voluntarily signed the foregoing document for the purpose stated therein and in the capacity indicated: John W. Hutton
name(s) of principal(s)

Date: 2/10/11

(official signature of Notary)

(Official Seal) DANIEL M TAYLOR NOTARY PUBLIC WAYNE COUNTY, N. C.

Daniel M. Taylor, Notary Public
(Notary's printed or typed name)

My commission expires: 10/04/2014

STATE OF NORTH CAROLINA

COUNTY OF Wake

I certify that the following person(s) personally appeared before me this day, each acknowledging to me that he or she voluntarily signed the foregoing document for the purpose stated therein and in the capacity indicated: Elmer Wayne Stewart and Julia Wommack Stewart
name(s) of principal(s)

Date: 02.12.2011

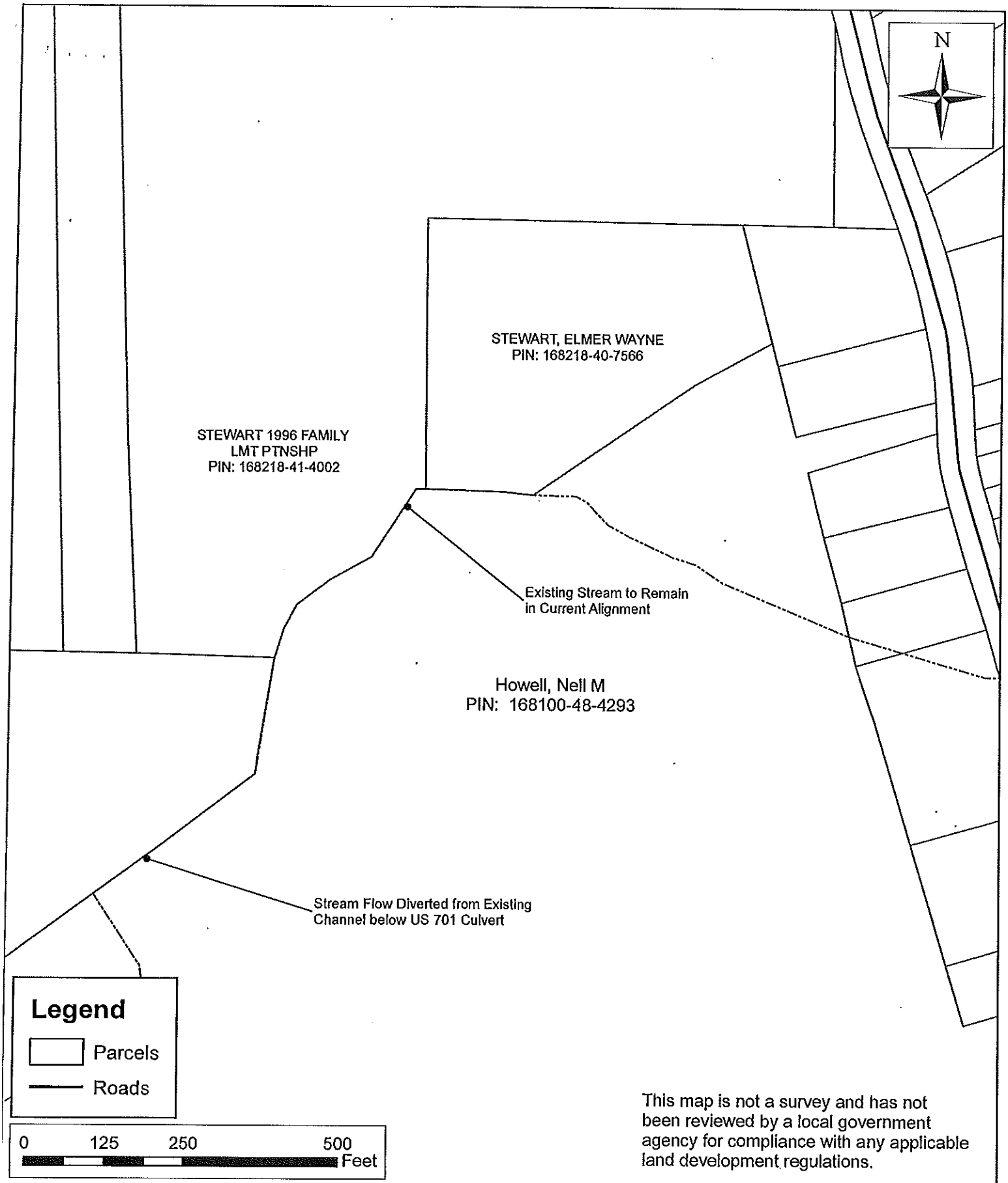
(official signature of Notary)

(Official Seal) MICHELLE R WALDEN-WYATT Daniel M. Taylor, Notary Public
(Notary's printed or typed name)

My commission expires: ~~10/04/2014~~ DB 26 2012

List of Exhibits

Exhibit A	-	Map Showing Grantor's Parcel, the Adjacent Parcels, and the Existing Location of the un-named non-navigable stream.



This map is not a survey and has not been reviewed by a local government agency for compliance with any applicable land development regulations.

WILDLANDS

Stewart Properties
Neuse 03020201
JOHNSTON COUNTY, NC

Exhibit A
Site Map

Appendix 4: USACE and NCDWQ Stream and Wetland Forms

U.S. ARMY CORPS OF ENGINEERS
WILMINGTON DISTRICT

Action Id. **SAW-2012-00810** County: **Johnston** U.S.G.S. Quad: **Four Oaks**

NOTIFICATION OF JURISDICTIONAL DETERMINATION

Property Owner: **Wildlands Engineering, Inc.**
Matt Jenkins
Address: **1430 South Mint St.**
Suite 104
Charlotte, NC, 28203

Agent:

Address:

Property description:
Size (acres) **100**
Nearest Waterway Neuse River
USGS HUC **03020201**

Nearest Town **Four Oaks**
River Basin **Neuse**
Coordinates **Latitude: 35.4488**
Longitude: -78.3804

Location description: **The property is located on each side of Devils Racetrack Rd, south of its intersection with I-95, east of US Hwy 701, east of Four Oaks, Johnston County, NC**

Indicate Which of the Following Apply:

A. Preliminary Determination

_ Based on preliminary information, there may be wetlands on the above described property. We strongly suggest you have this property inspected to determine the extent of Department of the Army (DA) jurisdiction. To be considered final, a jurisdictional determination must be verified by the Corps. This preliminary determination is not an appealable action under the Regulatory Program Administrative Appeal Process (Reference 33 CFR Part 331). If you wish, you may request an approved JD (which may be appealed), by contacting the Corps district for further instruction. Also, you may provide new information for further consideration by the Corps to reevaluate the JD.

B. Approved Determination

_ There are Navigable Waters of the United States within the above described property subject to the permit requirements of Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act. Unless there is a change in the law or our published regulations, this determination may be relied upon for a period not to exceed five years from the date of this notification.

X There are waters of the U.S. including wetlands on the above described property subject to the permit requirements of Section 404 of the Clean Water Act (CWA)(33 USC § 1344). Unless there is a change in the law or our published regulations, this determination may be relied upon for a period not to exceed five years from the date of this notification.

_ We strongly suggest you have the wetlands on your property delineated. Due to the size of your property and/or our present workload, the Corps may not be able to accomplish this wetland delineation in a timely manner. For a more timely delineation, you may wish to obtain a consultant. To be considered final, any delineation must be verified by the Corps.

X The waters of the U.S. including wetlands on your project area have been delineated and the delineation has been verified by the Corps. We strongly suggest you have this delineation surveyed. Upon completion, this survey should be reviewed and verified by the Corps. Once verified, this survey will provide an accurate depiction of all areas subject to CWA jurisdiction on your property which, provided there is no change in the law or our published regulations, may be relied upon for a period not to exceed five years.

_ The waters of the U.S. including wetlands have been delineated and surveyed and are accurately depicted on the plat signed by the Corps Regulatory Official identified below on ___. Unless there is a change in the law or our published regulations, this determination may be relied upon for a period not to exceed five years from the date of this notification.

_ There are no waters of the U.S., to include wetlands, present on the above described project area which are subject to the permit requirements of Section 404 of the Clean Water Act (33 USC 1344). Unless there is a change in the law or our

published regulations, this determination may be relied upon for a period not to exceed five years from the date of this notification.

- The property is located in one of the 20 Coastal Counties subject to regulation under the Coastal Area Management Act (CAMA). You should contact the Division of Coastal Management in Morehead City, NC, at (252) 808-2808 to determine their requirements.

Placement of dredged or fill material within waters of the US and/or wetlands without a Department of the Army permit may constitute a violation of Section 301 of the Clean Water Act (33 USC § 1311). If you have any questions regarding this determination and/or the Corps regulatory program, please contact **Thomas Brown** at **919-554-4884 x22/Thomas.L.Brown@usace.army.mil.**

C. Basis For Determination

Ordinary High Water Mark; 1987 manual Atlantic and Gulf Coastal Plain Regional Supplement

D. Remarks

E. Attention USDA Program Participants

This delineation/determination has been conducted to identify the limits of Corps' Clean Water Act jurisdiction for the particular site identified in this request. The delineation/determination may not be valid for the wetland conservation provisions of the Food Security Act of 1985. If you or your tenant are USDA Program participants, or anticipate participation in USDA programs, you should request a certified wetland determination from the local office of the Natural Resources Conservation Service, prior to starting work.

F. Appeals Information (This information applies only to approved jurisdictional determinations as indicated in B. above)

This correspondence constitutes an approved jurisdictional determination for the above described site. If you object to this determination, you may request an administrative appeal under Corps regulations at 33 CFR Part 331. Enclosed you will find a Notification of Appeal Process (NAP) fact sheet and request for appeal (RFA) form. If you request to appeal this determination you must submit a completed RFA form to the following address:

US Army Corps of Engineers
South Atlantic Division
Attn: Jason Steele, Review Officer
60 Forsyth Street SW, Room 10M15
Atlanta, Georgia 30303-8801

In order for an RFA to be accepted by the Corps, the Corps must determine that it is complete, that it meets the criteria for appeal under 33 CFR part 331.5, and that it has been received by the Division Office within 60 days of the date of the NAP. Should you decide to submit an RFA form, it must be received at the above address by August 12, 2012.

It is not necessary to submit an RFA form to the Division Office if you do not object to the determination in this correspondence.

Corps Regulatory Official: _____

Date: **June 13, 2012** Expiration Date: **June 13, 2017**

The Wilmington District is committed to providing the highest level of support to the public. To help us ensure we continue to do so, please complete the attached customer Satisfaction Survey or visit http://per2.nwp.usace.army.mil/survey.html to complete the survey online.

Copy furnished:

NOTIFICATION OF ADMINISTRATIVE APPEAL OPTIONS AND PROCESS AND REQUEST FOR APPEAL

Applicant: **Wildlands Engineering, Inc.**	File Number: **SAW-2012-00810**	Date: June 13, 2012

Attached is:	See Section below
☐ INITIAL PROFFERED PERMIT (Standard Permit or Letter of permission)	A
☐ PROFFERED PERMIT (Standard Permit or Letter of permission)	B
☐ PERMIT DENIAL	C
☒ APPROVED JURISDICTIONAL DETERMINATION	D
☐ PRELIMINARY JURISDICTIONAL DETERMINATION	E

SECTION I - The following identifies your rights and options regarding an administrative appeal of the above decision. Additional information may be found at http://www.usace.army.mil/inet/functions/cw/cecwo/reg or Corps regulations at 33 CFR Part 331.

A: INITIAL PROFFERED PERMIT: You may accept or object to the permit.

- ACCEPT: If you received a Standard Permit, you may sign the permit document and return it to the district engineer for final authorization. If you received a Letter of Permission (LOP), you may accept the LOP and your work is authorized. Your signature on the Standard Permit or acceptance of the LOP means that you accept the permit in its entirety, and waive all rights to appeal the permit, including its terms and conditions, and approved jurisdictional determinations associated with the permit.
- OBJECT: If you object to the permit (Standard or LOP) because of certain terms and conditions therein, you may request that the permit be modified accordingly. You must complete Section II of this form and return the form to the district engineer. Your objections must be received by the district engineer within 60 days of the date of this notice, or you will forfeit your right to appeal the permit in the future. Upon receipt of your letter, the district engineer will evaluate your objections and may: (a) modify the permit to address all of your concerns, (b) modify the permit to address some of your objections, or (c) not modify the permit having determined that the permit should be issued as previously written. After evaluating your objections, the district engineer will send you a proffered permit for your reconsideration, as indicated in Section B below.

B: PROFFERED PERMIT: You may accept or appeal the permit

- ACCEPT: If you received a Standard Permit, you may sign the permit document and return it to the district engineer for final authorization. If you received a Letter of Permission (LOP), you may accept the LOP and your work is authorized. Your signature on the Standard Permit or acceptance of the LOP means that you accept the permit in its entirety, and waive all rights to appeal the permit, including its terms and conditions, and approved jurisdictional determinations associated with the permit.
- APPEAL: If you choose to decline the proffered permit (Standard or LOP) because of certain terms and conditions therein, you may appeal the declined permit under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division engineer. This form must be received by the division engineer within 60 days of the date of this notice.

C: PERMIT DENIAL: You may appeal the denial of a permit under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division engineer. This form must be received by the division engineer within 60 days of the date of this notice.

D: APPROVED JURISDICTIONAL DETERMINATION: You may accept or appeal the approved JD or provide new information.

- ACCEPT: You do not need to notify the Corps to accept an approved JD. Failure to notify the Corps within 60 days of the date of this notice, means that you accept the approved JD in its entirety, and waive all rights to appeal the approved JD.
- APPEAL: If you disagree with the approved JD, you may appeal the approved JD under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the district engineer. This form must be received by the division engineer within 60 days of the date of this notice.

E: PRELIMINARY JURISDICTIONAL DETERMINATION: You do not need to respond to the Corps regarding the preliminary JD. The Preliminary JD is not appealable. If you wish, you may request an approved JD (which may be appealed), by contacting the Corps district for further instruction. Also you may provide new information for further consideration by the Corps to reevaluate the JD.

SECTION II - REQUEST FOR APPEAL or OBJECTIONS TO AN INITIAL PROFFERED PERMIT

REASONS FOR APPEAL OR OBJECTIONS: (Describe your reasons for appealing the decision or your objections to an initial proffered permit in clear concise statements. You may attach additional information to this form to clarify where your reasons or objections are addressed in the administrative record.)

ADDITIONAL INFORMATION: The appeal is limited to a review of the administrative record, the Corps memorandum for the record of the appeal conference or meeting, and any supplemental information that the review officer has determined is needed to clarify the administrative record. Neither the appellant nor the Corps may add new information or analyses to the record. However, you may provide additional information to clarify the location of information that is already in the administrative record.

POINT OF CONTACT FOR QUESTIONS OR INFORMATION:

If you have questions regarding this decision and/or the appeal process you may contact:	If you only have questions regarding the appeal process you may also contact:
District Engineer, Wilmington Regulatory Division, **Attn: Thomas Brown** **Raleigh Regualtory Field Office** **3331 Heritage Trade Dr, Suite 105** **Wake Forest, NC 27587**	Mr. Jason Steele, Administrative Appeal Review Officer CESAD-PDO U.S. Army Corps of Engineers, South Atlantic Division 60 Forsyth Street, Room 10M15 Atlanta, Georgia 30303-8801 Phone: (404) 562-5137

RIGHT OF ENTRY: Your signature below grants the right of entry to Corps of Engineers personnel, and any government consultants, to conduct investigations of the project site during the course of the appeal process. You will be provided a 15 day notice of any site investigation, and will have the opportunity to participate in all site investigations.

	Date:	Telephone number:
_____ Signature of appellant or agent.		

For appeals on Initial Proffered Permits send this form to:

District Engineer, Wilmington Regulatory Division, Attn: Thomas Brown, 69 Darlington Avenue, Wilmington, North Carolina 28403

For Permit denials, Proffered Permits and approved Jurisdictional Determinations send this form to:

Division Engineer, Commander, U.S. Army Engineer Division, South Atlantic, Attn: Mr. Jason Steele, Administrative Appeal Officer, CESAD-PDO, 60 Forsyth Street, Room 10M15, Atlanta, Georgia 30303-8801 Phone: (404) 562-5137

NC DWQ Stream Identification Form Version 4.11

Date: 2/23/12	Project/Site: Devils Racetrack	Latitude: 35.447875°N
Evaluator: Matt Jenkins	County: Johnston	Longitude: 78.386804°W
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 37	Stream Determination (circle one) Ephemeral Intermittent (Perennial)	Other SCPI - Upper e.g. Quad Name: Southwest Br.

A. Geomorphology (Subtotal = 17)	Absent	Weak	Moderate	Strong
1[a]. Continuity of channel bed and bank	0	1	2	(3)
2. Sinuosity of channel along thalweg	0	(1)	2	3
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	0	1	(2)	3
4. Particle size of stream substrate	0	1	(2)	3
5. Active/relict floodplain	0	(1)	2	3
6. Depositional bars or benches	0	1	(2)	3
7. Recent alluvial deposits	0	1	(2)	3
8. Headcuts	0	1	(2)	3
9. Grade control	0	0.5	(1)	1.5
10. Natural valley	0	0.5	(1)	1.5
11. Second or greater order channel	No = (0)		Yes = 3	

[a] artificial ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 10.5)				
12. Presence of Baseflow	0	1	2	(3)
13. Iron oxidizing bacteria	0	(1)	2	3
14. Leaf litter	(1.5)	1	0.5	0
15. Sediment on plants or debris	0	0.5	(1)	1.5
16. Organic debris lines or piles	0	0.5	(1)	1.5
17. Soil-based evidence of high water table?	No = 0		Yes = (3)	

C. Biology (Subtotal = 9.5)				
18. Fibrous roots in streambed	(3)	2	1	0
19. Rooted upland plants in streambed	(3)	2	1	0
20. Macrobenthos (note diversity and abundance)	0	(1)	2	3
21. Aquatic Mollusks	(0)	1	2	3
22. Fish	0	(0.5)	1	1.5
23. Crayfish	(0)	0.5	1	1.5
24. Amphibians	0	0.5	(1)	1.5
25. Algae	0	0.5	(1)	1.5
26. Wetland plants in streambed	FACW = 0.75; OBL = 1.5 Other = 0			

*perennial streams may also be identified using other methods. See p. 35 of manual.

Notes: Perennial channel begins at natural spring head.

Sketch:

NC DWQ Stream Identification Form Version 4.11

Date: 2/23/12	**Project/Site:** Devils Racetrack	**Latitude:** 35.449828°N
Evaluator: Matt Jenkins	**County:** Johnston	**Longitude:** 78.386857°W
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 34.5	**Stream Determination (circle one)** Ephemeral Intermittent (Perennial)	**Other** SCP2 - Lower *e.g. Quad Name:* Southwest Br.

A. Geomorphology (Subtotal = 13)	Absent	Weak	Moderate	Strong
1[a]. Continuity of channel bed and bank	0	1	2	(3)
2. Sinuosity of channel along thalweg	(0)	1	2	3
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	0	(1)	2	3
4. Particle size of stream substrate	0	(1)	2	3
5. Active/relict floodplain	0	1	2	(3)
6. Depositional bars or benches	0	1	(2)	3
7. Recent alluvial deposits	0	1	(2)	3
8. Headcuts	(0)	1	2	3
9. Grade control	(0)	0.5	1	1.5
10. Natural valley	0	0.5	(1)	1.5
11. Second or greater order channel	No = (0)		Yes = 3	

[a] artificial ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 10.5)				
12. Presence of Baseflow	0	1	2	(3)
13. Iron oxidizing bacteria	0	(1)	2	3
14. Leaf litter	(1.5)	1	0.5	0
15. Sediment on plants or debris	0	0.5	1	(1.5)
16. Organic debris lines or piles	0	(0.5)	1	1.5
17. Soil-based evidence of high water table?	No = 0		Yes = (3)	

C. Biology (Subtotal = 11)				
18. Fibrous roots in streambed	3	2	(1)	0
19. Rooted upland plants in streambed	(3)	2	1	0
20. Macrobenthos (note diversity and abundance)	0	(1)	2	3
21. Aquatic Mollusks	(0)	1	2	3
22. Fish	0	0.5	(1)	1.5
23. Crayfish	0	(0.5)	1	1.5
24. Amphibians	0	0.5	1	(1.5)
25. Algae	0	0.5	1	(1.5)
26. Wetland plants in streambed	FACW = 0.75; OBL = (1.5) Other = 0			

*perennial streams may also be identified using other methods. See p. 35 of manual.

Notes: Channel has been heavily manipulated and ditched.

Sketch:

NC DWQ Stream Identification Form Version 4.11

Date: 2/23/12	**Project/Site:** Devils Racetrack	**Latitude:** 35.450708°N
Evaluator: Matt Jenkins	**County:** Johnston	**Longitude:** 78.386406° W
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 38	**Stream Determination (circle one)** Ephemeral Intermittent (Perennial)	**Other** SCP 3 - Upper *e.g. Quad Name:* Devils Racetrack Creek

A. Geomorphology (Subtotal = 17)	Absent	Weak	Moderate	Strong
1[a]. Continuity of channel bed and bank	0	1	2	(3)
2. Sinuosity of channel along thalweg	(0)	1	2	3
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	0	1	(2)	3
4. Particle size of stream substrate	0	(1)	2	3
5. Active/relict floodplain	0	1	2	(3)
6. Depositional bars or benches	0	(1)	2	3
7. Recent alluvial deposits	0	1	(2)	3
8. Headcuts	0	(1)	2	3
9. Grade control	0	(0.5)	1	1.5
10. Natural valley	0	(0.5)	1	1.5
11. Second or greater order channel	No = 0		Yes = (3)	

[a] artificial ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 10.5)				
12. Presence of Baseflow	0	1	2	(3)
13. Iron oxidizing bacteria	0	(1)	2	3
14. Leaf litter	(1.5)	1	0.5	0
15. Sediment on plants or debris	0	0.5	(1)	1.5
16. Organic debris lines or piles	0	0.5	(1)	1.5
17. Soil-based evidence of high water table?	No = 0		Yes = (3)	

C. Biology (Subtotal = 10.5)				
18. Fibrous roots in streambed	(3)	2	1	0
19. Rooted upland plants in streambed	(3)	2	1	0
20. Macrobenthos (note diversity and abundance)	0	(1)	2	3
21. Aquatic Mollusks	(0)	1	2	3
22. Fish	0	0.5	(1)	1.5
23. Crayfish	0	(0.5)	1	1.5
24. Amphibians	0	0.5	1	(1.5)
25. Algae	0	(0.5)	1	1.5
26. Wetland plants in streambed	FACW = 0.75; OBL = 1.5 Other = 0			

*perennial streams may also be identified using other methods. See p. 35 of manual.

Notes: Channel has been heavily manipulated and ditched.

Sketch:

NC DWQ Stream Identification Form Version 4.11

Date: 2/23/12	**Project/Site:** Devils Racetrack	**Latitude:** 35.448919° N
Evaluator: Matt Jenkins	**County:** Johnston	**Longitude:** 78.384006° W
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 30	**Stream Determination (circle one)** Ephemeral Intermittent (Perennial)	**Other** SCP4 - Middle Branch *e.g. Quad Name:*

A. Geomorphology (Subtotal = 11.5)	Absent	Weak	Moderate	Strong
1[a]. Continuity of channel bed and bank	0	1	2	(3)
2. Sinuosity of channel along thalweg	(0)	1	2	3
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	0	(1)	2	3
4. Particle size of stream substrate	0	(1)	2	3
5. Active/relict floodplain	0	1	2	(3)
6. Depositional bars or benches	0	(1)	2	3
7. Recent alluvial deposits	0	(1)	2	3
8. Headcuts	0	(1)	2	3
9. Grade control	(0)	0.5	1	1.5
10. Natural valley	0	(0.5)	1	1.5
11. Second or greater order channel	No = (0)		Yes = 3	

[a] artificial ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 10)				
12. Presence of Baseflow	0	1	2	(3)
13. Iron oxidizing bacteria	0	(1)	2	3
14. Leaf litter	(1.5)	1	0.5	0
15. Sediment on plants or debris	0	(0.5)	1	1.5
16. Organic debris lines or piles	0	0.5	(1)	1.5
17. Soil-based evidence of high water table?	No = 0		Yes = (3)	

C. Biology (Subtotal = 8.5)				
18. Fibrous roots in streambed	(3)	2	1	0
19. Rooted upland plants in streambed	(3)	2	1	0
20. Macrobenthos (note diversity and abundance)	(0)	1	2	3
21. Aquatic Mollusks	(0)	1	2	3
22. Fish	(0)	0.5	1	1.5
23. Crayfish	(0)	0.5	1	1.5
24. Amphibians	0	0.5	(1)	1.5
25. Algae	0	0.5	1	(1.5)
26. Wetland plants in streambed	FACW = 0.75; OBL = 1.5 Other = 0			

*perennial streams may also be identified using other methods. See p. 35 of manual.

Notes: Channel is fed by ~1 acre pond and receives year-round flow. Channel has been heavily manipulated and ditched.

Sketch:

NC DWQ Stream Identification Form Version 4.11

Date: 2/23/12	**Project/Site:** Devils Racetrack	**Latitude:** 35.451509 °N
Evaluator: Matt Jenkins	**County:** Johnston	**Longitude:** 78.381222° W
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 37.5	**Stream Determination (circle one)** Ephemeral Intermittent (Perennial)	**Other** SCPS. Middle *e.g. Quad Name:* Devils Racetrack Creek

A. Geomorphology (Subtotal = 17)	Absent	Weak	Moderate	Strong
1[a]. Continuity of channel bed and bank	0	1	2	(3)
2. Sinuosity of channel along thalweg	0	(1)	2	3
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	0	(1)	2	3
4. Particle size of stream substrate	0	(1)	2	3
5. Active/relict floodplain	0	1	2	(3)
6. Depositional bars or benches	0	(1)	2	3
7. Recent alluvial deposits	0	1	(2)	3
8. Headcuts	0	(1)	2	3
9. Grade control	0	(0.5)	1	1.5
10. Natural valley	0	(0.5)	1	1.5
11. Second or greater order channel	No = 0		Yes = (3)	

[a] artificial ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 9.5)				
12. Presence of Baseflow	0	1	2	(3)
13. Iron oxidizing bacteria	(0)	1	2	3
14. Leaf litter	(1.5)	1	0.5	0
15. Sediment on plants or debris	0	0.5	(1)	1.5
16. Organic debris lines or piles	0	0.5	(1)	1.5
17. Soil-based evidence of high water table?	No = 0		Yes = (3)	

C. Biology (Subtotal = 11)				
18. Fibrous roots in streambed	(3)	2	1	0
19. Rooted upland plants in streambed	(3)	2	1	0
20. Macrobenthos (note diversity and abundance)	0	(1)	2	3
21. Aquatic Mollusks	(0)	1	2	3
22. Fish	0	0.5	(1)	1.5
23. Crayfish	0	(0.5)	1	1.5
24. Amphibians	0	0.5	1	(1.5)
25. Algae	0	0.5	(1)	1.5
26. Wetland plants in streambed	FACW = 0.75; OBL = 1.5 Other = 0			

*perennial streams may also be identified using other methods. See p. 35 of manual.

Notes:

Sketch:

NC DWQ Stream Identification Form Version 4.11

Date: 2/23/12	**Project/Site:** Devil's Racetrack	**Latitude:** 35.453276°N
Evaluator: Matt Jenkins	**County:** Johnston	**Longitude:** 78.379361°W
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 32	**Stream Determination (circle one)** Ephemeral Intermittent (Perennial)	**Other** SCP6 - North Branch *e.g. Quad Name:*

A. Geomorphology (Subtotal = 13)	Absent	Weak	Moderate	Strong
1[a]. Continuity of channel bed and bank	0	1	(2)	3
2. Sinuosity of channel along thalweg	0	1	2	(3)
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	0	(1)	2	3
4. Particle size of stream substrate	0	(1)	2	3
5. Active/relict floodplain	0	1	2	(3)
6. Depositional bars or benches	0	(1)	2	3
7. Recent alluvial deposits	0	(1)	2	3
8. Headcuts	(0)	1	2	3
9. Grade control	0	(0.5)	1	1.5
10. Natural valley	0	(0.5)	1	1.5
11. Second or greater order channel	No = (0)		Yes = 3	

[a] artificial ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 10)				
12. Presence of Baseflow	0	1	2	(3)
13. Iron oxidizing bacteria	0	(1)	2	3
14. Leaf litter	(1.5)	1	0.5	0
15. Sediment on plants or debris	0	(0.5)	1	1.5
16. Organic debris lines or piles	0	0.5	(1)	1.5
17. Soil-based evidence of high water table?	No = 0		Yes = (3)	

C. Biology (Subtotal = 9)				
18. Fibrous roots in streambed	(3)	2	1	0
19. Rooted upland plants in streambed	(3)	2	1	0
20. Macrobenthos (note diversity and abundance)	(0)	1	2	3
21. Aquatic Mollusks	(0)	1	2	3
22. Fish	0	(0.5)	1	1.5
23. Crayfish	0	(0.5)	1	1.5
24. Amphibians	0	0.5	1	(1.5)
25. Algae	0	(0.5)	1	1.5
26. Wetland plants in streambed	FACW = 0.75; OBL = 1.5 Other = 0			

*perennial streams may also be identified using other methods. See p. 35 of manual.

Notes:

Sketch:

NC DWQ Stream Identification Form Version 4.11

Date: 2/23/12	**Project/Site:** Devil's Racetrack	**Latitude:** 35.44601° N
Evaluator: Matt Jenkins	**County:** Johnston	**Longitude:** 78.384634° W
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 29	**Stream Determination (circle one)** Ephemeral (Intermittent) Perennial	**Other** SCP7- Upper *e.g. Quad Name:* South East Branch

A. Geomorphology (Subtotal = 14.5)	Absent	Weak	Moderate	Strong
1[a]. Continuity of channel bed and bank	0	1	2	(3)
2. Sinuosity of channel along thalweg	0	(1)	2	3
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	0	(1)	2	3
4. Particle size of stream substrate	0	(1)	2	3
5. Active/relict floodplain	0	(1)	2	3
6. Depositional bars or benches	0	(1)	2	3
7. Recent alluvial deposits	0	1	(2)	3
8. Headcuts	0	1	2	(3)
9. Grade control	0	(0.5)	1	1.5
10. Natural valley	0	0.5	(1)	1.5
11. Second or greater order channel	No = (0)		Yes = 3	

[a] artificial ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 7.5)				
12. Presence of Baseflow	0	1	(2)	3
13. Iron oxidizing bacteria	(0)	1	2	3
14. Leaf litter	(1.5)	1	0.5	0
15. Sediment on plants or debris	0	(0.5)	1	1.5
16. Organic debris lines or piles	0	(0.5)	1	1.5
17. Soil-based evidence of high water table?	No = 0		Yes = (3)	

C. Biology (Subtotal = 7)				
18. Fibrous roots in streambed	3	2	(1)	0
19. Rooted upland plants in streambed	(3)	2	1	0
20. Macrobenthos (note diversity and abundance)	(0)	1	2	3
21. Aquatic Mollusks	(0)	1	2	3
22. Fish	(0)	0.5	1	1.5
23. Crayfish	(0)	0.5	1	1.5
24. Amphibians	0	(0.5)	1	1.5
25. Algae	0	0.5	(1)	1.5
26. Wetland plants in streambed	FACW = 0.75; OBL = (1.5) Other = 0			

*perennial streams may also be identified using other methods. See p. 35 of manual.

Notes:

Sketch:

NC DWQ Stream Identification Form Version 4.11

Date: 2/23/12	**Project/Site:** Devils Racetrack	**Latitude:** 35.447651°N
Evaluator: Matt Jenkins	**County:** Johnston	**Longitude:** 78.381966°W
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 30.75	**Stream Determination (circle one)** Ephemeral Intermittent (Perennial)	**Other** SCP8 - Middle *e.g. Quad Name:* Southeast Branch

A. Geomorphology (Subtotal = 12.5)	Absent	Weak	Moderate	Strong
1[a]. Continuity of channel bed and bank	0	1	2	(3)
2. Sinuosity of channel along thalweg	(0)	1	2	3
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	0	(1)	2	3
4. Particle size of stream substrate	0	(1)	2	3
5. Active/relict floodplain	0	1	(2)	3
6. Depositional bars or benches	0	(1)	2	3
7. Recent alluvial deposits	0	1	(2)	3
8. Headcuts	0	(1)	2	3
9. Grade control	0	(0.5)	1	1.5
10. Natural valley	0	0.5	(1)	1.5
11. Second or greater order channel	No = (0)		Yes = 3	

[a] artificial ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 9.5)				
12. Presence of Baseflow	0	1	2	(3)
13. Iron oxidizing bacteria	0	(1)	2	3
14. Leaf litter	(1.5)	1	0.5	0
15. Sediment on plants or debris	0	(0.5)	1	1.5
16. Organic debris lines or piles	0	(0.5)	1	1.5
17. Soil-based evidence of high water table?	No = 0		Yes = (3)	

C. Biology (Subtotal = 8.75)				
18. Fibrous roots in streambed	3	(2)	1	0
19. Rooted upland plants in streambed	(3)	2	1	0
20. Macrobenthos (note diversity and abundance)	(0)	1	2	3
21. Aquatic Mollusks	(0)	1	2	3
22. Fish	(0)	0.5	1	1.5
23. Crayfish	(0)	0.5	1	1.5
24. Amphibians	0	0.5	1	(1.5)
25. Algae	0	0.5	1	(1.5)
26. Wetland plants in streambed	FACW = (0.75) OBL = 1.5 Other = 0			

*perennial streams may also be identified using other methods. See p. 35 of manual.

Notes:

Sketch:

NC DWQ Stream Identification Form Version 4.11

Date: 2/23/12	**Project/Site:** Devils Racetrack	**Latitude:** 35.446364°N
Evaluator: Matt Jenkins	**County:** Johnston	**Longitude:** 78.380506°W
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 19.25	**Stream Determination (circle one)** Ephemeral (Intermittent) Perennial	**Other** SCP9- UT to *e.g. Quad Name:* Southeast Branch

A. Geomorphology (Subtotal = 6)	Absent	Weak	Moderate	Strong
1[a]. Continuity of channel bed and bank	0	1	(2)	3
2. Sinuosity of channel along thalweg	(0)	1	2	3
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	(0)	1	2	3
4. Particle size of stream substrate	0	(1)	2	3
5. Active/relict floodplain	0	(1)	2	3
6. Depositional bars or benches	(0)	1	2	3
7. Recent alluvial deposits	0	(1)	2	3
8. Headcuts	(0)	1	2	3
9. Grade control	0	(0.5)	1	1.5
10. Natural valley	0	(0.5)	1	1.5
11. Second or greater order channel	No = (0)		Yes = 3	

[a] artificial ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 6.5)				
12. Presence of Baseflow	0	(1)	2	3
13. Iron oxidizing bacteria	(0)	1	2	3
14. Leaf litter	(1.5)	1	0.5	0
15. Sediment on plants or debris	0	(0.5)	1	1.5
16. Organic debris lines or piles	0	(0.5)	1	1.5
17. Soil-based evidence of high water table?	No = 0		Yes = (3)	

C. Biology (Subtotal = 6.75)				
18. Fibrous roots in streambed	3	2	(1)	0
19. Rooted upland plants in streambed	(3)	2	1	0
20. Macrobenthos (note diversity and abundance)	(0)	1	2	3
21. Aquatic Mollusks	(0)	1	2	3
22. Fish	(0)	0.5	1	1.5
23. Crayfish	(0)	0.5	1	1.5
24. Amphibians	0	0.5	(1)	1.5
25. Algae	0	0.5	(1)	1.5
26. Wetland plants in streambed	FACW = (0.75) OBL = 1.5 Other = 0			

*perennial streams may also be identified using other methods. See p. 35 of manual.

Notes:

Sketch:

NC DWQ Stream Identification Form Version 4.11

Date: 2/23/12	**Project/Site:** Devils Racetrack	**Latitude:** 35.449346° N
Evaluator: Matt Jenkins	**County:** Johnston	**Longitude:** 78.374524° W
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 37.5	**Stream Determination (circle one)** Ephemeral Intermittent (Perennial)	**Other** SCP10 - Lower *e.g. Quad Name:* Devils Racetrack Creek

A. Geomorphology (Subtotal = 16)	Absent	Weak	Moderate	Strong
1[a]. Continuity of channel bed and bank	0	1	2	(3)
2. Sinuosity of channel along thalweg	(0)	1	2	3
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	0	(1)	2	3
4. Particle size of stream substrate	0	(1)	2	3
5. Active/relict floodplain	0	1	2	(3)
6. Depositional bars or benches	0	(1)	2	3
7. Recent alluvial deposits	0	1	(2)	3
8. Headcuts	0	(1)	2	3
9. Grade control	0	(0.5)	1	1.5
10. Natural valley	0	(0.5)	1	1.5
11. Second or greater order channel	No = 0		Yes = (3)	

[a] artificial ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 10)				
12. Presence of Baseflow	0	1	2	(3)
13. Iron oxidizing bacteria	0	(1)	2	3
14. Leaf litter	(1.5)	1	0.5	0
15. Sediment on plants or debris	0	0.5	(1)	1.5
16. Organic debris lines or piles	0	(0.5)	1	1.5
17. Soil-based evidence of high water table?	No = 0		Yes = (3)	

C. Biology (Subtotal = 11.5)				
18. Fibrous roots in streambed	(3)	2	1	0
19. Rooted upland plants in streambed	(3)	2	1	0
20. Macrobenthos (note diversity and abundance)	0	(1)	2	3
21. Aquatic Mollusks	(0)	1	2	3
22. Fish	0	0.5	(1)	1.5
23. Crayfish	0	(0.5)	1	1.5
24. Amphibians	0	0.5	1	(1.5)
25. Algae	0	0.5	1	(1.5)
26. Wetland plants in streambed	FACW = 0.75; OBL = 1.5 Other = 0			

*perennial streams may also be identified using other methods. See p. 35 of manual.

Notes:

Sketch:

OFFICE USE ONLY: USACE AID#_____ DWQ #_____

SCP1 – Southwest Branch (Perennial RPW)

STREAM QUALITY ASSESSMENT WORKSHEET

1. Applicant's Name: Wildlands Engineering
2. Evaluator's Name: Matt Jenkins
3. Date of Evaluation: 2/23/12
4. Time of Evaluation: 9:00am
5. Name of Stream: Southwest Branch
6. River Basin: Neuse 03020201
7. Approximate Drainage Area: 20.6 acres
8. Stream Order: First
9. Length of Reach Evaluated: 200 lf
10. County: Johnston
11. Location of reach under evaluation (include nearby roads and landmarks): From Raleigh, NC, travel south on Interstate 40 for approximately 27 miles to Interstate 95 North. Travel approximately 9 miles on Interstate 95 and take exit 90 for NC 96 toward US 301. Turn left onto NC 96 and take an immediate right onto US 701. Travel approximately ½ mile; site is on the left.
12. Site Coordinates (if known): N 35.447875 °, W 78.386804°
13. Proposed Channel Work (if any): restoration
14. Recent Weather Conditions: no rain within the past 48 hours
15. Site conditions at time of visit: sunny, 65°
16. Identify any special waterway classifications known: ___Section 10 ___Tidal Waters ___Essential Fisheries Habitat ___Trout Waters ___Outstanding Resource Waters ___ Nutrient Sensitive Waters ___Water Supply Watershed ____(I-IV)
17. Is there a pond or lake located upstream of the evaluation point? YES (NO) If yes, estimate the water surface area:_____
18. Does channel appear on USGS quad map? YES (NO) 19. Does channel appear on USDA Soil Survey? YES (NO)
20. Estimated Watershed Land Use: ____% Residential ___% Commercial ___% Industrial 36 % Agricultural 38 % Forested ___% Cleared / Logged 26 % Other (Shrubland)
21. Bankfull Width: 10-12 feet
22. Bank Height (from bed to top of bank): 3-4 feet
23. Channel slope down center of stream: ___Flat (0 to 2%) X Gentle (2 to 4%) ___Moderate (4 to 10%) ___Steep (>10%)
24. Channel Sinuosity: ____Straight X Occasional Bends ___Frequent Meander ___Very Sinuous ___Braided Channel

Instructions for completion of worksheet (located on page 2): Begin by determining the most appropriate ecoregion based on location, terrain, vegetation, stream classification, etc. Every characteristic must be scored using the same ecoregion. Assign points to each characteristic within the range shown for the ecoregion. Page 3 provides a brief description of how to review the characteristics identified in the worksheet. Scores should reflect an overall assessment of the stream reach under evaluation. If a characteristic cannot be evaluated due to site or weather conditions, enter 0 in the scoring box and provide an explanation in the comment section. Where there are obvious changes in the character of a stream under review (e.g., the stream flows from a pasture into a forest), the stream may be divided into smaller reaches that display more continuity, and a separate form used to evaluate each reach. The total score assigned to a stream reach must range between 0 and 100, with a score of 100 representing a stream of the highest quality.

Total Score (from reverse): 59 **Comments:**_____

Evaluator's Signature_____ **Date** 2/23/2012

This channel evaluation form is intended to be used only as a guide to assist landowners and environmental professionals in gathering the data required by the United States Army Corps of Engineers in order to make a preliminary assessment of stream quality. The total score resulting from the completion of this form is subject to USACE approval and does not imply a particular mitigation ratio or requirement. Form subject to change – version 05/03. To Comment, please call 919-876-8441 x 26.

STREAM QUALITY ASSESSMENT WORKSHEET
SCP1 – Southwest Branch (Perennial RPW)

	#	CHARACTERISTICS	ECOREGION POINT RANGE			SCORE
			Coastal	Piedmont	Mountain	
PHYSICAL	1	**Presence of flow / persistent pools in stream** (no flow or saturation = 0; strong flow = max points)	0 – 5	0 – 4	0 – 5	5
	2	**Evidence of past human alteration** (extensive alteration = 0; no alteration = max points)	0 – 6	0 – 5	0 – 5	5
	3	**Riparian zone** (no buffer = 0; contiguous, wide buffer = max points)	0 – 6	0 – 4	0 – 5	4
	4	**Evidence of nutrient or chemical discharges** (extensive discharges = 0; no discharges = max points)	0 – 5	0 – 4	0 – 4	5
	5	**Groundwater discharge** (no discharge = 0; springs, seeps, wetlands, etc. = max points)	0 – 3	0 – 4	0 – 4	3
	6	**Presence of adjacent floodplain** (no floodplain = 0; extensive floodplain = max points)	0 – 4	0 – 4	0 – 2	2
	7	**Entrenchment / floodplain access** (deeply entrenched = 0; frequent flooding = max points)	0 – 5	0 – 4	0 – 2	2
	8	**Presence of adjacent wetlands** (no wetlands = 0; large adjacent wetlands = max points)	0 – 6	0 – 4	0 – 2	0
	9	**Channel sinuosity** (extensive channelization = 0; natural meander = max points)	0 – 5	0 – 4	0 – 3	3
	10	**Sediment input** (extensive deposition= 0; little or no sediment = max points)	0 – 5	0 – 4	0 – 4	3
	11	**Size & diversity of channel bed substrate** (fine, homogenous = 0; large, diverse sizes = max points)	NA*	0 – 4	0 – 5	N/A
STABILITY	12	**Evidence of channel incision or widening** (deeply incised = 0; stable bed & banks = max points)	0 – 5	0 – 4	0 – 5	2
	13	**Presence of major bank failures** (severe erosion = 0; no erosion, stable banks = max points)	0 – 5	0 – 5	0 – 5	3
	14	**Root depth and density on banks** (no visible roots = 0; dense roots throughout = max points)	0 – 3	0 – 4	0 – 5	2
	15	**Impact by agriculture or livestock production** (substantial impact =0; no evidence = max points)	0 – 5	0 – 4	0 – 5	4
HABITAT	16	**Presence of riffle-pool/ripple-pool complexes** (no riffles/ripples or pools = 0; well-developed = max points)	0 – 3	0 – 5	0 – 6	2
	17	**Habitat complexity** (little or no habitat = 0; frequent, varied habitats = max points)	0 – 6	0 – 6	0 – 6	4
	18	**Canopy coverage over streambed** (no shading vegetation = 0; continuous canopy = max points)	0 – 5	0 – 5	0 – 5	4
	19	**Substrate embeddedness** (deeply embedded = 0; loose structure = max)	NA*	0 – 4	0 – 4	N/A
BIOLOGY	20	**Presence of stream invertebrates** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 5	0 – 5	1
	21	**Presence of amphibians** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	2
	22	**Presence of fish** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	1
	23	**Evidence of wildlife use** (no evidence = 0; abundant evidence = max points)	0 – 6	0 – 5	0 – 5	2
Total Points Possible			100	100	100	
TOTAL SCORE (also enter on first page)						59

* These characteristics are not assessed in coastal streams.

OFFICE USE ONLY: USACE AID#_____ DWQ #_____

SCP2 – Southwest Branch (Perennial RPW)

STREAM QUALITY ASSESSMENT WORKSHEET

1. Applicant's Name: Wildlands Engineering
2. Evaluator's Name: Matt Jenkins
3. Date of Evaluation: 2/23/12
4. Time of Evaluation: 9:00am
5. Name of Stream: Southwest Branch
6. River Basin: Neuse 03020201
7. Approximate Drainage Area: 20.6 acres
8. Stream Order: First
9. Length of Reach Evaluated: 200 lf
10. County: Johnston
11. Location of reach under evaluation (include nearby roads and landmarks): From Raleigh, NC, travel south on Interstate 40 for approximately 27 miles to Interstate 95 North. Travel approximately 9 miles on Interstate 95 and take exit 90 for NC 96 toward US 301. Turn left onto NC 96 and take an immediate right onto US 701. Travel approximately ½ mile; site is on the left.
12. Site Coordinates (if known): N 35.447875 °, W 78.386804°
13. Proposed Channel Work (if any): restoration
14. Recent Weather Conditions: no rain within the past 48 hours
15. Site conditions at time of visit: sunny, 65°
16. Identify any special waterway classifications known: ___Section 10 ___Tidal Waters ___Essential Fisheries Habitat ___Trout Waters ___Outstanding Resource Waters ___ Nutrient Sensitive Waters ___Water Supply Watershed ____(I-IV)
17. Is there a pond or lake located upstream of the evaluation point? YES (NO) If yes, estimate the water surface area:_____
18. Does channel appear on USGS quad map? YES (NO) 19. Does channel appear on USDA Soil Survey? YES (NO)
20. Estimated Watershed Land Use: ____% Residential ___% Commercial ___% Industrial 36 % Agricultural 38 % Forested ___% Cleared / Logged 26 % Other (Shrubland)
21. Bankfull Width: 10-12 feet
22. Bank Height (from bed to top of bank): 4-6 feet
23. Channel slope down center of stream: X Flat (0 to 2%) ___Gentle (2 to 4%) ___Moderate (4 to 10%) ___Steep (>10%)
24. Channel Sinuosity: X Straight ___Occasional Bends ___Frequent Meander ___Very Sinuous ___Braided Channel

Instructions for completion of worksheet (located on page 2): Begin by determining the most appropriate ecoregion based on location, terrain, vegetation, stream classification, etc. Every characteristic must be scored using the same ecoregion. Assign points to each characteristic within the range shown for the ecoregion. Page 3 provides a brief description of how to review the characteristics identified in the worksheet. Scores should reflect an overall assessment of the stream reach under evaluation. If a characteristic cannot be evaluated due to site or weather conditions, enter 0 in the scoring box and provide an explanation in the comment section. Where there are obvious changes in the character of a stream under review (e.g., the stream flows from a pasture into a forest), the stream may be divided into smaller reaches that display more continuity, and a separate form used to evaluate each reach. The total score assigned to a stream reach must range between 0 and 100, with a score of 100 representing a stream of the highest quality.

Total Score (from reverse): 34 **Comments:**_____

Evaluator's Signature_____ **Date** 2/23/2012

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STREAM QUALITY ASSESSMENT WORKSHEET
SCP2 – Southwest Branch (Perennial RPW)

	#	CHARACTERISTICS	ECOREGION POINT RANGE			SCORE
			Coastal	Piedmont	Mountain	
PHYSICAL	1	**Presence of flow / persistent pools in stream** (no flow or saturation = 0; strong flow = max points)	0 – 5	0 – 4	0 – 5	5
	2	**Evidence of past human alteration** (extensive alteration = 0; no alteration = max points)	0 – 6	0 – 5	0 – 5	0
	3	**Riparian zone** (no buffer = 0; contiguous, wide buffer = max points)	0 – 6	0 – 4	0 – 5	0
	4	**Evidence of nutrient or chemical discharges** (extensive discharges = 0; no discharges = max points)	0 – 5	0 – 4	0 – 4	3
	5	**Groundwater discharge** (no discharge = 0; springs, seeps, wetlands, etc. = max points)	0 – 3	0 – 4	0 – 4	3
	6	**Presence of adjacent floodplain** (no floodplain = 0; extensive floodplain = max points)	0 – 4	0 – 4	0 – 2	4
	7	**Entrenchment / floodplain access** (deeply entrenched = 0; frequent flooding = max points)	0 – 5	0 – 4	0 – 2	2
	8	**Presence of adjacent wetlands** (no wetlands = 0; large adjacent wetlands = max points)	0 – 6	0 – 4	0 – 2	0
	9	**Channel sinuosity** (extensive channelization = 0; natural meander = max points)	0 – 5	0 – 4	0 – 3	0
	10	**Sediment input** (extensive deposition= 0; little or no sediment = max points)	0 – 5	0 – 4	0 – 4	2
	11	**Size & diversity of channel bed substrate** (fine, homogenous = 0; large, diverse sizes = max points)	NA*	0 – 4	0 – 5	N/A
STABILITY	12	**Evidence of channel incision or widening** (deeply incised = 0; stable bed & banks = max points)	0 – 5	0 – 4	0 – 5	2
	13	**Presence of major bank failures** (severe erosion = 0; no erosion, stable banks = max points)	0 – 5	0 – 5	0 – 5	2
	14	**Root depth and density on banks** (no visible roots = 0; dense roots throughout = max points)	0 – 3	0 – 4	0 – 5	0
	15	**Impact by agriculture or livestock production** (substantial impact =0; no evidence = max points)	0 – 5	0 – 4	0 – 5	0
HABITAT	16	**Presence of riffle-pool/ripple-pool complexes** (no riffles/ripples or pools = 0; well-developed = max points)	0 – 3	0 – 5	0 – 6	1
	17	**Habitat complexity** (little or no habitat = 0; frequent, varied habitats = max points)	0 – 6	0 – 6	0 – 6	1
	18	**Canopy coverage over streambed** (no shading vegetation = 0; continuous canopy = max points)	0 – 5	0 – 5	0 – 5	0
	19	**Substrate embeddedness** (deeply embedded = 0; loose structure = max)	NA*	0 – 4	0 – 4	N/A
BIOLOGY	20	**Presence of stream invertebrates** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 5	0 – 5	1
	21	**Presence of amphibians** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	4
	22	**Presence of fish** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	2
	23	**Evidence of wildlife use** (no evidence = 0; abundant evidence = max points)	0 – 6	0 – 5	0 – 5	2
Total Points Possible			100	100	100	
TOTAL SCORE (also enter on first page)						34

* These characteristics are not assessed in coastal streams.

OFFICE USE ONLY: USACE AID#_____ DWQ #_____

SCP3 – Devils Racetrack Creek (Perennial RPW)

STREAM QUALITY ASSESSMENT WORKSHEET

1. Applicant's Name: Wildlands Engineering
2. Evaluator's Name: Matt Jenkins
3. Date of Evaluation: 2/23/12
4. Time of Evaluation: 9:30am
5. Name of Stream: Devils Racetrack Creek
6. River Basin: Neuse 03020201
7. Approximate Drainage Area: 494 acres
8. Stream Order: Second
9. Length of Reach Evaluated: 200 lf
10. County: Johnston
11. Location of reach under evaluation (include nearby roads and landmarks): From Raleigh, NC, travel south on Interstate 40 for approximately 27 miles to Interstate 95 North. Travel approximately 9 miles on Interstate 95 and take exit 90 for NC 96 toward US 301. Turn left onto NC 96 and take an immediate right onto US 701. Travel approximately ½ mile; site is on the left.
12. Site Coordinates (if known): N 35.447875 °, W 78.386804°
13. Proposed Channel Work (if any): restoration
14. Recent Weather Conditions: no rain within the past 48 hours
15. Site conditions at time of visit: sunny, 65°
16. Identify any special waterway classifications known: ___Section 10 ___Tidal Waters ___Essential Fisheries Habitat ___Trout Waters ___Outstanding Resource Waters ___ Nutrient Sensitive Waters ___Water Supply Watershed ____(I-IV)
17. Is there a pond or lake located upstream of the evaluation point? YES (NO) If yes, estimate the water surface area:_____
18. Does channel appear on USGS quad map? (YES) NO 19. Does channel appear on USDA Soil Survey? (YES) NO
20. Estimated Watershed Land Use: ____% Residential 5 % Commercial ___% Industrial 44 % Agricultural 32 % Forested ___% Cleared / Logged 19 % Other (Shrubland)
21. Bankfull Width: 15-20 feet
22. Bank Height (from bed to top of bank): 6-8 feet
23. Channel slope down center of stream: X Flat (0 to 2%) ___Gentle (2 to 4%) ___Moderate (4 to 10%) ___Steep (>10%)
24. Channel Sinuosity: X Straight ___Occasional Bends ___Frequent Meander ___Very Sinuous ___Braided Channel

Instructions for completion of worksheet (located on page 2): Begin by determining the most appropriate ecoregion based on location, terrain, vegetation, stream classification, etc. Every characteristic must be scored using the same ecoregion. Assign points to each characteristic within the range shown for the ecoregion. Page 3 provides a brief description of how to review the characteristics identified in the worksheet. Scores should reflect an overall assessment of the stream reach under evaluation. If a characteristic cannot be evaluated due to site or weather conditions, enter 0 in the scoring box and provide an explanation in the comment section. Where there are obvious changes in the character of a stream under review (e.g., the stream flows from a pasture into a forest), the stream may be divided into smaller reaches that display more continuity, and a separate form used to evaluate each reach. The total score assigned to a stream reach must range between 0 and 100, with a score of 100 representing a stream of the highest quality.

Total Score (from reverse): 39 **Comments:**_____

Evaluator's Signature_____ **Date** 2/23/2012

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STREAM QUALITY ASSESSMENT WORKSHEET
SCP3 – Devils Racetrack Creek (Perennial RPW)

	#	CHARACTERISTICS	ECOREGION POINT RANGE			SCORE
			Coastal	Piedmont	Mountain	
PHYSICAL	1	**Presence of flow / persistent pools in stream** (no flow or saturation = 0; strong flow = max points)	0 – 5	0 – 4	0 – 5	5
	2	**Evidence of past human alteration** (extensive alteration = 0; no alteration = max points)	0 – 6	0 – 5	0 – 5	0
	3	**Riparian zone** (no buffer = 0; contiguous, wide buffer = max points)	0 – 6	0 – 4	0 – 5	2
	4	**Evidence of nutrient or chemical discharges** (extensive discharges = 0; no discharges = max points)	0 – 5	0 – 4	0 – 4	2
	5	**Groundwater discharge** (no discharge = 0; springs, seeps, wetlands, etc. = max points)	0 – 3	0 – 4	0 – 4	3
	6	**Presence of adjacent floodplain** (no floodplain = 0; extensive floodplain = max points)	0 – 4	0 – 4	0 – 2	4
	7	**Entrenchment / floodplain access** (deeply entrenched = 0; frequent flooding = max points)	0 – 5	0 – 4	0 – 2	3
	8	**Presence of adjacent wetlands** (no wetlands = 0; large adjacent wetlands = max points)	0 – 6	0 – 4	0 – 2	0
	9	**Channel sinuosity** (extensive channelization = 0; natural meander = max points)	0 – 5	0 – 4	0 – 3	0
	10	**Sediment input** (extensive deposition= 0; little or no sediment = max points)	0 – 5	0 – 4	0 – 4	1
	11	**Size & diversity of channel bed substrate** (fine, homogenous = 0; large, diverse sizes = max points)	NA*	0 – 4	0 – 5	N/A
STABILITY	12	**Evidence of channel incision or widening** (deeply incised = 0; stable bed & banks = max points)	0 – 5	0 – 4	0 – 5	2
	13	**Presence of major bank failures** (severe erosion = 0; no erosion, stable banks = max points)	0 – 5	0 – 5	0 – 5	2
	14	**Root depth and density on banks** (no visible roots = 0; dense roots throughout = max points)	0 – 3	0 – 4	0 – 5	1
	15	**Impact by agriculture or livestock production** (substantial impact =0; no evidence = max points)	0 – 5	0 – 4	0 – 5	0
HABITAT	16	**Presence of riffle-pool/ripple-pool complexes** (no riffles/ripples or pools = 0; well-developed = max points)	0 – 3	0 – 5	0 – 6	2
	17	**Habitat complexity** (little or no habitat = 0; frequent, varied habitats = max points)	0 – 6	0 – 6	0 – 6	1
	18	**Canopy coverage over streambed** (no shading vegetation = 0; continuous canopy = max points)	0 – 5	0 – 5	0 – 5	1
	19	**Substrate embeddedness** (deeply embedded = 0; loose structure = max)	NA*	0 – 4	0 – 4	N/A
BIOLOGY	20	**Presence of stream invertebrates** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 5	0 – 5	1
	21	**Presence of amphibians** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	4
	22	**Presence of fish** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	2
	23	**Evidence of wildlife use** (no evidence = 0; abundant evidence = max points)	0 – 6	0 – 5	0 – 5	3
Total Points Possible			100	100	100	
TOTAL SCORE (also enter on first page)						39

* These characteristics are not assessed in coastal streams.

OFFICE USE ONLY: USACE AID#_____ DWQ #_____

SCP4 – Middle Branch (Perennial RPW)

STREAM QUALITY ASSESSMENT WORKSHEET

1. Applicant's Name: Wildlands Engineering
2. Evaluator's Name: Matt Jenkins
3. Date of Evaluation: 2/23/12
4. Time of Evaluation: 10:00am
5. Name of Stream: Middle Branch
6. River Basin: Neuse 03020201
7. Approximate Drainage Area: 11 acres
8. Stream Order: First
9. Length of Reach Evaluated: 200 lf
10. County: Johnston
11. Location of reach under evaluation (include nearby roads and landmarks): From Raleigh, NC, travel south on Interstate 40 for approximately 27 miles to Interstate 95 North. Travel approximately 9 miles on Interstate 95 and take exit 90 for NC 96 toward US 301. Turn left onto NC 96 and take an immediate right onto US 701. Travel approximately ½ mile; site is on the left.
12. Site Coordinates (if known): N 35.447875 °, W 78.386804°
13. Proposed Channel Work (if any): restoration
14. Recent Weather Conditions: no rain within the past 48 hours
15. Site conditions at time of visit: sunny, 65°
16. Identify any special waterway classifications known: ___Section 10 ___Tidal Waters ___Essential Fisheries Habitat ___Trout Waters ___Outstanding Resource Waters ___ Nutrient Sensitive Waters ___Water Supply Watershed ____(I-IV)
17. Is there a pond or lake located upstream of the evaluation point? (YES) NO If yes, estimate the water surface area: ~ 1.0 ac
18. Does channel appear on USGS quad map? YES (NO) 19. Does channel appear on USDA Soil Survey? YES (NO)
20. Estimated Watershed Land Use: ____% Residential ___% Commercial ___% Industrial 60 % Agricultural 40 % Forested ___% Cleared / Logged ____% Other (_____)
21. Bankfull Width: 6-8 feet
22. Bank Height (from bed to top of bank): 3-4 feet
23. Channel slope down center of stream: X Flat (0 to 2%) ___Gentle (2 to 4%) ___Moderate (4 to 10%) ___Steep (>10%)
24. Channel Sinuosity: X Straight ___Occasional Bends ___Frequent Meander ___Very Sinuous ___Braided Channel

Instructions for completion of worksheet (located on page 2): Begin by determining the most appropriate ecoregion based on location, terrain, vegetation, stream classification, etc. Every characteristic must be scored using the same ecoregion. Assign points to each characteristic within the range shown for the ecoregion. Page 3 provides a brief description of how to review the characteristics identified in the worksheet. Scores should reflect an overall assessment of the stream reach under evaluation. If a characteristic cannot be evaluated due to site or weather conditions, enter 0 in the scoring box and provide an explanation in the comment section. Where there are obvious changes in the character of a stream under review (e.g., the stream flows from a pasture into a forest), the stream may be divided into smaller reaches that display more continuity, and a separate form used to evaluate each reach. The total score assigned to a stream reach must range between 0 and 100, with a score of 100 representing a stream of the highest quality.

Total Score (from reverse): 30 **Comments:**_____

Evaluator's Signature_____ **Date** 2/23/2012

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STREAM QUALITY ASSESSMENT WORKSHEET
SCP4 – Middle Branch (Perennial RPW)

	#	CHARACTERISTICS	ECOREGION POINT RANGE			SCORE
			Coastal	Piedmont	Mountain	
PHYSICAL	1	**Presence of flow / persistent pools in stream** (no flow or saturation = 0; strong flow = max points)	0 – 5	0 – 4	0 – 5	5
	2	**Evidence of past human alteration** (extensive alteration = 0; no alteration = max points)	0 – 6	0 – 5	0 – 5	0
	3	**Riparian zone** (no buffer = 0; contiguous, wide buffer = max points)	0 – 6	0 – 4	0 – 5	0
	4	**Evidence of nutrient or chemical discharges** (extensive discharges = 0; no discharges = max points)	0 – 5	0 – 4	0 – 4	2
	5	**Groundwater discharge** (no discharge = 0; springs, seeps, wetlands, etc. = max points)	0 – 3	0 – 4	0 – 4	3
	6	**Presence of adjacent floodplain** (no floodplain = 0; extensive floodplain = max points)	0 – 4	0 – 4	0 – 2	4
	7	**Entrenchment / floodplain access** (deeply entrenched = 0; frequent flooding = max points)	0 – 5	0 – 4	0 – 2	3
	8	**Presence of adjacent wetlands** (no wetlands = 0; large adjacent wetlands = max points)	0 – 6	0 – 4	0 – 2	0
	9	**Channel sinuosity** (extensive channelization = 0; natural meander = max points)	0 – 5	0 – 4	0 – 3	0
	10	**Sediment input** (extensive deposition= 0; little or no sediment = max points)	0 – 5	0 – 4	0 – 4	2
	11	**Size & diversity of channel bed substrate** (fine, homogenous = 0; large, diverse sizes = max points)	NA*	0 – 4	0 – 5	N/A
STABILITY	12	**Evidence of channel incision or widening** (deeply incised = 0; stable bed & banks = max points)	0 – 5	0 – 4	0 – 5	2
	13	**Presence of major bank failures** (severe erosion = 0; no erosion, stable banks = max points)	0 – 5	0 – 5	0 – 5	3
	14	**Root depth and density on banks** (no visible roots = 0; dense roots throughout = max points)	0 – 3	0 – 4	0 – 5	0
	15	**Impact by agriculture or livestock production** (substantial impact =0; no evidence = max points)	0 – 5	0 – 4	0 – 5	0
HABITAT	16	**Presence of riffle-pool/ripple-pool complexes** (no riffles/ripples or pools = 0; well-developed = max points)	0 – 3	0 – 5	0 – 6	1
	17	**Habitat complexity** (little or no habitat = 0; frequent, varied habitats = max points)	0 – 6	0 – 6	0 – 6	1
	18	**Canopy coverage over streambed** (no shading vegetation = 0; continuous canopy = max points)	0 – 5	0 – 5	0 – 5	0
	19	**Substrate embeddedness** (deeply embedded = 0; loose structure = max)	NA*	0 – 4	0 – 4	N/A
BIOLOGY	20	**Presence of stream invertebrates** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 5	0 – 5	0
	21	**Presence of amphibians** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	2
	22	**Presence of fish** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	0
	23	**Evidence of wildlife use** (no evidence = 0; abundant evidence = max points)	0 – 6	0 – 5	0 – 5	2
Total Points Possible			100	100	100	
TOTAL SCORE (also enter on first page)						30

* These characteristics are not assessed in coastal streams.

OFFICE USE ONLY: USACE AID#_____ DWQ #_____

SCP5 – Devils Racetrack Creek (Perennial RPW)

STREAM QUALITY ASSESSMENT WORKSHEET

1. Applicant's Name: Wildlands Engineering
2. Evaluator's Name: Matt Jenkins
3. Date of Evaluation: 2/23/12
4. Time of Evaluation: 10:30am
5. Name of Stream: Devils Racetrack Creek
6. River Basin: Neuse 03020201
7. Approximate Drainage Area: 500 acres
8. Stream Order: Second
9. Length of Reach Evaluated: 200 lf
10. County: Johnston
11. Location of reach under evaluation (include nearby roads and landmarks): From Raleigh, NC, travel south on Interstate 40 for approximately 27 miles to Interstate 95 North. Travel approximately 9 miles on Interstate 95 and take exit 90 for NC 96 toward US 301. Turn left onto NC 96 and take an immediate right onto US 701. Travel approximately ½ mile; site is on the left.
12. Site Coordinates (if known): N 35.447875 °, W 78.386804°
13. Proposed Channel Work (if any): restoration
14. Recent Weather Conditions: no rain within the past 48 hours
15. Site conditions at time of visit: sunny, 65°
16. Identify any special waterway classifications known: ___Section 10 ___Tidal Waters ___Essential Fisheries Habitat ___Trout Waters ___Outstanding Resource Waters ___ Nutrient Sensitive Waters ___Water Supply Watershed ____(I-IV)
17. Is there a pond or lake located upstream of the evaluation point? YES (NO) If yes, estimate the water surface area:_____
18. Does channel appear on USGS quad map? (YES) NO 19. Does channel appear on USDA Soil Survey? (YES) NO
20. Estimated Watershed Land Use: ____% Residential 5 % Commercial ___% Industrial 44 % Agricultural 32 % Forested ___% Cleared / Logged 19 % Other (Shrubland)
21. Bankfull Width: 15-20 feet
22. Bank Height (from bed to top of bank): 6-8 feet
23. Channel slope down center of stream: X Flat (0 to 2%) ___Gentle (2 to 4%) ___Moderate (4 to 10%) ___Steep (>10%)
24. Channel Sinuosity: X Straight ___Occasional Bends ___Frequent Meander ___Very Sinuous ___Braided Channel

Instructions for completion of worksheet (located on page 2): Begin by determining the most appropriate ecoregion based on location, terrain, vegetation, stream classification, etc. Every characteristic must be scored using the same ecoregion. Assign points to each characteristic within the range shown for the ecoregion. Page 3 provides a brief description of how to review the characteristics identified in the worksheet. Scores should reflect an overall assessment of the stream reach under evaluation. If a characteristic cannot be evaluated due to site or weather conditions, enter 0 in the scoring box and provide an explanation in the comment section. Where there are obvious changes in the character of a stream under review (e.g., the stream flows from a pasture into a forest), the stream may be divided into smaller reaches that display more continuity, and a separate form used to evaluate each reach. The total score assigned to a stream reach must range between 0 and 100, with a score of 100 representing a stream of the highest quality.

Total Score (from reverse): 38 **Comments:**_____

Evaluator's Signature_____ **Date** 2/23/2012

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STREAM QUALITY ASSESSMENT WORKSHEET
SCP5 – Devils Racetrack Creek (Perennial RPW)

	#	CHARACTERISTICS	ECOREGION POINT RANGE			SCORE
			Coastal	Piedmont	Mountain	
PHYSICAL	1	**Presence of flow / persistent pools in stream** (no flow or saturation = 0; strong flow = max points)	0 – 5	0 – 4	0 – 5	5
	2	**Evidence of past human alteration** (extensive alteration = 0; no alteration = max points)	0 – 6	0 – 5	0 – 5	0
	3	**Riparian zone** (no buffer = 0; contiguous, wide buffer = max points)	0 – 6	0 – 4	0 – 5	2
	4	**Evidence of nutrient or chemical discharges** (extensive discharges = 0; no discharges = max points)	0 – 5	0 – 4	0 – 4	2
	5	**Groundwater discharge** (no discharge = 0; springs, seeps, wetlands, etc. = max points)	0 – 3	0 – 4	0 – 4	3
	6	**Presence of adjacent floodplain** (no floodplain = 0; extensive floodplain = max points)	0 – 4	0 – 4	0 – 2	4
	7	**Entrenchment / floodplain access** (deeply entrenched = 0; frequent flooding = max points)	0 – 5	0 – 4	0 – 2	3
	8	**Presence of adjacent wetlands** (no wetlands = 0; large adjacent wetlands = max points)	0 – 6	0 – 4	0 – 2	0
	9	**Channel sinuosity** (extensive channelization = 0; natural meander = max points)	0 – 5	0 – 4	0 – 3	0
	10	**Sediment input** (extensive deposition= 0; little or no sediment = max points)	0 – 5	0 – 4	0 – 4	1
	11	**Size & diversity of channel bed substrate** (fine, homogenous = 0; large, diverse sizes = max points)	NA*	0 – 4	0 – 5	N/A
STABILITY	12	**Evidence of channel incision or widening** (deeply incised = 0; stable bed & banks = max points)	0 – 5	0 – 4	0 – 5	2
	13	**Presence of major bank failures** (severe erosion = 0; no erosion, stable banks = max points)	0 – 5	0 – 5	0 – 5	2
	14	**Root depth and density on banks** (no visible roots = 0; dense roots throughout = max points)	0 – 3	0 – 4	0 – 5	1
	15	**Impact by agriculture or livestock production** (substantial impact =0; no evidence = max points)	0 – 5	0 – 4	0 – 5	0
HABITAT	16	**Presence of riffle-pool/ripple-pool complexes** (no riffles/ripples or pools = 0; well-developed = max points)	0 – 3	0 – 5	0 – 6	1
	17	**Habitat complexity** (little or no habitat = 0; frequent, varied habitats = max points)	0 – 6	0 – 6	0 – 6	1
	18	**Canopy coverage over streambed** (no shading vegetation = 0; continuous canopy = max points)	0 – 5	0 – 5	0 – 5	1
	19	**Substrate embeddedness** (deeply embedded = 0; loose structure = max)	NA*	0 – 4	0 – 4	N/A
BIOLOGY	20	**Presence of stream invertebrates** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 5	0 – 5	1
	21	**Presence of amphibians** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	4
	22	**Presence of fish** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	2
	23	**Evidence of wildlife use** (no evidence = 0; abundant evidence = max points)	0 – 6	0 – 5	0 – 5	3
Total Points Possible			100	100	100	
TOTAL SCORE (also enter on first page)						38

* These characteristics are not assessed in coastal streams.

OFFICE USE ONLY: USACE AID#_____ DWQ #_____

SCP6 – North Branch (Perennial RPW)

STREAM QUALITY ASSESSMENT WORKSHEET

1. Applicant's Name: Wildlands Engineering
2. Evaluator's Name: Matt Jenkins
3. Date of Evaluation: 2/23/12
4. Time of Evaluation: 10:45am
5. Name of Stream: North Branch
6. River Basin: Neuse 03020201
7. Approximate Drainage Area: 50 acres
8. Stream Order: First
9. Length of Reach Evaluated: 100 lf
10. County: Johnston
11. Location of reach under evaluation (include nearby roads and landmarks): From Raleigh, NC, travel south on Interstate 40 for approximately 27 miles to Interstate 95 North. Travel approximately 9 miles on Interstate 95 and take exit 90 for NC 96 toward US 301. Turn left onto NC 96 and take an immediate right onto US 701. Travel approximately ½ mile; site is on the left.
12. Site Coordinates (if known): N 35.447875 °, W 78.386804°
13. Proposed Channel Work (if any): restoration
14. Recent Weather Conditions: no rain within the past 48 hours
15. Site conditions at time of visit: sunny, 65°
16. Identify any special waterway classifications known: ___Section 10 ___Tidal Waters ___Essential Fisheries Habitat ___Trout Waters ___Outstanding Resource Waters ___ Nutrient Sensitive Waters ___Water Supply Watershed ____(I-IV)
17. Is there a pond or lake located upstream of the evaluation point? YES (NO) If yes, estimate the water surface area:_____
18. Does channel appear on USGS quad map? (YES) NO 19. Does channel appear on USDA Soil Survey? (YES) NO
20. Estimated Watershed Land Use: ____% Residential 15 % Commercial ___% Industrial 42 % Agricultural 34 % Forested ___% Cleared / Logged 9 % Other (Shrubland)
21. Bankfull Width: 4-6 feet
22. Bank Height (from bed to top of bank): 2-3 feet
23. Channel slope down center of stream: X Flat (0 to 2%) ___Gentle (2 to 4%) ___Moderate (4 to 10%) ___Steep (>10%)
24. Channel Sinuosity: ____Straight ___Occasional Bends X Frequent Meander ___Very Sinuous ___Braided Channel

Instructions for completion of worksheet (located on page 2): Begin by determining the most appropriate ecoregion based on location, terrain, vegetation, stream classification, etc. Every characteristic must be scored using the same ecoregion. Assign points to each characteristic within the range shown for the ecoregion. Page 3 provides a brief description of how to review the characteristics identified in the worksheet. Scores should reflect an overall assessment of the stream reach under evaluation. If a characteristic cannot be evaluated due to site or weather conditions, enter 0 in the scoring box and provide an explanation in the comment section. Where there are obvious changes in the character of a stream under review (e.g., the stream flows from a pasture into a forest), the stream may be divided into smaller reaches that display more continuity, and a separate form used to evaluate each reach. The total score assigned to a stream reach must range between 0 and 100, with a score of 100 representing a stream of the highest quality.

Total Score (from reverse): 53 **Comments:**_____

Evaluator's Signature_____ **Date** 2/23/2012

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STREAM QUALITY ASSESSMENT WORKSHEET
SCP6 – North Branch (Perennial RPW)

	#	CHARACTERISTICS	ECOREGION POINT RANGE			SCORE
			Coastal	Piedmont	Mountain	
PHYSICAL	1	**Presence of flow / persistent pools in stream** (no flow or saturation = 0; strong flow = max points)	0 – 5	0 – 4	0 – 5	5
	2	**Evidence of past human alteration** (extensive alteration = 0; no alteration = max points)	0 – 6	0 – 5	0 – 5	2
	3	**Riparian zone** (no buffer = 0; contiguous, wide buffer = max points)	0 – 6	0 – 4	0 – 5	0
	4	**Evidence of nutrient or chemical discharges** (extensive discharges = 0; no discharges = max points)	0 – 5	0 – 4	0 – 4	4
	5	**Groundwater discharge** (no discharge = 0; springs, seeps, wetlands, etc. = max points)	0 – 3	0 – 4	0 – 4	3
	6	**Presence of adjacent floodplain** (no floodplain = 0; extensive floodplain = max points)	0 – 4	0 – 4	0 – 2	4
	7	**Entrenchment / floodplain access** (deeply entrenched = 0; frequent flooding = max points)	0 – 5	0 – 4	0 – 2	4
	8	**Presence of adjacent wetlands** (no wetlands = 0; large adjacent wetlands = max points)	0 – 6	0 – 4	0 – 2	0
	9	**Channel sinuosity** (extensive channelization = 0; natural meander = max points)	0 – 5	0 – 4	0 – 3	4
	10	**Sediment input** (extensive deposition= 0; little or no sediment = max points)	0 – 5	0 – 4	0 – 4	4
	11	**Size & diversity of channel bed substrate** (fine, homogenous = 0; large, diverse sizes = max points)	NA*	0 – 4	0 – 5	N/A
STABILITY	12	**Evidence of channel incision or widening** (deeply incised = 0; stable bed & banks = max points)	0 – 5	0 – 4	0 – 5	4
	13	**Presence of major bank failures** (severe erosion = 0; no erosion, stable banks = max points)	0 – 5	0 – 5	0 – 5	5
	14	**Root depth and density on banks** (no visible roots = 0; dense roots throughout = max points)	0 – 3	0 – 4	0 – 5	2
	15	**Impact by agriculture or livestock production** (substantial impact =0; no evidence = max points)	0 – 5	0 – 4	0 – 5	1
HABITAT	16	**Presence of riffle-pool/ripple-pool complexes** (no riffles/ripples or pools = 0; well-developed = max points)	0 – 3	0 – 5	0 – 6	1
	17	**Habitat complexity** (little or no habitat = 0; frequent, varied habitats = max points)	0 – 6	0 – 6	0 – 6	2
	18	**Canopy coverage over streambed** (no shading vegetation = 0; continuous canopy = max points)	0 – 5	0 – 5	0 – 5	0
	19	**Substrate embeddedness** (deeply embedded = 0; loose structure = max)	NA*	0 – 4	0 – 4	N/A
BIOLOGY	20	**Presence of stream invertebrates** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 5	0 – 5	0
	21	**Presence of amphibians** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	4
	22	**Presence of fish** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	1
	23	**Evidence of wildlife use** (no evidence = 0; abundant evidence = max points)	0 – 6	0 – 5	0 – 5	3
Total Points Possible			100	100	100	
TOTAL SCORE (also enter on first page)						53

* These characteristics are not assessed in coastal streams.

OFFICE USE ONLY: USACE AID#_____ DWQ #_____

SCP7 – Southeast Branch (Intermittent RPW)

STREAM QUALITY ASSESSMENT WORKSHEET

1. Applicant's Name: Wildlands Engineering
2. Evaluator's Name: Matt Jenkins
3. Date of Evaluation: 2/23/12
4. Time of Evaluation: 11:00am
5. Name of Stream: Southeast Branch
6. River Basin: Neuse 03020201
7. Approximate Drainage Area: 70 acres
8. Stream Order: First
9. Length of Reach Evaluated: 200 lf
10. County: Johnston
11. Location of reach under evaluation (include nearby roads and landmarks): From Raleigh, NC, travel south on Interstate 40 for approximately 27 miles to Interstate 95 North. Travel approximately 9 miles on Interstate 95 and take exit 90 for NC 96 toward US 301. Turn left onto NC 96 and take an immediate right onto US 701. Travel approximately ½ mile; site is on the left.
12. Site Coordinates (if known): N 35.447875 °, W 78.386804°
13. Proposed Channel Work (if any): restoration
14. Recent Weather Conditions: no rain within the past 48 hours
15. Site conditions at time of visit: sunny, 65°
16. Identify any special waterway classifications known: ___Section 10 ___Tidal Waters ___Essential Fisheries Habitat ___Trout Waters ___Outstanding Resource Waters ___ Nutrient Sensitive Waters ___Water Supply Watershed ____(I-IV)
17. Is there a pond or lake located upstream of the evaluation point? YES (NO) If yes, estimate the water surface area:_____
18. Does channel appear on USGS quad map? YES (NO) 19. Does channel appear on USDA Soil Survey? YES (NO)
20. Estimated Watershed Land Use: ____% Residential ___% Commercial ___% Industrial 77 % Agricultural 23 % Forested ___% Cleared / Logged ____% Other (_____)
21. Bankfull Width: 3-5 feet
22. Bank Height (from bed to top of bank): 2-3 feet
23. Channel slope down center of stream: ___Flat (0 to 2%) X Gentle (2 to 4%) ___Moderate (4 to 10%) ___Steep (>10%)
24. Channel Sinuosity: ____Straight X Occasional Bends ___Frequent Meander ___Very Sinuous ___Braided Channel

Instructions for completion of worksheet (located on page 2): Begin by determining the most appropriate ecoregion based on location, terrain, vegetation, stream classification, etc. Every characteristic must be scored using the same ecoregion. Assign points to each characteristic within the range shown for the ecoregion. Page 3 provides a brief description of how to review the characteristics identified in the worksheet. Scores should reflect an overall assessment of the stream reach under evaluation. If a characteristic cannot be evaluated due to site or weather conditions, enter 0 in the scoring box and provide an explanation in the comment section. Where there are obvious changes in the character of a stream under review (e.g., the stream flows from a pasture into a forest), the stream may be divided into smaller reaches that display more continuity, and a separate form used to evaluate each reach. The total score assigned to a stream reach must range between 0 and 100, with a score of 100 representing a stream of the highest quality.

Total Score (from reverse): 39 **Comments:**_____

Evaluator's Signature_____ **Date** 2/23/2012

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STREAM QUALITY ASSESSMENT WORKSHEET
SCP7 – Southeast Branch (Intermittent RPW)

	#	CHARACTERISTICS	ECOREGION POINT RANGE			SCORE
			Coastal	Piedmont	Mountain	
PHYSICAL	1	**Presence of flow / persistent pools in stream** (no flow or saturation = 0; strong flow = max points)	0 – 5	0 – 4	0 – 5	2
	2	**Evidence of past human alteration** (extensive alteration = 0; no alteration = max points)	0 – 6	0 – 5	0 – 5	3
	3	**Riparian zone** (no buffer = 0; contiguous, wide buffer = max points)	0 – 6	0 – 4	0 – 5	1
	4	**Evidence of nutrient or chemical discharges** (extensive discharges = 0; no discharges = max points)	0 – 5	0 – 4	0 – 4	4
	5	**Groundwater discharge** (no discharge = 0; springs, seeps, wetlands, etc. = max points)	0 – 3	0 – 4	0 – 4	2
	6	**Presence of adjacent floodplain** (no floodplain = 0; extensive floodplain = max points)	0 – 4	0 – 4	0 – 2	2
	7	**Entrenchment / floodplain access** (deeply entrenched = 0; frequent flooding = max points)	0 – 5	0 – 4	0 – 2	2
	8	**Presence of adjacent wetlands** (no wetlands = 0; large adjacent wetlands = max points)	0 – 6	0 – 4	0 – 2	0
	9	**Channel sinuosity** (extensive channelization = 0; natural meander = max points)	0 – 5	0 – 4	0 – 3	1
	10	**Sediment input** (extensive deposition= 0; little or no sediment = max points)	0 – 5	0 – 4	0 – 4	2
	11	**Size & diversity of channel bed substrate** (fine, homogenous = 0; large, diverse sizes = max points)	NA*	0 – 4	0 – 5	N/A
STABILITY	12	**Evidence of channel incision or widening** (deeply incised = 0; stable bed & banks = max points)	0 – 5	0 – 4	0 – 5	2
	13	**Presence of major bank failures** (severe erosion = 0; no erosion, stable banks = max points)	0 – 5	0 – 5	0 – 5	3
	14	**Root depth and density on banks** (no visible roots = 0; dense roots throughout = max points)	0 – 3	0 – 4	0 – 5	2
	15	**Impact by agriculture or livestock production** (substantial impact =0; no evidence = max points)	0 – 5	0 – 4	0 – 5	2
HABITAT	16	**Presence of riffle-pool/ripple-pool complexes** (no riffles/ripples or pools = 0; well-developed = max points)	0 – 3	0 – 5	0 – 6	1
	17	**Habitat complexity** (little or no habitat = 0; frequent, varied habitats = max points)	0 – 6	0 – 6	0 – 6	3
	18	**Canopy coverage over streambed** (no shading vegetation = 0; continuous canopy = max points)	0 – 5	0 – 5	0 – 5	4
	19	**Substrate embeddedness** (deeply embedded = 0; loose structure = max)	NA*	0 – 4	0 – 4	N/A
BIOLOGY	20	**Presence of stream invertebrates** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 5	0 – 5	0
	21	**Presence of amphibians** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	1
	22	**Presence of fish** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	0
	23	**Evidence of wildlife use** (no evidence = 0; abundant evidence = max points)	0 – 6	0 – 5	0 – 5	2
Total Points Possible			100	100	100	
TOTAL SCORE (also enter on first page)						39

* These characteristics are not assessed in coastal streams.

OFFICE USE ONLY: USACE AID#_____ DWQ #_____

SCP8 – Southeast Branch (Perennial RPW)

STREAM QUALITY ASSESSMENT WORKSHEET

1. Applicant's Name: Wildlands Engineering
2. Evaluator's Name: Matt Jenkins
3. Date of Evaluation: 2/23/12
4. Time of Evaluation: 11:15am
5. Name of Stream: Southeast Branch
6. River Basin: Neuse 03020201
7. Approximate Drainage Area: 70 acres
8. Stream Order: First
9. Length of Reach Evaluated: 200 lf
10. County: Johnston
11. Location of reach under evaluation (include nearby roads and landmarks): From Raleigh, NC, travel south on Interstate 40 for approximately 27 miles to Interstate 95 North. Travel approximately 9 miles on Interstate 95 and take exit 90 for NC 96 toward US 301. Turn left onto NC 96 and take an immediate right onto US 701. Travel approximately ½ mile; site is on the left.
12. Site Coordinates (if known): N 35.447875 °, W 78.386804°
13. Proposed Channel Work (if any): restoration
14. Recent Weather Conditions: no rain within the past 48 hours
15. Site conditions at time of visit: sunny, 65°
16. Identify any special waterway classifications known: ___Section 10 ___Tidal Waters ___Essential Fisheries Habitat ___Trout Waters ___Outstanding Resource Waters ___ Nutrient Sensitive Waters ___Water Supply Watershed ____(I-IV)
17. Is there a pond or lake located upstream of the evaluation point? YES (NO) If yes, estimate the water surface area:_____
18. Does channel appear on USGS quad map? YES (NO) 19. Does channel appear on USDA Soil Survey? YES (NO)
20. Estimated Watershed Land Use: ____% Residential ___% Commercial ___% Industrial 77 % Agricultural 23 % Forested ___% Cleared / Logged ____% Other (_____)
21. Bankfull Width: 4-6 feet
22. Bank Height (from bed to top of bank): 2-3 feet
23. Channel slope down center of stream: ___Flat (0 to 2%) X Gentle (2 to 4%) ___Moderate (4 to 10%) ___Steep (>10%)
24. Channel Sinuosity: X Straight ___Occasional Bends ___Frequent Meander ___Very Sinuous ___Braided Channel

Instructions for completion of worksheet (located on page 2): Begin by determining the most appropriate ecoregion based on location, terrain, vegetation, stream classification, etc. Every characteristic must be scored using the same ecoregion. Assign points to each characteristic within the range shown for the ecoregion. Page 3 provides a brief description of how to review the characteristics identified in the worksheet. Scores should reflect an overall assessment of the stream reach under evaluation. If a characteristic cannot be evaluated due to site or weather conditions, enter 0 in the scoring box and provide an explanation in the comment section. Where there are obvious changes in the character of a stream under review (e.g., the stream flows from a pasture into a forest), the stream may be divided into smaller reaches that display more continuity, and a separate form used to evaluate each reach. The total score assigned to a stream reach must range between 0 and 100, with a score of 100 representing a stream of the highest quality.

Total Score (from reverse): 32 **Comments:**_____

Evaluator's Signature_____ **Date** 2/23/2012

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STREAM QUALITY ASSESSMENT WORKSHEET
SCP8 – Southeast Branch (Perennial RPW)

	#	CHARACTERISTICS	ECOREGION POINT RANGE			SCORE
			Coastal	Piedmont	Mountain	
PHYSICAL	1	**Presence of flow / persistent pools in stream** (no flow or saturation = 0; strong flow = max points)	0 – 5	0 – 4	0 – 5	4
	2	**Evidence of past human alteration** (extensive alteration = 0; no alteration = max points)	0 – 6	0 – 5	0 – 5	0
	3	**Riparian zone** (no buffer = 0; contiguous, wide buffer = max points)	0 – 6	0 – 4	0 – 5	0
	4	**Evidence of nutrient or chemical discharges** (extensive discharges = 0; no discharges = max points)	0 – 5	0 – 4	0 – 4	3
	5	**Groundwater discharge** (no discharge = 0; springs, seeps, wetlands, etc. = max points)	0 – 3	0 – 4	0 – 4	3
	6	**Presence of adjacent floodplain** (no floodplain = 0; extensive floodplain = max points)	0 – 4	0 – 4	0 – 2	4
	7	**Entrenchment / floodplain access** (deeply entrenched = 0; frequent flooding = max points)	0 – 5	0 – 4	0 – 2	3
	8	**Presence of adjacent wetlands** (no wetlands = 0; large adjacent wetlands = max points)	0 – 6	0 – 4	0 – 2	0
	9	**Channel sinuosity** (extensive channelization = 0; natural meander = max points)	0 – 5	0 – 4	0 – 3	0
	10	**Sediment input** (extensive deposition= 0; little or no sediment = max points)	0 – 5	0 – 4	0 – 4	2
	11	**Size & diversity of channel bed substrate** (fine, homogenous = 0; large, diverse sizes = max points)	NA*	0 – 4	0 – 5	N/A
STABILITY	12	**Evidence of channel incision or widening** (deeply incised = 0; stable bed & banks = max points)	0 – 5	0 – 4	0 – 5	2
	13	**Presence of major bank failures** (severe erosion = 0; no erosion, stable banks = max points)	0 – 5	0 – 5	0 – 5	3
	14	**Root depth and density on banks** (no visible roots = 0; dense roots throughout = max points)	0 – 3	0 – 4	0 – 5	0
	15	**Impact by agriculture or livestock production** (substantial impact =0; no evidence = max points)	0 – 5	0 – 4	0 – 5	0
HABITAT	16	**Presence of riffle-pool/ripple-pool complexes** (no riffles/ripples or pools = 0; well-developed = max points)	0 – 3	0 – 5	0 – 6	1
	17	**Habitat complexity** (little or no habitat = 0; frequent, varied habitats = max points)	0 – 6	0 – 6	0 – 6	1
	18	**Canopy coverage over streambed** (no shading vegetation = 0; continuous canopy = max points)	0 – 5	0 – 5	0 – 5	0
	19	**Substrate embeddedness** (deeply embedded = 0; loose structure = max)	NA*	0 – 4	0 – 4	N/A
BIOLOGY	20	**Presence of stream invertebrates** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 5	0 – 5	0
	21	**Presence of amphibians** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	4
	22	**Presence of fish** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	0
	23	**Evidence of wildlife use** (no evidence = 0; abundant evidence = max points)	0 – 6	0 – 5	0 – 5	2
Total Points Possible			100	100	100	
TOTAL SCORE (also enter on first page)						32

* These characteristics are not assessed in coastal streams.

OFFICE USE ONLY: USACE AID#_____ DWQ #_____

SCP9 – UT to Southeast Branch (Intermittent RPW)

STREAM QUALITY ASSESSMENT WORKSHEET

1. Applicant's Name: Wildlands Engineering
2. Evaluator's Name: Matt Jenkins
3. Date of Evaluation: 2/23/12
4. Time of Evaluation: 11:30am
5. Name of Stream: UT to Southeast Branch
6. River Basin: Neuse 03020201
7. Approximate Drainage Area: 17 acres
8. Stream Order: First
9. Length of Reach Evaluated: 100 lf
10. County: Johnston
11. Location of reach under evaluation (include nearby roads and landmarks): From Raleigh, NC, travel south on Interstate 40 for approximately 27 miles to Interstate 95 North. Travel approximately 9 miles on Interstate 95 and take exit 90 for NC 96 toward US 301. Turn left onto NC 96 and take an immediate right onto US 701. Travel approximately ½ mile; site is on the left.
12. Site Coordinates (if known): N 35.447875 °, W 78.386804°
13. Proposed Channel Work (if any): restoration
14. Recent Weather Conditions: no rain within the past 48 hours
15. Site conditions at time of visit: sunny, 65°
16. Identify any special waterway classifications known: ___Section 10 ___Tidal Waters ___Essential Fisheries Habitat ___Trout Waters ___Outstanding Resource Waters ___ Nutrient Sensitive Waters ___Water Supply Watershed ____(I-IV)
17. Is there a pond or lake located upstream of the evaluation point? YES (NO) If yes, estimate the water surface area:_____
18. Does channel appear on USGS quad map? YES (NO) 19. Does channel appear on USDA Soil Survey? YES (NO)
20. Estimated Watershed Land Use: ____% Residential ___% Commercial ___% Industrial 40 % Agricultural 47 % Forested ___% Cleared / Logged 13 % Other (Shrubland)
21. Bankfull Width: 2-3 feet
22. Bank Height (from bed to top of bank): 1-3 feet
23. Channel slope down center of stream: ___Flat (0 to 2%) X Gentle (2 to 4%) ___Moderate (4 to 10%) ___Steep (>10%)
24. Channel Sinuosity: ____Straight X Occasional Bends ___Frequent Meander ___Very Sinuous ___Braided Channel

Instructions for completion of worksheet (located on page 2): Begin by determining the most appropriate ecoregion based on location, terrain, vegetation, stream classification, etc. Every characteristic must be scored using the same ecoregion. Assign points to each characteristic within the range shown for the ecoregion. Page 3 provides a brief description of how to review the characteristics identified in the worksheet. Scores should reflect an overall assessment of the stream reach under evaluation. If a characteristic cannot be evaluated due to site or weather conditions, enter 0 in the scoring box and provide an explanation in the comment section. Where there are obvious changes in the character of a stream under review (e.g., the stream flows from a pasture into a forest), the stream may be divided into smaller reaches that display more continuity, and a separate form used to evaluate each reach. The total score assigned to a stream reach must range between 0 and 100, with a score of 100 representing a stream of the highest quality.

Total Score (from reverse): 28 **Comments:**_____

Evaluator's Signature_____ **Date** 2/23/2012

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STREAM QUALITY ASSESSMENT WORKSHEET
SCP9 – UT to Southeast Branch (Intermittent RPW)

	#	CHARACTERISTICS	ECOREGION POINT RANGE			SCORE
			Coastal	Piedmont	Mountain	
PHYSICAL	1	**Presence of flow / persistent pools in stream** (no flow or saturation = 0; strong flow = max points)	0 – 5	0 – 4	0 – 5	1
	2	**Evidence of past human alteration** (extensive alteration = 0; no alteration = max points)	0 – 6	0 – 5	0 – 5	0
	3	**Riparian zone** (no buffer = 0; contiguous, wide buffer = max points)	0 – 6	0 – 4	0 – 5	0
	4	**Evidence of nutrient or chemical discharges** (extensive discharges = 0; no discharges = max points)	0 – 5	0 – 4	0 – 4	3
	5	**Groundwater discharge** (no discharge = 0; springs, seeps, wetlands, etc. = max points)	0 – 3	0 – 4	0 – 4	1
	6	**Presence of adjacent floodplain** (no floodplain = 0; extensive floodplain = max points)	0 – 4	0 – 4	0 – 2	4
	7	**Entrenchment / floodplain access** (deeply entrenched = 0; frequent flooding = max points)	0 – 5	0 – 4	0 – 2	4
	8	**Presence of adjacent wetlands** (no wetlands = 0; large adjacent wetlands = max points)	0 – 6	0 – 4	0 – 2	0
	9	**Channel sinuosity** (extensive channelization = 0; natural meander = max points)	0 – 5	0 – 4	0 – 3	1
	10	**Sediment input** (extensive deposition= 0; little or no sediment = max points)	0 – 5	0 – 4	0 – 4	3
	11	**Size & diversity of channel bed substrate** (fine, homogenous = 0; large, diverse sizes = max points)	NA*	0 – 4	0 – 5	N/A
STABILITY	12	**Evidence of channel incision or widening** (deeply incised = 0; stable bed & banks = max points)	0 – 5	0 – 4	0 – 5	2
	13	**Presence of major bank failures** (severe erosion = 0; no erosion, stable banks = max points)	0 – 5	0 – 5	0 – 5	4
	14	**Root depth and density on banks** (no visible roots = 0; dense roots throughout = max points)	0 – 3	0 – 4	0 – 5	0
	15	**Impact by agriculture or livestock production** (substantial impact =0; no evidence = max points)	0 – 5	0 – 4	0 – 5	0
HABITAT	16	**Presence of riffle-pool/ripple-pool complexes** (no riffles/ripples or pools = 0; well-developed = max points)	0 – 3	0 – 5	0 – 6	0
	17	**Habitat complexity** (little or no habitat = 0; frequent, varied habitats = max points)	0 – 6	0 – 6	0 – 6	1
	18	**Canopy coverage over streambed** (no shading vegetation = 0; continuous canopy = max points)	0 – 5	0 – 5	0 – 5	0
	19	**Substrate embeddedness** (deeply embedded = 0; loose structure = max)	NA*	0 – 4	0 – 4	N/A
BIOLOGY	20	**Presence of stream invertebrates** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 5	0 – 5	0
	21	**Presence of amphibians** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	2
	22	**Presence of fish** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	0
	23	**Evidence of wildlife use** (no evidence = 0; abundant evidence = max points)	0 – 6	0 – 5	0 – 5	2
Total Points Possible			100	100	100	
TOTAL SCORE (also enter on first page)						28

* These characteristics are not assessed in coastal streams.

OFFICE USE ONLY: USACE AID#_____ DWQ #_____

SCP10 – Devils Racetrack Creek (Perennial RPW)

STREAM QUALITY ASSESSMENT WORKSHEET

1. Applicant's Name: Wildlands Engineering
2. Evaluator's Name: Matt Jenkins
3. Date of Evaluation: 2/23/12
4. Time of Evaluation: 1:30pm
5. Name of Stream: Devils Racetrack Creek
6. River Basin: Neuse 03020201
7. Approximate Drainage Area: 783 acres
8. Stream Order: Third
9. Length of Reach Evaluated: 200 lf
10. County: Johnston
11. Location of reach under evaluation (include nearby roads and landmarks): From Raleigh, NC, travel south on Interstate 40 for approximately 27 miles to Interstate 95 North. Travel approximately 9 miles on Interstate 95 and take exit 90 for NC 96 toward US 301. Turn left onto NC 96 and take an immediate right onto US 701. Travel approximately ½ mile; site is on the left.
12. Site Coordinates (if known): N 35.447875 °, W 78.386804°
13. Proposed Channel Work (if any): restoration
14. Recent Weather Conditions: no rain within the past 48 hours
15. Site conditions at time of visit: sunny, 65°
16. Identify any special waterway classifications known: ___Section 10 ___Tidal Waters ___Essential Fisheries Habitat ___Trout Waters ___Outstanding Resource Waters ___ Nutrient Sensitive Waters ___Water Supply Watershed ____(I-IV)
17. Is there a pond or lake located upstream of the evaluation point? (YES) NO If yes, estimate the water surface area: ~1.0 ac
18. Does channel appear on USGS quad map? (YES) NO 19. Does channel appear on USDA Soil Survey? (YES) NO
20. Estimated Watershed Land Use: ____% Residential 3 % Commercial ___% Industrial 38 % Agricultural 45 % Forested ___% Cleared / Logged 14 % Other (Shrubland)
21. Bankfull Width: 20-25 feet
22. Bank Height (from bed to top of bank): 6-12 feet
23. Channel slope down center of stream: X Flat (0 to 2%) ___Gentle (2 to 4%) ___Moderate (4 to 10%) ___Steep (>10%)
24. Channel Sinuosity: X Straight ___Occasional Bends ___Frequent Meander ___Very Sinuous ___Braided Channel

Instructions for completion of worksheet (located on page 2): Begin by determining the most appropriate ecoregion based on location, terrain, vegetation, stream classification, etc. Every characteristic must be scored using the same ecoregion. Assign points to each characteristic within the range shown for the ecoregion. Page 3 provides a brief description of how to review the characteristics identified in the worksheet. Scores should reflect an overall assessment of the stream reach under evaluation. If a characteristic cannot be evaluated due to site or weather conditions, enter 0 in the scoring box and provide an explanation in the comment section. Where there are obvious changes in the character of a stream under review (e.g., the stream flows from a pasture into a forest), the stream may be divided into smaller reaches that display more continuity, and a separate form used to evaluate each reach. The total score assigned to a stream reach must range between 0 and 100, with a score of 100 representing a stream of the highest quality.

Total Score (from reverse): 49 **Comments:**_____

Evaluator's Signature_____ **Date** 2/23/2012

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STREAM QUALITY ASSESSMENT WORKSHEET
SCP10 – Devils Racetrack Creek (Perennial RPW)

	#	CHARACTERISTICS	ECOREGION POINT RANGE			SCORE
			Coastal	Piedmont	Mountain	
PHYSICAL	1	**Presence of flow / persistent pools in stream** (no flow or saturation = 0; strong flow = max points)	0 – 5	0 – 4	0 – 5	5
	2	**Evidence of past human alteration** (extensive alteration = 0; no alteration = max points)	0 – 6	0 – 5	0 – 5	0
	3	**Riparian zone** (no buffer = 0; contiguous, wide buffer = max points)	0 – 6	0 – 4	0 – 5	5
	4	**Evidence of nutrient or chemical discharges** (extensive discharges = 0; no discharges = max points)	0 – 5	0 – 4	0 – 4	3
	5	**Groundwater discharge** (no discharge = 0; springs, seeps, wetlands, etc. = max points)	0 – 3	0 – 4	0 – 4	3
	6	**Presence of adjacent floodplain** (no floodplain = 0; extensive floodplain = max points)	0 – 4	0 – 4	0 – 2	4
	7	**Entrenchment / floodplain access** (deeply entrenched = 0; frequent flooding = max points)	0 – 5	0 – 4	0 – 2	3
	8	**Presence of adjacent wetlands** (no wetlands = 0; large adjacent wetlands = max points)	0 – 6	0 – 4	0 – 2	2
	9	**Channel sinuosity** (extensive channelization = 0; natural meander = max points)	0 – 5	0 – 4	0 – 3	0
	10	**Sediment input** (extensive deposition= 0; little or no sediment = max points)	0 – 5	0 – 4	0 – 4	1
	11	**Size & diversity of channel bed substrate** (fine, homogenous = 0; large, diverse sizes = max points)	NA*	0 – 4	0 – 5	N/A
STABILITY	12	**Evidence of channel incision or widening** (deeply incised = 0; stable bed & banks = max points)	0 – 5	0 – 4	0 – 5	1
	13	**Presence of major bank failures** (severe erosion = 0; no erosion, stable banks = max points)	0 – 5	0 – 5	0 – 5	2
	14	**Root depth and density on banks** (no visible roots = 0; dense roots throughout = max points)	0 – 3	0 – 4	0 – 5	2
	15	**Impact by agriculture or livestock production** (substantial impact =0; no evidence = max points)	0 – 5	0 – 4	0 – 5	0
HABITAT	16	**Presence of riffle-pool/ripple-pool complexes** (no riffles/ripples or pools = 0; well-developed = max points)	0 – 3	0 – 5	0 – 6	1
	17	**Habitat complexity** (little or no habitat = 0; frequent, varied habitats = max points)	0 – 6	0 – 6	0 – 6	3
	18	**Canopy coverage over streambed** (no shading vegetation = 0; continuous canopy = max points)	0 – 5	0 – 5	0 – 5	3
	19	**Substrate embeddedness** (deeply embedded = 0; loose structure = max)	NA*	0 – 4	0 – 4	N/A
BIOLOGY	20	**Presence of stream invertebrates** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 5	0 – 5	1
	21	**Presence of amphibians** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	4
	22	**Presence of fish** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	2
	23	**Evidence of wildlife use** (no evidence = 0; abundant evidence = max points)	0 – 6	0 – 5	0 – 5	4
Total Points Possible			100	100	100	
TOTAL SCORE (also enter on first page)						49

* These characteristics are not assessed in coastal streams.

WETLAND DETERMINATION DATA FORM – Atlantic and Gulf Coastal Plain Region

Project/Site: Devils Ractrack City/County: Johnston Sampling Date: 2/23/12

Applicant/Owner: Wildlands Engineering State: NC Sampling Point: DP1

Investigator(s): Matt Jenkins, PWS; Mike Ortosky, LSS Section, Township, Range: Ingrams Township

Landform (hillslope, terrace, etc.): floodplain Local relief (concave, convex, none): none Slope (%): 0%

Subregion (LRR or MLRA): MLRA 133A Lat: N 35.447875 Long: W 78.386804 Datum: _____

Soil Map Unit Name: Bibb sandy loam (Bb) NWI classification: N/A

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✔ No _____ (If no, explain in Remarks.)

Are Vegetation ✔, Soil ✔, or Hydrology ✔ significantly disturbed? Are "Normal Circumstances" present? Yes _____ No ✔

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes _____	No ✔	**Is the Sampled Area within a Wetland?** Yes _____ No ✔
Hydric Soil Present?	Yes ✔	No _____	
Wetland Hydrology Present?	Yes _____	No ✔	

Remarks:

Sampling point is representative of a non-jurisdictional agricultural row crop field. These areas have been regularly plowed, ditched, and planted since between 1949 and 1971.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15) **(LRR U)**
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes _____ No _____ Depth (inches): _____

Water Table Present? Yes _____ No _____ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No _____ Depth (inches): _____

Wetland Hydrology Present? Yes _____ No ✔

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants. Sampling Point: DP1

Tree Stratum (Plot sizes: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	= Total Cover		
Sapling Stratum (15')			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	= Total Cover		
Shrub Stratum (15')			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	= Total Cover		
Herb Stratum (5')			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	= Total Cover		
Woody Vine Stratum (30')			
1.			
2.			
3.			
4.			
5.			
	= Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: _____ (A)

Total Number of Dominant Species Across All Strata: _____ (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: _____ (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species _____	x 1 = _____
FACW species _____	x 2 = _____
FAC species _____	x 3 = _____
FACU species _____	x 4 = _____
UPL species _____	x 5 = _____
Column Totals: _____ (A)	_____ (B)

Prevalence Index = B/A = _____

Hydrophytic Vegetation Indicators:

___ Dominance Test is >50%

___ Prevalence Index is ≤3.0[1]

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present.

Definitions of Vegetation Strata:

Tree – Woody plants, excluding woody vines, approximately 20 ft (6 m) or more in height and 3 in. (7.6 cm) or larger in diameter at breast height (DBH).

Sapling – Woody plants, excluding woody vines, approximately 20 ft (6 m) or more in height and less than 3 in. (7.6 cm) DBH.

Shrub – Woody plants, excluding woody vines, approximately 3 to 20 ft (1 to 6 m) in height.

Herb – All herbaceous (non-woody) plants, including herbaceous vines, regardless of size. Includes woody plants, except woody vines, less than approximately 3 ft (1 m) in height.

Woody vine – All woody vines, regardless of height.

Hydrophytic Vegetation Present? **Yes** _____ **No** ✔

Remarks: (If observed, list morphological adaptations below).

Area is an active row crop field that is regularly planted and tilled. No vegetation existed on-site during the jurisdictional investigations.

SOIL

Sampling Point: DP1

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-12	10YR 3/2	100					sandy lo	
12-22+	10YR 5/1	75	10YR 5/6	25	C	PL	sandy lo	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Organic Bodies (A6) **(LRR P, T, U)**
- ___ 5 cm Mucky Mineral (A7) **(LRR P, T, U)**
- ___ Muck Presence (A8) **(LRR U)**
- ___ 1 cm Muck (A9) **(LRR P, T)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Coast Prairie Redox (A16) **(MLRA 150A)**
- ___ Sandy Mucky Mineral (S1) **(LRR O, S)**
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7) **(LRR P, S, T, U)**
- ___ Polyvalue Below Surface (S8) **(LRR S, T, U)**
- ___ Thin Dark Surface (S9) **(LRR S, T, U)**
- ___ Loamy Mucky Mineral (F1) **(LRR O)**
- ___ Loamy Gleyed Matrix (F2)
- ✔ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Marl (F10) **(LRR U)**
- ___ Depleted Ochric (F11) **(MLRA 151)**
- ___ Iron-Manganese Masses (F12) **(LRR O, P, T)**
- ___ Umbric Surface (F13) **(LRR P, T, U)**
- ___ Delta Ochric (F17) **(MLRA 151)**
- ___ Reduced Vertic (F18) **(MLRA 150A, 150B)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 149A)**
- ___ Anomalous Bright Loamy Soils (F20) **(MLRA 149A, 153C, 153D)**

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) **(LRR O)**
- ___ 2 cm Muck (A10) **(LRR S)**
- ___ Reduced Vertic (F18) **(outside MLRA 150A,B)**
- ___ Piedmont Floodplain Soils (F19) **(LRR P, S, T)**
- ___ Anomalous Bright Loamy Soils (F20) **(MLRA 153B)**
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12) (LRR T, U)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** ✔ **No** _____

Remarks:

The upper 12 inches of the soil surface exhibit disturbance from regular seasonal tilling and fertilizing with organic matter from planted row crops.

WETLAND DETERMINATION DATA FORM – Atlantic and Gulf Coastal Plain Region

Project/Site: Devils Ractrack City/County: Johnston Sampling Date: 2/23/12

Applicant/Owner: Wildlands Engineering State: NC Sampling Point: DP2

Investigator(s): Matt Jenkins, PWS; Mike Ortosky, LSS Section, Township, Range: Ingrams Township

Landform (hillslope, terrace, etc.): floodplain Local relief (concave, convex, none): none Slope (%): 0%

Subregion (LRR or MLRA): MLRA 133A Lat: N 35.447875 Long: W 78.386804 Datum: _____

Soil Map Unit Name: Leaf silt loam (Le) NWI classification: N/A

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✔ No _____ (If no, explain in Remarks.)

Are Vegetation ✔, Soil ✔, or Hydrology ✔ significantly disturbed? Are "Normal Circumstances" present? Yes _____ No ✔

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes _____	No ✔	**Is the Sampled Area within a Wetland?** Yes _____ No ✔
Hydric Soil Present?	Yes ✔	No _____	
Wetland Hydrology Present?	Yes _____	No ✔	

Remarks:

Sampling point is representative of a non-jurisdictional agricultural row crop field. These areas have been regularly plowed, ditched, and planted since between 1949 and 1971.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15) **(LRR U)**
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes _____ No _____ Depth (inches): _____

Water Table Present? Yes _____ No _____ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No _____ Depth (inches): _____

Wetland Hydrology Present? Yes _____ No ✔

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: DP2

Tree Stratum (Plot sizes: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	= Total Cover		
Sapling Stratum (15')			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	= Total Cover		
Shrub Stratum (15')			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	= Total Cover		
Herb Stratum (5')			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	= Total Cover		
Woody Vine Stratum (30')			
1.			
2.			
3.			
4.			
5.			
	= Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: _____ (A)

Total Number of Dominant Species Across All Strata: _____ (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: _____ (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species _____	x 1 = _____
FACW species _____	x 2 = _____
FAC species _____	x 3 = _____
FACU species _____	x 4 = _____
UPL species _____	x 5 = _____
Column Totals: _____ (A)	_____ (B)

Prevalence Index = B/A = _____

Hydrophytic Vegetation Indicators:

___ Dominance Test is >50%

___ Prevalence Index is ≤3.0[1]

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present.

Definitions of Vegetation Strata:

Tree – Woody plants, excluding woody vines, approximately 20 ft (6 m) or more in height and 3 in. (7.6 cm) or larger in diameter at breast height (DBH).

Sapling – Woody plants, excluding woody vines, approximately 20 ft (6 m) or more in height and less than 3 in. (7.6 cm) DBH.

Shrub – Woody plants, excluding woody vines, approximately 3 to 20 ft (1 to 6 m) in height.

Herb – All herbaceous (non-woody) plants, including herbaceous vines, regardless of size. Includes woody plants, except woody vines, less than approximately 3 ft (1 m) in height.

Woody vine – All woody vines, regardless of height.

Hydrophytic Vegetation Present? **Yes** _____ **No** ✔

Remarks: (If observed, list morphological adaptations below).

Area is an active row crop field that is regularly planted and tilled. No vegetation existed on-site during the jurisdictional investigations.

SOIL

Sampling Point: DP2

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-12	10YR 3/1	100					sandy lo	
12-18+	10YR 5/2	60	10YR 4/6	30	C	PL	sandy lo	
			10YR 4/1	10	D	M	sandy cl	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Organic Bodies (A6) **(LRR P, T, U)**
- ___ 5 cm Mucky Mineral (A7) **(LRR P, T, U)**
- ___ Muck Presence (A8) **(LRR U)**
- ___ 1 cm Muck (A9) **(LRR P, T)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Coast Prairie Redox (A16) **(MLRA 150A)**
- ___ Sandy Mucky Mineral (S1) **(LRR O, S)**
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7) **(LRR P, S, T, U)**
- ___ Polyvalue Below Surface (S8) **(LRR S, T, U)**
- ___ Thin Dark Surface (S9) **(LRR S, T, U)**
- ___ Loamy Mucky Mineral (F1) **(LRR O)**
- ___ Loamy Gleyed Matrix (F2)
- ✔ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Marl (F10) **(LRR U)**
- ___ Depleted Ochric (F11) **(MLRA 151)**
- ___ Iron-Manganese Masses (F12) **(LRR O, P, T)**
- ___ Umbric Surface (F13) **(LRR P, T, U)**
- ___ Delta Ochric (F17) **(MLRA 151)**
- ___ Reduced Vertic (F18) **(MLRA 150A, 150B)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 149A)**
- ___ Anomalous Bright Loamy Soils (F20) **(MLRA 149A, 153C, 153D)**

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) **(LRR O)**
- ___ 2 cm Muck (A10) **(LRR S)**
- ___ Reduced Vertic (F18) **(outside MLRA 150A,B)**
- ___ Piedmont Floodplain Soils (F19) **(LRR P, S, T)**
- ___ Anomalous Bright Loamy Soils (F20) **(MLRA 153B)**
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12) (LRR T, U)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

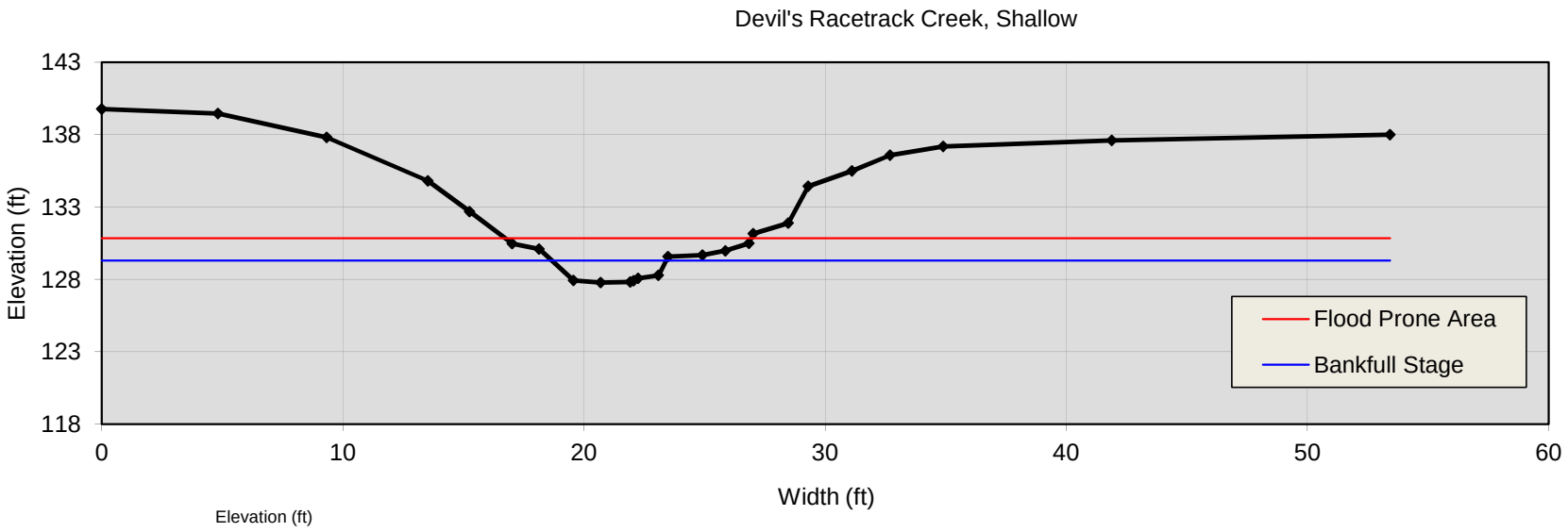
Hydric Soil Present? **Yes** ✔ **No** _____

Remarks:

The upper 12 inches of the soil surface exhibit disturbance from regular seasonal tilling and fertilizing with organic matter from planted row crops.

Appendix 5: Existing Conditions Morphologic Survey Data

Cross Section XS 1



Elevation (ft)

Bankfull Dimensions

5.7	x-section area (ft.sq.)
4.8	width (ft)
1.2	mean depth (ft)
1.5	max depth (ft)
6.4	wetted parimeter (ft)
0.9	hyd radi (ft)
4.0	width-depth ratio

Flood Dimensions

10.2	W flood prone area (ft)
2.1	entrenchment ratio
6.7	low bank height (ft)
4.3	low bank height ratio

Materials

---	D50 (mm)
---	D84 (mm)
11	threshold grain size (mm):

Bankfull Flow

1.8	velocity (ft/s)
10.0	discharge rate (cfs)
0.33	Froude number

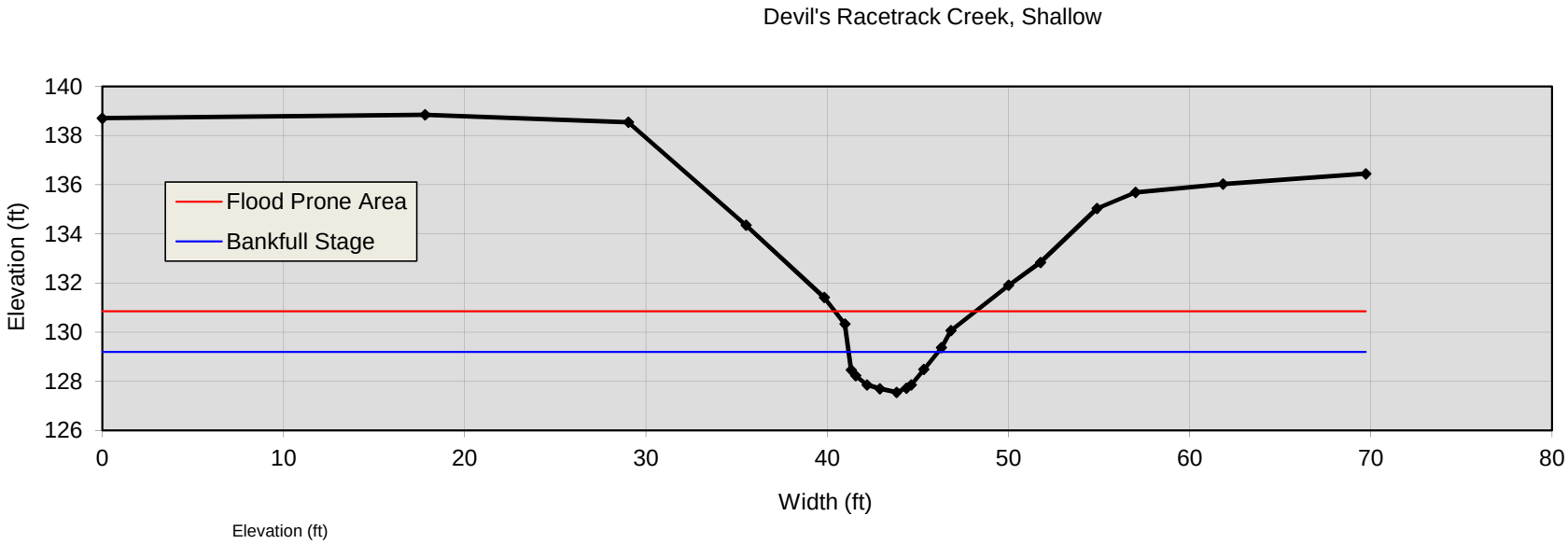
Flow Resistance

0.050	Manning's roughness
---	D'Arcy-Weisbach fric.
---	resistance factor u/u*
---	relative roughness

Forces & Power

0.41	channel slope (%)
0.23	shear stress (lb/sq.ft.)
0.34	shear velocity (ft/s)
0.54	unit strm power (lb/ft/s)

Cross Section XS 2



Elevation (ft)

Bankfull Dimensions

5.7	x-section area (ft.sq.)
4.9	width (ft)
1.2	mean depth (ft)
1.6	max depth (ft)
6.4	wetted parimeter (ft)
0.9	hyd radi (ft)
4.3	width-depth ratio

Flood Dimensions

7.8	W flood prone area (ft)
1.6	entrenchment ratio
7.5	low bank height (ft)
4.5	low bank height ratio

Materials

---	D50 (mm)
---	D84 (mm)
11	threshold grain size (mm):

Bankfull Flow

1.8	velocity (ft/s)
10.1	discharge rate (cfs)
0.33	Froude number

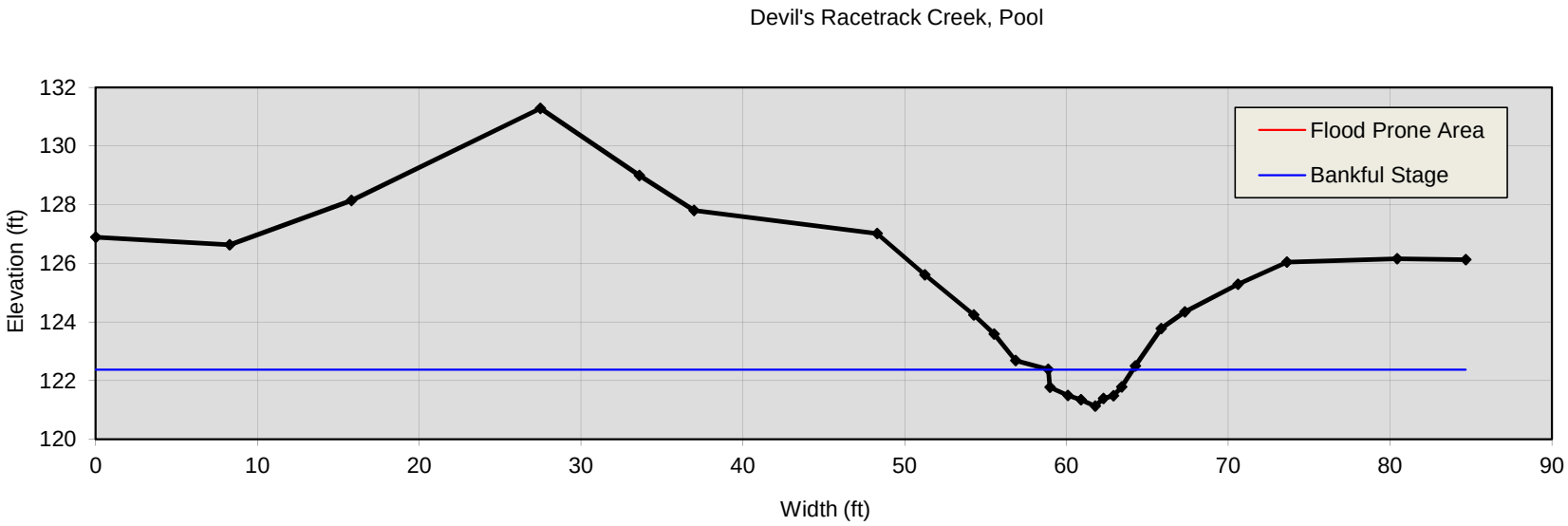
Flow Resistance

0.050	Manning's roughness
---	D'Arcy-Weisbach fric.
---	resistance factor u/u*
---	relative roughness

Forces & Power

0.41	channel slope (%)
0.23	shear stress (lb/sq.ft.)
0.34	shear velocity (ft/s)
0.52	unit strm power (lb/ft/s)

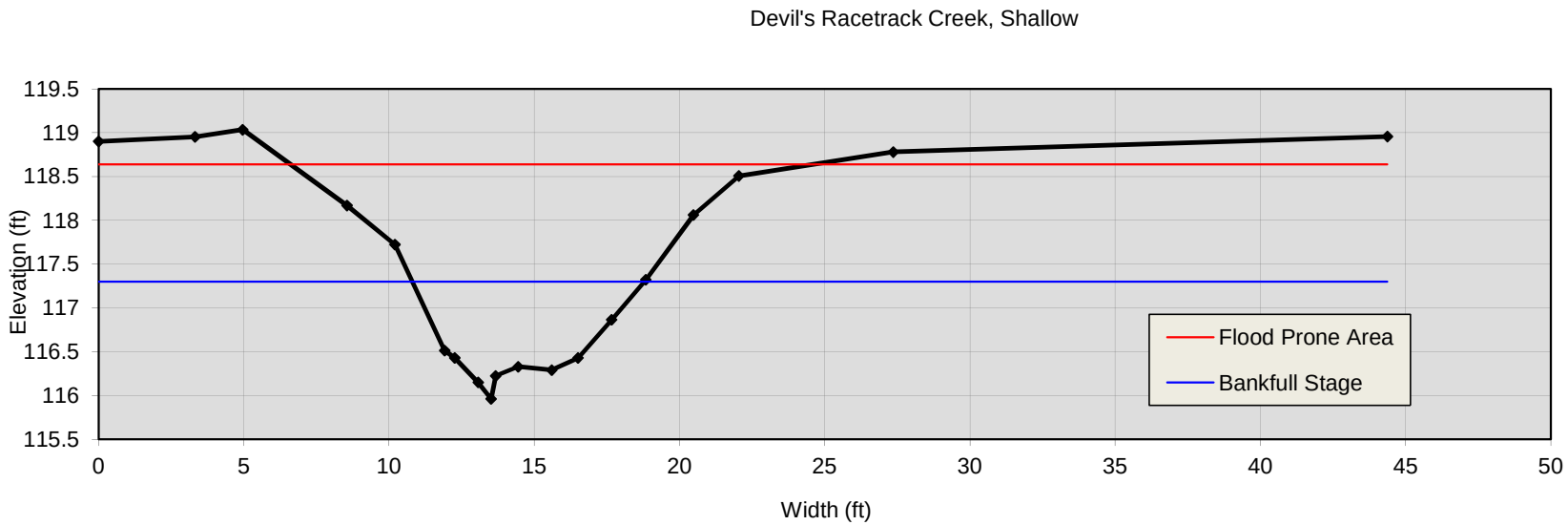
Cross Section XS 3



Bankfull Dimensions		Flood Dimensions		Materials	
4.4	x-section area (ft.sq.)	---	W flood prone area (ft)	---	D50 (mm)
5.2	width (ft)	---	entrenchment ratio	---	D84 (mm)
0.8	mean depth (ft)	4.7	low bank height (ft)	9	threshold grain size (mm):
1.2	max depth (ft)	3.8	low bank height ratio		
6.2	wetted parimeter (ft)				
0.7	hyd radi (ft)				
6.3	width-depth ratio				

Bankfull Flow		Flow Resistance		Forces & Power	
1.5	velocity (ft/s)	0.050	Manning's roughness	0.41	channel slope (%)
6.6	discharge rate (cfs)	---	D'Arcy-Weisbach fric.	0.18	shear stress (lb/sq.ft.)
0.32	Froude number	---	resistance factor u/u*	0.31	shear velocity (ft/s)
		---	relative roughness	0.32	unit strm power (lb/ft/s)

Cross Section XS 4



Bankfull Dimensions

6.1	x-section area (ft.sq.)
8.0	width (ft)
0.8	mean depth (ft)
1.3	max depth (ft)
8.7	wetted parimeter (ft)
0.7	hyd radi (ft)
10.5	width-depth ratio

Flood Dimensions

18.0	W flood prone area (ft)
2.2	entrenchment ratio
2.6	low bank height (ft)
1.9	low bank height ratio

Materials

---	D50 (mm)
---	D84 (mm)
9	threshold grain size (mm):

Bankfull Flow

1.5	velocity (ft/s)
9.2	discharge rate (cfs)
0.32	Froude number

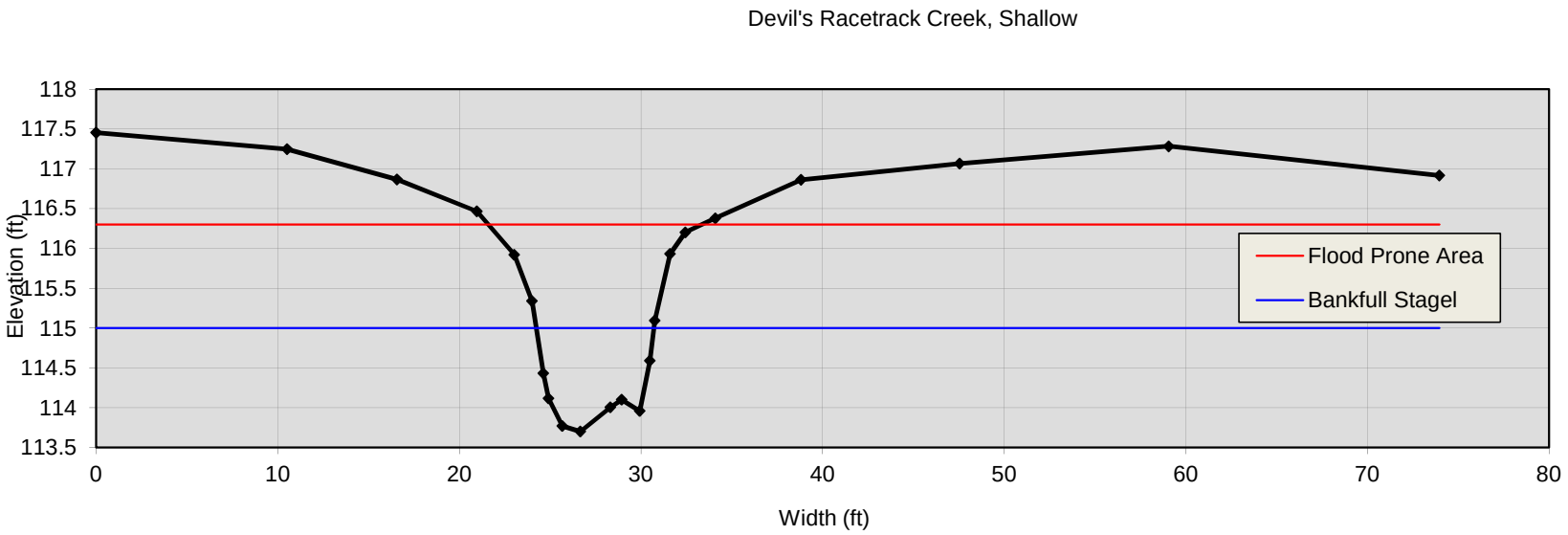
Flow Resistance

0.050	Manning's roughness
---	D'Arcy-Weisbach fric.
---	resistance factor u/u*
---	relative roughness

Forces & Power

0.41	channel slope (%)
0.18	shear stress (lb/sq.ft.)
0.30	shear velocity (ft/s)
0.29	unit strm power (lb/ft/s)

Cross Section XS 5



Bankfull Dimensions

6.3	x-section area (ft.sq.)
6.5	width (ft)
1.0	mean depth (ft)
1.3	max depth (ft)
7.6	wetted parimeter (ft)
0.8	hyd radi (ft)
6.7	width-depth ratio

Flood Dimensions

11.7	W flood prone area (ft)
1.8	entrenchment ratio
2.5	low bank height (ft)
1.9	low bank height ratio

Materials

---	D50 (mm)
---	D84 (mm)
10	threshold grain size (mm):

Bankfull Flow

1.7	velocity (ft/s)
10.6	discharge rate (cfs)
0.33	Froude number

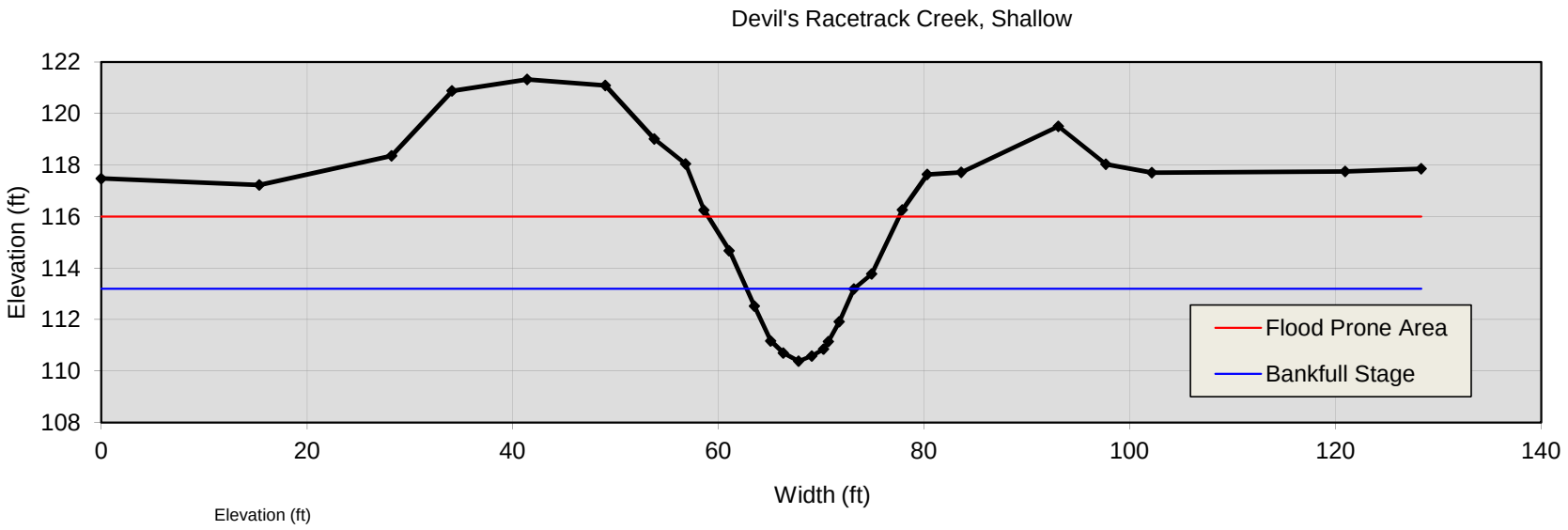
Flow Resistance

0.050	Manning's roughness
---	D'Arcy-Weisbach fric.
---	resistance factor u/u*
---	relative roughness

Forces & Power

0.41	channel slope (%)
0.21	shear stress (lb/sq.ft.)
0.33	shear velocity (ft/s)
0.42	unit strm power (lb/ft/s)

Cross Section XS 6



Elevation (ft)

Bankfull Dimensions

19.1	x-section area (ft.sq.)
10.4	width (ft)
1.8	mean depth (ft)
2.8	max depth (ft)
12.2	wetted parimeter (ft)
1.6	hyd radi (ft)
5.7	width-depth ratio

Flood Dimensions

18.6	W flood prone area (ft)
1.8	entrenchment ratio
7.3	low bank height (ft)
2.6	low bank height ratio

Materials

---	D50 (mm)
---	D84 (mm)
0	threshold grain size (mm):

Bankfull Flow

0.4	velocity (ft/s)
8.5	discharge rate (cfs)
0.06	Froude number

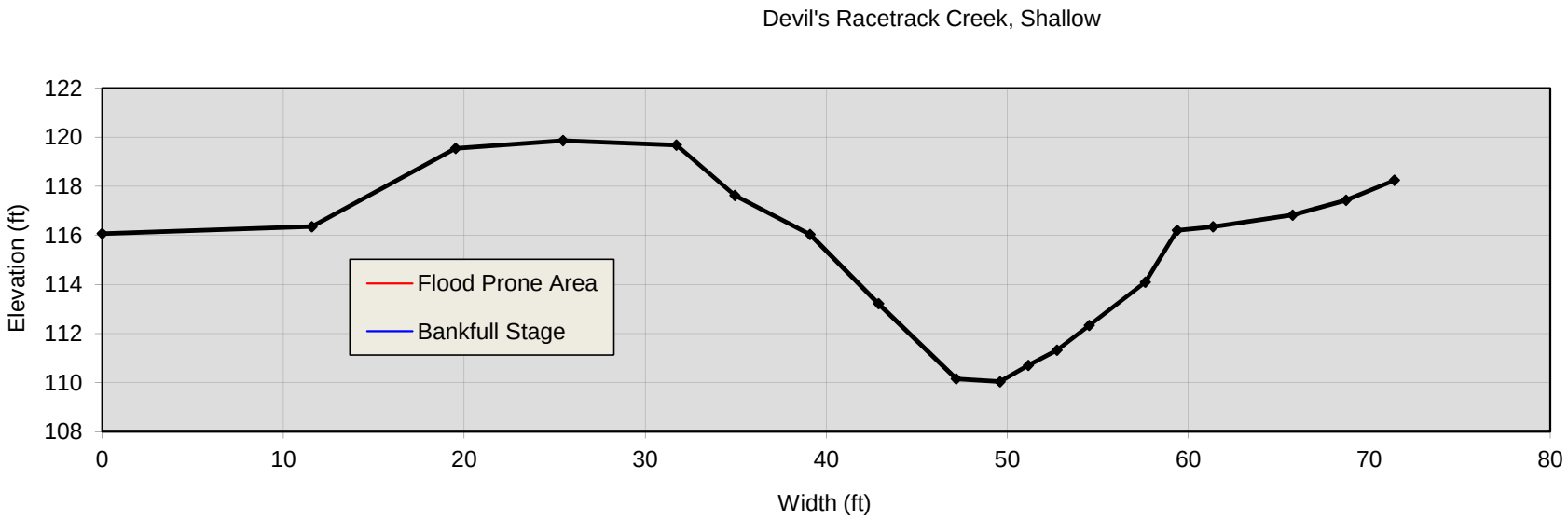
Flow Resistance

0.045	Manning's roughness
---	D'Arcy-Weisbach fric.
---	resistance factor u/u*
---	relative roughness

Forces & Power

0.01	channel slope (%)
0.01	shear stress (lb/sq.ft.)
0.07	shear velocity (ft/s)
0.0051	unit strm power (lb/ft/s)

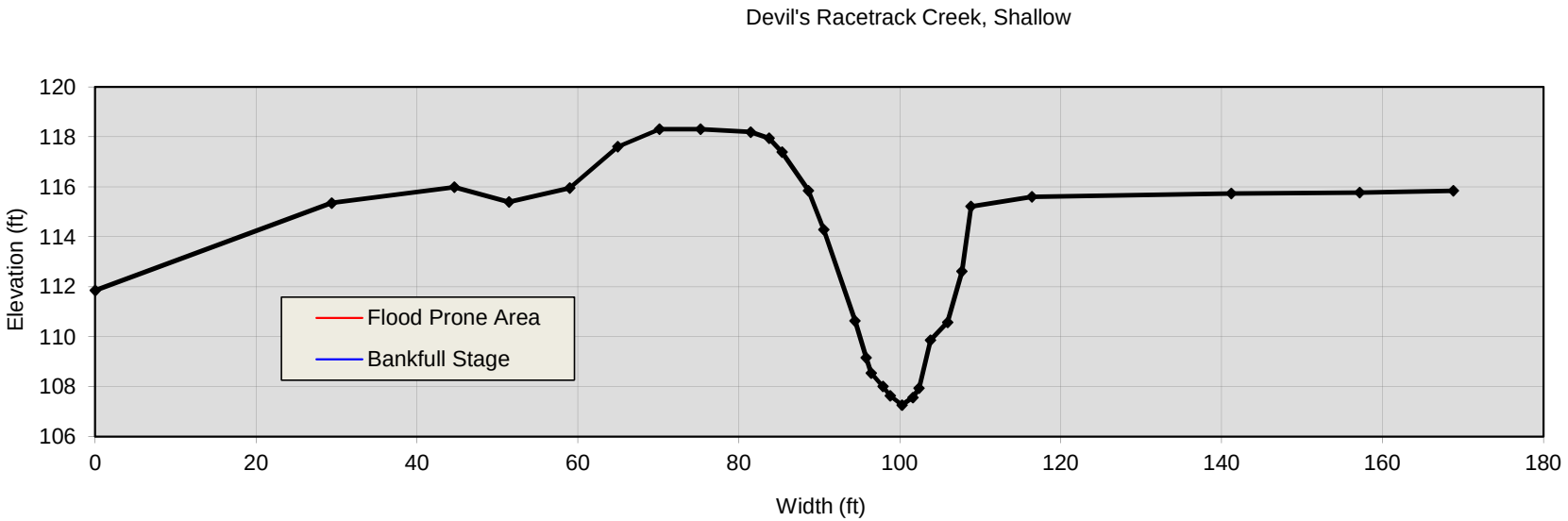
Cross Section XS 7



Bankfull Dimensions		Flood Dimensions		Materials	
0.0	x-section area (ft.sq.)	---	W flood prone area (ft)	---	D50 (mm)
0.0	width (ft)	---	entrenchment ratio	---	D84 (mm)
0.0	mean depth (ft)	---	low bank height (ft)	---	threshold grain size (mm):
0.0	max depth (ft)	---	low bank height ratio		
0.0	wetted parimeter (ft)				
0.0	hyd radi (ft)				
0.0	width-depth ratio				

Bankfull Flow		Flow Resistance		Forces & Power	
---	velocity (ft/s)	0.045	Manning's roughness	0.01	channel slope (%)
---	discharge rate (cfs)	---	D'Arcy-Weisbach fric.	---	shear stress (lb/sq.ft.)
---	Froude number	---	resistance factor u/u*	---	shear velocity (ft/s)
		---	relative roughness	---	unit strm power (lb/ft/s)

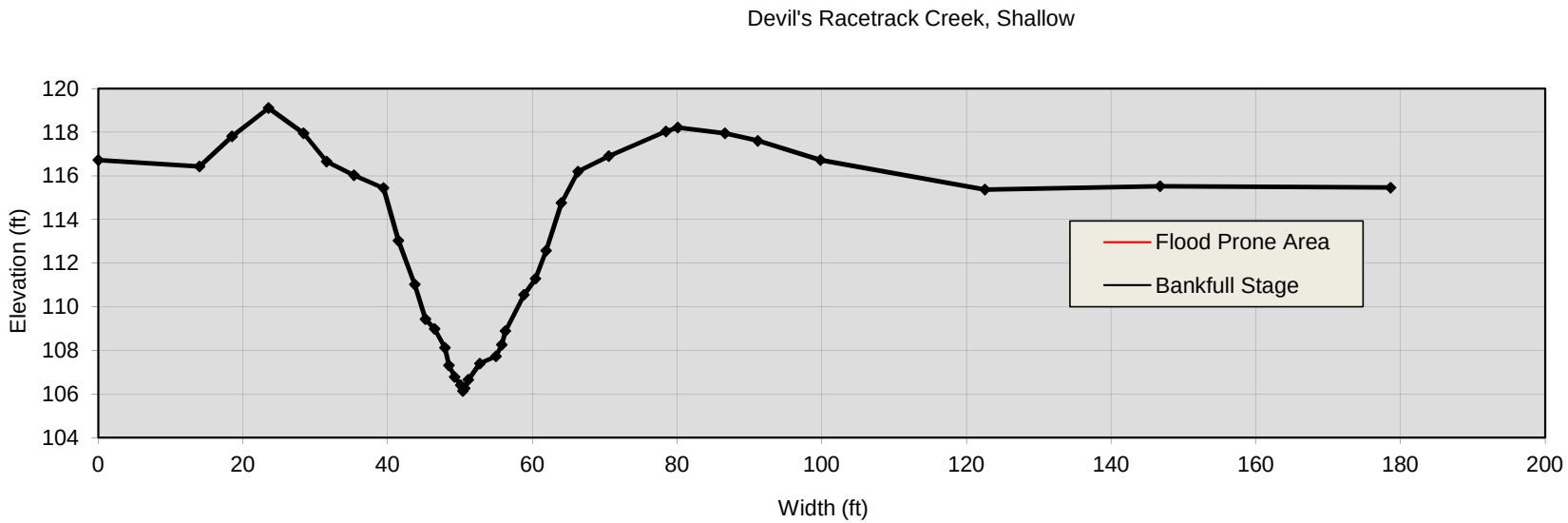
Cross Section XS 8



Bankfull Dimensions		Flood Dimensions		Materials	
0.0	x-section area (ft.sq.)	---	W flood prone area (ft)	---	D50 (mm)
0.0	width (ft)	---	entrenchment ratio	---	D84 (mm)
0.0	mean depth (ft)	---	low bank height (ft)	---	threshold grain size (mm):
0.0	max depth (ft)	---	low bank height ratio		
0.0	wetted parimeter (ft)				
0.0	hyd radi (ft)				
0.0	width-depth ratio				

Bankfull Flow		Flow Resistance		Forces & Power	
---	velocity (ft/s)	0.045	Manning's roughness	0.01	channel slope (%)
---	discharge rate (cfs)	---	D'Arcy-Weisbach fric.	---	shear stress (lb/sq.ft.)
---	Froude number	---	resistance factor u/u*	---	shear velocity (ft/s)
		---	relative roughness	---	unit strm power (lb/ft/s)

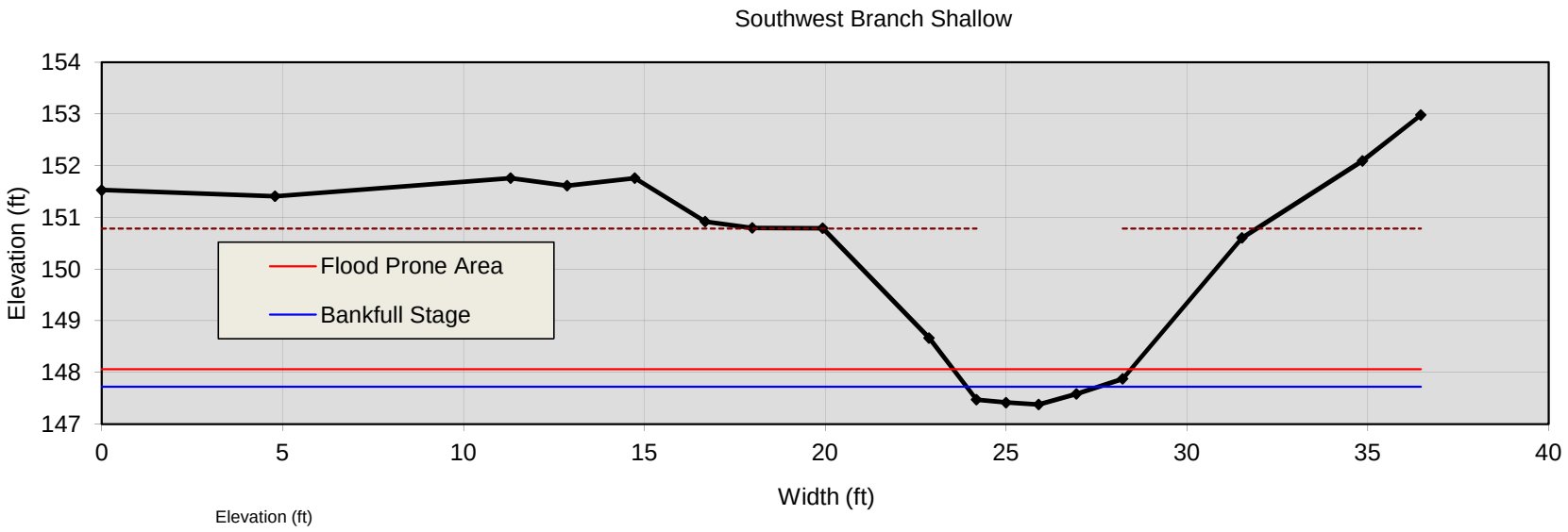
Cross Section XS 9



Bankfull Dimensions		Flood Dimensions		Materials	
0.0	x-section area (ft.sq.)	---	W flood prone area (ft)	---	D50 (mm)
0.0	width (ft)	---	entrenchment ratio	---	D84 (mm)
0.0	mean depth (ft)	---	low bank height (ft)	---	threshold grain size (mm):
0.0	max depth (ft)	---	low bank height ratio		
0.0	wetted parimeter (ft)				
0.0	hyd radi (ft)				
0.0	width-depth ratio				

Bankfull Flow		Flow Resistance		Forces & Power	
---	velocity (ft/s)	0.045	Manning's roughness	0.01	channel slope (%)
---	discharge rate (cfs)	---	D'Arcy-Weisbach fric.	---	shear stress (lb/sq.ft.)
---	Froude number	---	resistance factor u/u*	---	shear velocity (ft/s)
		---	relative roughness	---	unit strm power (lb/ft/s)

Cross Section XS 10



Elevation (ft)

Bankfull Dimensions

0.8	x-section area (ft.sq.)
3.4	width (ft)
0.2	mean depth (ft)
0.3	max depth (ft)
3.4	wetted parimeter (ft)
0.2	hyd radi (ft)
14.0	width-depth ratio

Flood Dimensions

4.9	W flood prone area (ft)
1.5	entrenchment ratio
3.4	low bank height (ft)
10.0	low bank height ratio

Materials

---	D50 (mm)
---	D84 (mm)
20	threshold grain size (mm):

Bankfull Flow

1.9	velocity (ft/s)
1.6	discharge rate (cfs)
0.69	Froude number

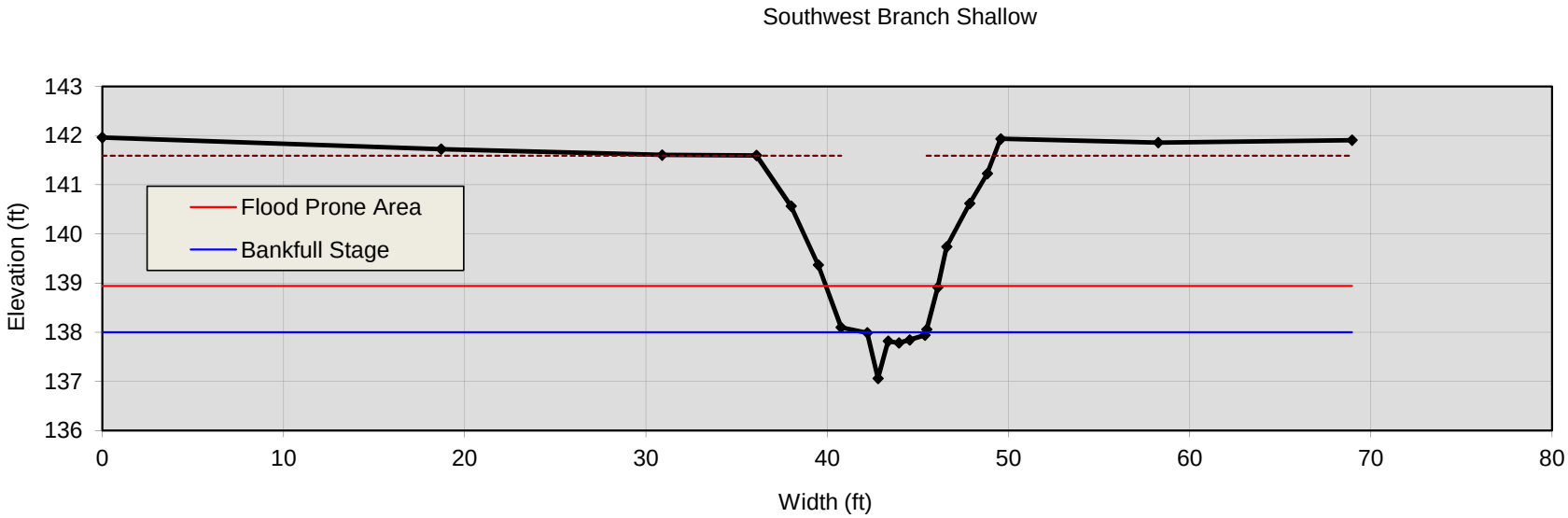
Flow Resistance

0.050	Manning's roughness
---	D'Arcy-Weisbach fric.
---	resistance factor u/u*
---	relative roughness

Forces & Power

2.8	channel slope (%)
0.42	shear stress (lb/sq.ft.)
0.46	shear velocity (ft/s)
0.81	unit strm power (lb/ft/s)

Cross Section XS 11



Bankfull Dimensions	
0.9	x-section area (ft.sq.)
3.4	width (ft)
0.3	mean depth (ft)
0.9	max depth (ft)
4.4	wetted parimeter (ft)
0.2	hyd radi (ft)
12.7	width-depth ratio

Flood Dimensions	
6.2	W flood prone area (ft)
1.8	entrenchment ratio
4.5	low bank height (ft)
4.8	low bank height ratio

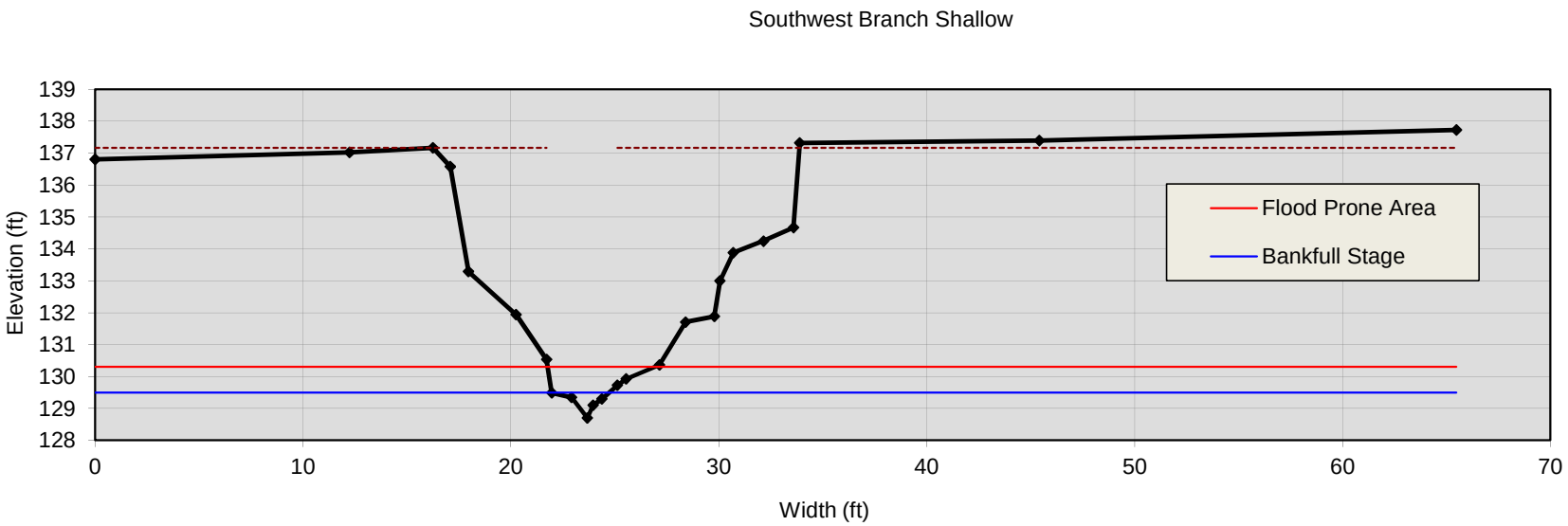
Materials	
---	D50 (mm)
---	D84 (mm)
18	threshold grain size (mm):

Bankfull Flow	
1.8	velocity (ft/s)
1.7	discharge rate (cfs)
0.68	Froude number

Flow Resistance	
0.050	Manning's roughness
---	D'Arcy-Weisbach fric.
---	resistance factor u/u*
---	relative roughness

Forces & Power	
2.8	channel slope (%)
0.37	shear stress (lb/sq.ft.)
0.44	shear velocity (ft/s)
0.84	unit strm power (lb/ft/s)

Cross Section XS 12



Bankfull Dimensions

0.8	x-section area (ft.sq.)
2.8	width (ft)
0.3	mean depth (ft)
0.8	max depth (ft)
3.3	wetted parimeter (ft)
0.2	hyd radi (ft)
10.0	width-depth ratio

Flood Dimensions

5.1	W flood prone area (ft)
1.9	entrenchment ratio
8.5	low bank height (ft)
10.6	low bank height ratio

Materials

---	D50 (mm)
---	D84 (mm)
20	threshold grain size (mm):

Bankfull Flow

1.9	velocity (ft/s)
1.4	discharge rate (cfs)
0.69	Froude number

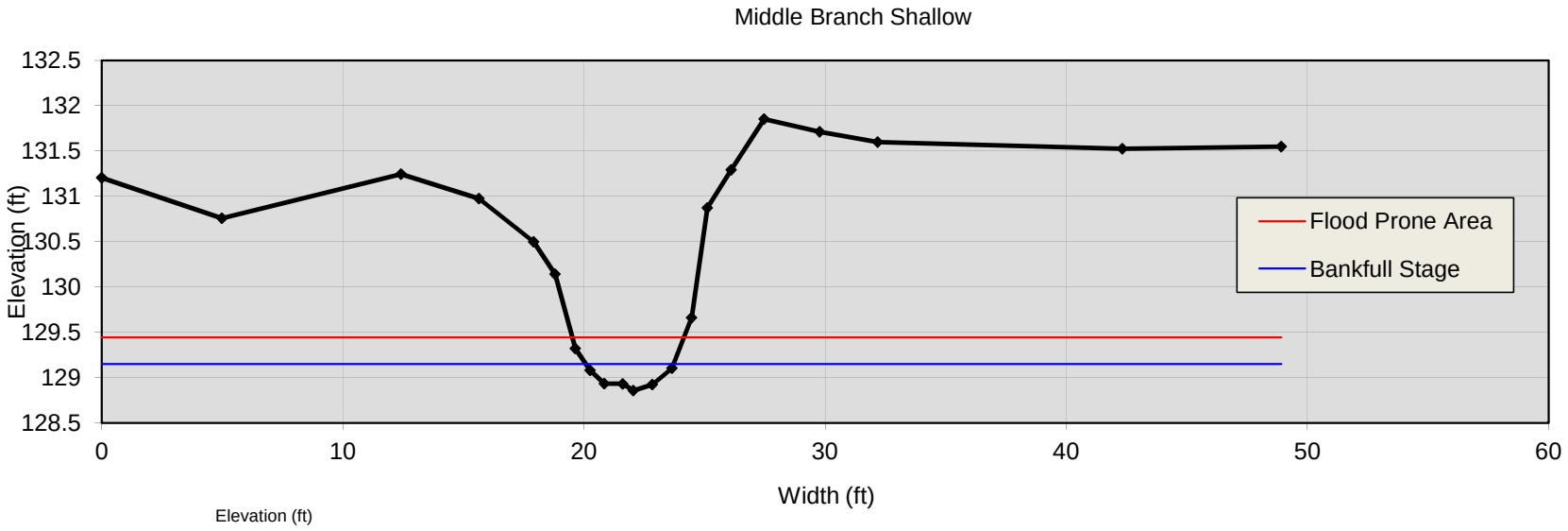
Flow Resistance

0.050	Manning's roughness
---	D'Arcy-Weisbach fric.
---	resistance factor u/u*
---	relative roughness

Forces & Power

2.8	channel slope (%)
0.40	shear stress (lb/sq.ft.)
0.46	shear velocity (ft/s)
0.91	unit strm power (lb/ft/s)

Cross Section XS 13



Elevation (ft)

Bankfull Dimensions

0.4	x-section area (ft.sq.)
2.3	width (ft)
0.2	mean depth (ft)
0.3	max depth (ft)
2.4	wetted parimeter (ft)
0.2	hyd radi (ft)
12.0	width-depth ratio

Flood Dimensions

4.6	W flood prone area (ft)
2.0	entrenchment ratio
---	low bank height (ft)
---	low bank height ratio

Materials

---	D50 (mm)
---	D84 (mm)
12	threshold grain size (mm):

Bankfull Flow

1.4	velocity (ft/s)
0.6	discharge rate (cfs)
0.58	Froude number

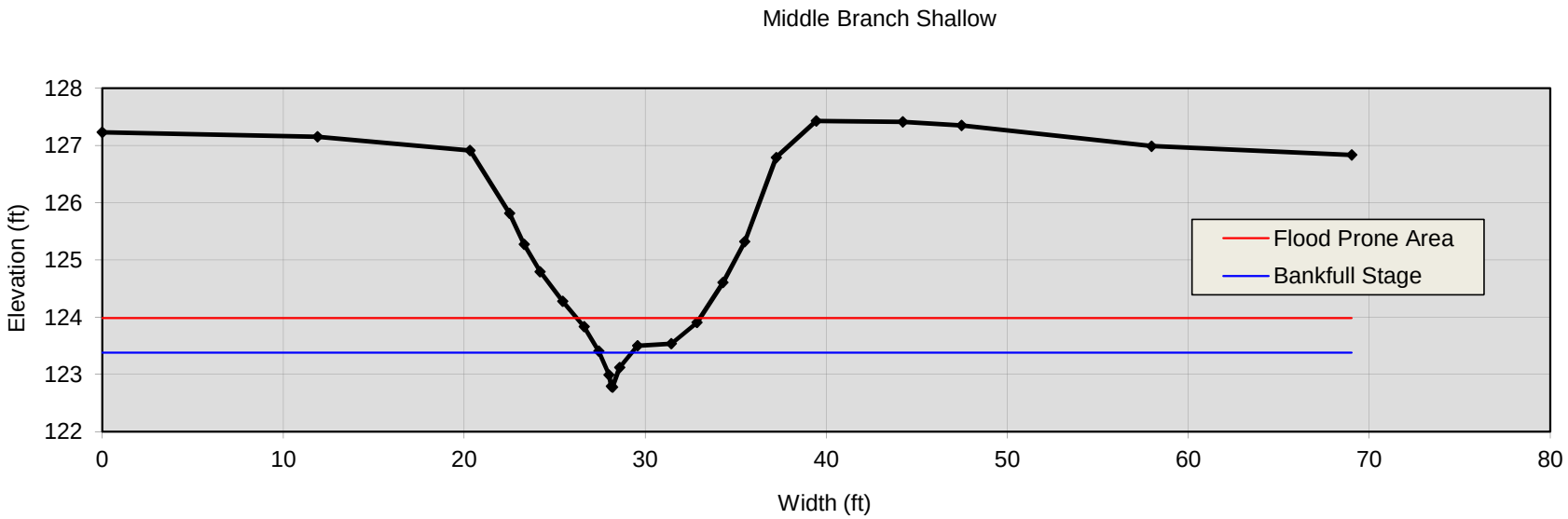
Flow Resistance

0.050	Manning's roughness
---	D'Arcy-Weisbach fric.
---	resistance factor u/u*
---	relative roughness

Forces & Power

2.1	channel slope (%)
0.24	shear stress (lb/sq.ft.)
0.35	shear velocity (ft/s)
0.35	unit strm power (lb/ft/s)

Cross Section XS 14



Bankfull Dimensions

0.5	x-section area (ft.sq.)
1.8	width (ft)
0.3	mean depth (ft)
0.6	max depth (ft)
2.2	wetted parimeter (ft)
0.2	hyd radi (ft)
6.9	width-depth ratio

Flood Dimensions

6.8	W flood prone area (ft)
3.8	entrenchment ratio
---	low bank height (ft)
---	low bank height ratio

Materials

---	D50 (mm)
---	D84 (mm)
14	threshold grain size (mm):

Bankfull Flow

1.5	velocity (ft/s)
0.7	discharge rate (cfs)
0.59	Froude number

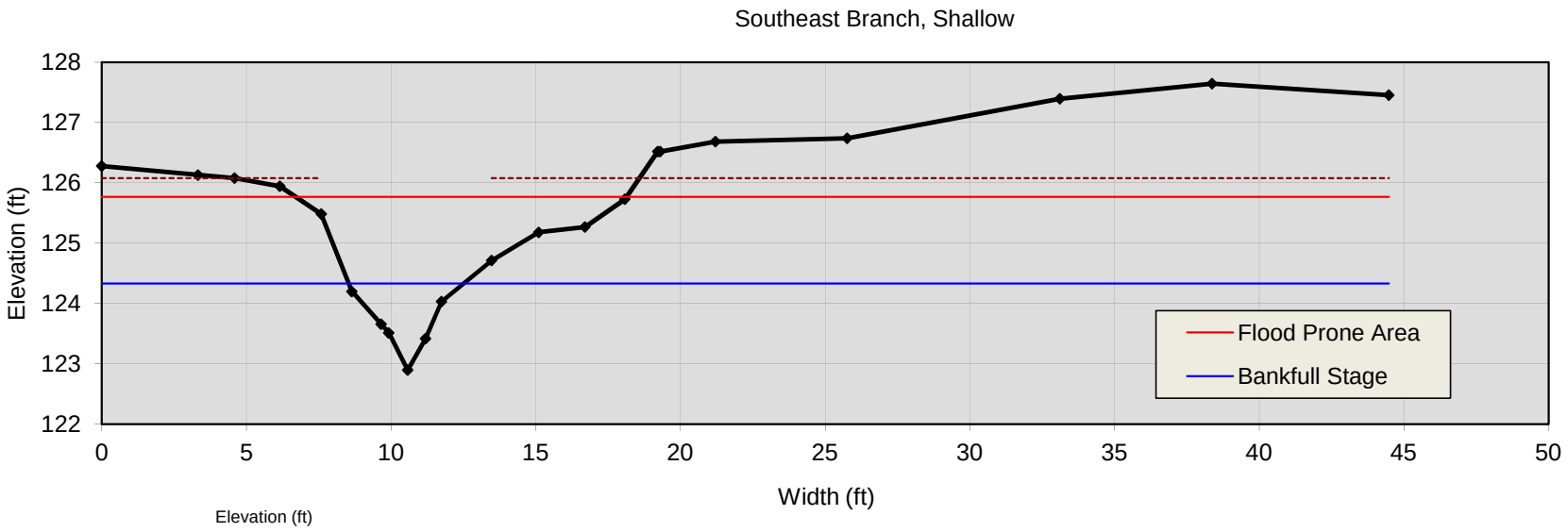
Flow Resistance

0.050	Manning's roughness
---	D'Arcy-Weisbach fric.
---	resistance factor u/u*
---	relative roughness

Forces & Power

2.1	channel slope (%)
0.27	shear stress (lb/sq.ft.)
0.38	shear velocity (ft/s)
0.52	unit strm power (lb/ft/s)

Cross Section XS 15



Elevation (ft)

Bankfull Dimensions

1.1	x-section area (ft.sq.)
2.7	width (ft)
0.4	mean depth (ft)
1.4	max depth (ft)
3.3	wetted parimeter (ft)
0.3	hyd radi (ft)
6.8	width-depth ratio

Flood Dimensions

11.4	W flood prone area (ft)
4.2	entrenchment ratio
3.0	low bank height (ft)
2.1	low bank height ratio

Materials

---	D50 (mm)
---	D84 (mm)
25	threshold grain size (mm):

Bankfull Flow

2.2	velocity (ft/s)
2.4	discharge rate (cfs)
0.69	Froude number

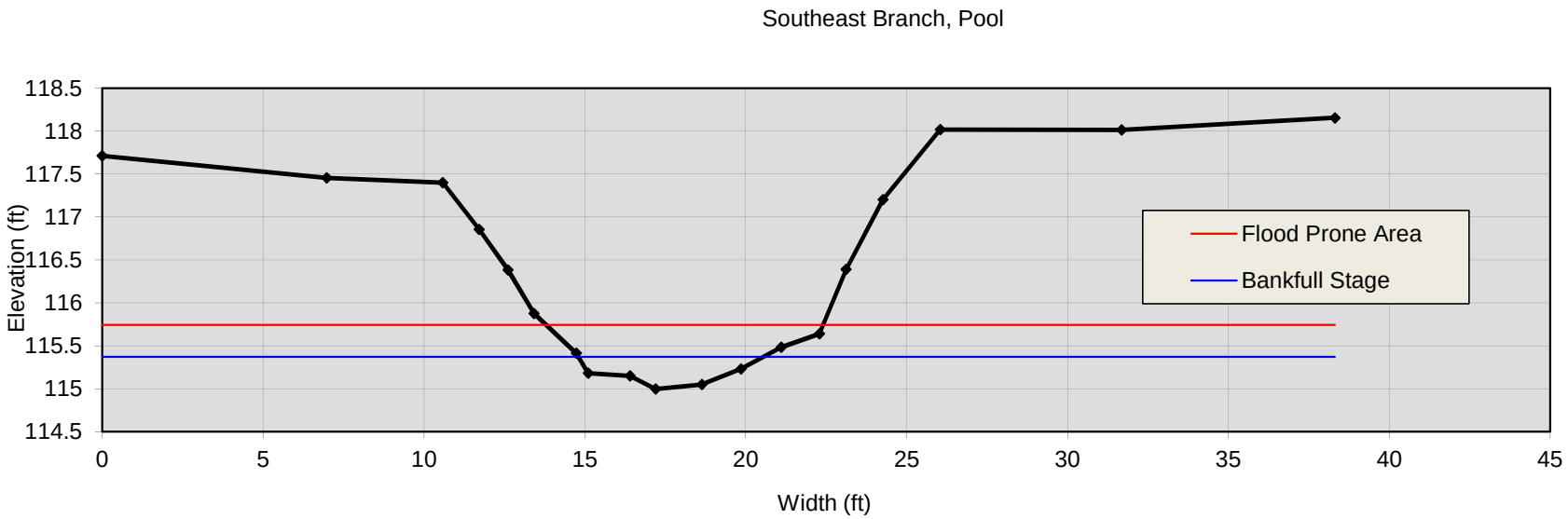
Flow Resistance

0.050	Manning's roughness
---	D'Arcy-Weisbach fric.
---	resistance factor u/u*
---	relative roughness

Forces & Power

2.5	channel slope (%)
0.51	shear stress (lb/sq.ft.)
0.51	shear velocity (ft/s)
1.38	unit strm power (lb/ft/s)

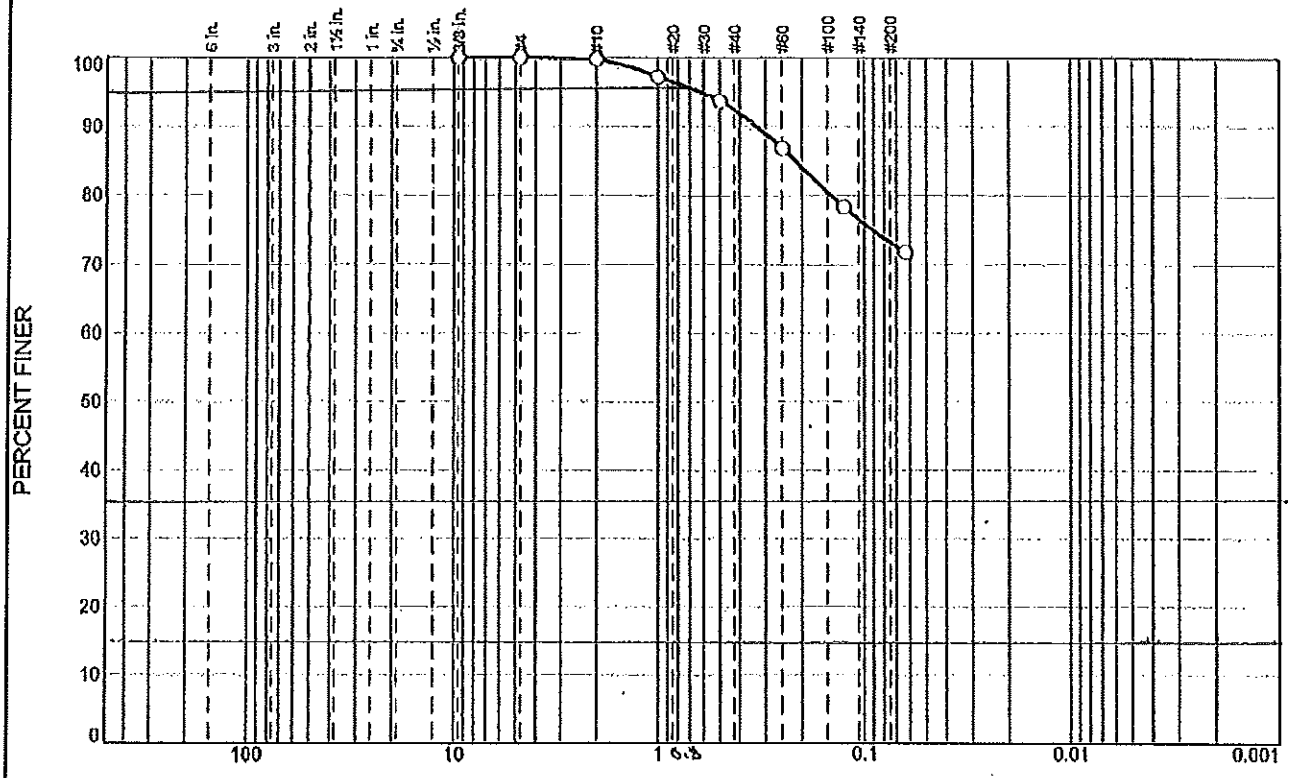
Cross Section XS 16



Bankfull Dimensions		Flood Dimensions		Materials	
1.4	x-section area (ft.sq.)	8.6	W flood prone area (ft)	---	D50 (mm)
5.7	width (ft)	1.5	entrenchment ratio	---	D84 (mm)
0.2	mean depth (ft)	---	low bank height (ft)	18	threshold grain size (mm):
0.4	max depth (ft)	---	low bank height ratio		
5.8	wetted parimeter (ft)				
0.2	hyd radi (ft)				
24.3	width-depth ratio				

Bankfull Flow		Flow Resistance		Forces & Power	
1.8	velocity (ft/s)	0.050	Manning's roughness	2.5	channel slope (%)
2.4	discharge rate (cfs)	---	D'Arcy-Weisbach fric.	0.36	shear stress (lb/sq.ft.)
0.65	Froude number	---	resistance factor u/u*	0.43	shear velocity (ft/s)
		---	relative roughness	0.66	unit strm power (lb/ft/s)

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.2	7.5	19.1	73.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375	100.0		
#4	100.0		
#10	99.8		
#18	97.2		
#35	93.6		
#60	86.8		
#120	78.2		
#230	71.7		

* (no specification provided)

Material Description

D16 = D35 = D95 = 0.8

D100 = 9.6

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.3334 D_{85}= 0.2169 D_{60}=

D_{50}= D_{30}= D_{15}=

D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: [redacted] D/S of D.12. Road

Date: 10-20-2011

Summit Engineering

Ft. Mill, South Carolina

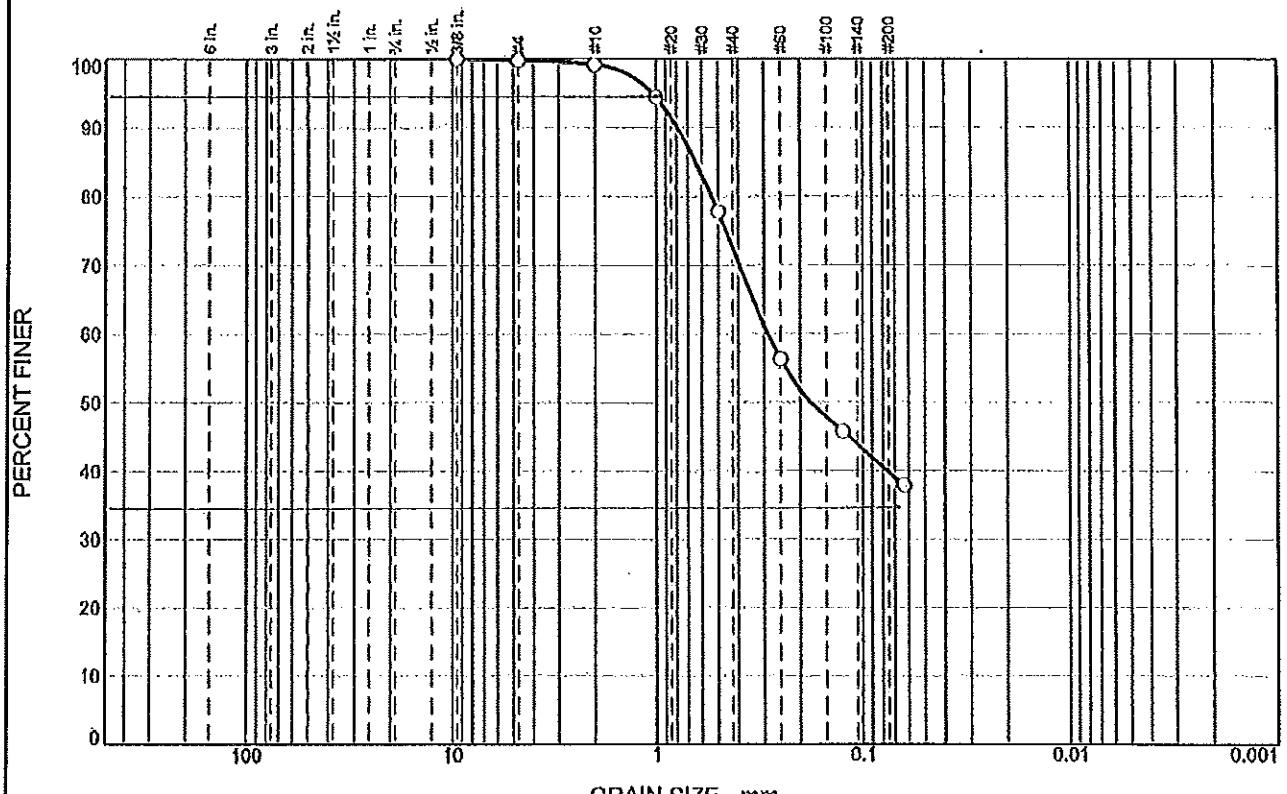
Client: Wildlands Engineering Inc.

Project: Devil's Racetrack Site

Project No: SL-262-11 Figure

Tested By: Mimi Hourani

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.3	0.6	26.7	32.5	39.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375	100.0		
#4	99.7		
#10	99.1		
#18	94.3		
#35	77.7		
#60	56.2		
#120	45.7		
#230	37.8		

* (no specification provided)

Material Description

D_{35} = N/A D_{95} = 1.0 D_{100} = 9.6

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.7897 D_{85}= 0.6423 D_{60}= 0.2886
D_{50}= 0.1790 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: [redacted] D/S OF D.R. ROAD

Date: 10-20-2011

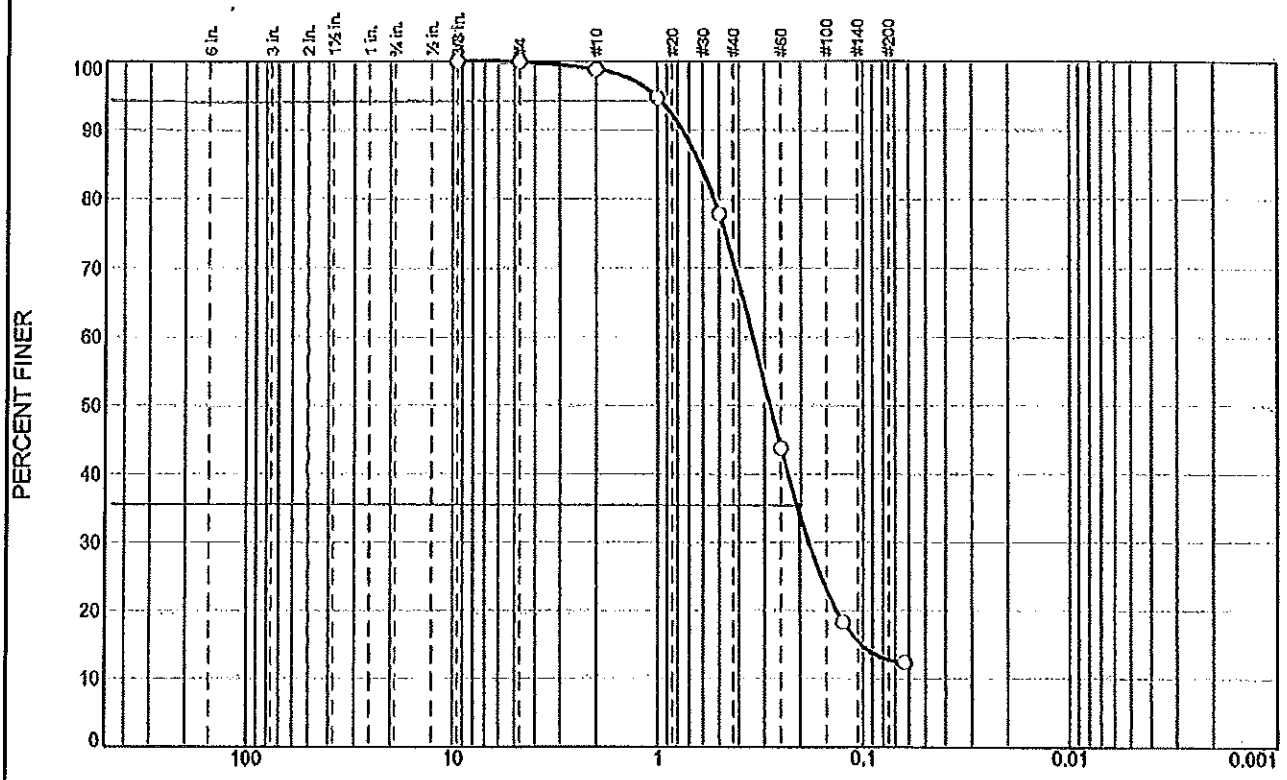
Summit Engineering

Ft. Mill, South Carolina

Client: Wildlands Engineering Inc.
Project: Devil's Racetrack Site
Project No: SL-262-11 Figure

Tested By: Mimi Hourani

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.1	1.1	28.1	58.0	12.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375	100.0		
#4	99.9		
#10	98.8		
#18	94.6		
#35	77.8		
#60	43.6		
#120	18.1		
#230	12.3		

* (no specification provided)

Material Description

D16 = D35 = 0.2 D95 = 1.2
D100 = 9.6

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.7532 D_{85}= 0.6170 D_{60}= 0.3433
D_{50}= 0.2834 D_{30}= 0.1841 D_{15}= 0.1031
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: [redacted] U/S of D.R. Road

Date: 10-20-2011

Summit Engineering

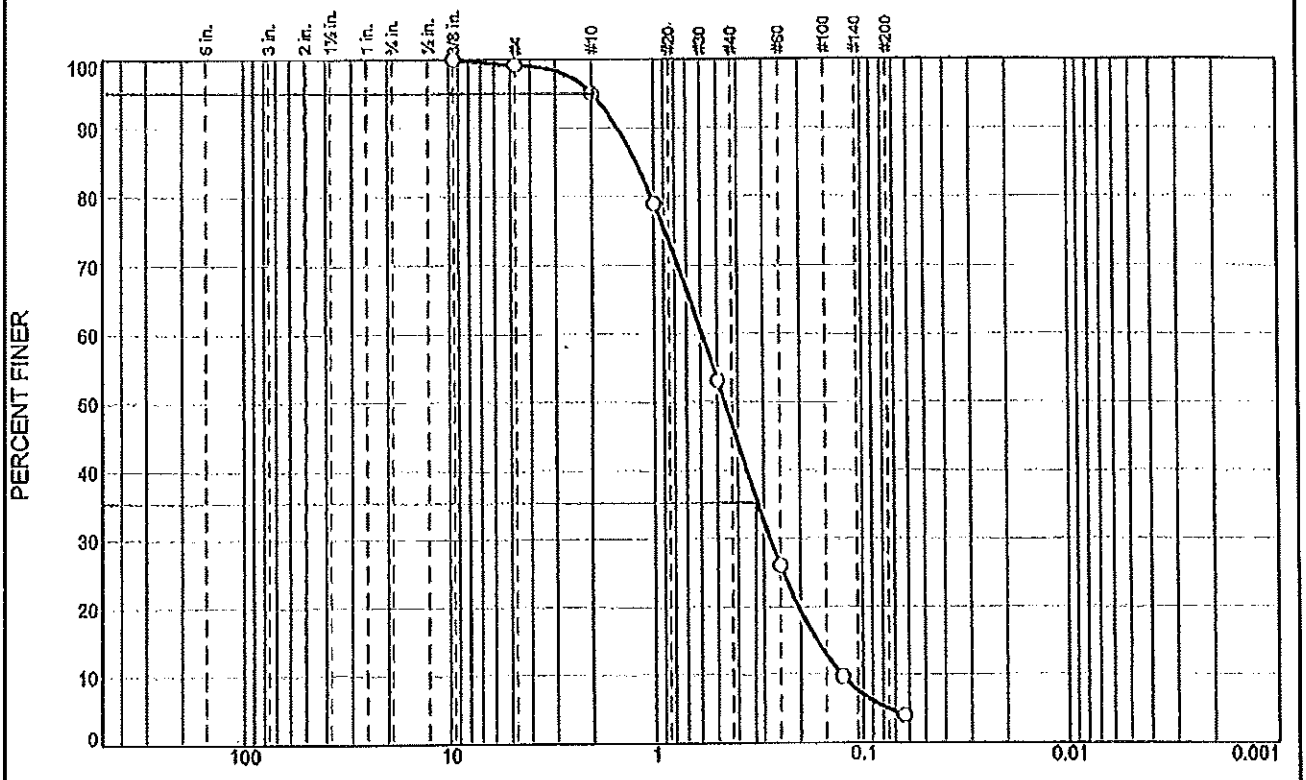
Ft. Mill, South Carolina

Client: Wildlands Engineering Inc.
Project: Devil's Racetrack Site

Project No: SL-262-11 Figure

Tested By: Mimi Hourani

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.9	4.2	48.5	41.4	5.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375	100.0		
#4	99.1		
#10	94.9		
#18	79.0		
#35	53.1		
#60	25.9		
#120	9.6		
#230	4.0		

* (no specification provided)

Material Description

D35 = .33 D65 = 2.6 D10 = 9.6

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 1.5120 D_{85}= 1.2299 D_{60}= 0.5924
D_{50}= 0.4635 D_{30}= 0.2809 D_{15}= 0.1682
D_{10}= 0.1282 C_u= 4.62 C_c= 1.04

Classification

USCS= AASHTO=

Remarks

Location: [redacted] U/S OF D.R. ROAD

Date: 10-20-2011

Summit Engineering

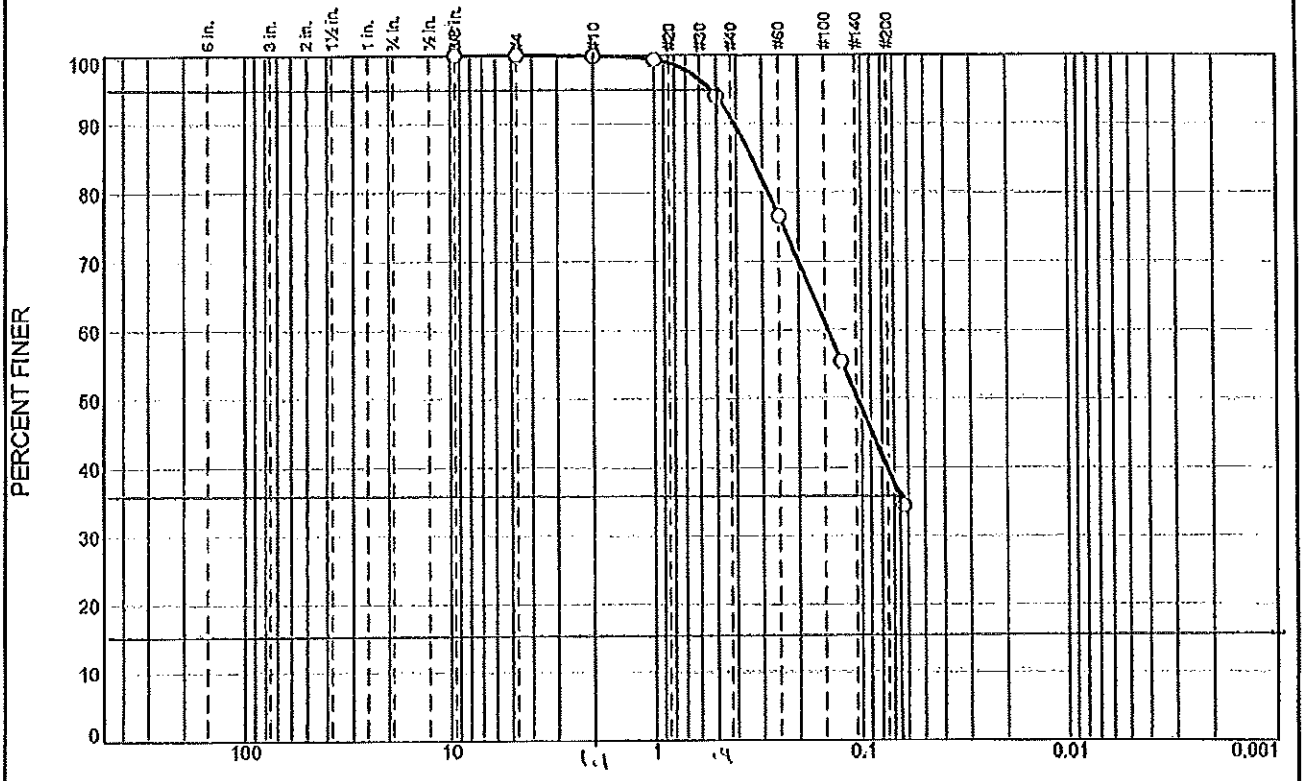
Ft. Mill, South Carolina

Client: Wildlands Engineering Inc.
Project: Devil's Racetrack Site

Project No: SL-262-11 Figure

Tested By: Mimi Hourani

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.1	9.1	51.1	39.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375	100.0		
#4	100.0		
#10	99.9		
#18	99.3		
#35	93.9		
#60	76.5		
#120	55.4		
#230	34.3		

* (no specification provided)

Material Description

D16 = N/A D35 = 0.065 D95 = .4

D100 = [redacted] 9.6

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.4103 D_{85}= 0.3362 D_{60}= 0.1452

D_{50}= 0.1048 D_{30}= D_{15}=

D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: [redacted] SW Branch

Date: 10-20-2011

Summit Engineering

Ft. Mill, South Carolina

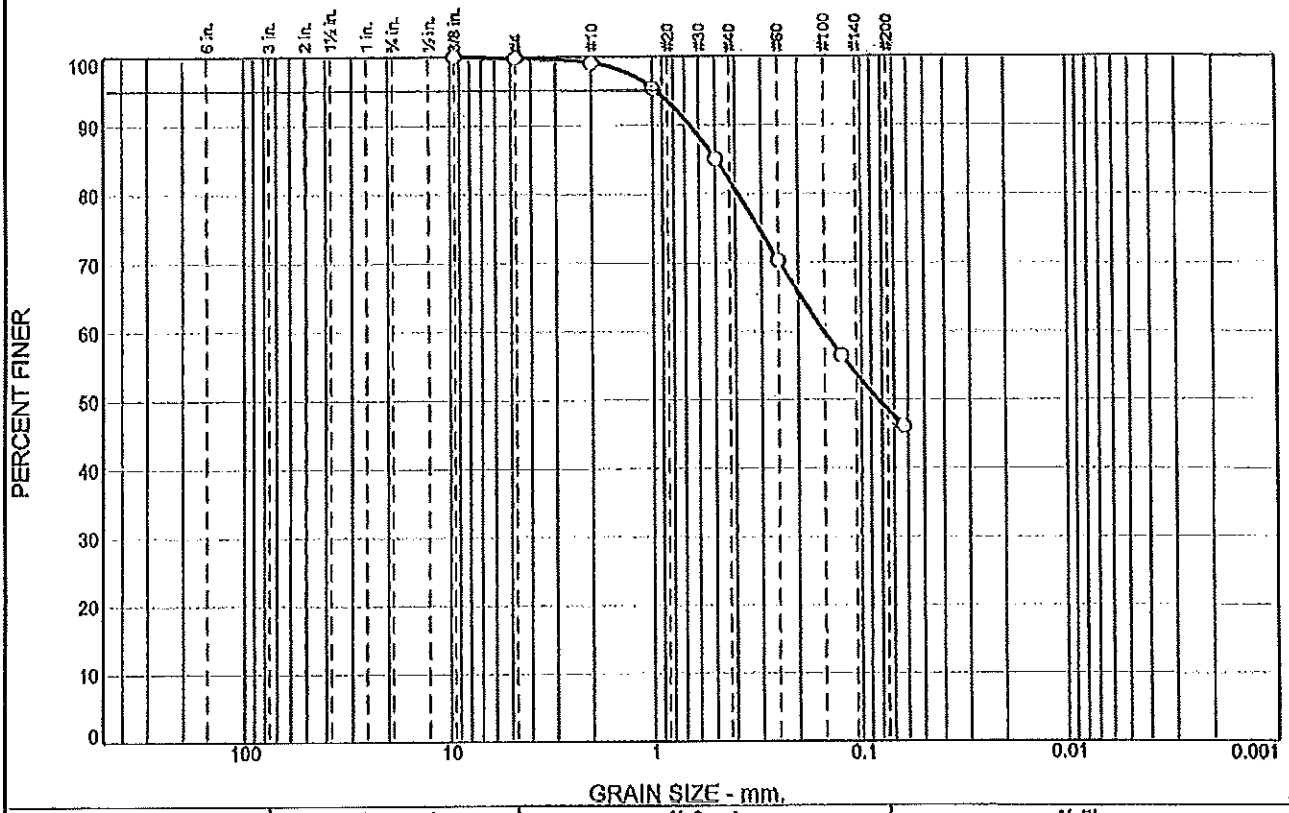
Client: Wildlands Engineering Inc.

Project: Devil's Racetrack Site

Project No: SL-262-11 Figure

Tested By: Mimi Hourani

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.3	0.7	17.2	33.3	48.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375	100.0		
#4	99.7		
#10	99.0		
#18	95.3		
#35	85.1		
#60	70.3		
#120	56.3		
#230	46.1		

* (no specification provided)

Material Description

D_{35} = N/A D_{95} = 0.9 D_{100} = 9.6

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.6622 D_{85}= 0.4980 D_{60}= 0.1525
D_{50}= 0.0833 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: Middle Br. [redacted]

Date: 10-20-2011

Summit Engineering

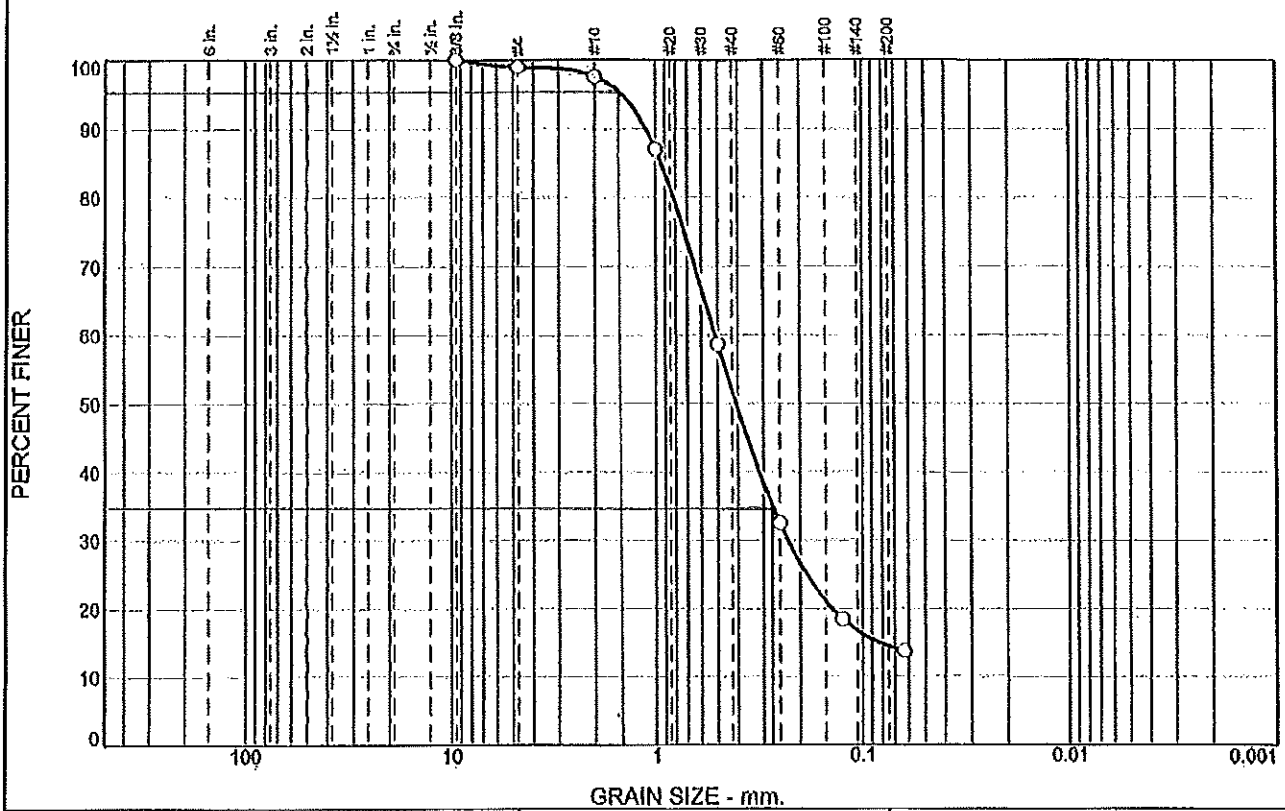
Ft. Mill, South Carolina

Client: Wildlands Engineering Inc.
Project: Devil's Racetrack Site

Project No: SL-262-11 Figure

Tested By: Mimi Hourani

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.1	1.3	46.0	37.2	14.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375	100.0		
#4	98.9		
#10	97.6		
#18	87.0		
#35	58.6		
#60	32.4		
#120	18.3		
#230	13.7		

* (no specification provided)

Material Description

D_{35} = 0.275 D_{95} = 1.16 D_{100} = 9.6

Attorberg Limits

PL= LL= PI=

Coefficients

D_{90}= 1.1184 D_{85}= 0.9385 D_{60}= 0.5161
D_{50}= 0.4088 D_{30}= 0.2295 D_{15}= 0.0838
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: SE Br. [redacted]

Date: 10-20-2011

Summit Engineering

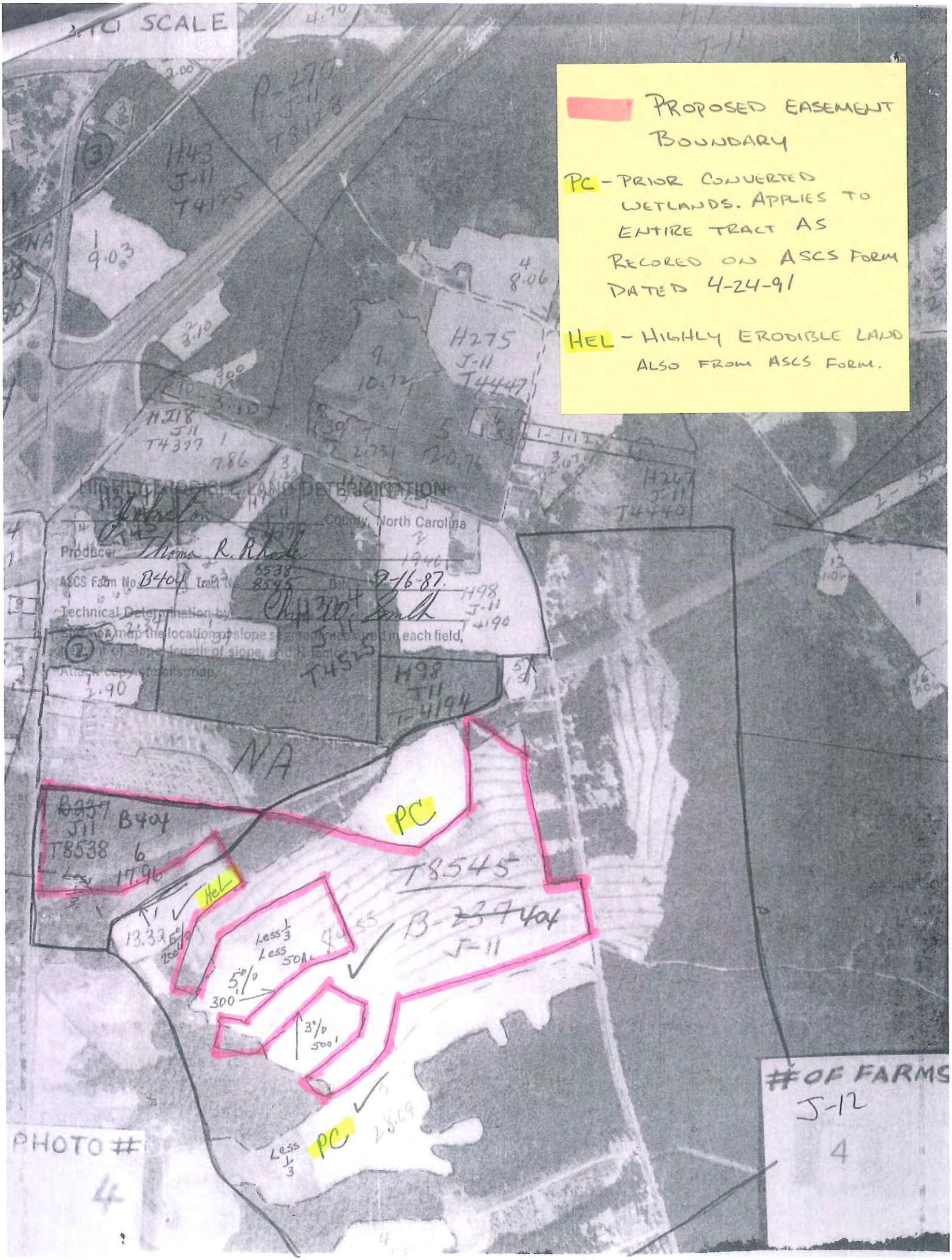
Ft. Mill, South Carolina

Client: Wildlands Engineering Inc.
Project: Devil's Racetrack Site

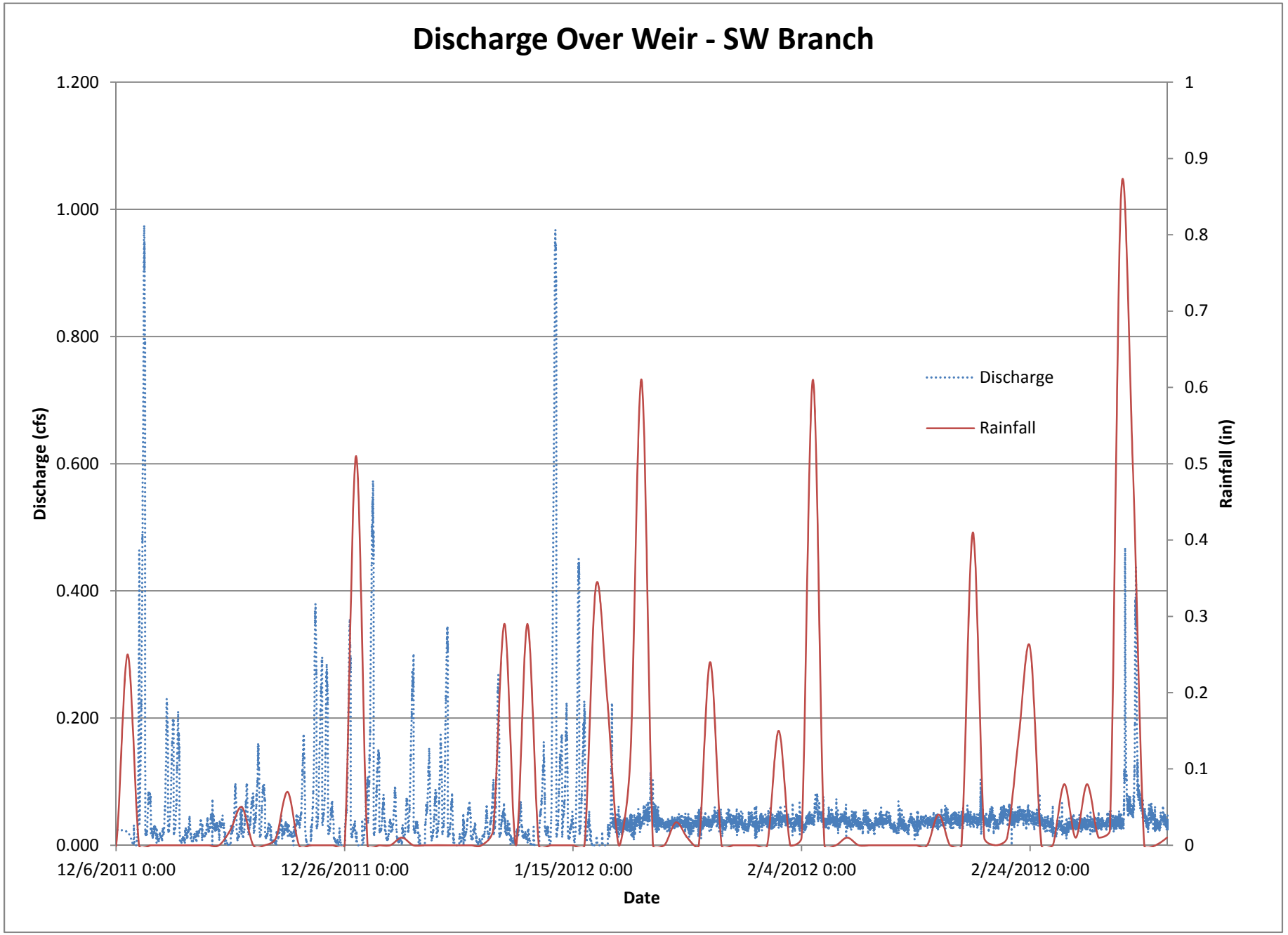
Project No: SL-262-11 Figure

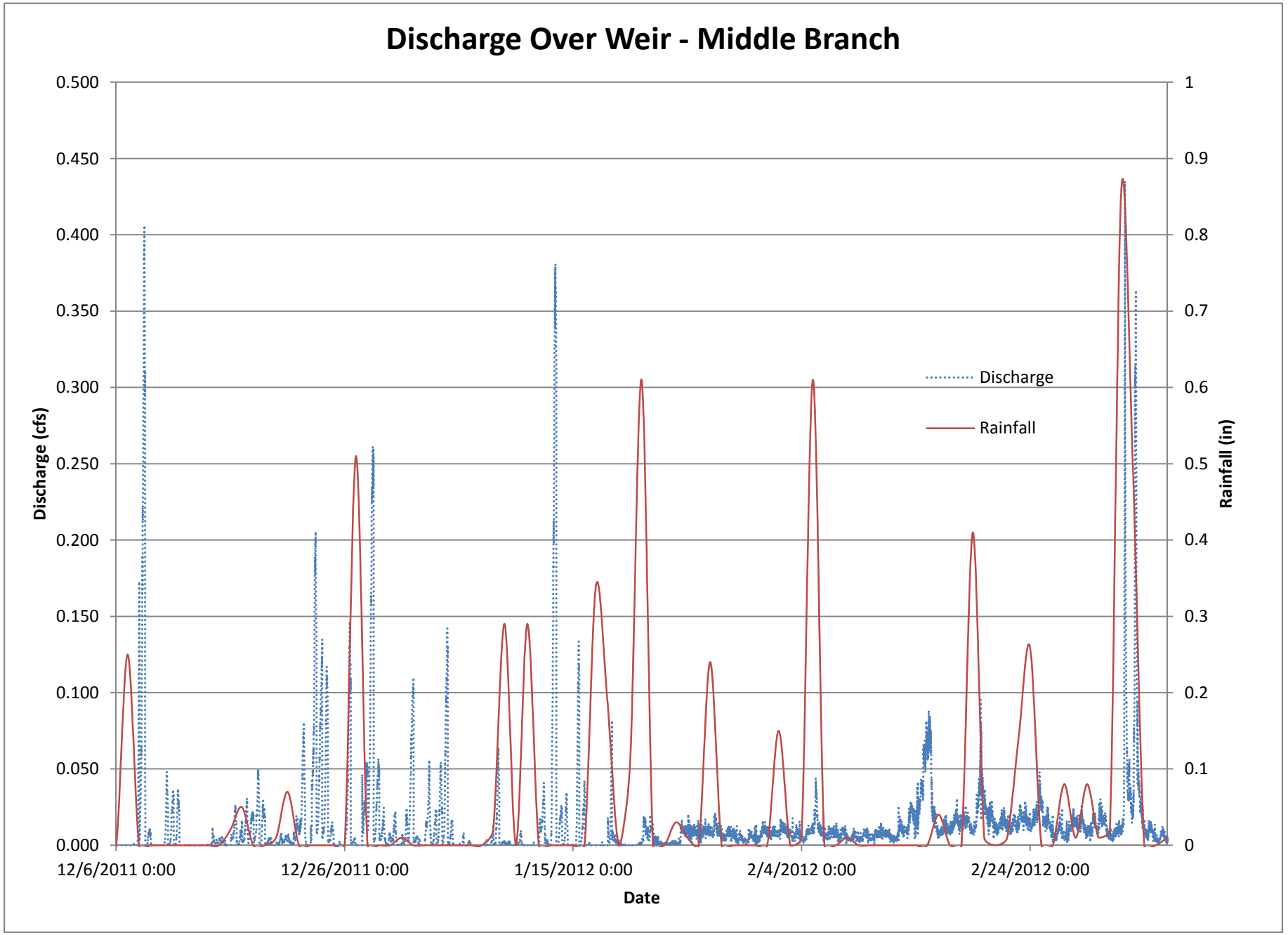
Tested By: Mimi Hourani

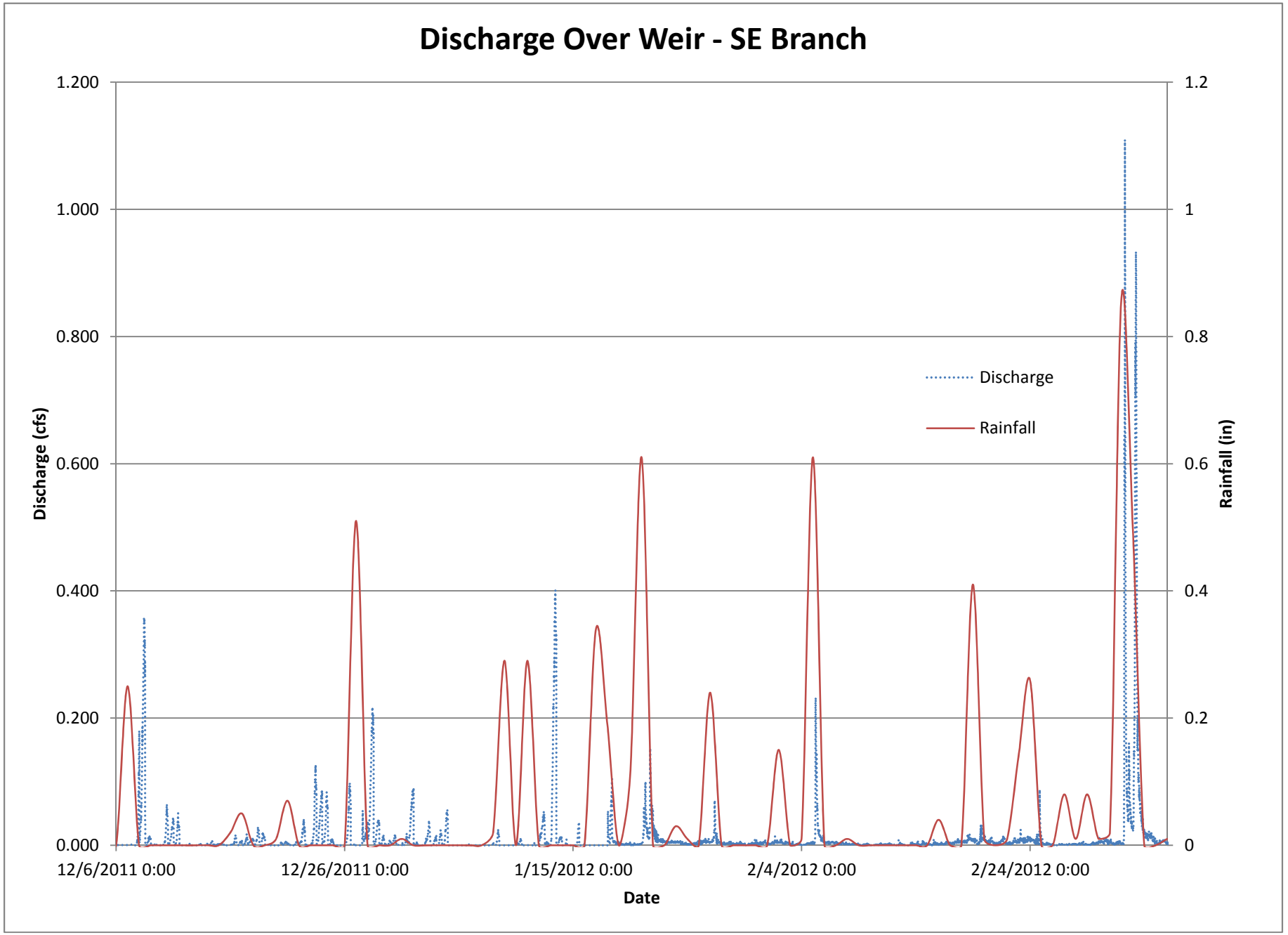
Appendix 6: NRCS Map


NO SCALE
PROPOSED EASEMENT BOUNDARY
PC - PRIOR CONVERTED WETLANDS. APPLIES TO ENTIRE TRACT AS RECORED ON ASCS FORM DATED 4-24-91
HEL - HIGHLY ERODIBLE LAND ALSO FROM ASCS FORM.
HIGHLY ERODIBLE LAND DETERMINATION
County, North Carolina
Producer Thomas R. Rhodes
ASCS Farm No. B404
Date 9-16-87
PC
HEL
T8545
B-404
J-11
Less 1/3
Less 5 Ac.
5%
300'
3%
500'
PC
Less 1/3
#OF FARMS
J-12
4
PHOTO #
4

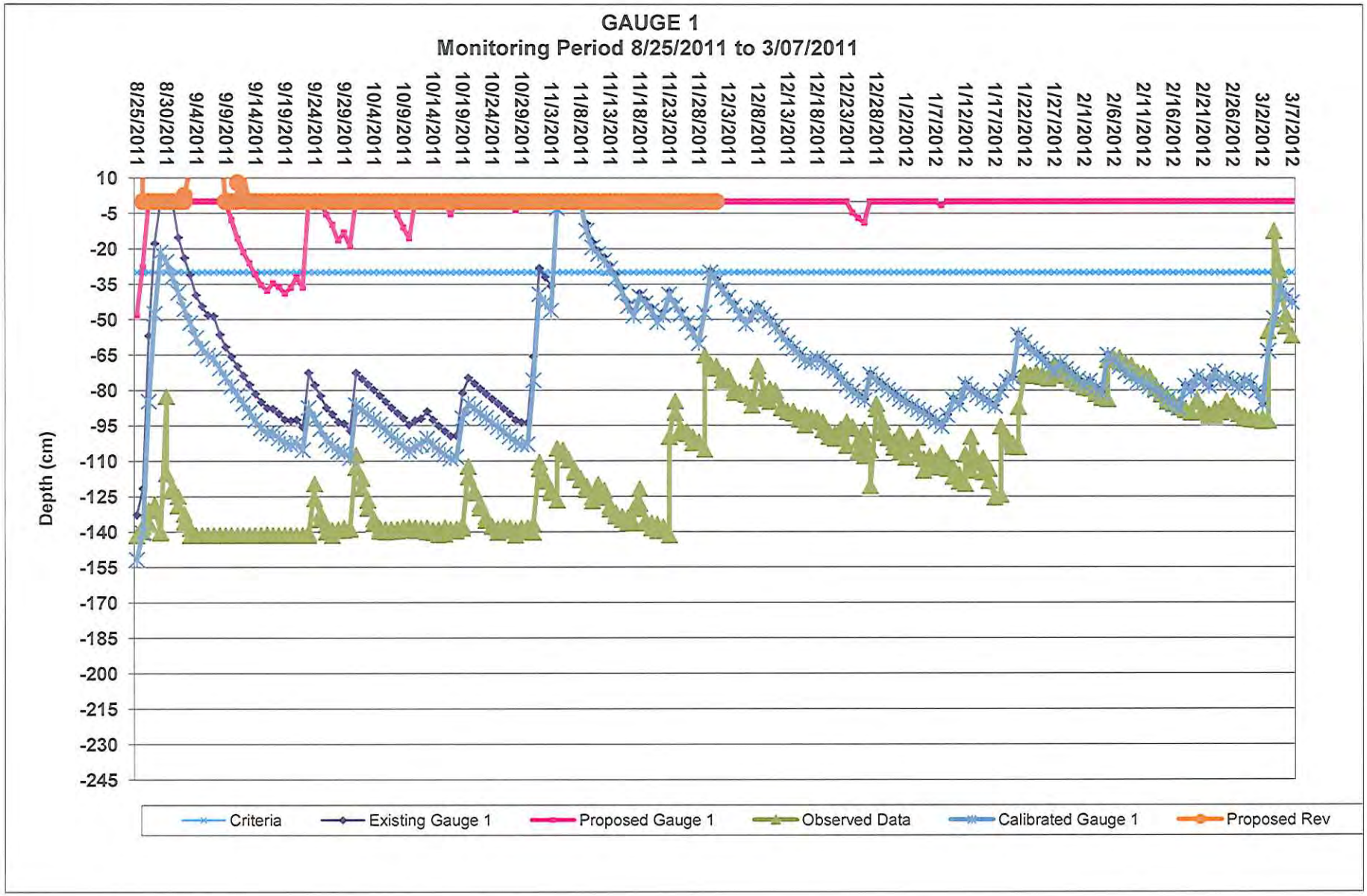
Appendix 7: Streamflow Monitoring Weir Hydrographs

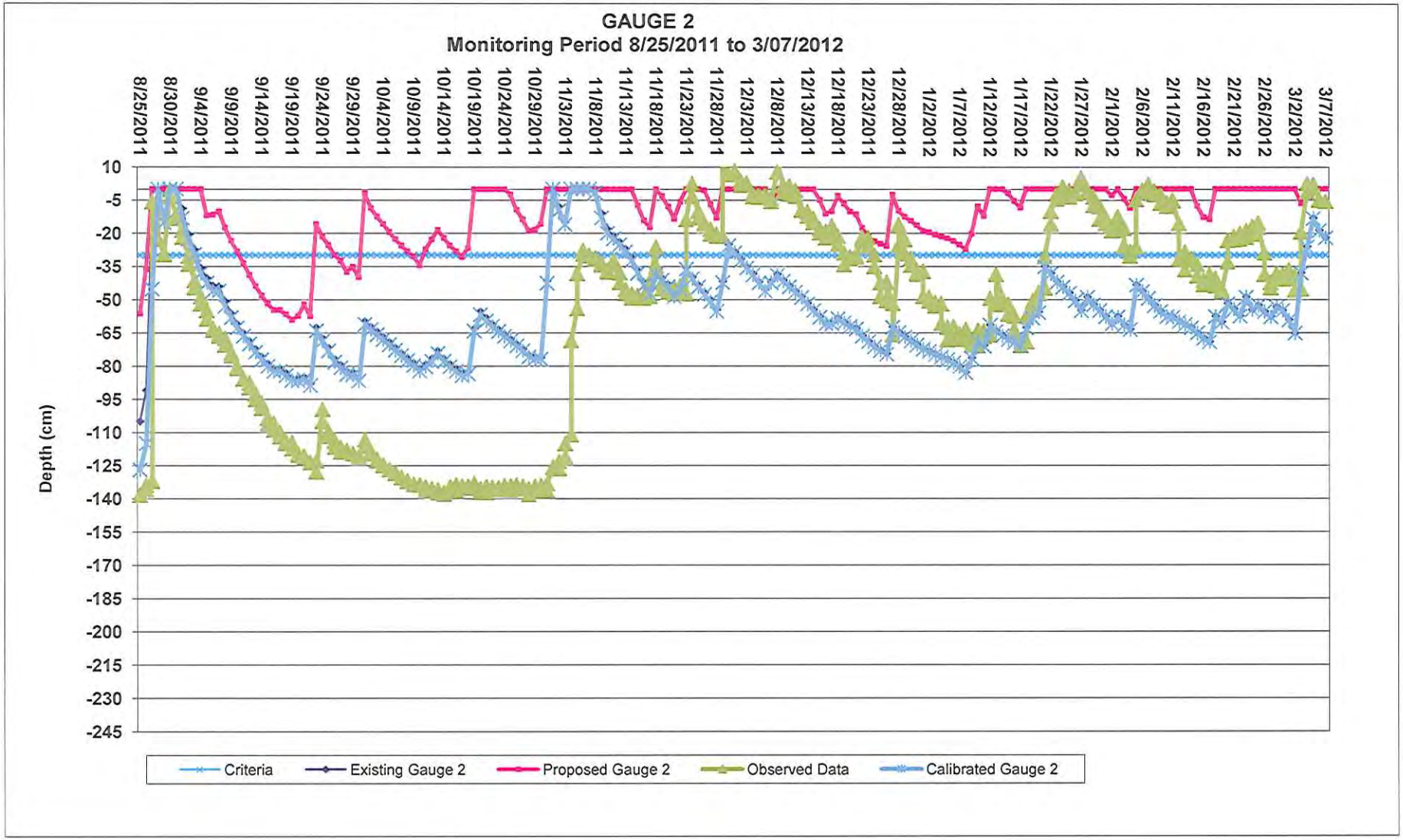

Discharge Over Weir - SW Branch
1.200
1.000
0.800
0.600
0.400
0.200
0.000
Discharge (cfs)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Rainfall (in)
Discharge
Rainfall
12/6/2011 0:00
12/26/2011 0:00
1/15/2012 0:00
2/4/2012 0:00
2/24/2012 0:00
Date


Discharge Over Weir - Middle Branch
0.500
0.450
0.400
0.350
0.300
0.250
0.200
0.150
0.100
0.050
0.000
Discharge (cfs)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Rainfall (in)
Discharge
Rainfall
12/6/2011 0:00
12/26/2011 0:00
1/15/2012 0:00
2/4/2012 0:00
2/24/2012 0:00
Date


Discharge Over Weir - SE Branch
1.200
1.000
0.800
0.600
0.400
0.200
0.000
Discharge (cfs)
1.2
1
0.8
0.6
0.4
0.2
0
Rainfall (in)
Discharge
Rainfall
12/6/2011 0:00
12/26/2011 0:00
1/15/2012 0:00
2/4/2012 0:00
2/24/2012 0:00
Date

Appendix 8: Drainmod Calibration Plots


GAUGE 1
Monitoring Period 8/25/2011 to 3/07/2011
Depth (cm)
10
-5
-20
-35
-50
-65
-80
-95
-110
-125
-140
-155
-170
-185
-200
-215
-230
-245
8/25/2011
8/30/2011
9/4/2011
9/9/2011
9/14/2011
9/19/2011
9/24/2011
9/29/2011
10/4/2011
10/9/2011
10/14/2011
10/19/2011
10/24/2011
10/29/2011
11/3/2011
11/8/2011
11/13/2011
11/18/2011
11/23/2011
11/28/2011
12/3/2011
12/8/2011
12/13/2011
12/18/2011
12/23/2011
12/28/2011
1/2/2012
1/7/2012
1/12/2012
1/17/2012
1/22/2012
1/27/2012
2/1/2012
2/6/2012
2/11/2012
2/16/2012
2/21/2012
2/26/2012
3/2/2012
3/7/2012
Criteria
Existing Gauge 1
Proposed Gauge 1
Observed Data
Calibrated Gauge 1
Proposed Rev


GAUGE 2
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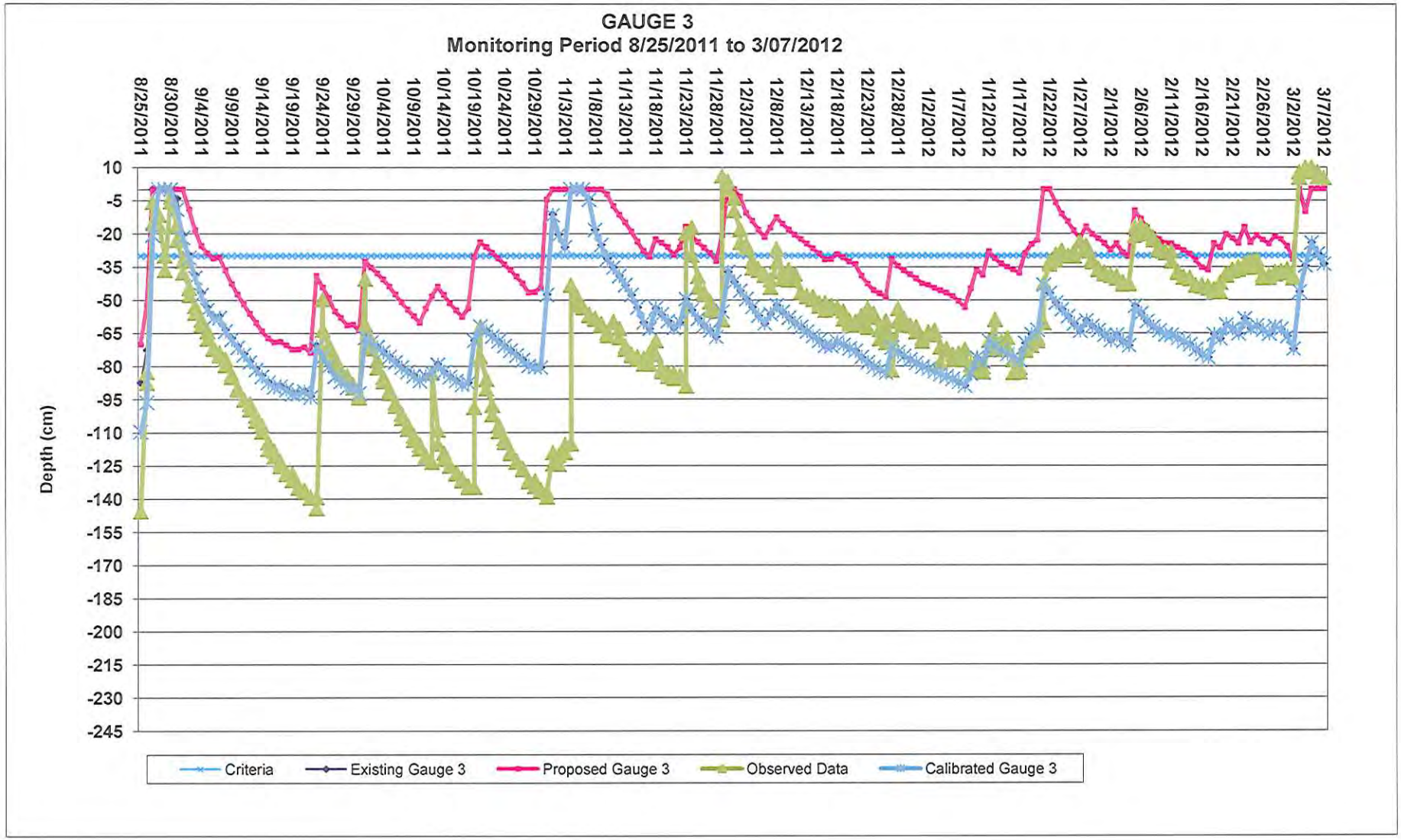
Depth (cm)
10
-5
-20
-35
-50
-65
-80
-95
-110
-125
-140
-155
-170
-185
-200
-215
-230
-245
8/25/2011
8/30/2011
9/4/2011
9/9/2011
9/14/2011
9/19/2011
9/24/2011
9/29/2011
10/4/2011
10/9/2011
10/14/2011
10/19/2011
10/24/2011
10/29/2011
11/3/2011
11/8/2011
11/13/2011
11/18/2011
11/23/2011
11/28/2011
12/3/2011
12/8/2011
12/13/2011
12/18/2011
12/23/2011
12/28/2011
1/2/2012
1/7/2012
1/12/2012
1/17/2012
1/22/2012
1/27/2012
2/1/2012
2/6/2012
2/11/2012
2/16/2012
2/21/2012
2/26/2012
3/2/2012
3/7/2012
Criteria
Existing Gauge 2
Proposed Gauge 2
Observed Data
Calibrated Gauge 2


GAUGE 3
Monitoring Period 8/25/2011 to 3/07/2012
Depth (cm)
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-5
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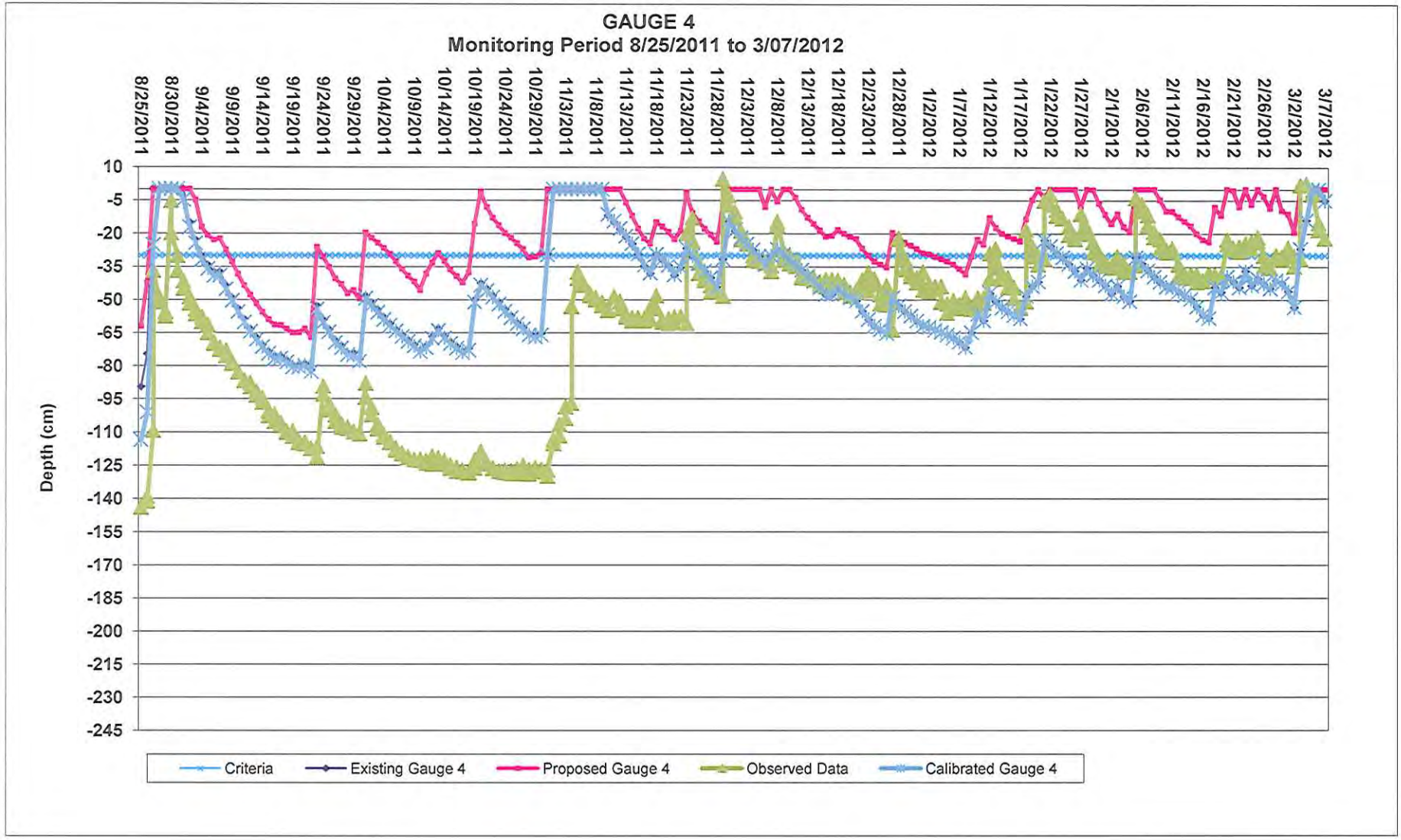
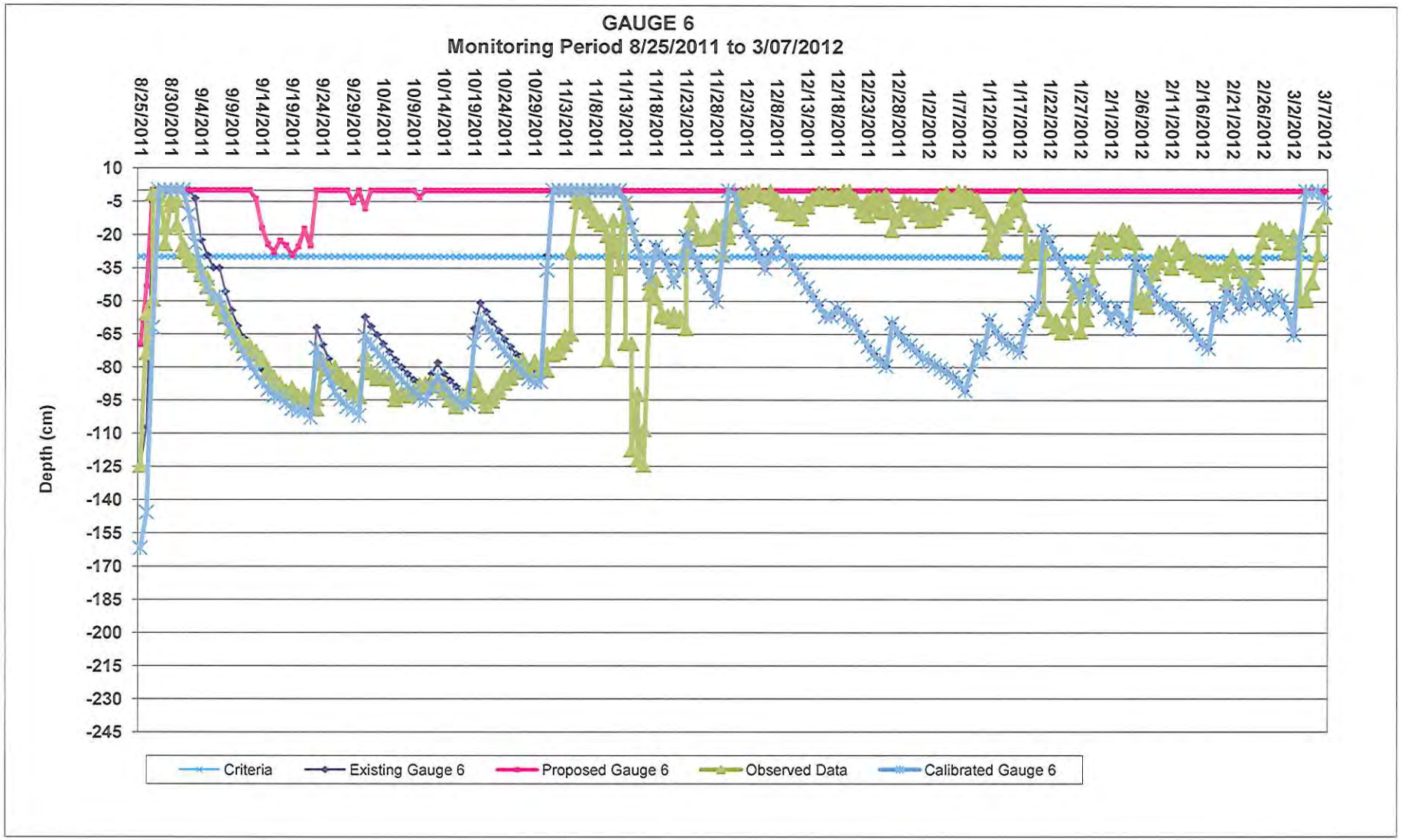
-35
-50
-65
-80
-95
-110
-125
-140
-155
-170
-185
-200
-215
-230
-245
8/25/2011
8/30/2011
9/4/2011
9/9/2011
9/14/2011
9/19/2011
9/24/2011
9/29/2011
10/4/2011
10/9/2011
10/14/2011
10/19/2011
10/24/2011
10/29/2011
11/3/2011
11/8/2011
11/13/2011
11/18/2011
11/23/2011
11/28/2011
12/3/2011
12/8/2011
12/13/2011
12/18/2011
12/23/2011
12/28/2011
1/2/2012
1/7/2012
1/12/2012
1/17/2012
1/22/2012
1/27/2012
2/1/2012
2/6/2012
2/11/2012
2/16/2012
2/21/2012
2/26/2012
3/2/2012
3/7/2012
Criteria
Existing Gauge 3
Proposed Gauge 3
Observed Data
Calibrated Gauge 3


GAUGE 4
Monitoring Period 8/25/2011 to 3/07/2012
Depth (cm)
10
-5
-20
-35
-50
-65
-80
-95
-110
-125
-140
-155
-170
-185
-200
-215
-230
-245
8/25/2011
8/30/2011
9/4/2011
9/9/2011
9/14/2011
9/19/2011
9/24/2011
9/29/2011
10/4/2011
10/9/2011
10/14/2011
10/19/2011
10/24/2011
10/29/2011
11/3/2011
11/8/2011
11/13/2011
11/18/2011
11/23/2011
11/28/2011
12/3/2011
12/8/2011
12/13/2011
12/18/2011
12/23/2011
12/28/2011
1/2/2012
1/7/2012
1/12/2012
1/17/2012
1/22/2012
1/27/2012
2/1/2012
2/6/2012
2/11/2012
2/16/2012
2/21/2012
2/26/2012
3/2/2012
3/7/2012
Criteria
Existing Gauge 4
Proposed Gauge 4
Observed Data
Calibrated Gauge 4


GAUGE 6
Monitoring Period 8/25/2011 to 3/07/2012
Depth (cm)
10
-5
-20
-35
-50
-65
-80
-95
-110
-125
-140
-155
-170
-185
-200
-215
-230
-245
8/25/2011
8/30/2011
9/4/2011
9/9/2011
9/14/2011
9/19/2011
9/24/2011
9/29/2011
10/4/2011
10/9/2011
10/14/2011
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10/24/2011
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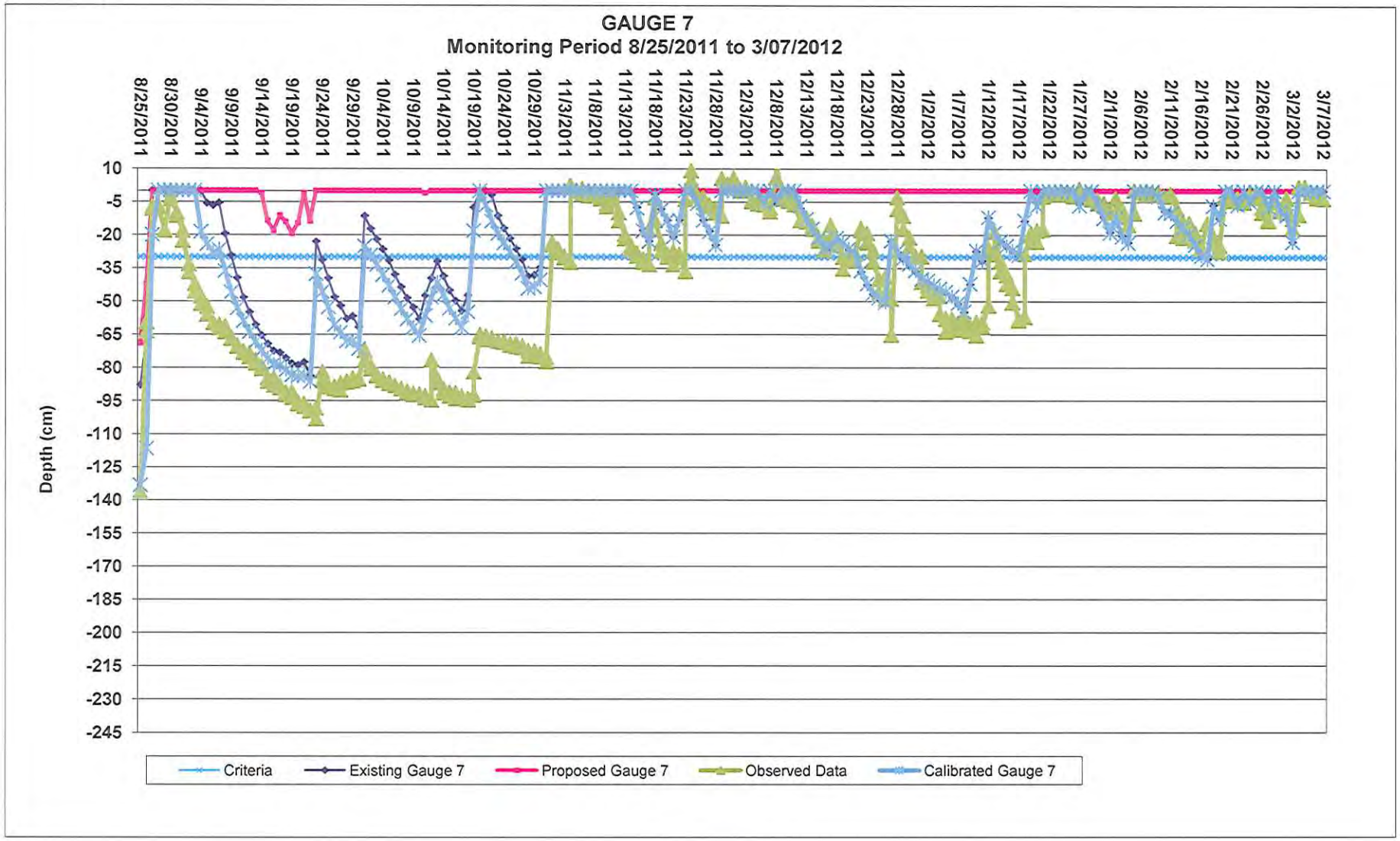
11/3/2011
11/8/2011
11/13/2011
11/18/2011
11/23/2011
11/28/2011
12/3/2011
12/8/2011
12/13/2011
12/18/2011
12/23/2011
12/28/2011
1/2/2012
1/7/2012
1/12/2012
1/17/2012
1/22/2012
1/27/2012
2/1/2012
2/6/2012
2/11/2012
2/16/2012
2/21/2012
2/26/2012
3/2/2012
3/7/2012
Criteria
Existing Gauge 6
Proposed Gauge 6
Observed Data
Calibrated Gauge 6


GAUGE 7
Monitoring Period 8/25/2011 to 3/07/2012
Depth (cm)
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-5
-20
-35
-50
-65
-80
-95
-110
-125
-140
-155
-170
-185
-200
-215
-230
-245
8/25/2011
8/30/2011
9/4/2011
9/9/2011
9/14/2011
9/19/2011
9/24/2011
9/29/2011
10/4/2011
10/9/2011
10/14/2011
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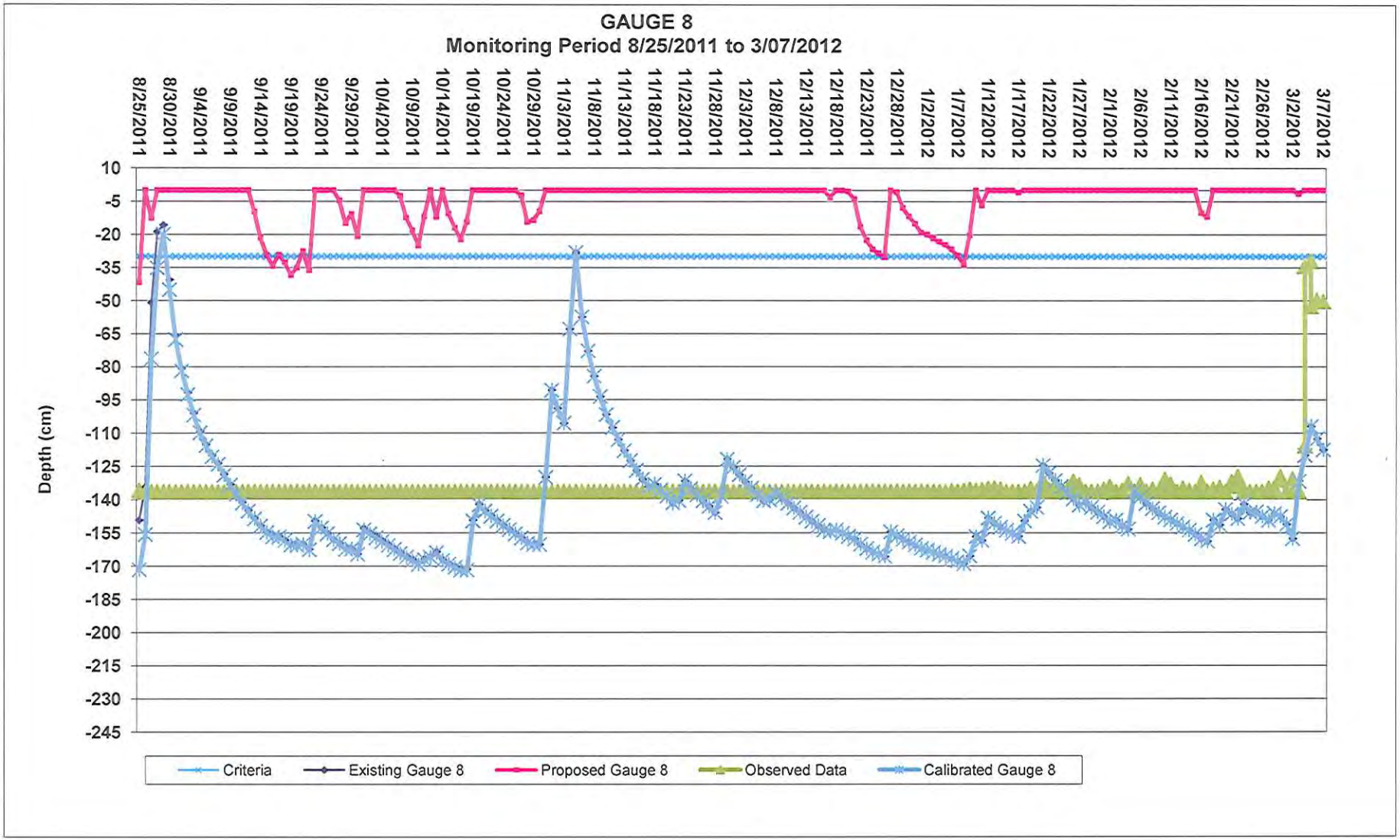
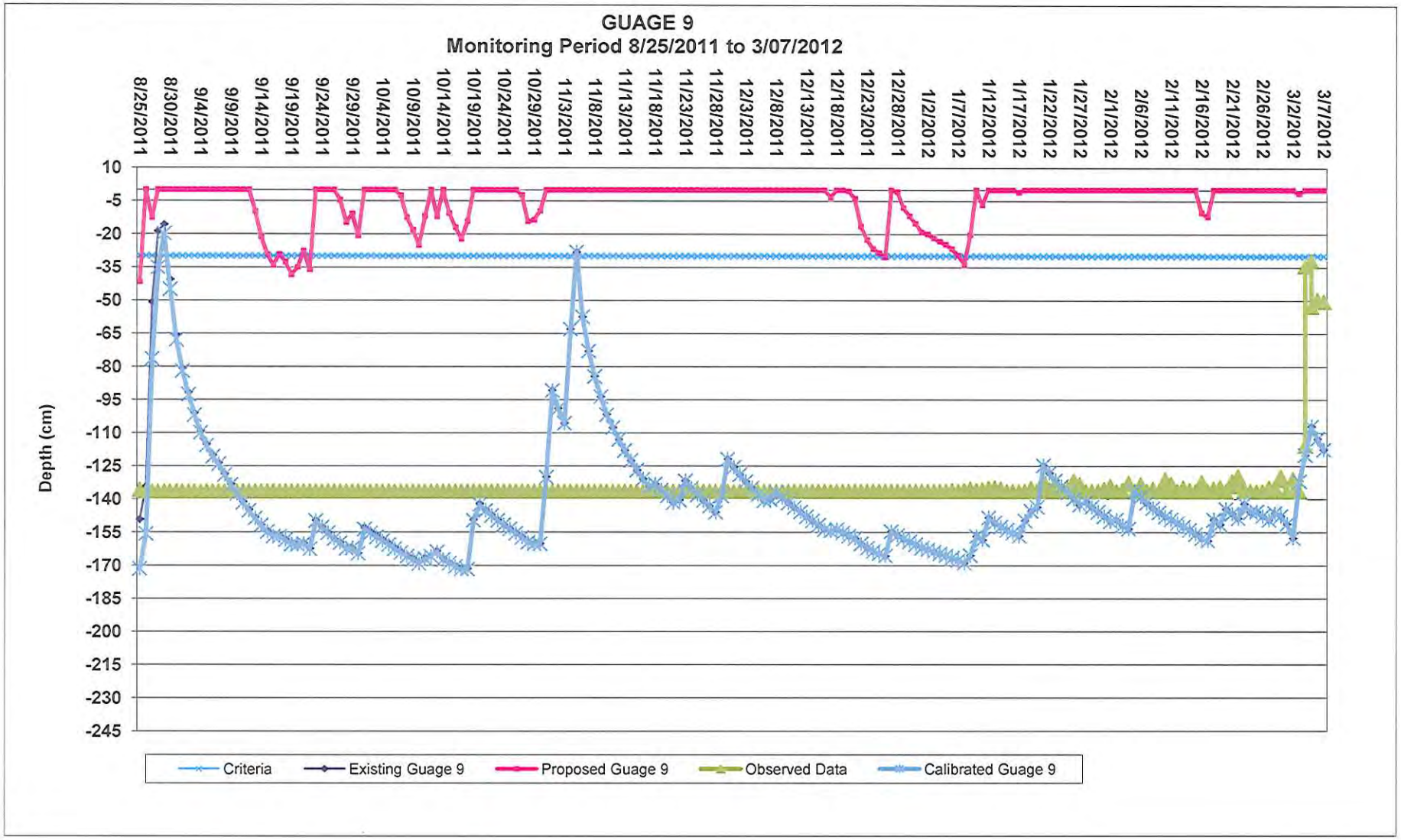
10/29/2011
11/3/2011
11/8/2011
11/13/2011
11/18/2011
11/23/2011
11/28/2011
12/3/2011
12/8/2011
12/13/2011
12/18/2011
12/23/2011
12/28/2011
1/2/2012
1/7/2012
1/12/2012
1/17/2012
1/22/2012
1/27/2012
2/1/2012
2/6/2012
2/11/2012
2/16/2012
2/21/2012
2/26/2012
3/2/2012
3/7/2012
Criteria
Existing Gauge 7
Proposed Gauge 7
Observed Data
Calibrated Gauge 7


GAUGE 8
Monitoring Period 8/25/2011 to 3/07/2012
Depth (cm)
10
-5
-20
-35
-50
-65
-80
-95
-110
-125
-140
-155
-170
-185
-200
-215
-230
-245
8/25/2011
8/30/2011
9/4/2011
9/9/2011
9/14/2011
9/19/2011
9/24/2011
9/29/2011
10/4/2011
10/9/2011
10/14/2011
10/19/2011
10/24/2011
10/29/2011
11/3/2011
11/8/2011
11/13/2011
11/18/2011
11/23/2011
11/28/2011
12/3/2011
12/8/2011
12/13/2011
12/18/2011
12/23/2011
12/28/2011
1/2/2012
1/7/2012
1/12/2012
1/17/2012
1/22/2012
1/27/2012
2/1/2012
2/6/2012
2/11/2012
2/16/2012
2/21/2012
2/26/2012
3/2/2012
3/7/2012
Criteria
Existing Gauge 8
Proposed Gauge 8
Observed Data
Calibrated Gauge 8


GUAGE 9
Monitoring Period 8/25/2011 to 3/07/2012
Depth (cm)
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-5
-20
-35
-50
-65
-80
-95
-110
-125
-140
-155
-170
-185
-200
-215
-230
-245
8/25/2011
8/30/2011
9/4/2011
9/9/2011
9/14/2011
9/19/2011
9/24/2011
9/29/2011
10/4/2011
10/9/2011
10/14/2011
10/19/2011
10/24/2011
10/29/2011
11/3/2011
11/8/2011
11/13/2011
11/18/2011
11/23/2011
11/28/2011
12/3/2011
12/8/2011
12/13/2011
12/18/2011
12/23/2011
12/28/2011
1/2/2012
1/7/2012
1/12/2012
1/17/2012
1/22/2012
1/27/2012
2/1/2012
2/6/2012
2/11/2012
2/16/2012
2/21/2012
2/26/2012
3/2/2012
3/7/2012
Criteria
Existing Guage 9
Proposed Guage 9
Observed Data
Calibrated Guage 9

Appendix 9: Soil Core Maps and Data

Devil's Racetrack Mitigation Site
Neuses River Basin (03020201)
Johnston County, NC

Legend

- Stream Points
- LSS Soil Borings
- Hydric Soil Boundary
- Project Hydric Soils
- Project Area
- Enhancement II
- Enhancement I
- Headwater Restoration
- Stream Restoration
- Not For Credit
- Power Line Easement

N

0 150 300 Feet

WILDLANDS ENGINEERING

LSS 1
LSS 2
LSS 3
LSS 4
LSS 5
LSS 6
LSS 7
LSS 8
LSS 9
LSS 10
LSS 11
LSS 12
LSS 13
LSS 14
LSS 15
LSS 16
LSS 17
LSS 18
LSS 19
LSS 20
Lss 21
Lss 22
Lss 23
LSS 24
LSS 25
LSS 26
LSS 27
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LSS 30
LSS 31
LSS 32
LSS 33
LSS 34
LSS 35
LSS 36
LSS 37
LSS 38
LSS 39
LSS 40
LSS 41
LSS 42
LSS 43
LSS 44
LSS 45
LSS 46
LSS 47

Devil's Racetrack Road
North Branch
Devil's Racetrack Creek
Southwest Branch
Middle Branch
Southeast Branch
UT to Southeast Branch
US HWY 701

2005 Aerial Photography

Devils Racetrack Soil Borings, February 22-23, 2012
Mike Ortosky, LSS

Profile #1 Hydric

Depth	Color (Munsell)	Mottles	Texture	Notes
0-6	10YR 3/2		sandy loam	
6-18+	10YR 6/2	C2D 5YR 5/6	sandy loam	

Profile #2 Hydric

Depth	Color (Munsell)	Mottles	Texture	Notes
0-12	10YR 3/2		sandy loam	
12-22+	10YR 5/1	F2D 5YR 5/6	sandy clay loam	

Profile #3 Hydric

Depth	Color (Munsell)	Mottles	Texture	Notes
0-6	10YR 3/2		sandy loam	
6-18+	10YR 5/1	F2D 10YR 5/6	sandy loam	

Profile #4 Hydric

Depth	Color (Munsell)	Mottles	Texture	Notes
0-14	10YR 4/2		sandy loam	
14-20+	10YR 5/1	F2D 10YR 5/6	sandy loam	

Profile #5 Hydric

Depth	Color (Munsell)	Mottles	Texture	Notes
0-5	10YR 4/3		loam	upslope sediment
5-12	10YR 3/1		loam	
12-18+	10YR 4/1	F2D 10YR 5/6	sandy loam	

Profile #6 Hydric

Depth	Color (Munsell)	Mottles	Texture	Notes
0-6	10YR 4/1		loam	
6-14	10YR 4/2	C2D 10YR 5/6	loam	
14-18+	10YR 6/1	C3F 10YR 4/1	sandy loam	

Profile #7 Hydric

Depth	Color (Munsell)	Mottles	Texture	Notes
0-5	10YR 3/2		sandy loam	
5-14	10YR 4/2	C2D 10YR 5/6	sandy clay loam	
14-18+	10YR 5/2	C2D 10YR 5/6	sandy loam	

Profile #8 Hydric

Depth	Color (Munsell)	Mottles	Texture	Notes
0-5	10YR 3/2		sandy loam	
5-10	10YR 3/2	C2D 10YR 5/6	sandy loam	
10-18+	10YR 6/2	C2D 10YR 5/6	sandy loam	

Profile #9 Hydric

Depth	Color (Munsell)	Mottles	Texture	Notes
0-6	10YR 4/2		sandy loam	
6-12	10YR 4/2	C2D 10YR 5/6	sandy loam	
12-18+	10YR 6/2	M2D 10YR 5/6	sandy clay loam	

Profile #10 Hydric

Depth	Color (Munsell)	Mottles	Texture	Notes
0-6	10YR 4/2		sandy loam	
6-18+	10YR 4/2	C2D 10YR 5/6	sandy loam	

Profile #11 Hydric

Depth	Color (Munsell)	Mottles	Texture	Notes
0-6	10YR 3/2		sandy loam	
6-18+	10YR 6/2	F2D 10YR 5/6	sandy loam	

Profile #12 Hydric

Depth	Color (Munsell)	Mottles	Texture	Notes
0-6	10YR 4/2		sandy loam	
6-14	10YR 4/2	C2D 10YR 4/6	sandy clay loam	
14-20+	10YR 6/1	C2F 10YR 5/1	sandy clay loam	
		C2D 10YR 5/6	sandy clay loam	

Profile #13 Hydric

Depth	Color (Munsell)	Mottles	Texture	Notes
0-6	10YR 4/2		sandy loam	
6-14	10YR 4/2	C2D 10YR 4/6	sandy loam	
14-18+	10YR 6/1	C2D 10YR 4/6	sandy clay loam	
	10YR 5/1			

Profile #14 Hydric

Depth	Color (Munsell)	Mottles	Texture	Notes
0-6	10YR 4/2		sandy loam	
6-14	10YR 5/2	C2D 7.5YR 4/6	sandy loam	
14-20+	10YR 6/2	C2D 10YR 5/6	sandy loam	

Profile #15 Hydric

Depth	Color (Munsell)	Mottles	Texture	Notes
0-6	10YR 4/2		sandy loam	
6-10	10YR 4/2	F2D 10YR 5/6	sandy loam	
10-18+	10YR 5/2	M2D 10YR 5/6	sandy clay loam	
	10YR 6/2			

Profile #16 Hydric

Depth	Color (Munsell)	Mottles	Texture	Notes
0-5	10YR 4/2		sandy loam	
5-10	10YR 4/2	F2D 10YR 5/6	sandy loam	
10-18+	10YR 6/2	M2D 10YR 5/6	sandy loam	

Profile #17 Hydric

Depth	Color (Munsell)	Mottles	Texture	Notes
0-6	10YR 4/2		sandy loam	
6-8	10YR 5/1		loam	
8-12	10YR 4/2	C2D 10YR 5/6	sandy loam	
12-18+	10YR 7/2	C2D 10YR 5/6	sandy loam	

Profile #18 Hydric

Depth	Color (Munsell)	Mottles	Texture	Notes
0-6	10YR 4/2		sandy loam	
6-10	10YR 4/2	C2D 10YR 5/6	sandy loam	
10-18+	10YR 6/1	C2D 10YR 5/6	sandy loam	

Profile #19 Hydric

Depth	Color (Munsell)	Mottles	Texture	Notes
0-5	10YR 3/2		sandy loam	
5-10	10YR 3/2	C2D 10YR 5/6	sandy loam	
10-18+	10YR 6/2	C2D 10YR 4/1	sandy loam	
		C2D 10YR 5/6		

Profile #20 Non-Hydric (Borderline)

Depth	Color (Munsell)	Mottles	Texture	Notes
0-6	10YR 4/3		sandy loam	
6-12+	10YR 5/3		sandy loam	

Profile #21 Hydric

Depth	Color (Munsell)	Mottles	Texture	Notes
0-6	10YR 3/2		sandy loam	
6-18	10YR 4/2	C2D 10YR 5/3	sandy loam	
18-24+	10YR 5/2	C2D 10YR 5/6	sandy clay loam	
	10YR 4/2			

Profile #22 Hydric

Depth	Color (Munsell)	Mottles	Texture	Notes
0-5	10YR 4/2		sandy loam	
5-10	10YR 4/2	C2D 10YR 5/4	sandy loam	
10-18+	10YR 6/2	C3D 10YR 6/6	sandy clay loam	

Profile #23 Hydric

Depth	Color (Munsell)	Mottles	Texture	Notes
0-6	10YR 4/2		sandy loam	
6-12	10YR 4/2	F2D 10YR 4/6	sandy loam	
12-18+	10YR 6/2	C2D 10YR 5/6	sandy loam	

Profile #24 Hydric

Depth	Color (Munsell)	Mottles	Texture	Notes
0-8	10YR 4/2		sandy loam	
8-18+	10YR 6/2	M3D 10YR 5/6	sandy clay loam	

Profile #25 Hydric

Depth	Color (Munsell)	Mottles	Texture	Notes
0-8	10YR 4/2		sandy loam	
8-18+	10YR 6/2	C2D 10YR 5/6	sandy clay loam	

Profile #26 Hydric

Depth	Color (Munsell)	Mottles	Texture	Notes
0-6	10YR 3/2		sandy loam	
6-12	10YR 4/2	F2D 10YR 5/4	sandy loam	
12-18+	10YR 6/1	C2D 10YR 5/6	sandy clay loam	

Profile #27 Hydric

Depth	Color (Munsell)	Mottles	Texture	Notes
0-6	10YR 4/2		sandy loam	
6-12	10YR 4/2	C2D 10YR 5/3	sandy loam	
12-18+	10YR 6/2	M3D 10YR 6/3	sandy clay loam	

Profile #28 Hydric

Depth	Color (Munsell)	Mottles	Texture	Notes
0-8	10YR 3/2		sandy loam	
8-20+	10YR 4/2		sandy loam	
	10YR 5/3			
	10YR 5/1			

Profile #29 Hydric

Depth	Color (Munsell)	Mottles	Texture	Notes
0-6	10YR 4/2		sandy loam	
6-14	10YR 4/2	C3D 10YR 5/4	sandy loam	
14-20+	10YR 5/1	C2D 7.5YR 4/6	sandy clay loam	

Profile #30 Hydric

Depth	Color (Munsell)	Mottles	Texture	Notes
0-6	10YR 4/2		sandy loam	
6-10	10YR 4/2	C2D 10YR 4/6	sandy loam	
10-18+	10YR 5/1	C2D 10YR 4/6	sandy clay loam	

Profile #31 Hydric

Depth	Color (Munsell)	Mottles	Texture	Notes
0-6	10YR 4/2		sandy loam	
6-10	10YR 4/2	C2D 10YR 4/6	sandy loam	
10-18+	10YR 5/1	C2D 10YR 4/6	sandy clay loam	

Profile #32 Hydric

Depth	Color (Munsell)	Mottles	Texture	Notes
0-6	10YR 4/2		sandy loam	
6-12	10YR 4/2	C2F 10YR 5/1	sandy clay loam	
		C2D 10YR 4/6		
12-18+	10YR 5/1	C2D 10YR 5/6	sandy clay loam	

Profile #33 Hydric

Depth	Color (Munsell)	Mottles	Texture	Notes
0-8	10YR 4/3		sandy loam	
8-14	10YR 4/2	C2F 10YR 5/2	sandy loam	
14-20+	10YR 6/1	C2D 10YR 4/6	sandy clay loam	

Profile #34 Hydric

Depth	Color (Munsell)	Mottles	Texture	Notes
0-8	10YR 4/3		sandy loam	
8-14	10YR 5/2	C2D 10YR 4/6	sandy loam	
14-20+	10YR 6/1	C2D 10YR 4/6	sandy loam	

Profile #35 Hydric

Depth	Color (Munsell)	Mottles	Texture	Notes
0-10	10YR 4/2		sandy loam	
10-18+	10YR 4/1	F1D 10YR 4/6	sandy loam	

Profile #36 Hydric

Depth	Color (Munsell)	Mottles	Texture	Notes
0-3	10YR 4/3		sandy clay loam	surface fill
3-18+	10YR 4/2	F1D 10YR 4/6	sandy loam	

Profile #37 Hydric

Depth	Color (Munsell)	Mottles	Texture	Notes
0-6	10YR 4/2		sandy loam	
6-14	10YR 4/2	F1D 10YR 4/6	sandy loam	
14-20+	10YR 6/1	C2D 7.5YR 4/6	sandy loam	

Profile #38 Hydric

Depth	Color (Munsell)	Mottles	Texture	Notes
0-6	10YR 4/2		sandy loam	
6-12	10YR 5/2		sandy loam	
12-18+	10YR 5/2	C2D 10YR 4/6	sandy loam	

Profile #39 Hydric

Depth	Color (Munsell)	Mottles	Texture	Notes
0-10	10YR 4/1		sandy loam	
10-18+	10YR 6/1		clay loam	
	10YR 4/1			
	10YR 5/6			

Profile #40 Hydric

Depth	Color (Munsell)	Mottles	Texture	Notes
0-10	10YR 3/1		sandy loam	
10-18+	10YR 5/1	C2D 10YR 5/6	sandy clay loam	

Profile #41 Hydric

Depth	Color (Munsell)	Mottles	Texture	Notes
0-12	10YR 3/1		sandy loam	
12-18+	10YR 5/2	F2D 10YR 4/6	sandy clay loam	
		C2F 10YR 4/1		

Profile #42 Hydric

Depth	Color (Munsell)	Mottles	Texture	Notes
0-10	10YR 4/1		loam	
10-18+	10YR 5/2	F2D 10YR 4/6	clay	
		C2F 10YR 4/1		

Profile #43 Hydric

Depth	Color (Munsell)	Mottles	Texture	Notes
0-6	10YR 4/1		sandy loam	
6-10	10YR 5/1		sandy loam	
	10YR 5/2			
10-16+	10YR 5/2	F2D 10YR 4/6	clay	
		C2F 10YR 4/1		

Profile #44 Hydric

Depth	Color (Munsell)	Mottles	Texture	Notes
0-8	10YR 3/2		sandy loam	
8-18+	10YR 3/2	F2D 10YR 4/6	sandy loam	
	10YR 4/2			

Profile #45 Hydric

Depth	Color (Munsell)	Mottles	Texture	Notes
0-6	10YR 3/1		sandy loam	
6-12	10YR 3/2		sandy loam	
	10YR 4/2			
12-18+	10YR 5/3		sandy clay loam	
	10YR 5/2			

Profile #46 Hydric

Depth	Color (Munsell)	Mottles	Texture	Notes
0-8	10YR 3/2		sandy loam	
8-18+	10YR 5/2		clay	
	10YR 5/8			

Profile #47 Hydric

Depth	Color (Munsell)	Mottles	Texture	Notes
0-8	10YR 3/2		sandy loam	
8-18+	10YR 6/2	C2D 10YR 5/6	sandy loam	

Appendix 10: Agency Correspondence

North Carolina Department of Cultural Resources

State Historic Preservation Office

Claudia Brown, Acting Administrator

Beverly Eaves Perdue, Governor
Linda A. Carlisle, Secretary
Jeffrey J. Crow, Deputy Secretary

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

July 20, 2011

Andrea Eckardt
Wildlands Engineering
1430 South Mint Street
Suite 104
Charlotte, NC 28203

Re: Devil's Racetrack Mitigation Project, Johnston County, ER 11-1406

Dear Ms. Eckardt:

Thank you for your letter of July 8, 2011, concerning the above project.

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

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

Thank you for your cooperation and consideration. If you have questions concerning the above comment, please contact Renee Gledhill-Earley, environmental review coordinator, at 919-807-6579. In all future communication concerning this project, please cite the above-referenced tracking number.

Sincerely,

Renee Gledhill-Earley

for Claudia Brown

WILDLANDS ENGINEERING

July 8, 2011

Renee Gledhill-Earley
State Historic Preservation Office
4617 Mail Service Center
Raleigh, NC 27699-4617

Subject: EEP Stream and Wetland mitigation project in Johnston County.
Devil's Racetrack Mitigation Project

Dear Ms. Gledhill-Earley,

The Ecosystem Enhancement Program (EEP) requests review and comment on any possible issues that might emerge with respect to archaeological or cultural resources associated with a potential stream and wetland restoration project on the attached site (USGS site map with approximate areas of potential ground disturbance is enclosed).

The Devil's Racetrack site has been identified for the purpose of providing in-kind mitigation for unavoidable stream channel and wetland impacts. Several sections of channel have been identified as significantly degraded.

Recently, we contracted with New South Associates to perform an "in-office" historical and archaeological screening of the Devil's Racetrack site. Maps from 1911 and 1938 show no buildings on the project site. There has been no professional archaeological survey in this location. There are no previously recorded sites.

We ask that you review this site based on the attached information to determine the presence of any historic properties.

We thank you in advance for your timely response and cooperation. Please feel free to contact us with any questions that you may have concerning the extent of site disturbance associated with this project.

Sincerely,

Andrea S. Eckardt

Andrea S. Eckardt
Senior Environmental Planner

1430 South Mint Street, Suite 104 Charlotte, NC 28203 ◦ (P) 704-332-7754 ◦ (F) 704-332-3306

WILDLANDS ENGINEERING

June 30, 2011

Dale Suiter
US Fish and Wildlife Service
Raleigh Field Office
P.O. Box 33726
Raleigh, NC 27636

Subject: **Devil's Racetrack Mitigation Site**
Johnston County, North Carolina

Dear Mr. Suiter,

The Devil's Racetrack Mitigation Site has been identified for the purpose of providing in-kind mitigation for unavoidable stream channel and wetland impacts. Several sections of stream channels throughout the site have been identified as significantly degraded as a result of past agricultural activities. Additionally, several on-site areas have been identified for wetland restoration and preservation.

We have already obtained an updated species list for Johnston County from your web site (http://nc-es.fws.gov/es/countyfr.html). The threatened or endangered species for this county are: the Bald eagle (*Haliaeetus leucocephalus*), red-cockaded woodpecker (*Picoides borealis*), dwarf wedgemussel (*Alasmidonta heterodon*), Tar River spinymussel (*Elliptio steinstansana*), and Michaux's sumac (*Rhus michauxii*). We are requesting that you please provide any known information for each species in the county. The USFWS will be contacted if suitable habitat for any listed species is found or if we determine that the project may affect one or more federally listed species or designated critical habitat.

Please provide comments on any possible issues that might emerge with respect to endangered species, migratory birds or other trust resources from the construction of a stream and wetland restoration project on the subject properties. A USGS map (Figure 1) showing the approximate property lines and area of potential ground disturbance is enclosed. Figure 1 was prepared from the Four Oaks and Four Oaks NE, NC 7.5-Minute Topographic Quadrangles.

If we have not heard from you in 30 days we will assume that our species list and site determination are correct, that you do not have any comments regarding associated laws and that you do not have any information relevant to this project at the current time.

1430 South Mint Street, Suite 104 Charlotte, NC 28203 ◦ (P) 704-332-7754 ◦ (F) 704-332-3306

Appendix 11: EEP Floodplain Checklist

EEP Floodplain Requirements Checklist

This form was developed by the National Flood Insurance program, NC Floodplain Mapping program and Ecosystem Enhancement Program to be filled for all EEP projects. The form is intended to summarize the floodplain requirements during the design phase of the projects. The form should be submitted to the Local Floodplain Administrator with three copies submitted to NFIP (attn. Edward Curtis), NC Floodplain Mapping Unit (attn. John Gerber) and NC Ecosystem Enhancement Program.

Project Location

Name of project:	Devil's Racetrack Mitigation Project
Name of stream or feature:	Unnamed tributaries in Neuse River Floodplain
County:	Johnston
Name of river basin:	Neuse River Basin
Is project urban or rural?	Rural
Name of Jurisdictional municipality/county:	Johnston County
DFIRM panel number for entire site:	FIRM Panel 1680 Community No.: 370138 Map Number: 3720168000J Effective Map Date: December 2, 2005
Consultant name:	Wildlands Engineering, Inc. Nicole Macaluso, PE
Phone number:	919-851-9986
Address:	5605 Chapel Hill Road, Suite 122 Raleigh, NC 27607

Design Information

Provide a general description of project (one paragraph). Include project limits on a reference orthophotograph at a scale of 1" = 500".

Wildlands Engineering is designing a stream and wetland restoration project to provide stream and wetland mitigation units (SMUs and WMUs) for the NC Ecosystem Enhancement Program. No work is proposed on the Neuse River, the FEMA-mapped stream; however, grading is proposed on a tributary (Devil's Racetrack Creek) located within the mapped Neuse River floodplain. No studies or modeling exist for any of the project streams.

Reach	Length	Priority
Devil's Racetrack Creek	*10,549 LF*	*One and Two (Restoration)*
Devil's Racetrack Creek	*169 LF*	*Two (Enhancement)*
North Branch	*2,034 LF*	*One (Restoration)*
Southwest Branch	*154 LF*	*Two (Enhancement)*
Southwest Branch	*926 LF*	*Headwater Restoration*
Southwest Branch	*75 LF*	*Two (Enhancement)*
Middle Branch	*1,839 LF*	*Headwater Restoration*
Southeast Branch	*2,864 LF*	*Headwater Restoration*

Floodplain Information

Is project located in a Special Flood Hazard Area (SFHA)?

(•) Yes ( ) No

- Grading will take place in the Neuse River SFHA

If project is located in a SFHA, check how it was determined:

- [ ] Redelineation
- [x] Detailed Study
- [ ] Limited Detail Study
- [ ] Approximate Study
- [ ] Don't know

List flood zone designation: Zone AE and Zone X

Check if applies:

- [x] AE Zone
  - (•) Floodway
  - ( ) Non-Encroachment
  - ( ) None
- [ ] A Zone
  - ( ) Local Setbacks Required

○ No Local Setbacks Required
If local setbacks are required, list how many feet:
Does proposed channel boundary encroach outside floodway/non-encroachment/setbacks? ○ Yes ◉ No
Land Acquisition (Check) ☐ State owned (fee simple) ☐ Conservation easment (Design Bid Build) ☑ Conservation Easement (Full Delivery Project) Note: if the project property is state-owned, then all requirements should be addressed to the Department of Administration, State Construction Office (attn: Herbert Neily, (919) 807-4101)
Is community/county participating in the NFIP program? ◉ Yes ○ No Note: if community is not participating, then all requirements should be addressed to NFIP (attn: Edward Curtis, (919) 715-8000 x369)
Name of Local Floodplain Administrator: Pauline Ketchum Phone Number: (919) 963-3112, ext. 21

Floodplain Requirements

This section to be filled by designer/applicant following verification with the LFPA

☑ No Action

☐ No Rise

☐ Letter of Map Revision

☐ Conditional Letter of Map Revision

☑ Other Requirements

List other requirements: We have been in contact with Johnston County and the Town of Four Oaks. A technical memo will be prepared for approval by the Town of Four Oaks to include detailed grading plan and an explanation of the proposed effects on hydrology at the confluence of Devil's Racetrack Creek with the Neuse River showing no net fill in the Neuse River Floodplain.

Comments:

Name: Nicole Macaluso, PE Signature: 

Title: Water Resources Engineer Date: 5/11//2012

Appendix 12: Coastal Plain Reference Reach Database

Low - Moderate Slope C / E Composite Reference Data

Site	Stream Type	Avg. Slope (%)	Riffle Slope Ratio			Pool Slope Ratio			Pool to Pool Spacing Ratio			Pool Depth Ratio			Pool Area Ratio			Pool Width Ratio			Designer	Year
			Min	Average	Max	Min	Average	Max	Min	Average	Max	Min	Average	Max	Min	Average	Max					
Jarmon Oak Reference	E6	0.4	1.4	1.7	3.2	0.0	0.7	2.4	3.4	4.6	5.9	1.8	2.5	3.3	1.0	1.4	1.7	0.9	1.0	1.0	Axiom	2006
Jarmon Oak Design	E5/6	0.44	0.4	1.3	2.2	0.0	0.6	3.0	4.0	5.0	7.0	1.8	2.5	3.3	1.1	1.6	2.1	1.0	1.4	1.7	Axiom	2006
Cox Site Reference (Johanna Creek)	E5/C5	0.22	---	---	---	---	---	---	16.0	---	59.0	---	1.9	---	---	---	---	---	---	---	Buck	2005
Cox Site Design	C5	0.28	1.4	---	2.5	0.0	---	0.2	4.0	---	6.0	2.0	---	2.5	---	---	---	1.2	---	1.5	Buck	2005
Haw Branch Reference (Beaverdam Branch)	C5c	0.04	---	---	---	---	---	---	2.5	---	3.4	2.1	---	2.4	---	---	---	0.8	---	1.0	Buck	2005
Haw Branch Design	C5c	0.13	---	---	---	---	---	---	2.5	---	5.0	1.8	---	2.0	---	---	---	1.3	---	1.7	Buck	2005
Conoconarra Reference 3	E5	0.5	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	WKD	2006
Conoconarra Design R1	E5	0.96	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	WKD	2006
Conoconarra Design R2	E5	0.8	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	WKD	2006
Brown Marsh Reference (UT to Ironhill Branch)	E5	0.13	---	---	---	1.2	---	5.0	3.9	---	6.3	---	1.6	---	---	---	---	---	1.6	---	Ko & Associates	2006
Brown Marsh Reference (Mill Creek)	E5	0.26	---	---	---	0.0	---	3.0	1.0	---	5.4	---	1.7	---	---	---	---	---	1.1	---	Ko & Associates	2006
Brown Marsh Reference (UT to Wildcat Branch)	E5	0.24	---	---	---	0.0	---	0.0	1.7	---	2.0	---	1.7	---	---	---	---	---	1.1	---	Ko & Associates	2006
Brown Marsh Northern UT	E5	0.1	---	---	---	---	0.4	---	2.4	---	6.1	---	2.0	---	---	---	---	---	1.0	---	Ko & Associates	2006
Brown Marsh Southern UT	E5	0.03	---	---	---	---	0.0	---	4.7	---	9.7	---	1.0	---	---	---	---	---	1.0	---	Ko & Associates	2006
Brown Marsh Swamp Reference (UT to Hog Swamp)	E5	0.68	---	---	---	0.0	---	0.9	2.4	---	6.1	---	2.3	---	---	---	---	---	1.0	---	Ko & Associates	2006
Ellington Branch Reach 1	C5	0.56	---	2.7	---	---	0.0	---	2.3	---	8.6	---	2.1	---	---	1.4	---	---	1.6	---	Sungate	2007
Ellington Branch Reach 2	C5	0.56	---	2.7	---	---	0.0	---	2.6	---	6.6	---	2.0	---	---	1.2	---	---	1.5	---	Sungate	2007
Ellington Branch Reach 3	C5	0.9	---	2.2	---	---	0.0	---	4.3	---	9.1	---	2.3	---	---	1.6	---	---	1.3	---	Sungate	2007
Ellington Branch Reference 2	E5	0.7	---	2.0	---	---	0.4	---	2.7	---	6.6	---	2.1	---	---	1.2	---		0.9		Sungate	2007
Ellington Branch Reference 3	E5	1.1	---	---	---	0.0	---	0.8	4.3	---	9.1	0.7	---	2.2	2.6	---	6.2	2.1	---	2.6	Sungate	2007
Jacksonville CC Reference	E5	0.5	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	Blue	2006
Jacksonville CC Reach AB	E5	0.7	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	Blue	2006
Jacksonville CC Reach BC	C5	0.7	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	Blue	2007
Reference Composite	---	---	1.4	1.9	3.2	0.0	0.6	5.0	1.0	4.6	59.0	0.7	2.0	3.3	1.0	1.3	6.2	0.8	1.1	2.6	---	---
Design Composite	---	---	0.4	2.2	2.5	0.0	0.2	3.0	2.3	5.0	9.7	1.8	2.0	3.3	1.1	1.5	2.1	1.0	1.3	1.7	---	---

DA System Composite Reference Data

Site	Stream Type	Avg. Slope (%)	Riffle Slope Ratio			Pool Slope Ratio			Pool to Pool Spacing Ratio			Pool Depth Ratio			Pool Area Ratio			Pool Width Ratio			Designer	Year
Conoconarra Reference 4*	DA	0.09	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	WKD	2006
Conoconarra Design R3	DA	0.8	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	WKD	2006
Reference Composite	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---		
Design Composite	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---		

High Slope C / E Composite Reference Data

Site	Stream Type	Avg. Slope (%)	Riffle Slope Ratio			Pool Slope Ratio			Pool to Pool Spacing Ratio			Pool Depth Ratio			Pool Area Ratio			Pool Width Ratio			Designer	Year
Ellington Branch Reference 1	B4c	1.3	---	2.8	---	---	0.008	---	---	5.5	---	---	2.1	---	---	1.5	---	---	1.6	---	Sungate	2007

Low - Moderate Slope C / E Composite Reference Data

Site	Stream Type	W/D Ratio			Linear Wavelength Ratio (Formerly Meander Length Ratio)			Radius of Curvature Ratio			Meander Width Ratio			Sinuosity		Designer	Year
		Min	Average	Max	Min	Average	Max	Min	Average	Max	Min	Average	Max	Min	Max		
Jarmon Oak Reference	E6	---	7.4	---	5.9	7.6	8.8	1.5	1.7	2.0	2.3	3.7	3.9	1.4		Axiom	2006
Jarmon Oak Design	E5/6	9.0	9.0	10.0	6.0	8.0	14.0	2.0	2.2	4.0	2.0	4.0	7.0	1.3	1.4	Axiom	2006
Cox Site Reference (Johanna Creek)	E5/C5	10.0	---	19.7	4.0	---	5.9	1.5	---	2.8	1.4	---	2.1	1.2		Buck	2005
Cox Site Design	C5	14.0	14.0	14.0	8.0	---	12.0	2.0	---	3.0	5.0	---	8.0	1.3	1.8	Buck	2005
Haw Branch Reference (Beaverdam Branch)	C5c	11.0	---	17.0	4.9	---	6.7	1.8	---	2.4	2.9	---	6.3	1.7		Buck	2005
Haw Branch Design	C5c	9.0	---	14.0	8.0	---	12.0	2.0	---	4.0	5.0	---	8.0	1.5	1.9	Buck	2005
Conoconarra Reference 3	E5	---	7.1	---	---	3.8	---	---	1.7	---	---	3.6	---	1.5		WKD	2006
Conoconarra Design R1	E5	---	7.1	---	---	3.8	---	---	1.7	---	---	3.6	---	1.5		WKD	2006
Conoconarra Design R2	E5	---	7.1	---	---	3.8	---	---	1.7	---	---	3.6	---	1.5		WKD	2006
Brown Marsh Reference (UT to Ironhill Branch)	E5	---	10.8	---	4.1	---	7.0	1.3	---	2.0	2.9	---	5.7	1.3		Ko & Associates	2006
Brown Marsh Reference (Mill Creek)	E5	---	6.1	---	3.3	---	6.4	0.9	---	2.6	1.3	---	2.4	1.2		Ko & Associates	2006
Brown Marsh Reference (UT to Wildcat Branch)	E5	---	8.0	---	2.7	---	3.5	1.3	---	1.9	1.7	---	2.4	1.2		Ko & Associates	2006
Brown Marsh Northern UT	E5	---	7.5	---	3.0	---	10.0	2.0	---	3.0	2.0	---	6.0	1.4		Ko & Associates	2006
Brown Marsh Southern UT	E5	---	9.5	---	3.0	---	10.0	2.0	---	3.0	2.0	---	6.0	1.2		Ko & Associates	2006
Brown Marsh Swamp Reference (UT to Hog Swamp)	E5	---	7.9	---	3.2	---	18.6	1.2	---	12.1	1.5	---	4.2	1.2		Ko & Associates	2006
Ellington Branch Reach 1	C5	---	11.2	---	4.7	---	11.3	1.7	---	3.4	1.6	---	5.1	1.3		Sungate	2007
Ellington Branch Reach 2	C5	---	11.1	---	4.5	---	9.8	1.5	---	3.2	1.3	---	4.6	1.3		Sungate	2007
Ellington Branch Reach 3	C5	---	13.3	---	3.7	---	12.2	1.6	---	3.1	1.4	---	5.3	1.3		Sungate	2007
Ellington Branch Reference 2	E5	6.1	---	8.8	1.1	---	2.5	0.4	---	1.1	1.7	---	4.2	1.7		Sungate	2007
Ellington Branch Reference 3	E5	3.4	---	3.8	3.4	---	15.2	1.1	---	4.8	1.5	---	8.0	1.2		Sungate	2007
Jacksonville CC Reference	E5	4.8	5.7	7.2	---	7.1	---	---	1.6	---	---	2.3	---	1.6		Blue	2006
Jacksonville CC Reach AB	E5	---	7.5	---	---	5.3	---	---	3.0	---	---	1.8	---	1.1		Blue	2006
Jacksonville CC Reach BC	C5	---	10.0	---	---	5.3	---	---	3.0	---	---	1.8	---	1.8	1.9	Blue	2007
Reference Composite	---	**3.4**	**7.6**	**19.7**	**2.7**	**6.2**	**18.6**	**0.4**	**1.7**	**4.8**	**1.3**	**3.2**	**8.0**	**1.2**	**1.7**	---	---
Design Composite	---	**9.0**	**9.8**	**14.0**	**3.0**	**5.2**	**14.0**	**1.5**	**2.3**	**4.0**	**1.3**	**3.0**	**8.0**	**1.1**	**1.9**	---	---

DA System Composite Reference Data

Site	Stream Type	W/D Ratio			Meander Length Ratio			Radius of Curvature Ratio			Meander Width Ratio			Sinuosity	Designer	Year
Conoconarra Reference 4*	DA	---	18.3	---	---	4.4	---	---	3.3	---	---	1.4	---	1.2	WKD	2006
Conoconarra Design R3	DA	---	18.3	---	---	4.4	---	---	3.3	---	---	1.4	---	1.2	WKD	2006
Reference Composite	---	---	18.3	---	---	4.4	---	---	3.3	---	---	1.4	---	1.2	---	---
Design Composite	---	---	18.3	---	---	4.4	---	---	3.3	---	---	1.4	---	1.2	---	---

High Slope C / E Composite Reference Data

Site	Stream Type	W/D Ratio			Meander Length Ratio			Radius of Curvature Ratio			Meander Width Ratio			Sinuosity	Designer	Year
Ellington Branch Reference 1	B4c	6.5	---	6.7	0.6	---	2.5	0.3	---	1.8	---	4.7	---	1.5	Sungate	2007