FINAL MITIGATION PLAN

Mud Lick Creek Mitigation Site
Chatham County, North Carolina
DEQ Contract No. D14001i
SCO No. 1209857-01
DMS ID No. 93482

Cape Fear River Basin
HUC 03030003

Prepared for:

NC Department of Environmental Quality
Division of Mitigation Services
1652 Mail Service Center
Raleigh, NC 27699-1652

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December, 2015

EXECUTIVE SUMMARY

Wildlands Engineering, Inc. (Wildlands) is completing a stream restoration and enhancement project at the Mud Lick Creek Mitigation Site (Site) for the North Carolina Division of Mitigation Services (DMS) to restore and enhance a total of 3,750 linear feet (LF) of perennial stream in Chatham County, NC. The Site is proposed to generate 2,938 Stream Mitigation Units (SMUs). This site is located in the Upper Rocky River Watershed within Cape Fear River Basin Hydrologic Unit Code (HUC) 03030003 (Cape Fear 03). Restoration and enhancement activities will be performed on Mud Lick Creek and two unnamed tributaries hereafter referred to as North Branch and East Branch.

Mud Lick Creek has been classified by the North Carolina Department of Environmental Quality (NCDEQ) as a Class WS-III; CA surface water (DENR, 2004). The proposed project will improve water quality as well as provide numerous ecological benefits within the Cape Fear River Basin. The project will help meet management recommendations of the Upper Rocky River Local Watershed Plan by restoring a vegetated riparian buffer zone, stabilizing eroding stream banks, and removing livestock from streams and riparian zones. These activities will result in reduced nutrient, sediment, and fecal coliform inputs; improved aquatic and riparian habitat, and other ecological benefits.

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).
- NCDEQ Ecosystem Enhancement Program In-Lieu Fee Instrument signed and dated July 28, 2010.

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

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1.0 Restoration Project Goals and Objectives

The Mud Lick Creek project site is located within the Cape Fear River Basin in Hydrologic Unit Code (HUC) 03030003. The site is also within the Upper Rocky River local watershed planning (LWP) area and was identified as a priority mitigation project in the Detailed Assessment and Targeting of Management Report (Tetra Tech, 2005). The main stressors to aquatic resources identified during the watershed assessments described in the in the LWP documents include:

- Nutrient (nitrogen and phosphorous) loading from farming;
- Sediment loading from overland runoff, disturbed surfaces, and streambank erosion;
- Cattle access to streams resulting in increased bank erosion and fecal coliform contamination; and
- Insufficient bank vegetation.

The project will contribute to meeting management recommendations to offset these stressors as described above for the LWP area by accomplishing the following primary goals:

- Control and reduce nutrient sources from the site;
- Reduce sediment loads from disturbed areas on the site and from eroding stream banks;
- Increased aeration of flows within the project extent promoting increases in dissolved oxygen concentrations;
- Reduce sources of fecal coliform pollution;
- Improve instream habitat;
- Reduce thermal loadings;
- Reconnect channels with floodplains and raise local water table; and
- Restore riparian habitat.

These goals will be accomplished through the following objectives:

- Restore riparian vegetation on the site and thereby reduce sediment loads to streams from stream banks and existing pastures, increase on-site retention of sediment and nutrients, create riparian habitat, and provide shade for streams to reduce thermal loadings;
- Stabilize eroding streambanks to reduce sediment inputs;
- Install fencing around the perimeter of the conservation easement to eliminate livestock access to streams. This will reduce sediment, nutrient, and fecal coliform inputs.
- Plant restored and stabilized streambanks with native species to improve stability and habitat.
- Install instream structures to improve stability, create habitat, and help aerate streamflows;
- Raise streambeds to reconnect restored channels to floodplains and raise local water tables; and
- Restore streams and vegetation so that the site looks natural and aesthetically pleasing.

Additional credits are proposed to cover the costs of supplemental monitoring of additional water quality and biological parameters. These data are intended to contribute to a dataset from multiple projects over the ensuing years to help characterize the combinations of site and watershed characteristics that will help:

- Identify thresholds for detection of improvements in higher functions within the constraints of typical mitigation monitoring timeframes.

- Calibrate expectations regarding what levels of improvement can be observed in those timeframes for different levels of restoration.
- Tailor goals and success criteria.

Given the investigative nature of these data, these parameters will not be used in determination of mitigation success and associated crediting; rather credits will be issued in an amount proportional to the actual monitoring costs, not to exceed 10% of the credit yield.

2.0 Project Site Location and Selection

2.1 Directions to Project Site

The Site is located in northwestern Chatham County, north of Siler City and northwest of Silk Hope (Figure 1). From Silk Hope take Silk Hope-Liberty Road west for 4.1 miles. Turn right on Siler City-Snow Camp Road. Travel 0.2 miles. The farm entrance to the project is located on the left side of the road.

2.2 Site Selection and Project Components

The site was selected to provide stream mitigation units (SMUs) in the Cape Fear Basin based on the current degraded condition of the onsite streams and the potential for functional restoration described in Section 1.0. Credit determinations are presented in Section 9.0.

Streams proposed for restoration and enhancement include Mud Lick Creek and two unnamed tributaries hereafter referred to as North Branch and East Branch (Figure 2). Photographs of the project site area included in Appendix 1.

3.0 Site Protection Instrument

The land required for construction, management, and stewardship of the mitigation project includes portions of the parcel(s) listed in Table 1. A conservation easement was recorded on the parcel in 2006. Additional acreage was added to the easement to accommodate the updated site design.

Table 1. Site Protection Instrument

Landowner	PIN	County	Site Protection Instrument	Deed Book and Page Number	Acreage Protected
Thomas Grayson Heirs	8775-11-1240	Chatham	Conservation Easement	DB: 1233 PG: 849[1]	11.23

1. Deed Book and Page Number provided for conservation easement.

All site protection instruments require 60-day advance notification to the U.S Army Corps of Engineers 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

4.1 Watershed Existing Conditions

Table 2 presents the project information and baseline watershed information. The watershed areas were delineated using a combination of site existing conditions survey, Chatham County GIS data and USGS 7.5-minute topographic quadrangles (Figure 3).

Table 2. Project and Watershed Information

Project County	Chatham County					
Easement Area (acres)	11.2					
Project Coordinates	35° 48' 46'' N, 79° 26' 6''W					
Physiographic Region	Carolina Slate Belt of the Piedmont Physiographic Province					
Ecoregion	Piedmont					
River Basin	Cape Fear					
USGS HUC (8 digit, 14 digit)	03030003, 03030003070010					
NCDWQ Sub-basin	03-06-12					
Reaches	MLC-R1	MLC-R2	MLC-R3	NB-R1	NB-R2	EB
Drainage Area (acres)	1,747	2,170	2,330	236.8	416	172.8
Drainage Area (miles^2)	2.73	3.39	3.64	0.37	0.65	0.27
NCCGIA Land Cover Classification						
Developed	5%	5%	6%	4%	6%	9%
Forested/Scrubland	44%	42%	41%	31%	32%	33%
Agriculture/Managed Herb.	50%	52%	52%	65%	62%	57%
Open Water	1%	1%	1%	0%	0%	1%
Watershed Impervious Cover	< 1%	< 1%	< 1%	< 1%	< 1%	< 1%

4.2 Watershed Historical Land Use and Development Trends

The Mud Lick Creek Watershed (Figure 4) is located in the rural countryside approximately 4 miles northwest of Silk Hope. Topography can be described as somewhat hilly to gently rolling. The stream valleys within the watershed and on site are characterized by relatively narrow floodplains and moderately steep side slopes.

A review of historical aerials of the Site and immediately adjacent parcels from 1973, 1983, 1993, 1999, 2005, 2006, and 2008 (Appendix 2) revealed that the project site has been used for agricultural livestock production since before 1973. Sometime between 1973 and 1983 the riparian buffers were removed in order to expand livestock access on Site; however, since 1983 the land use on site has remained constant.

Further investigation was done on landuse throughout the entire watershed using the aerial photographs listed above and additional aerials from Google Earth (1993-2012). The most common landuse types are silviculture, livestock grazing, and crop production. Wildlands conducted a watershed reconnaissance visit to verify current land uses observed from the aerial photography and to identify potential stressors. Consistent with information depicted in aerial photography, land use within the Mud Lick Creek watershed is predominantly forest and agricultural production. Disturbed areas within the watershed consist primarily of tillage for new crop planting. As this is a long-term, on-going practice (dating to before 1973) it is not considered a new stressor to the watershed. There are no signs of impending land use changes or development pressure that would impact the project in the Mud Lick Creek Watershed. The Conservation Easement will eliminate potential for future development or agricultural use in the immediate area of the onsite streams.

4.3 Physiography, Geology, and Soils

The Project is located in the Slate Belt of the Piedmont Physiographic Province. The Piedmont Province is characterized by gently rolling, well rounded hills with long low ridges, with elevations ranging from 300-1,500 feet above sea level. The Carolina Slate Belt consists of heated and deformed volcanic and sedimentary rocks. Specifically, the proposed restoration site is located in the felsic metavolcanic rock (mapped CZfv) of the Carolina Slate Belt. This unit consists of light gray to greenish gray, felsic metavolcanic rock interbedded with mafic and intermediate metavolcanic rock, meta-argillite, and metamudstone (NCGS, 2009). Note: This information was obtained from geologic mapping; no field investigations of rock lithology were performed.

Soil mapping units are based on the U.S. Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) Soil Survey for Chatham County. Soil types within the study area were mapped with the NRCS Web Soil Survey and are described below in Table 3. A soils map based on this information is provided in Figure 5. Note: No field mapping of soils was performed for this project.

Table 3. Floodplain Soil Types and Descriptions

Soil Name	Location	Description
Chewacla and Wehadkee soils, 0-2% slopes	Mud Lick Creek-R3 near culvert	Chewacla soils are somewhat poorly drained soils located in floodplains, which flood frequently. Wehadkee soils are poorly drained soils located in depressions on floodplains, which flood frequently. Both have high water capacities.
Cid-Lignum Complex, 2-6% slopes	Mud Lick Creek-R2, Mud Lick Creek- R3	Cid and Lignum soils are moderately well drained soils located in Interfluves with low water capacity. This soil is not subject to flooding.
Nanford-Badin Complex, 6-10% slopes	Mud Lick Creek-R1, Mud Lick Creek-R2, North Branch-R1, North Branch-R2, East Branch	Nanford-Badin complexes are well drained soils located on hillsides on ridges with low water capacity. This soil is not frequently subject to flooding.
Georgeville silt loam, 2-6% slopes	Floodplain of Mud Lick Creek-R2 and Mud Lick Creek-R3	Georgeville silt loam is a well-drained soil located in interfluves with a high water capacity. This soil is not subject to flooding.

Source: NRCS Web Soil Survey

4.4 Valley Classification

The topography around the project site primarily consists of gently rolling hills interspersed with narrow valleys. The stream valleys on site are characterized by relatively narrow floodplains with side slopes ranging from 8% - 20% and valley slopes ranging from 0.1% to 1%. The project streams flow through alluvial valleys in a fluvial-dissected landscape.

4.5 Surface Water Classification and Water Quality

On August 22, 2013 Wildlands investigated on-site jurisdictional waters of the U.S. using the U.S. Army Corps of Engineers (USACE) Routine On-Site Determination Method. This method is defined in the 1987 Corps of Engineers Wetlands Delineation Manual and subsequent Eastern Mountain and Piedmont Regional Supplement. Determination methods included stream classification utilizing the NCDWQ Stream Identification Form and the USACE Stream Quality Assessment Worksheet. Potential jurisdictional wetland areas were classified using the USACE Wetland Determination Data Form (refer to Section 5.1 below for information on jurisdictional wetlands).

The results of the on-site field investigation indicate that there are five jurisdictional stream channels located within the proposed project area including Mud Lick Creek and four tributaries to Mud Lick Creek. Figure 6 shows the hydrologic features on the site. Stream classification forms representative of on-site jurisdictional stream channels have been enclosed in Appendix 3 (SCP1-SCP5). Site photographs are included in Appendix 1.

The North Carolina Division of Water Quality (NCDWR) assigns best usage classifications to State Waters that reflect water quality conditions and potential resource usage. Mud Lick Creek has been classified by the North Carolina Department of Environmental Quality (NCDEQ) as a Class-III; CA surface water (DENR, 2011). It is a Critical Area for water supply.

4.6 Existing Stream Condition

An existing conditions assessment was performed on Mud Lick Creek, North Branch, and East Branch in September, 2013. No work will be performed on South Branch except for planting along 66 LF of this tributary where it flows into the easement along Mud Lick Creek. Therefore, no assessment work was performed on South Branch. The purposes of the assessment were to characterize the existing morphology of the project reaches; identify problems such as incision, bank erosion, lack of native vegetation, sedimentation, and poor habitat conditions; and to provide a basis for developing a design to enhance the ecological function of the site. During existing conditions assessments, Mud Lick Creek was separated into three reaches based on differences in channel conditions: Mud Lick Creek-R1, Mud Lick Creek-R2 and Mud Lick Creek-R3. North Branch was separated into two reaches up and downstream of the confluence with East Branch: North Branch-R1 and North Branch-R2. East Branch is considered a single reach. The locations of the project reaches and surveyed cross sections are shown in Figure 6. Existing conditions geomorphic survey data are included in Appendix 4. Table 4 presents the reach summary information.

Table 4. Reach Summary Information

	Mud Lick Creek - R1	Mud Lick Creek – R2	Mud Lick Creek – R3	North Branch- R1	North Branch- R2	East Branch
Restored Length (LF)	623	693	748	656	577	296
Valley Slope (feet/ foot)	0.0031	0.0043	0.001	0.0048	0.0076	0.0098
Drainage Area (acres)	1,747	2,170	2,330	236.8	416	172.8
Drainage Area ($miles^2$)	2.73	3.39	3.64	0.37	0.65	0.27
NCDWQ Stream ID Score	42	42	42	34.5	34.5	34
Perennial or Intermittent	P	P	P	P	P	P

	Mud Lick Creek - R1	Mud Lick Creek – R2	Mud Lick Creek – R3	North Branch- R1	North Branch- R2	East Branch
NCDWQ Classification	WS-III/CA					
Rosgen Classification of Existing Conditions	E4	C4	E4	E4	B4c	B4c
Simon Evolutionary Stage	IV/V	IV/V	IV/V	IV	IV	IV
FEMA zone Classification	AE	AE	AE	AE	AE	AE

Mud Lick Creek

The channel slopes and valley slopes for Mud Lick Creek are typical for Piedmont streams in similar valley types (Table 4). The bed of Mud Lick Creek is characterized by short riffles, long pools, mid-channel bars, large debris dams, and macrophyte communities at certain locations in the channel bed. In many areas, the density of macrophytes has caused accretion of the channel bed and the development of a bench feature. The substrate coarsens somewhat in the downstream direction, from sand in Reach 1 to fine gravel in Reaches 2 and 3. While the dominant substrate size is small gravel, bedrock outcrops and some larger gravel and small cobble were observed throughout the site. There is a double box culvert at the downstream end that sets base level.

Though Mud Lick Creek is only slightly incised, the bed and banks of the stream are severely impacted by historic and continued livestock access and fluvial erosion. Wallow areas and on-going bank trampling continue to destabilize banks along large portions of the reach. There is some mass wasting of bank material and areas where trees have fallen into the stream. The bank trampling has likely contributed to the fining of bed material. The sinuosity of the each reach is fairly high and the pattern of the stream and its location within the valley appear to indicate that the alignment has not been greatly altered by past land owners. The riparian vegetation is predominantly pasture grasses with a few large trees such as hickory (*Carya spp*.), river birch (*Betula nigra*), red maple (*Acer rubrum*), green ash (*Fraxinus pennsylvanica*), and red cedar (*Juniperus virginiana*) with some areas dominated by Chinese privet (*Ligustrum sinense*). Results of the existing conditions morphologic survey of Mud Lick Creek are summarized in Table 5a. Morphologic survey data are included in Appendix 4.

Table 5a. Existing Stream Conditions – Mud Lick Creek

Parameter	Notation	Units	Mud Lick Creek-R1		Mud Lick Creek - R2		Mud Lick Creek-R3	
			min	max	min	max	min	max
stream type			E4		C4		E4	
drainage area	DA	sq mi	2.73		3.39		3.64	
bankfull cross-sectional area	A_{bkf}	SF	41.3		47.5		46.3	
avg velocity during bankfull event	v_{bkf}	fps	3		3		3.4	
width at bankfull	w_{bkf}	feet	18.2		24.6		22	
maximum depth at bankfull	d_{max}	feet	4.2		3		4	
mean depth at bankfull	d_{bkf}	feet	2.3		1.9		2.1	
bankfull width to depth ratio	w_{bkf}/d_{bkf}		8		12.8		10.5	
low bank height		feet	5.2		3.4		4.7	
bank height ratio	BHR		1.2		1.1		1.2	

Parameter	Notation	Units	Mud Lick Creek-R1		Mud Lick Creek - R2		Mud Lick Creek-R3	
			min	max	min	max	min	max
max pool depth at bankfull	d_{pool}	feet	4.4		3.7		5.2	
pool depth ratio	d_{pool}/d_{bkf}		1.1		1.2		1.3	
pool width at bankfull	w_{pool}	feet	19.1		25.9		24.7	
pool width ratio	w_{pool}/w_{bkf}		1.05		1.05		1.1	
Bkf pool cross-sectional area	A_{pool}	SF	58.1		65.5		69.7	
pool area ratio	A_{pool}/A_{bkf}		1.4		1.4		1.5	
floodprone area width	w_{fpa}	feet	250		306		378	
entrenchment ratio	ER		13.7		12.4		17.2	
valley slope	S_{valley}	feet/ foot	0.0031		0.0043		0.001	
channel slope[1]	$S_{channel}$	feet/ foot	0.002		0.002		0.003	
sinuosity	K		1.37		1.35		1.2	
belt width	w_{blt}	feet	26.1	69.9	38.8	67.0	33.0	67.0
meander width ratio	w_{blt}/w_{bkf}		1.4	3.8	1.6	2.7	1.5	3.0
meander length	L_m	feet	144.9	244.4	59.9	208.7	70.5	174.2
meander length ratio	L_m/w_{bkf}		8.0	13.4	2.4	8.5	3.2	7.9
radius of curvature	R_c	feet	9.9	36.7	12.9	58.8	10.9	38.5
radius of curvature ratio	R_c/ w_{bkf}		0.54	2.01	0.53	2.39	0.50	1.75
Particle Size Distribution from Reachwide Pebble Count								
d_{50} Description			very fine gravel		medium gravel		fine gravel	
	d_{16}	mm	Sand[2]		Sand[2]		Sand[2]	
	d_{35}	mm	Sand[2]		2.8		Sand[2]	
	d_{50}	mm	1.7		8		6	
	d_{84}	mm	15		21		28	
	d_{95}	mm	36		76		58	
	d_{100}	mm	bedrock		362		bedrock	

1. Channel slopes are specific to the length of profile studied
2. Sand particles were not measured. Bed material size distributions including D16 and D35 values for riffle bulk samples are included in Appendix 4.

North Branch

North Branch is separated into upstream (Reach 1) and downstream (Reach 2) reaches. The valley slope is gentler in Reach 1 and increases in Reach 2. North Branch becomes more incised in the downstream direction, i.e. is deeper relative to the floodplain at the downstream end compared to the upstream end. This results in a channel slope that is higher than valley slope. In addition, the bank height ratios are high and increase from the Reach 1 reach to Reach 2 indicating significant and increasing incision. The degree of bank erosion also increases in the downstream direction. The bed is characterized by long riffles and runs with little bedform variation. While there are large bedrock seams in the channel, it is dominated by a sand and fine gravel substrate. The sinuosity of the Reach 1 channel is less than that of the Reach 2 channel. Reach 1 runs along the northwestern edge of its valley and the left floodplain is much more extensive than the right floodplain. Reach 2 moves more to the center of its valley as it approaches the confluence with Mud Lick Creek. It is unclear if the channel has been straightened or relocated in the past. Livestock access to North Branch has been prohibited in Reach 1 in recent years. As a result, the

riparian zone is characterized by young early successional trees such as sweetgum (*Liquidambar styraciflua*) and red maple. The Reach 2 riparian zone is more sparsely vegetated with a few trees such as sweetgum, red maple, river birch, and sycamore (*Platanus occidentalis).* Chinese privet is also common along this reach. Results of the existing conditions morphologic survey of North Branch are summarized in Table 5b. Morphologic survey data are included in Appendix 4.

East Branch

The valley slope and the channel slope for this reach are the steepest of any of the project reaches. This reach has been recently fenced to prohibit cattle access and contains young early successional trees dominated by sweetgum and red maple. While there is significant evidence of channel degradation from past livestock access, sections of the reach have begun to stabilize and become vegetated. This channel is narrow and deep and is severely incised. The bed is mostly sand and fine gravel, though there is some larger gravel and cobble material, and the bedforms are dominated by riffles and runs with a few shallow pools. The valley floor is narrow at the upstream end and widens significantly near the confluence with North Branch. The channel is very straight and there is a remnant channel near the downstream section indicating that this reach has been straightened and moved in the past. Results of the existing conditions morphologic survey of East Branch are summarized in Table 5b. Morphologic survey data are included in Appendix 4.

Table 5b. Existing Stream Conditions – North Branch and East Branch

Parameter	Notation	Units	North Branch-R1		North Branch-R2		East Branch
			min	max	min	max	
stream type			E5		B5c		B4c
drainage area	DA	sq mi	0.37		0.65		0.27
bankfull cross-sectional area	A_{bkf}	SF	7.7		12.7		4.8
avg velocity during bankfull	v_{bkf}	fps	3.3		3.5		4.2
width at bankfull	w_{bkf}	feet	10.4		8.3		4.3
maximum depth at bankfull	d_{max}	feet	1.5		2.3		1.4
mean depth at bankfull	d_{bkf}	feet	0.7		1.5		1.1
bankfull width to depth ratio	w_{bkf}/d_{bkf}		14		5.4		3.9
low bank height		feet	2.6		4.6		2.7
bank height ratio	BHR		1.7		2.0		1.9
max pool depth at bankfull	d_{pool}	feet	2.1		2.7		1.6
pool depth ratio	d_{pool}/d_{bkf}		1.4		1.17		1.1
pool width at bankfull	w_{pool}	feet	6.3		9.3		6.1
pool width ratio	w_{pool}/w_{bkf}		0.6		1.12		1.4
Bkf pool cross-sectional area	A_{pool}	SF	8.2		16.2		7.2
pool area ratio	A_{pool}/A_{bkf}		1.1		1.3		1.5
floodprone area width	w_{fpa}	feet	33.3		80		23
entrenchment ratio	ER		10.1		1.9		2.1
valley slope	S_{valley}	feet/	0.0048		0.0076		0.0098
channel slope[1]	$S_{channel}$	feet/	0.01		0.005		0.013
sinuosity	K		1.22		1.32		1
belt width	w_{blt}	feet	11	35	17	38.5	--
meander width ratio	w_{blt}/w_{bkf}		1.1	3.4	2	4.6	--

Parameter	Notation	Units	North Branch-R1		North Branch-R2		East Branch
			min	max	min	max	
meander length	L_m	feet	39.9	100.6	37.9	88.3	--
meander length ratio	L_m/w_{bkf}		3.8	9.7	4.6	10.6	--
radius of curvature	R_c	feet	10.7	23.2	6.1	37	--
radius of curvature ratio	R_c/ w_{bkf}		1.03	2.23	0.73	4.46	--
Particle Size Distribution from Reachwide Pebble Count							
d_{50} Description			Sand				Medium Gravel
	d_{16}	mm	Sand[2]				Sand[2]
	d_{35}	mm	Sand[2]				6.1
	d_{50}	mm	Sand[2]				10
	d_{84}	mm	8				15
	d_{95}	mm	15				27
	d_{100}	mm	32				64

1. Channel slopes are specific to the length of profile.
2. Sand particles were not measured.

4.7 Channel Evolution

The evolution of the project streams has been analyzed and is described here in terms of the channel evolution model (Simon, 1989). The project streams were surrounded by forest in 1973 (see aerial photos in Appendix 2) but it is unknown if the site was previously cleared for logging or agriculture. The road at the downstream end of Mud Lick Creek on the project site was in its current configuration in 1973 and the culvert under that road is likely the one that remains there today. That culvert invert sets the local base level for the project site. It seems likely that the streams incised long ago, either as a result of historic land uses on the site and downstream or as a result of the culvert installation moving the channel from Stage I (Equilibrium) of the channel evolution model through Stage III (Degradation). At some point between 1973 and 1983, the forest on the site was almost completely cleared and the land use was converted to livestock grazing. In the years following clearing of the vegetation, the channels began to erode laterally (Stage IV-Degradation and Widening). The widening process has been mostly driven by cattle trampling the banks, though there are some areas where fluvial erosion is apparent. These processes have continued for years and in the current condition, the streams are severely degraded. Without intervention, the streams will not re-stabilize and reach a new equilibrium state (Stage VI).

Mud Lick Creek appears to have stopped incising. Certain areas of this stream continue to have bank failure and widening (Stage IV) while other areas have begun to aggrade forming new inner berms and bankfull features (Stage V-Aggradation and Widening). Mud Lick Creek is sinuous and it is not clear if it has been channelized in the past (it remains in a similar alignment to that at the time of clearing). North Branch followed a similar evolutionary pattern post-disturbance. The degree of channel incision is greater than Mud Lick Creek and it has not yet moved beyond Stage IV. East Branch appears to have been channelized at some point in the past and has a similar degree of incision as North Branch. The stream was recently fenced and livestock access has been prohibited, therefore, some banks have begun to stabilize. However, there are few new bankfull features forming and the stream is at the beginning of Stage IV.

4.8 Channel Stability

Wildlands 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 2006 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. 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 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 Mud Lick Creek site indicate that all of the streams are all rated fair (the second to lowest category). These results indicate that the stream channel exhibit signs of instability and that increased erosion of the channels is likely. For every stream assessed, the lateral fraction was greater than the vertical fraction indicating that the streams are more laterally unstable than vertically unstable. This is mostly because of cattle impacts. The streams are also incised and have large amounts of fine material in the bed substrate resulting in scores that indicate some vertical instability. Total scores, stability ratings, and vertical and horizontal fractions are provided in Table 6.

Table 6. Existing Conditions Channel Stability Assessment Results

Parameter	Mud Lick Creek R1	Mud Lick Creek R2	Mud Lick Creek R3	North Branch R1	North Branch R2	East Branch
1. Watershed characteristics	4	4	4	4	4	4
2. Flow habit	3	3	3	3	3	3
3. Channel pattern	3	3	4	5	6	7
4. Entrenchment	9	9	8	8	10	8
5. Bed material	9	10	10	6	6	6
6. Bar development	6	6	7	4	6	6

Parameter	Mud Lick Creek R1	Mud Lick Creek R2	Mud Lick Creek R3	North Branch R1	North Branch R2	East Branch
7. Obstructions	7	9	8	5	5	5
8. Bank soil texture and	5	5	5	5	5	5
9. Average bank slope angle	9	9	9	8	9	8
10. Bank protection	11	11	9	7	9	9
11. Bank cutting	9	10	10	9	8	9
12. Mass wasting or bank	9	10	10	9	6	3
Score	**84**	**89**	**87**	**73**	**77**	**73**
Ranking	**Fair**	**Fair**	**Fair**	**Fair**	**Fair**	**Fair**
Lateral Score	43	45	43	38	37	34
Vertical Score	24	25	25	18	22	20
Lateral Fraction	71.7%	75.0%	71.7%	63.3%	61.7%	56.7%
Vertical Fraction	66.7%	69.4%	69.4%	50.0%	61.1%	55.6%

Possible range of score for each parameter: Excellent (1-3), Good (4-6), Fair (7-9), Poor (10-12)

4.9 Utilities and Site Access

There are no underground or overhead utilities on the project site. There are existing culverts under state maintained roads at the upstream end of North Branch and East Branch and at the downstream end of Mud Lick Creek. The project will not affect these culverts; they will remain in place in their current configuration once the project is complete.

The site can be easily accessed from a driveway off of Siler City-Snow Camp Road (SR 1004). Two 20 foot breaks in the conservation easement are proposed to provide the farmer access to the fields as depicted on Figure 2. A ford stream crossing will be provided on Mud Lick Creek due to the size of the channel. A culvert stream crossing will be provided along North Branch. Each crossing will be fenced and gated to prevent livestock from wallowing in the streams. The farmer will be required to maintain these crossings. No mitigation credit is requested for the portions of the streams that are outside of the conservation easement.

5.0 Regulatory Considerations

5.1 401/404

Five jurisdictional streams (Mud Lick Creek and four tributaries (North Branch, East Branch, South Branch, and West Branch)) and six wetlands (A-F) were delineated during an on-site review of jurisdictional waters of the U.S using the U.S. Army Corps of Engineers (USACE) Routine On-Site Determination Method. This method is defined in the 1987 Corps of Engineers Wetlands Delineation Manual and subsequent Eastern Mountain and Piedmont Regional Supplement. Streams assessments also utilized the NCDWR Stream Identification Form (see Appendix 3) to determine flow permanence. Potential jurisdictional wetland areas were classified using the USACE Wetland Determination Data Form (see Appendix 5). The approved Jurisdictional Determination is included in Appendix 5. Project waters are approximately 38 river miles upstream from a Traditional Navigable Water (TNW), the Cape Fear River.

All project streams were classified as perennial using NCDWQ guidance. South Branch and West Branch scored below the NCDWQ 30-point threshold typical of perennial channels due to historical manipulation

but because these channels support numerous aquatic biota including macroinvertebrate, aquatic mollusk, fish, crayfish, and amphibians they were determined to be perennial.

On-site wetlands (Wetlands A – F) are relatively small, ranging in size from 0.01 to 0.08 acres (see Table 7) and are located within maintained agricultural fields (Figure 6). Wetlands A and F exhibited pockets of shallow inundation, saturation within the upper twelve inches of the soil profile, and low chroma soils (10YR 4/2 to 2.5Y 6/2). Vegetation within Wetlands A and F is entirely herbaceous due to cattle grazing activities. Wetlands B and C are small linear depressions in the pasture that are inundated for long periods. These wetlands exhibited inundation of a foot or more, aquatic fauna, saturation within the upper twelve inches of the soil profile, and low chroma soils (10YR 5/1 to 2.5Y 5/2) with distinct mottles (7.5YR 4/6). Due to long term inundation and grazing herbaceous vegetation is primarily only along the edges of these two wetland areas. Wetland D is a mix of herbaceous pasture and grazed woods. Wetland E exhibited shallow inundation, water-stained leaves, and low chroma soils (10YR 5/2) with distinct mottles (10YR 3/4). This wetland is entirely herbaceous due to cattle grazing.

Table 7. Wetland Summary Information

	Wetland A	Wetland B	Wetland C
Size of Wetland (acres)	0.04	0.01	0.08
Wetland Type (non-riparian, riparian riverine, or riparian) non-riverine)	Riparian	Riparian	Riparian
Mapped Soil Series	Nanford-Badin complex	Nanford-Badin complex	Cid-Lignum complex and Georgeville
Drainage Class	Well drained	Well drained	Moderate to well drained
Soil Hydric Series	N/A	N/A	N/A
Source of Hydrology	Groundwater, overbank flooding	Groundwater, overbank flooding	Groundwater, overbank flooding
Hydrologic Impairment	Ditching	N/A	N/A
Native vegetation community	Piedmont Alluvial Forest	Piedmont Alluvial Forest	Piedmont Alluvial Forest
% exotic invasive vegetation	0%	0%	0%

	Wetland D	Wetland E	Wetland F
Size of Wetland (acres)	0.03	0.02	0.005
Wetland Type (non-riparian, riparian riverine, or riparian non-	Riparian	Riparian	Riparian
Mapped Soil Series	Chewacla and Wehadkee	Nanford-Badin complex	Cid-Lignum complex
Drainage Class	Somewhat poorly drained	Well drained	Moderate to well drained
Soil Hydric Series	Chewacla and Wehadkee	N/A	N/A
Source of Hydrology	Groundwater, overbank flooding	Groundwater, overbank flooding	Groundwater, overbank flooding
Hydrologic Impairment	N/A	N/A	N/A
Native vegetation community	Piedmont Alluvial Forest	Piedmont Alluvial Forest	Piedmont Alluvial Forest
% exotic invasive vegetation	0%	0%	0%

5.2 Threatened and Endangered Species

5.2.1 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).

Wildlands utilized the U.S. Fish and Wildlife Service (USFWS) and North Carolina Natural Heritage Program (NHP) databases in order to identify federally listed Threatened and Endangered plant and animal species for Chatham County, NC (USFWS, 2010 and NHP, 2013). Four federally listed species are currently listed in Chatham County (Table 8): red-cockaded woodpecker (Picoides borealis), the bald eagle (Haliaeetus leucocephalus), Cape Fear shiner (Notropis mekistocholas), and harperella (Ptilimnium nodosum). The Categorical Exclusion (included in Appendix 6) has been approved by the Federal Highway Administration.

Table 8. Listed Threatened and Endangered Species in Chatham County, NC

Species	Federal Status	Habitat	Biological Conclusion
Vertebrate			
Red-cockaded woodpecker (*Picoides borealis*)	E	Open stands of mature pines	No effect
Bald eagle (*Haliaeetus leucocephalus*)	BGPA	Near large open water bodies: lakes, marshes, seacoasts, and rivers	No effect

Species	Federal Status	Habitat	Biological Conclusion
Cape Fear shiner (*Notropis mekistocholas*)	E	Pools, riffles, and runs of rocky, clean freshwater streams	No effect
Vascular Plant			
Harperella (*Ptilimnium nodosum*)	E	Rocky or gravely shoals of clear swift-moving streams	No effect

T (S/A) =Threatened due to similarity of appearance, BGPA = Bald and Golden Eagle Protection Act

5.2.2 Threatened and Endangered Species Descriptions

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. Occurrences of the red-cockaded woodpecker are listed as historic within Chatham County.

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 (BGPA). This species is known to occur in every U.S. state except Hawaii.

Cape Fear Shiner

The Cape Fear shiner is a small minnow fish species, typically 6 centimeters in length. This species is pale silvery yellow in color with a black stripe along each side and yellow fins. Water willow beds in flowing areas of creeks and rivers appear to be part of the essential habitat for this species. Individuals can be found in pools, riffles, and slow runs of clean, rocky streams composed of gravel, cobble, and boulder substrates. Critical habitat for this species within Chatham County includes approximately 4.1 miles of the Rocky River from the NC-902 bridge downstream to the County Road 1010 Bridge. Additional critical habitat includes 0.5 mile of Bear Creek from the County Road 2156 bridge downstream to the Rocky River and 4.2 miles downstream within the Rocky River to 2.6 miles of the Deep River.

Harparella

Harperella is an obligate, annual vascular plant ranging in height from 6 to 36 inches. This plant exhibits small white clusters of flowers at the stem tops similar to Queen Anne's lace. This species typically flowers from May until the first frost. Ideal habitat for this species includes pond and riverine areas with gravelly shoals of clear, swift-flowing streams. These areas typically require moderately intensive spring floods to scour gravel bars and rock crevices to remove any competing vegetation. Known population occurrences of harperella have been observed in Chatham County within the past 20 years.

5.2.3 Biological Conclusion

Based on a pedestrian survey of the project area performed August 22, 2013, no individual species, critical habitat, nor suitable habitat was found to exist on the site. It is determined that the proposed restoration and enhancement activities will have "no effect" on the federally listed threatened and endangered species.

5.2.4 USFWS Concurrence

Wildlands requested review and comment from the USFWS on July 24, 2013, regarding the project's potential impacts on threatened or endangered species. USFWS responded on August 29, 2013 and stated that the proposed project is "not likely to adversely affect any federally-listed endangered or threatened species, their formally designated critical habitat, or species currently proposed for listing" and that the requirements of section 7(a)(2) of the Endangered Species Act "have been satisfied" for the project. All correspondence with USFWS is included in Appendix 7.

5.3 Federally Designated Critical Habitat

The USFWS has designated Chatham County as exhibiting critical habitat for the Cape Fear shiner. This Critical Habitat includes approximately 4.1 miles of the Rocky River from the NC-902 Bridge downstream to the County Road 1010 Bridge. Additional critical habitat includes the following three sections of stream: 0.5 miles of Bear Creek from the County Road 2156 Bridge downstream to the confluence with the Rocky River, 4.2 miles downstream of the Rocky River downstream of Bear Creek to where it joins the Deep River, followed by 2.6 miles of the Deep River downstream of the confluence with the Rocky River. These Critical Habitat locations, however, do not fall within the Lacys Creek – Rocky River watershed in which Mud Lick Creek is located.

Clean, rocky streams composed of gravel, cobble, and boulder substrates with water willow beds in the flowing areas of creeks and rivers appear to be part of the essential habitat for this species. The results of the pedestrian survey performed on August 22, 2013 indicate that in-stream habitat exhibits poor conditions for the presence of Cape Fear shiner. No Critical Habitat for the listed species exists within the project areas.

5.4 Cultural Resources

5.4.1 Site Evaluation Methodology

The National Historic Preservation Act (NHPA) of 1966, as 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 that is included in, or is eligible for inclusion in, the National Register of Historic Places.

5.4.2 SHPO/THPO Concurrence

A letter was sent to the North Carolina State Historic Preservation Office (SHPO) on July 24, 2013, requesting review and comment for the potential of cultural resources potentially affected by the Project. SHPO responded on September 3, 2013, and stated they were aware of no historic resources which would be affected by the project. All correspondence with SHPO is included in Appendix 7.

5.5 FEMA Floodplain Compliance and Hydrologic Trespass

The entire length of Mud Lick Creek, North Branch, and East Branch on the project site are within a FEMA Zone AE floodplain on FIRM panel 8764. Mud Lick Creek is a modeled stream. North Branch and East Branch are in the "flood fringe" of Mud Lick Creek but are not modeled. It was confirmed through conversations with the local floodplain administrator that no hydraulic analysis or floodplain development permit is required for the project. The DMS Floodplain Requirements Checklist is included in Appendix 8 and has been submitted to the Chatham County floodplain administrator.

6.0 Reference Sites

6.1 Reference Streams

Reference reaches are used to provide geomorphic parameters of stable streams of similar type in similar landscapes that are used as a source of information to develop design parameters. Four reference reaches were identified near the Site and used to support the design of the proposed restoration and enhancement measures (Figure 7). These reference reaches were chosen because of their similarity to the project streams including drainage area, valley slope, morphology, and bed material. The reference reaches are within the Carolina Slate Belt region of the Piedmont with the exception of UT to Cane Creek. Geomorphic parameters for these reference reaches are summarized in Tables 11a and 11b. DMS will also attempt to find a water quality reference site and measure the physico-chemical parameters in association with the supplementary monitoring described in section 12.

6.2 Channel Morphology and Classification of Reference Streams

Spencer Creek is located in western Montgomery County near the town of Ophir. This site consists of two reaches (Spencer Creek Reach 1 and Reach 2) that classified as E4 stream types situated within a mature forest (Buck Engineering, 2004). Wildlands visited Spencer Creek Reach 1 in March, 2012 and visually confirmed that the land use is unchanged and that the stream is laterally and vertically stable. Wildlands conducted a detailed survey of Spencer Creek Reach 2 in March, 2012. Spencer Creek is an E4 stream type.

The UT to Cane Creek reference is located in northeastern Rutherford County. The dataset was used as a reference stream for the Cane Creek Restoration prepared by Restoration Systems and Axiom Environmental in 2007. The reach is located in mature forest and is classified as a C4/E4 stream type.

The UT to Polecat Creek reference reach is located in northern Randolph County. The site was identified by Wolf Creek Engineering and used as a reference reach for the Holly Grove Restoration Site (Wolf Creek Engineering, 2007). Wildlands conducted a site visit and reference reach survey in March, 2013 to confirm the geomorphic parameters listed on the Holly Grove Restoration Plan. The UT to polecat Creek reference reach is classified as an E4 stream type.

6.3 Reference Streams Vegetation Community Types Descriptions

Restored riparian vegetation communities will be similar to that found along the upstream reaches of Mud Lick Creek that have been fenced off from cattle. The upstream reach is surrounded by mature hardwood forest composed of typical piedmont bottomland riparian forest tree species. Dominant canopy species in this area include green ash, river birch (*Betula nigra*), sycamore, box elder (*Acer negundo*), and red maple.

Table 11a. Summary of Reference Reach Geomorphic Parameters

			UT to Polecat Creek		Spencer Creek 1	
Parameter	**Notation**	**Units**	**min**	**max**	**min**	**max**
stream type			E4		E4	
drainage area	DA	sq mi	0.41		0.96	
bankfull discharge	Q_{bkf}	cfs	20		97	
bankfull cross-sectional area	A_{bkf}	SF	5.4	12.4	17.8	19.7
average bankfull velocity	v_{bkf}	fps	2.2	3.5	4.9	5.4
Cross Section						
width at bankfull	w_{bkf}	feet	5.3	10.9	10.7	11.2
maximum depth at bankfull	d_{max}	feet	1.4	1.7	2.1	2.6
mean depth at bankfull	d_{bkf}	feet	1.0	1.1	1.6	1.8
bankfull width to depth ratio	w_{bkf}/d_{bkf}		5.2	9.6	5.8	7.1
depth ratio	d_{max}/d_{bkf}		1.4	1.7	1.3	1.4
bank height ratio	BHR		1.0	1.1	1.0	
floodprone area width	w_{fpa}	feet	25	65	60	>114
entrenchment ratio	ER		3.2	8.3	5.5	>10.2
Slope						
valley slope	S_{valley}	ft/ft	0.017		0.0109	
channel slope	$S_{channel}$	ft/ft	0.012		0.0047	
Profile						
riffle slope	S_{riffle}	ft/ft	0.004	0.047	0.013	
riffle slope ratio	$S_{riffle}/S_{channel}$		0.3	4	2.8	
pool slope	S_{pool}	ft/ft	0.017		0.0007	0.0009
pool slope ratio	$S_{pool}/S_{channel}$		1.4		0.15	0.19
pool-to-pool spacing	L_{p-p}	feet	34	52	71	
pool spacing ratio	L_{p-p}/w_{bkf}		0.3	3.2	6.3	6.6
pool cross-sectional area at bankfull	A_{pool}	SF	9.3		24.5	
pool area ratio	A_{pool}/A_{bkf}		0.8	1.7	1.2	1.4

			UT to Polecat Creek		Spencer Creek 1	
Parameter	**Notation**	**Units**	**min**	**max**	**min**	**max**
maximum pool depth at bankfull	d_{pool}	feet	1.8		3.3	
pool depth ratio	d_{pool}/d_{bkf}		1.6	1.8	1.8	2.0
pool width at bankfull	w_{pool}	feet	8		17.5	
pool width ratio	w_{pool}/w_{bkf}		0.7	1.5	1.6	
Pattern						
sinuosity	K		1.4		2.3	
belt width	w_{blt}	feet	28	50	38	41
meander width ratio	w_{blt}/w_{bkf}		3.0	5.3	3.4	3.6
linear wavelength	L_m	feet	56	85	46	48
linear wavelength ratio	L_m/w_{bkf}		6.0	9.0	4.1	4.4
meander length		feet	--	--	--	--
meander length ratio			--	--	--	--
radius of curvature	R_c	feet	19	50	11	15
radius of curvature ratio	R_c/ w_{bkf}		2.0	5.3	1.3	1.4

Table 11b. Summary of Reference Reach Geomorphic Parameters

			Spencer Creek 2		UT to Cane Creek	
Parameter	**Notation**	**Units**	**min**	**max**	**min**	**max**
stream type			E4		C4/E4	
drainage area	DA	sq mi	0.37		0.29	
bankfull discharge	Q_{bkf}	cfs	35		40	
bankfull cross-sectional area	A_{bkf}	SF	6.6	8.7	8.9	12.2
average velocity during bankfull event	v_{bkf}	fps	5	5.6	3.8	
Cross-Section						
width at bankfull	w_{bkf}	feet	6.3	9.3	11.5	12.3
maximum depth at bankfull	d_{max}	feet	1	1.2	1.2	1.6

			Spencer Creek 2		UT to Cane Creek	
Parameter	**Notation**	**Units**	**min**	**max**	**min**	**max**
mean depth at bankfull	d_{bkf}	feet	0.8	1.0	0.8	1.0
bankfull width to depth ratio	w_{bkf}/d_{bkf}		7.9	9.3	12.3	14.4
depth ratio	d_{max}/d_{bkf}		1.2	1.3	1.7	
bank height ratio	BHR		1.0	1.0	--	--
floodprone area width	w_{fpa}	feet	14	125	31	
entrenchment ratio	ER		1.7	4.3	>2.5	
Slope						
valley slope	S_{valley}	ft/ft	0.022	0.031	0.0262	
channel slope	$S_{channel}$	ft/ft	0.019	0.022	0.015	
Profile						
riffle slope	S_{riffle}	ft/ft	0.0184	0.0343	0.0188	0.0704
riffle slope ratio	$S_{riffle}/S_{channel}$		1	1.6	1.3	4.7
pool slope	S_{pool}	ft/ft	0.0007	0.014	0.0005	0.0108
pool slope ratio	$S_{pool}/S_{channel}$		0	0.6	0	0.72
pool-to-pool spacing	L_{p-p}	feet	9	46	27	73
pool spacing ratio	L_{p-p}/w_{bkf}		1.4	4.9	2.3	6.1
pool cross-sectional area at bankfull	A_{pool}	SF	6.5	9.8	11.9	
pool area ratio	A_{pool}/A_{bkf}		1	1.1	1	1.3
maximum pool depth at bankfull	d_{pool}	feet	1.2	1.8	2.6	
pool depth ratio	d_{pool}/d_{bkf}		1.5	1.8	1.7	
pool width at bankfull	w_{pool}	feet	6	12	8.5	
pool width ratio	w_{pool}/w_{bkf}		1.0	1.3	0.7	
Pattern						
sinuosity	K		1.0	1.3	1.4	
belt width	w_{blt}	feet	10	50	102	
meander width ratio	w_{blt}/w_{bkf}		1.6	5.4	8.3	8.9

			Spencer Creek 2		UT to Cane Creek	
Parameter	**Notation**	**Units**	**min**	**max**	**min**	**max**
linear wavelength (formerly meander	L_m	feet	55	142	45	81
linear wavelength ratio (formerly meander	L_m/w_{bkf}		8.7	15.3	3.9	6.6
meander length		feet	53	178	--	--
meander length ratio			8.4	19.1	--	--
radius of curvature	R_c	feet	12	85	23	38
radius of curvature ratio	R_c/ w_{bkf}		1.9	9.1	2	3.1

7.0 Determination of Credits

Mitigation credits presented in Table 12 are projections based upon site design. Upon completion of site construction, the project components and credit data will be adjusted, if necessary, to be consistent with the as-built condition.

7.1 Enhancement II Ratio

The proposed ratio for the enhancement II on the project site is 1.5:1 based on the following:

1. The extensive bank stabilization work proposed on Mud Lick Creek is well beyond typical enhancement II treatments. Thirty-eight percent of the channel will be treated with bank repairs. Instream habitat will also be enhanced. Livestock will be fenced out of the easement and a forested buffer will be installed along this reach.

2. Adding constructed riffles to the enhancement II sections of North Branch and East Branch will raise the channel bed and improve bed form in those reaches which is also beyond typical EII practices. Fencing and planting will also be implemented along theses reaches.

7.2 Additional Credits for Supplemental Monitoring

Additional credits are proposed to cover the costs of supplemental monitoring of additional water quality and biological parameters. These data are intended to contribute to a dataset from multiple projects over the ensuing years to help characterize the combinations of site and watershed characteristics that will help:

1. Identify thresholds for detection of improvements in higher functions within the constraints of typical mitigation monitoring timeframes.

2. Calibrate expectations regarding what levels of improvement can be observed in those timeframes for different levels of restoration.

3. Better tailor project goals and success criteria.

Given the investigative nature of these data, these parameters will not be used in determination of mitigation success and associated crediting; rather credits will be issued in an amount proportional to the actual monitoring costs, not to exceed 10% of the credit yield. However, the pre-con monitoring will inform the parameters that are ultimately measured and result in refinements to the monitoring plan accordingly. In the event storm samples of sufficient number prior to construction cannot be obtained, the entire supplemental monitoring effort will be evaluated. In the event circumstances dictate scaling back or eliminating the supplemental monitoring then the associated credits will not be sought. These credits will be released at the end of the monitoring period upon completion of a data summary and a short report. The report will summarize the results and describe what was learned regarding items 1 - 3 above in this section for projects with site and watershed characteristics in the range of those observed for the Mud Lick Creek project. A more detailed discussion of the proposed monitoring plan can be found in section 12.

Table 12. Determination of Credits

Mitigation Credits									
	Stream		Riparian Wetland		Non-riparian Wetland		Buffer	Nitrogen Nutrient Offset	Phosphorus Nutrient Offset
Type	R	RE	R	RE	R	RE			
Totals	2,938	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Project Components								
Project Component or Reach ID	Existing Footage / Acreage	Proposed Stationing/Location	Approach (P1, P2, etc.)	Restoration (R) or Restoration Equivalent (RE)	Restoration Level	Restoration Footage or Acreage	Mitigation Ratio	Proposed Credit
North Branch R1	327	100+00 to 103+27	Planting, fencing	R	EII	327	1.5:1	218
North Branch R1	297	103+27 to 108+47	P1	R	R	520	1:1	520
North Branch R2	577	108+47 to 111+50	P2	R	R	303	1:1	303
East Branch	168	200+00 to 201+68	Planting, fencing	R	EII	168	1.5:1	112
East Branch	317	201+68 to 205+77	P2	R	R	409	1:1	409
Mud Lick Creek R1	623	300+00 to 306+23	Planting, fencing, bank repairs	R	EII	623	1.5:1	415.3
Mud Lick Creek R2	693	306+23 to 313+16	Planting, fencing, bank repairs	R	EII	693	1.5:1	462
Mud Lick Creek R3	748	313+16 to 320+64	Planting, fencing, bank repairs	R	EII	748	1.5:1	498.7

Component Summation					
Restoration Level	Stream (linear feet)	Riparian Wetland (acres)	Non-Riparian Wetland (acres)	Buffer (square feet)	Upland (acres)
Restoration	1,232	N/A	N/A	N/A	N/A
Enhancement	N/A	N/A	N/A	N/A	N/A
Enhancement I	N/A	N/A	N/A	N/A	N/A
Enhancement II	2,559	N/A	N/A	N/A	N/A
Creation	N/A	N/A	N/A	N/A	N/A
Preservation	N/A	N/A	N/A	N/A	N/A

8.0 Credit Release Schedule

All credit releases will be based on the total credit generated as reported by the as-built survey of the mitigation site. Under no circumstances shall any mitigation project be debited until the necessary DA authorization has been received for its construction or the District Engineer (DE) has otherwise provided written approval for the project in the case where no DA authorization is required for construction of the mitigation project. The DE, in consultation with the Interagency Review Team (IRT), will determine if performance standards have been satisfied sufficiently to meet the requirements of the release schedules below. In cases where some performance standards have not been met, credits may still be released depending on the specifics of the case. Monitoring may be required to restart or be extended, depending on the extent to which the site fails to meet the specified performance standard. The release of project credits will be subject to the criteria described as follows:

Table 13. Credit Release Schedule – Stream Credits

Monitoring Year	Credit Release Activity	Interim Release	Total Released
0	Initial Allocation – see requirements below	30%	30%
1	First year monitoring report demonstrates performance standards are being met	10%	40%
2	Second year monitoring report demonstrates performance standards are being met	10%	50% (60%*)
3	Third year monitoring report demonstrates performance standards are being met	10%	60 (70%*)
4	Fourth year monitoring report demonstrates performance standards are being met	5%	65% (75%*)
5	Fifth year monitoring report demonstrates performance standards are being met	10%	75% (85%*)
6	Sixth year monitoring report demonstrates performance standards are being met	5%	80% (90%)
7	Seventh year monitoring report demonstrates performance standards are being met and the project has received closeout approval	10%	90% (100%)

Monitoring Year	Credit Release Activity	Interim Release	Total Released
8	Supplementary monitoring described in section 12 upon completion of associated closeout report attachment (Not to exceed 10%).	TBD	-

**Numbers reported without parenthesis account for the 10% of credits that are withheld until two bankfull events have occurred.*

8.1 Initial Allocation of Released Credits

The initial allocation of released credits, as specified in the mitigation plan can be released by the DMS without prior written approval of the DE upon satisfactory completion of the following activities:

a. Approval of the final Mitigation Plan
b. Recordation of the preservation mechanism, as well as a title opinion acceptable to the USACE covering the property
c. Completion of project construction (the initial physical and biological improvements to the mitigation site) pursuant to the mitigation plan; Per the DMS Instrument, construction means that a mitigation site has been constructed in its entirety, to include planting, and an as-built report has been produced. As-built reports must be sealed by an engineer prior to project closeout, if appropriate but not prior to the initial allocation of released credits.
d. Receipt of necessary DA permit authorization or written DA approval for projects where DA permit issuance is not required.

8.2 Subsequent Credit Releases

All subsequent credit releases must be approved by the DE, in consultation with the IRT, based on a determination that required performance standards have been achieved. For stream projects a reserve of 10% of a site's total stream credits shall be released after two bank-full events have occurred, in separate years, provided the channel is stable and all other performance standards are met. In the event that less than two bank-full events occur during the monitoring period, release of these reserve credits shall be at the discretion of the IRT. As projects approach milestones associated with credit release, the DMS will submit a request for credit release to the DE along with documentation substantiating achievement of criteria required for release to occur. This documentation will be included with the annual monitoring report. Upon completion of the final item in table 12, the credits indicated will be released upon submission of a closeout monitoring report attachment. It will summarize the supplementary monitoring data described in section 12.4 and any inferences which can be made about the ability to detect uplift in water quality support functions for projects with site and watershed characteristics within the range of Mud Lick Creek.

9.0 Project Site Mitigation Plan

9.1 Justification for Proposed Intervention

The primary goals and objectives of the proposed project described in Section 1.0 are all part of improving the ecological function of the project site. This site provides an excellent opportunity to alleviate stressors identified in the Upper Rocky River local watershed plan. The existing conditions assessments demonstrate that the streams on the property have been degraded due to livestock access, removal of

riparian vegetation, and, in the case of East Branch, channelization and relocation. The bedforms of the channels are highly degraded due to trampling by cattle, fining of the bed material due to bank erosion, mass wasting of bank material, and growth of macrophytes on the streambed. The stream banks have been trampled and there is active fluvial erosion that is quite severe along some portions of the project. The riparian vegetation has largely been removed and Chinese privet has been allowed to grow up along portions of the streams. However, only East Branch shows significant indications of past channelization and relocation. Though North Branch and East Branch are severely incised and over-enlarged, most of Mud Lick Creek on the site is only slightly incised.

Intervention is needed to rectify these problems; however, full restoration of all of the project reaches is not necessary in this case. Wildlands proposes to use minimal intervention to reestablish functional stream and riparian ecosystems and protect them from future damage. Stream enhancement techniques will be used in cases where most appropriate. Enhancement reaches include all of Mud Lick Creek, which is only slightly incised and has a natural, sinuous pattern and the upstream ends of both North Branch and East Branch. Full restoration is proposed for the downstream portions of North Branch and East Branch where incision is greater and, in the case of East Branch, where past channelization is apparent.

9.2 Stream Restoration and Enhancement Design Overview

The project consists of stream restoration and enhancement (Figure 8). All three reaches of Mud Lick Creek (Sta. 300+00 to 320+64) and the upstream ends of both North Branch (Sta. 100+00 to 103+27) and East Branch (Sta. 200+00 to 201+89) will be treated as enhancement II. The enhancement II designs include replanting riparian buffers, fencing out of livestock, and bank stabilization in specific locations. The designs for portions of North Branch (Sta. 103+27 to 108+47) and East Branch (Sta. 201+89 to 205+77) are a combination of Priority 1 and Priority 2 stream restoration. The stream restoration includes of full redesign of the stream channels with natural channel design techniques. A more complete description of the enhancement II and restoration components of the project are described below in Section 9.6.

9.3 Design Bankfull Discharge Analysis

Multiple methods were used to develop bankfull discharges estimates for each of the project restoration reaches. The resulting values were compared and concurrence between the estimates and best professional judgment were used to determine the specific design discharge for each restoration reach. The methods to estimate discharge are described below and the results are summarized in Table 14 and on Figure 9.

9.3.1 NC Rural Piedmont Regional Curve Predictions

The published NC rural Piedmont curve (Harman et al., 1999) was used to estimate discharge based on drainage area.

9.3.2 Provisional Updated NC Piedmont/Mountain Regional Curve Predictions

Design discharges using the draft updated curve for rural Piedmont and mountain streams (Walker, unpublished) were estimated based on drainage area.

9.3.3 Drainage Area-Discharge Relationships from Reference Reaches

Four reference reaches were identified for this project. Each reference reach was surveyed to develop information for analyzing drainage area-discharge relationships as well as development of design

parameters. Stable cross-sectional dimensions and channel slopes were used to compute a bankfull discharge with Manning's equation for each reference reach. The resulting discharge values were plotted with drainage area and compared to the regional curve datasets described in Sections 9.3.1 and 9.3.2 (Figure 9).

9.3.4 Regional Flood Frequency Analysis

Four USGS stream gage sites were identified within reasonable proximity of the project site for use in development of a project specific regional flood frequency analysis as described by Dalrymple (1960). The gages used were:

- 02123567 – Dutchman's Creek near Uwharrie, NC (drainage area 3.44 square miles);
- 0212467595 – Goose Creek near Indian Trail, NC (drainage area 11 square miles);
- 0210166029 – Rocky River near Crutchfield Crossroads, NC (drainage area 7.42 square miles);
- 02096846 – Cane Creek near Orange Grove, NC (drainage area 7.54 square miles).

Flood frequency curves were developed for the 1.2 year and 1.5 year recurrence interval discharges. These relationships can be used to estimate discharge of those recurrence intervals for ungauged streams in the same hydrologic region and were solved for discharge with the drainage area for each project reach as the input.

9.3.5 USGS Flood Frequency Equations for Rural Watersheds in North Carolina

USGS flood frequency equations for rural watersheds in North Carolina (Weaver et al., 2009) were used to estimate peak discharges for each reach for floods with a recurrence interval of two years.

Table 14. Design Bankfull Discharge Analysis Summary

Discharge Estimate Analysis	Parameter	North Branch R1	North Branch R2	East Branch
Drainage Area	(sq. mi.)	0.37	0.65	0.27
USGS rural flood frequency 2-year discharge (Weaver et al., 2009)	2-yr Discharge	83	120	68
Piedmont Regional Curve (Harman et al., 1999)	Bankfull Discharge	43	65	35
Piedmont/Mountain Regional Curve (Walker, unpublished)	Bankfull Discharge	25	40	20
Regional Flood Frequency Analysis	1.2-yr Discharge	18	33	13
	1.5-yr Discharge	24	43	18
Reference Reach Curve	Bankfull Discharge	37	57	29
Final Design Q	Bankfull Discharge	**35**	**67**	**32**

9.4 Design Channel Morphologic Parameters

Design parameters were developed for the restoration reaches based on the design bankfull discharge, the dimensionless ratios from the reference reach data, and professional judgment of the designers. The restoration reaches were designed to be similar to type C streams according to the Rosgen classification system (Rosgen, 1996). Type C streams are slightly entrenched, meandering streams with access to the floodplain (entrenchment ratios >2.2) and channel slopes of 2% or less. They occur within a wide range of valley types and are appropriate for the project landscape. The design morphologic parameters are shown in Table 15.

Table 15. Design Morphologic Parameters

	Notation	Units	North Branch - Reach 1		North Branch - Reach 2		East Branch	
			Min	Max	Min	Max	Min	Max
stream type			C4		C4		C4	
drainage area	DA	sq mi	0.37		0.65		0.27	
design discharge	Q	cfs	35.0		67.0		32.0	
bankfull cross-sectional area	A_{bkf}	SF	14.4		16.3		9.7	
average velocity during bankfull event	v_{bkf}	fps	2.4		4.3		3.3	
Cross-Section								
width at bankfull	w_{bkf}	feet	13.8		14.0		11.0	
maximum depth at bankfull	d_{max}	feet	1.3	1.8	1.4	2.0	0.9	1.5
mean depth at bankfull	d_{bkf}	feet	1.0		1.2		0.9	
bankfull width to depth ratio	w_{bkf}/d_{bkf}		13.0		12.0		12.4	
depth ratio		feet	1.2	1.7	1.2	1.7	1.2	1.7
bank height ratio	BHR		1.0	1.0	1.0	1.0	1.0	1.0
floodprone area width	w_{fpa}	feet	30	69	31	70	24	55
entrenchment ratio	ER		2.2	5.0	2.2	5.0	2.2	5.0
Slope								
valley slope	S_{valley}	feet/ foot	0.0048		0.0076		0.0098	
channel slope	S_{chnl}	feet/ foot	0.0100	0.0100	0.0050	0.0050	0.0130	0.0130
Profile								
riffle slope	S_{riffle}	feet/ foot	0.0120	0.0340	0.0060	0.0170	0.0156	0.0442
riffle slope ratio	S_{riffle}/S_{chnl}		1.2	3.4	1.2	3.4	1.2	3.4
pool slope	S_p	feet/ foot	0.0000	0.0040	0.0000	0.0020	0.0000	0.0052
pool slope ratio	S_p/S_{chnl}		0.00	0.40	0.00	0.40	0.00	0.40
pool-to-pool spacing	L_{p-p}	feet	19	91	20	92	15	73
pool spacing ratio	L_{p-p}/w_{bkf}		1.4	6.6	1.4	6.6	1.4	6.6
pool cross-sectional area		SF	16.6	28.9	17.9	32.6	9.8	20.0

	Notation	Units	North Branch - Reach 1		North Branch - Reach 2		East Branch	
			Min	Max	Min	Max	Min	Max
pool area ratio			1.2	2.0	1.1	2.0	1.1	2.0
maximum pool depth		feet	1.3	3.1	1.4	4.7	1.0	3.5
pool depth ratio			1.2	3.0	1.2	4.0	1.2	4.0
pool width at bankfull		feet	13.8	22.1	14.0	22.4	11.0	17.6
pool width ratio			1.0	1.6	1.0	1..6	1.0	1.6
Pattern								
sinuosity	K		1.20	1.30	1.20	1.30	1.20	1.30
belt width	w_{blt}	feet	41	123	42	125	22	98
meander width ratio	w_{blt}/w_{bkf}		3.0	8.9	3.0	8.9	2.0	8.9
linear wavelength (formerly meander length)	L_m	feet	41	207	42	210	30	165
linear wavelength ratio (formerly meander length ratio)	L_m/w_{bkf}		3.0	15.0	3.0	15.0	3.0	15.0
meander length		feet	41	166	42	168	33	132
meander length ratio			3.0	12.0	3.0	15.0	3.0	12.0
radius of curvature	R_c	feet	25	41	25	42	20	33
radius of curvature ratio	R_c/ w_{bkf}		1.8	3.0	1.8	3.0	1.8	3.0

9.5 Sediment Transport Analysis

A sediment transport analysis was performed for the restoration reaches. For gravel bed channels, it is important to analyze both sediment transport competence and capacity and both were analyzed for this project. HEC-RAS models were developed for the existing and proposed conditions of each restoration reach in order to perform the sediment transport calculations.

As an initial step in the sediment transport analysis, Wildlands performed an assessment of the existing watershed and stream channels as well as a determination of expected changes to the watershed during the life of the project. This is necessary to qualitatively understand the sediment supply for the design reaches and to determine what level of transport analysis is needed to properly design the system. In unstable or rapidly changing watersheds or for streams with visual signs of high bedload supply, detailed analysis including field data collection may be necessary to ensure a proper design. A watershed assessment was conducted for this project as described in Sections 4.1 and 4.2 of this document. Historical land use changes within the watershed were analyzed through aerial photo review, the existing conditions were evaluated on the ground, and future land use changes were determined to be minor based on historical trends and the rural character of the surrounding area. The watershed was therefore determined to be stable and is expected to remain stable for the foreseeable future. In addition, the existing stream channels on the project site do not show signs of significant deposition or aggradation. This assessment indicates that the Mud Lick Creek system has a relatively low bedload supply and, therefore, no bedload monitoring was performed. The competence and capacity analyses are described below.

9.5.1 Competence Analysis

A competence analysis was performed for each of the design reaches by comparing shear stresses along the channel at the design bankfull discharge with the size distribution of the bed material. The proposed conditions HEC-RAS model for each restoration reach was used to generate bankfull shear stresses at cross sections throughout each restoration reach. These shear stresses were compared with the critical shear stresses obtained from the revised Shields Diagram (Rosgen, 2013), shown in Table 16, to provide a rough estimate of the degree to which shear stress in the proposed stream will be able to move the bed material. The results in Table 16 indicate that the proposed North Branch channel will have enough shear stress to move both the D_{50} and D_{100} particle sizes and that East Branch will have enough shear stress to move the D_{50} but not enough to move the D_{100}. These results indicate that the existing bed material sizes (which are not expected to change significantly after construction) will be entrained at higher flows and that channel aggradation will not become a problem. Grade control will also be installed in both streams to prevent incision (see Section 9.6). It should be noted that, although the upstream sediment supply is not expected to change as described above, fine bed materials from fluvial erosion and trampling of the banks will be reduced after construction resulting in some coarsening of bed materials. This will not result in changes of larger sized particles.

Table 16. Competence Analysis Results

Stream	Avg. Boundary Shear Stress (lb/ft^2)	Shear Stress Required to Move D_{50} (lb/ft^2)	Shear Stress Required to Move D_{100} (lb/ft^2)
North Branch	0.5	0.0075	0.5
East Branch	0.4	0.15	0.9

9.5.2 Capacity Analysis

Based on the watershed assessment described above, the project streams currently appear to be supply limited, or in other words, have at least enough capacity to transport the sediment loads supplied to them. In addition, the sediment loads are not expected to change significantly in the future. In this case, an appropriate transport capacity analysis is to compare the capacity of the existing channels to that of the proposed. If the proposed channels have similar or greater capacity to move sediment supply as the existing channels, they will not be expected to aggrade. Excess capacity that might cause incision can be controlled by grade control structures.

This analysis was done with the sediment transport capacity module of HEC-RAS. HEC-RAS models were built for existing and proposed conditions of both design reaches. The sediment transport capacity module uses the hydraulic models along with bed material data to estimate capacity. Various capacity equations can be used to analyze a stream reach but should be carefully selected with consideration of channel size and slope, bed material size ranges, channel velocities, and other variables. For this analysis, the Meyer-Peter-Muller equation was used to calculate an average capacity value each existing and proposed model. For information on this and other equations please consult the HEC-RAS user's manual (HEC, 2010). These average results for each existing reach and the proposed reach are shown in Table 17.

Table 17. Capacity Analysis Results

Reach	Existing Capacity (tons/day)	Proposed Capacity (tons/day)
North Branch	25.2	37.4
East Branch	344.2	150.4

The results in Table 17 indicate that the sediment transport capacity for North Branch will increase significantly when the proposed design is implemented. These results indicate that aggradation is not a likely problem and any excess stream power will be controlled through grade control to reduce the potential for bed degradation. Grade control structures are described in Section 9.6. However, the results indicate that the capacity of East Branch will be significantly reduced, primarily due to an increase in channel length and corresponding decrease in slope and channel velocities (which are quite high in the existing condition). This would be a concern if there were indications that the bedload supply to the stream was high. But, in this case, assessments of the channel and watershed do not indicate a high bedload system and the existing condition likely has excess capacity. East Branch above the project site is surrounded by a mature buffer for approximately 2,000 feet and the stream is impounded above that. There is no reason to believe that a disturbance in the East Branch watershed that would increase the sediment yield is likely in the foreseeable future. In this case, the reduction of the very high channel capacity will be a positive change and will create a more stable condition. The proposed designs of both streams are expected to remain stable.

9.6 Project Implementation

9.6.1 Grading and Installation of Structures

Mud Lick Creek and the upstream portions of North Branch and East Branch will be improved through enhancement II techniques. Treatments for these areas will include replanting the riparian buffer with native tree species, fencing out livestock, and treatment of invasive species. On Mud Lick Creek an additional component of the design will be repair of actively eroding banks in specific locations where needed. Constructed riffles will be added to the beds of downstream ends of enhancement II reaches on North Branch and East Branch in order to tie into raised bed elevations of the restoration sections of these streams. There will be no alterations to floodplain grades or to the streambed on Mud Lick Creek. Channel dimensions will not be altered for these sections of stream.

The majority of North Branch and East Branch will be stream restoration. Beginning at the downstream ends of enhancement II sections on each of these two streams, new channels will be constructed (mostly offline). The channels will be reconstructed as a combination of Priority 1 and Priority 2 restoration. The new North Branch channel will then tie back into a similar location and elevation on Mud Lick Creek. East Branch will tie into a new elevation and location on North Branch. The beds of the channels will be raised so that the floodplains are inundated during flow events larger than the design bankfull discharge. The cross-sectional dimensions of the channels will be reconstructed to the appropriate dimensions. The streambeds will be composed of alternating riffle-pool sequences. The channel banks will be reconstructed with stable side slopes, and matted and planted with native vegetation for long-term stability. Brush toe and root wad revetments built from on-site materials will be used to protect banks. The sinuous planform of the channel will be built to mimic a natural Piedmont stream.

Instream structures will primarily include constructed riffles, angled log sills, and log vanes. Several types of constructed riffles will be utilized in the restoration reaches to establish a varied flow pattern, habitat, and grade control while providing a source of carbon for nutrient cycling. Native rock of various sizes (cobble, gravel, and fines) harvested from the site will be utilized as much as possible to create these riffles. Types of riffles proposed for this site include:

- Woody riffles with brush and logs compacted into the bed of native rock to increase woody material in the channel.
- Chunky riffles with larger (small boulder) rock embedded throughout the length of the native rock riffle to provide additional habitat as well as grade control.
- Log roll riffles to increase woody material and meander the thalweg.

Heterogeneity and complexity of materials and form will be stressed on all constructed riffles. In longer riffle sections, micropools and pocket water will be established along their length to provide diversity of habitat and more accurately mimic the appearance and function of natural systems.

9.6.2 Riparian Planting

As a final stage of construction, riparian buffers of restoration and enhancement reaches will be planted with native trees. The natural community immediately upstream of the project easement can be classified as Piedmont bottomland forest (Schafale and Weakley, 1990). The species to be planted were selected based on this community type, observations of the occurrence of species in the upstream forest, and best professional judgment on species establishment and anticipated site conditions in the early years following project implementation. The riparian buffers areas will be planted with bare root seedlings. In addition, the stream banks will be planted with live stakes and the channel toe will be planted with plugs of *juncus effusus*. Permanent herbaceous seed will be placed on stream banks, floodplain areas, and all disturbed areas within the project easement. Proposed plant species are shown in the plan set.

To help ensure tree growth and survival, soil amendments will be added to areas of floodplain cut along North Branch and East Branch. Topsoil will be stockpiled, reapplied, and disked. In addition, soil tests will be performed in areas of cut and fertilizer and lime will be applied based on the results of the soils test to encourage growth of hardwood tree species.

Species planted as bare roots will be spaced at an initial density of 605 plants per acre based on 12 feet by 6 feet spacing (targeted densities after monitoring year 3 are 320 woody stems per acre). 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.

10.0 Maintenance Plan

DMS shall monitor the site on a regular basis and shall conduct a physical inspection of the site 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 components listed in Table 18.

Table 18. Maintenance Plan Components

Component / Feature	Maintenance Through Project Close-Out
Stream	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 stormwater 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 plant community. 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.
Ford Crossing	Ford crossings within the site may be maintained only as allowed by Conservation Easement or existing easement, deed restrictions, rights-of-way, or corridor agreements.
Road Crossing	Road crossings within the site may be maintained only as allowed by Conservation Easement or existing easement, deed restrictions, rights-of-way, or corridor agreements.
Beaver Management	If beaver dams are observed on site, DMS will remove the dams and attempt to remove the beavers from the site.

11.0 Performance Standards

The stream restoration performance criteria for the project site will follow approved performance criteria presented in the DMS Mitigation Plan Template (6/08/2012), the DMS Annual Monitoring and Closeout Template (2/2014), and the Stream Mitigation Guidelines issued in April 2003 by the USACE and NCDWR. DMS will oversee annual monitoring of channel stability and vegetation to assess the condition of the finished project for seven years, or until success criteria are met. Stream and vegetation success criteria are described in more detail below.

11.1 Streams

11.1.1 Dimension

Riffle cross-sections on the restoration reaches and enhancement II reaches where bank re-grading will be done (three reaches of Mud Lick Creek) should be stable and should show little change in bankfull area, maximum depth ratio, and width-to-depth ratio. Bank height ratios shall not exceed 1.2 and entrenchment ratios shall be at least 2.2 for restored channels to be considered stable. All riffle cross-sections should fall within the parameters defined for channels of the appropriate stream type. 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.

11.1.2 Pattern and Profile

The as-built survey will include a longitudinal profile for the baseline monitoring report. 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.

11.1.3 Substrate

Substrate materials in the restoration reaches should indicate a progression towards or the maintenance of coarser materials in the riffle features and smaller particles in the pool features.

11.1.4 Bankfull Events

Two bankfull flow events must be documented on the restoration reaches and enhancement II reaches where bank re-grading will be done (three reaches of Mud Lick Creek) 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. Refer to Section 8.2 for discussion of credits held in reserve until 2 bankfull events are documented.

11.1.5 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.

11.2 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 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. 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 with written approval 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 (seven years).

11.3 Visual Assessments

Visual assessments should support the specific performance standards for each metric as described above.

12.0 Monitoring Plan

Annual monitoring data will be reported using the DMS Monitoring Report Template (2/2014). The monitoring report shall provide a project data chronology that will facilitate an understanding of project status and trends, population of DMS databases for analysis, and assist in decision making regarding close-out. The monitoring period will extend seven years beyond completion of construction or until performance criteria have been met. All survey will be tied to grid.

12.1 Regulatory Monitoring Parameters for Mitigation Success

Following the DMS As-Built Baseline Monitoring Plan Template (2/2014), a baseline monitoring document and as-built record drawings of the project will be developed within 60 days of the planting completion and monitoring installation on the restored site. As-built drawings will follow the DMS Format, Data Requirements, and Content Guidance for Digital Drawings Submitted to DMS (version 2.0, 09/2014). Monitoring reports will be prepared in the fall of each year of monitoring and submitted to DMS. These reports will be based on the DMS Monitoring Report Template (2/2014). The monitoring period will extend seven years beyond completion of construction or until performance criteria have been met per the criteria stated in DMS Monitoring Requirements and Performance Standards for Stream and/or Wetland Mitigation and the Stream Mitigation Guidelines issued in April 2003 by the USACE and NCDWQ. Project monitoring requirements are listed in more detail in Tables 19 and locations are shown on Figure 10.

Table 19. Monitoring Requirements

Parameter	Monitoring Feature	Quantity/ Length by Reach						Frequency	Notes
		Mud Lick Creek R1	Mud Lick Creek R2	Mud Lick Creek R3	North Branch R1	North Branch R2	East Branch		
Dimension	Riffle Cross Sections	1	1	1	1	1	1	Annual	1
	Pool Cross Section	N/A	N/A	N/A	1	1	1		
Pattern	Pattern	N/A	N/A	N/A	N/A	N/A	N/A	n/a	2
Profile	Longitudinal Profile	N/A	N/A	N/A	N/A	N/A	N/A	n/a	
Substrate	Reach wide (RW), Riffle (RF) 100 pebble	N/A	N/A	N/A	1 RW, 1 RF	1 RW, 1 RF	1 RW, 1 RF	Annual	

Parameter	Monitoring Feature	Quantity/ Length by Reach						Frequency	Notes
		Mud Lick Creek R1	Mud Lick Creek R2	Mud Lick Creek R3	North Branch R1	North Branch R2	East Branch		
Hydrology	Crest Gage	1			1		1	Annual	3
Vegetation	Vegetation Plots	12						Annual	
Visual Assessment	All Streams	Y	Y	Y	Y	Y	Y	Bi-annual	
Exotic and nuisance vegetation								Annual	4
Project Boundary								Annual	5
Reference Photos	Photos	19						Annual	6

Notes:

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. The number of cross-sections proposed was established using 1 cross-section per 20 bankfull widths.
2. Entire profile will be surveyed during the as-built for all project streams.
3. One crest gage will be installed along each stream. Where there is more than one approach applied to a reach, the crest gage will be installed in a central location to capture bankfull events for both design approaches. Device will be inspected quarterly or semi-annually, evidence of bankfull will be documented with a photo.
4. Locations of exotic and nuisance vegetation will be recorded using a GPS and mapped.
5. Locations of fence damage, vegetation damage, boundary encroachments, etc. will be recorded using a GPS and mapped.
6. Markers will be established and recorded using a GPS so that the same locations and view directions on the site are monitored.

12.2 Streams

12.2.1 Dimension

In order to monitor the channel dimension, permanent cross-sections will be installed along riffle and pool sections in proportion to DMS guidance. One permanent cross-section will be installed per 20 bankfull channel widths along the restored streams and enhancement II reaches where bank re-grading will be done (three reaches on Mud Lick Creek). Each cross-section will be permanently marked with pins to establish its location. Cross-section surveys will include points measured at all breaks in slope, including top of bank, bankfull, edge of water, and thalweg. Cross-sections will be surveyed annually for the seven year monitoring period.

12.2.2 Bank Pins – Rates of Lateral Migration

In order to try and evaluate the current rates of erosion and the difference in lateral bank erosion between restoration and enhancement reaches, six cross sections will be monitored for approximately one year prior to construction in order to observe any response after exposure to flows capable of doing geomorphologic work. Similar measurements will take place as part of the post-construction monitoring period. The cross sections monitored will include the following locations:

a. Two locations on Mud Lick Creek within the project limits

b. One location on Mud Lick Creek upstream of the project limits
c. Two locations on North Branch
d. One location on East Branch

For the pre-construction monitoring, the locations chosen shall include an array with sufficient lateral and vertical coverage to represent the variability of apparent erosion rates.

Bank and toe pins will be installed at each cross section. A rain gauge will be set up on the site and one stage monitoring station (a pressure transducer installed on the stream bed) will be established on Mud Lick Creek. A bank profile will be surveyed at each location at the time of the installation of the bank and toe pins. The profile will be resurveyed approximately one year after installation or after at least 2 events of geomorphological significance (whichever comes first), so that an annual erosion rate can be determined. The bank pins will be monitored quarterly for one year after installation. The stage monitoring station will be downloaded at the time of each bank pin measurement. Erosion indicated by pin measurements will be compared to the stage record for the quarter to relate the erosion rates to high flows. The rain gauge data will be used to determine if precipitation levels are above, at, or below normal during the pre- and post-construction monitoring period

After construction, lateral erosion rates will be monitored by cross-section dimension surveys (Section 12.2.1). If areas of erosion develop during the post-construction monitoring period, bank pins will be installed and monitored similar to the pre-construction program described above to characterize the range of rates.

12.2.3 Pattern and Profile

The as-built survey will include a longitudinal profile for the baseline monitoring report. 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. If a longitudinal profile is deemed necessary, monitoring will follow standards as described in the DMS Monitoring Report Template (2/2014) and the 2003 USACE and NCDWQ Stream Mitigation Guidance for the necessary reaches.

12.2.4 Substrate

A reach-wide pebble count will be performed in each restoration reach (North Branch Reaches 1 and 2 and East Branch) each year for classification purposes. A pebble count will be performed at each surveyed riffle to characterize the bed material during the years of the cross section survey.

12.2.5 Bankfull Events

Bankfull events will be documented using a crest gage, photographs, and visual assessments such as debris lines. Three crest gages will be installed: one on Mud Lick Creek (for information purposes only), one on North Branch, and one on East Branch. The crest gages will be installed within a riffle cross-section of the restored channels in surveyed riffle cross-sections. The gages will be checked at each site visit to determine if a bankfull event has occurred. Photographs will be used to document the occurrence of debris lines and sediment deposition.

12.2.6 Photo Documentation

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

Longitudinal reference photos will be established at the tail of riffles approximately every 200 LF along the channel by taking a photo looking upstream and downstream. Cross-sectional photos will be taken of each permanent cross-section looking upstream and downstream. Reference photos will also be taken for each of the vegetation plots. Representative digital photos of each permanent photo point, cross-section and vegetation plot will be taken on the same day of the stream and vegetation assessments are conducted. The photographer will make every effort to consistently maintain the same area in each photo over time.

12.2.7 Vegetation

Vegetation monitoring plots will be installed and evaluated within the restoration and enhancement areas to measure the survival of the planted trees and track the occurrence of volunteer species as well. Vegetation plots will be established for repeat survey.

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 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.

12.3 Visual Assessments

Visual assessments will be performed along all streams on a bi-annual basis during the seven year monitoring period. Problem areas will be noted such as channel instability (i.e. lateral and/or vertical instability, in-stream structure failure/instability and/or piping, headcuts), vegetated buffer health (i.e. low stem density, vegetation mortality, invasive species or encroachment), beaver activity, or livestock access. Areas of concern will be mapped and photographed accompanied by a written description in the annual report. Problem areas will be re-evaluated during each subsequent visual assessment. Should remedial actions be required, recommendations will be provided in the annual monitoring report. A habitat assessment along each restoration and enhancement reach will also be conducted at the time of the visual assessments to document project uplift.

12.4 Supplementary Monitoring

These parameters are being monitored for analytical purposes and are not tied to mitigation success and associated credit releases. See section 7.0 for crediting information.

12.4.1 Justification and Objectives

As this site is an active cattle pasture, water quality is a concern. DMS seeks to monitor parameters that will characterize improvements in higher functions. Higher system functions refer to the processes that contribute to the regulation of the physico-chemical parameters that characterize water quality and in turn support biological communities. Using the terminology of the Functional Pyramid system these would be represented by functional levels 4 and 5 (Harman et. al. 2012). The challenges to developing appropriate project goals and performance criteria when attempting to characterize improvement in higher system functions relates to the uncertainties surrounding the following:

- The thresholds for detection of improvements in higher functions are dependent upon various combinations of site and watershed characteristics. Examples include:
    a. The proportion of the drainage or drainage network encompassed by the project
    b. The degree of impairment within the project compared to that of the contributing drainage
    c. The restoration treatments implemented
    d. The timeframe available for monitoring/evaluation
    e. Expected biomass of the buffer relative to the size of the channel within that timeframe.
- The sources of variability in parameters and their measurement and the number of measurements needed for reliable characterization of their distributions.

The uncertainties described above can limit practitioners in terms of assessing restoration potential and optimizing the level of intervention. Assuming an adequate baseline inclusive of storm flows can be obtained, DMS is proposing to monitor additional parameters to help characterize the functional lift at these levels, to see if they are detectable, and to help understand the degree of uplift that occurs within the monitoring timeframe from the treatments applied at Mud Lick Creek. These data are intended to contribute to a dataset from multiple projects over the ensuing years to help characterize the combinations of site and watershed characteristics that will help:

- Identify thresholds for detection of improvements in higher functions within the constraints of typical mitigation monitoring timeframes.
- Calibrate expectations regarding what levels of improvement can be observed in those timeframes for different levels of restoration.
- Better tailor project goals and success criteria.

12.4.2 Supplementary Monitoring Plan

The supplementary monitoring and assessment plan will include the parameters as indicated in Table 20 below at the station locations in Figure 10. The locations above the project on Mud Lick and North Branch will serve as watershed control points to provide a watershed water quality context to the variations in results from sampling points within the project extent. These measurements will be taken into account when assessing the measurements observed from within the project extent.

Table 20. Parameters and Sampling Frequency by Station

Site	Parameters	Phys-Chem Baseflow Samples Per Interval	Phys-Chem Stormflow Samples Per Interval	Macro-benthos Samplings per Interval	Fish Samplings per Interval	Measurement Interval/Year
1_MLWC	PC,M,F	4	4	1	1	Pre, 4,7
2_MLUP	PC,M,F	4	4	1	1	Pre, 4,7
3_MLDN	PC,M,F	4	4	1	1	Pre, 4,7
4_NBWC	PC,M	4	4	1		Pre, 4,7
5_NBDN	PC,M	4	4	1		Pre, 4,7

PC – Physico-Chemical Parameters (see parameter list below; grabs,)
M – Macrobenthos (NCBI, EPT%, abundance and diversity; NCDWR Qual 4 Method; Spring Sampling)
F – Fish (IBI, abundance and diversity; NCDWR Sampling Method; Spring Sampling)

The physico-chemical parameters that will be measured include the following

a. Total Nitrogen
b. Total Phosphorus
c. Fecal Coliform
d. TSS
e. Turbidity
f. Temperature
g. pH
h. Dissolved Oxygen and % Saturation
i. Specific Conductance

Parameters a through d above will be collected as grab samples for base and elevated flows and will be analyzed by a State-certified water quality lab. Items d through i (field parameters) will be measured with water quality meters in the field using appropriate calibration procedures as per NCDWR methodologies.

12.4.3 Assessment of Functional Changes

Physico-chemical parameters (Level 4 parameters)

Changes in physico-chemical parameters will be assessed by comparing statistical distributions from the pre-construction (precon) phase to the post-construction (postcon) monitoring data. As indicated above, implementation of the post-con supplemental monitoring may be altered or abandoned based on what is learned from the pre-con baseline. No credit will be sought associated with this work if the pre-con monitoring indicates post-con monitoring will not be of value. The precon baseline will be compared to each subsequent monitoring year as well as to the postcon data set as a whole. The results for baseflow and elevated flow measurements will be analyzed independently and together as a single data set for the precon and postcon conditions. Simple statistical hypothesis testing will be employed; however, if the variance limits the statistical power then means or, in the case of fecal coliform, geometric means will simply be compared for % change and plotted.

Biological parameters (Level 5 parameters)

The primary criteria for indication of improvement for the benthos and fish will be an increase of at least one bioclassification between the pre-con assessment and the post-con monitoring. Richness and EPT metrics will be analyzed as well.

Interpretation of Functional Change

The pre-construction monitoring due to take place over the 2015 calendar year will in part inform the potential for improvement. Although these channels have poor buffers and are impacted by cattle, it is possible that certain parameters may demonstrate values that are acceptable/functional even under current conditions. The table below includes a column titled "High Function Threshold Value." The values in this column indicate a level for that parameter, which will likely leave little opportunity for improvement based on the data references footnoted below in Table 21. This criterion indicates reasonably high quality in the current condition for the parameter in question. These references included data ranges indicative of the project ecoregion. This may impact the practical need/ability to examine certain parameters for functional improvement. DMS anticipates that all of the listed parameters will be measured to characterize any change regardless. However, it is important to understand that, since these parameters have yet to be measured, it is possible that the monitoring and analytical plan may need to be adapted to the observed pre-construction values. The table below also includes NC regulatory limits for the water quality parameters. Collectively, this information is intended to provide a quality scale. Lastly, the measured values of these parameters will be evaluated at each interval in the context of the watershed control stations above Mud Lick and above North Branch. Ultimately, some interpretation will be needed to determine whether observations within the reach can be attributed to the restoration measures employed or whether they represent fluctuations in influences from the watershed.

Table 21. Parameter Limits, Ranges, and Improvement Criteria

Parameter	Units	NC Regulatory Standard/Limit	High Function Threshold Value[7]	Mud Lick Improvement Criteria[7]
Physico-chem				
TN	mg/L	-	≤0.7 [3,4]	Statistical hyp. or reduction in mean
TP	ug/L	-	≤35 [3,4]	Statistical hyp. or reduction in mean
Fecal	CFU/100 ml	200	≤30	Statistical hyp. or reduction in mean
Turbidity	NTU	50	≤10	Statistical hyp. or reduction in mean
Temperature	C	32	-	Statistical hyp. or reduction in mean
pH	SU	6-9	>6.5 - <7.8	Statistical hyp. or movement of mean towards ideal range
DO conc	mg/L	4/5[6]	>7.5	Statistical hyp. or increase in mean
DO % Saturation	%	-	>67%[8]	Statistical hyp. or increase in mean
Specific Conductance	Umhos/cm @ 25C	-	≤80 [3,4,5]	Statistical hyp. or increase in mean
Biology				
Benthos Biotic Index[1]	NA	≥Good-Fair	≥Good	Bioclassification moves up at least one class
Fish IBI[2]	NA	≥Good-Fair	≥Good	Bioclassification moves up at least one class

1 --Biotic Index – (NCDEQ - DWQ (2009) Small Stream Biocriteria Development

2 –Index of Biotic Integrity (NCDEQ – DWR (2013) Stream Fish Community Assessment Program SOP

3 –NCDEQ-DWQ (2004) Technical Memorandum "Rocky River Water Quality Survey – Chatham County"

4 --USEPA (2000) 822-B-00-019 Ambient Water Quality Criteria Recommendations, Stream Nutrient Criteria for Ecoregion IX

5 --NCDEQ-DWR (2011) "Explorations of Relationships Between Specific Conductance Values and Benthic Macroinvertebrate Community Bioclassifications in NC

6 --4 mg/L is instantaneous Standard, 5 mg/L is the daily average
7--See explanation of these fields in the narrative immediately above table.
8 --FDEP (2013) Technical Support Document: "Derivation of Dissolved Oxygen Criteria to Protect Aquatic Life in Florida's Fresh and Marine Waters". Percent Sat criteria utilized for Western Panhandle compatible overlap with Ecoregion 9 subregion 65.

13.0 Long-Term Management Plan

Upon approval for close-out by the Interagency Review Team (IRT) the site will be transferred to the NCDEQ 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 NCDEQ Division of Natural Resource Planning and Conservation's Stewardship Program currently houses DMS 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 NCDEQ 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.

14.0 Adaptive Management Plan

Upon completion of site construction DMS 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, DMS will notify the USACE of the need to develop a Plan of Corrective Action. The Plan of Corrective Action may be prepared using in-house technical staff or may require engineering and consulting services. Once the Corrective Action Plan is prepared and finalized DMS will:

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

15.0 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 Environmental Quality has provided the US Army Corps of Engineers Wilmington District with a formal commitment to fund projects to satisfy mitigation requirements assumed by DMS. This commitment provides financial assurance for all mitigation projects implemented by the program.

16.0 References

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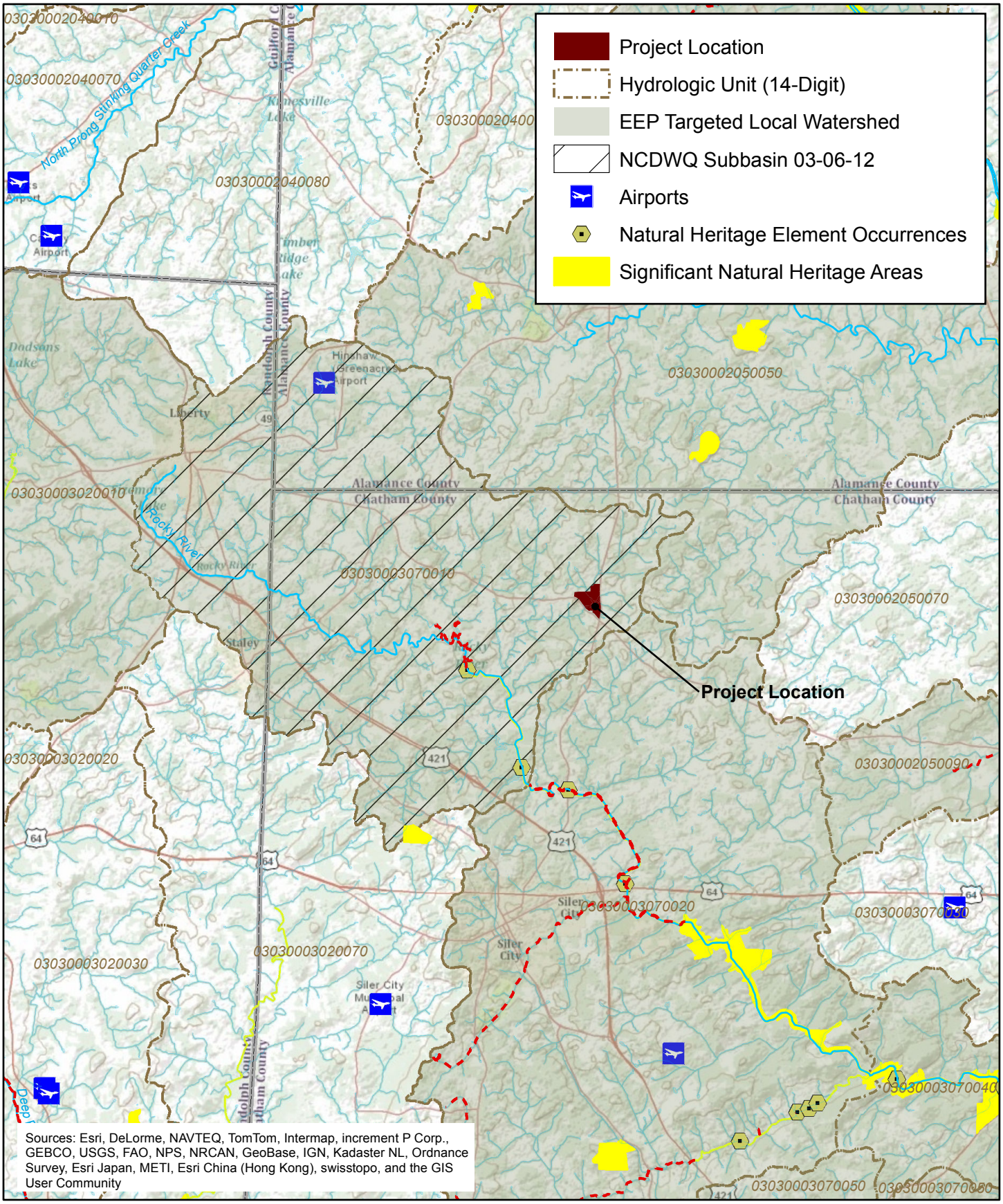
FIGURES



WILDLANDS ENGINEERING

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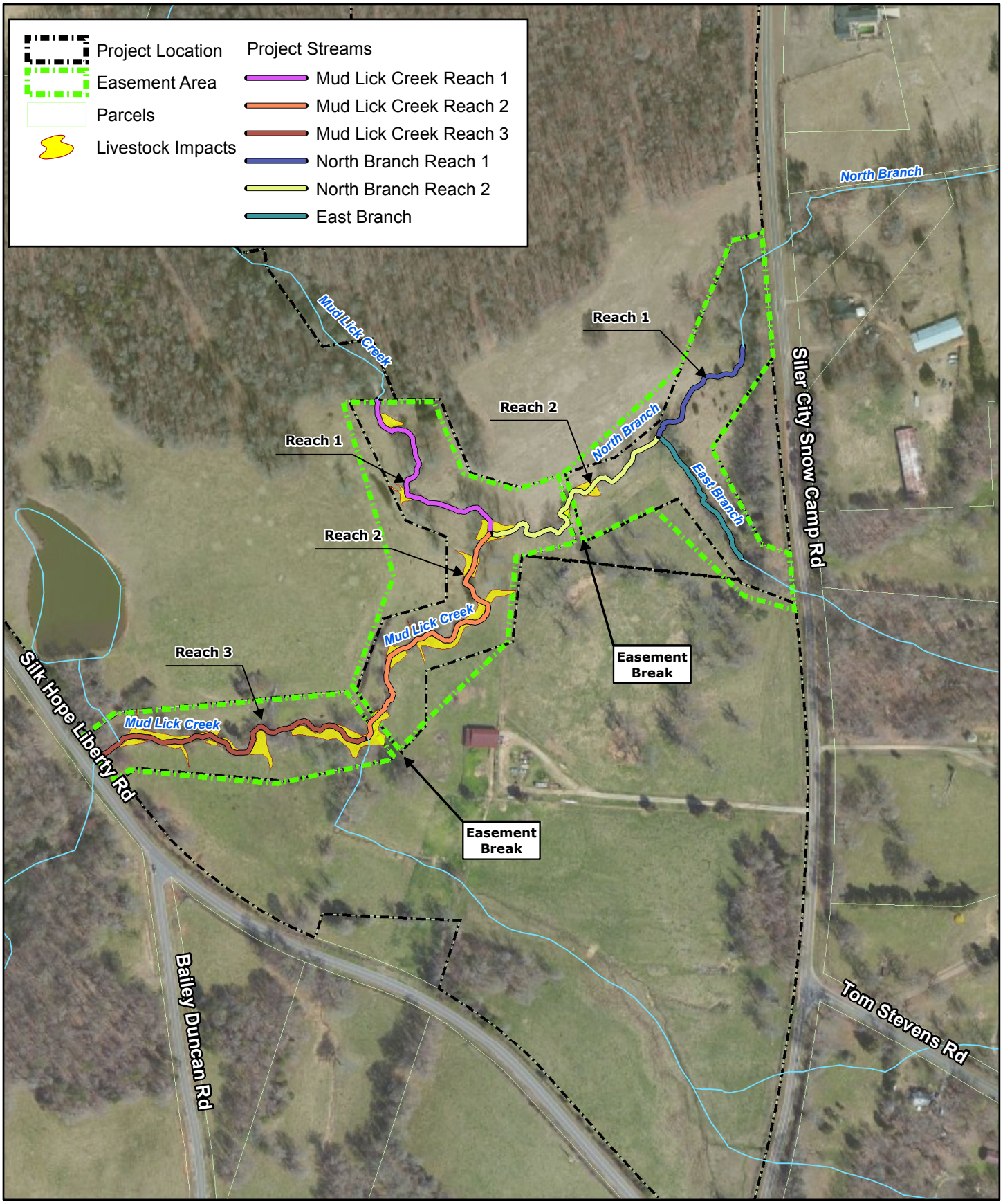
Figure 1 Vicinity Map
Mud Lick Creek Mitigation Site
Mitigation Plan
DMS #93482

Chatham County, NC



WILDLANDS ENGINEERING

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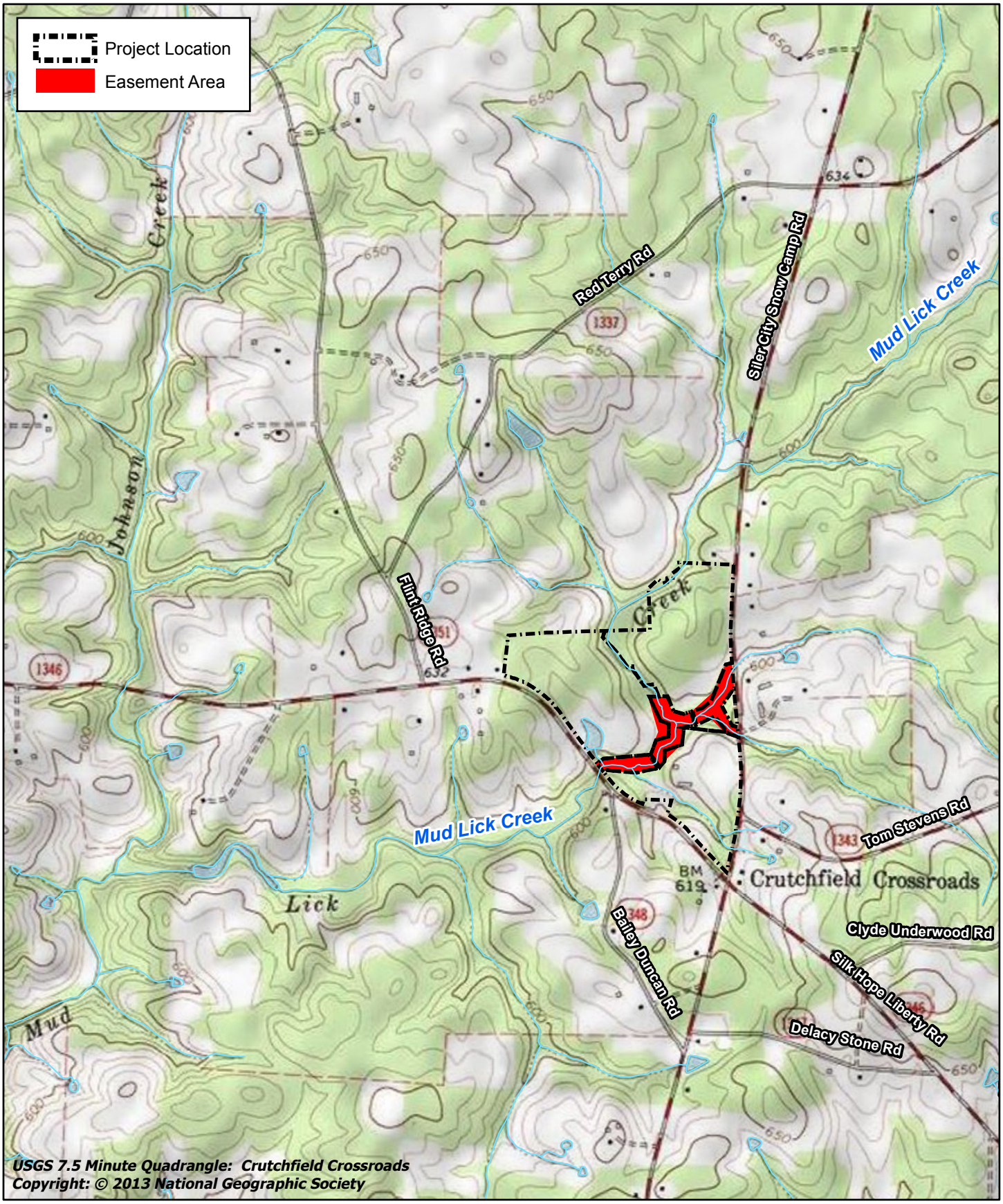
Figure 2 Existing Conditions Map
Mud Lick Creek Mitigation Site
Mitigation Plan
DMS #93482

Chatham County, NC



WILDLANDS ENGINEERING

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Figure 3 USGS Topographic Map
Mud Lick Creek Mitigation Site
Mitigation Plan
DMS #93482

Chatham County, NC

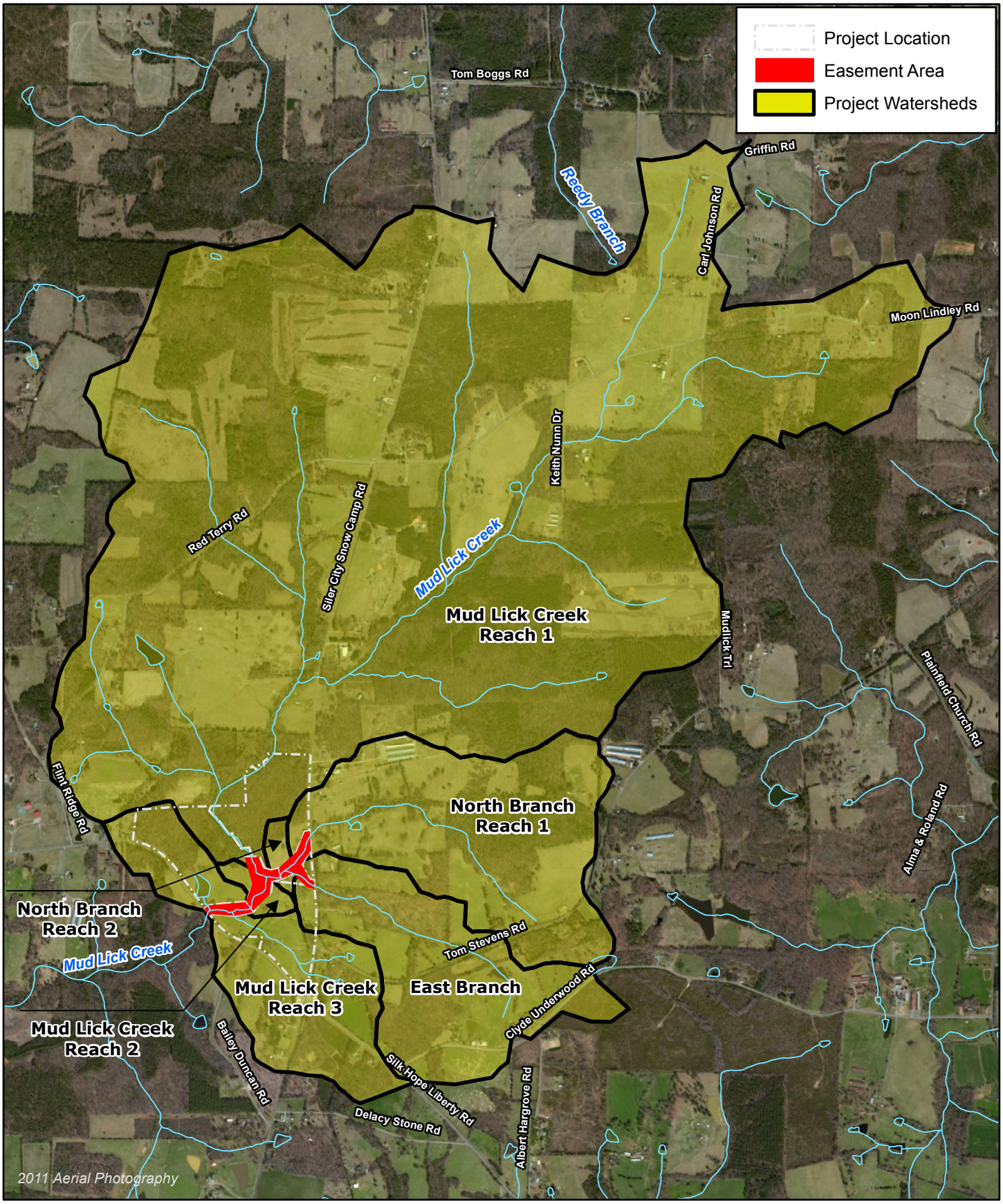

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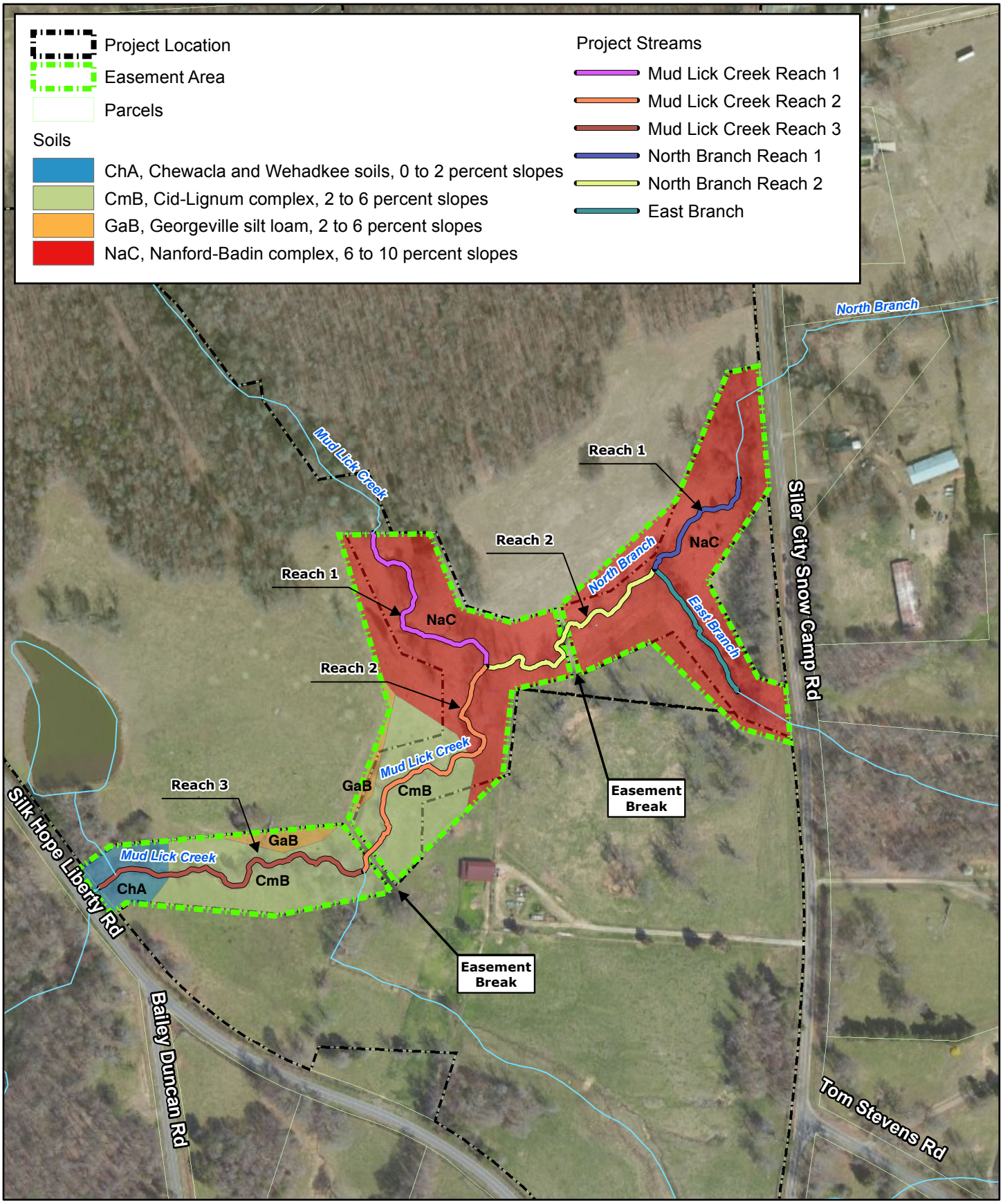
Figure 4 Watershed Map
Mud Lick Creek Mitigation Site
Mitigation Plan
DMS #93482

Chatham County, NC



WILDLANDS ENGINEERING

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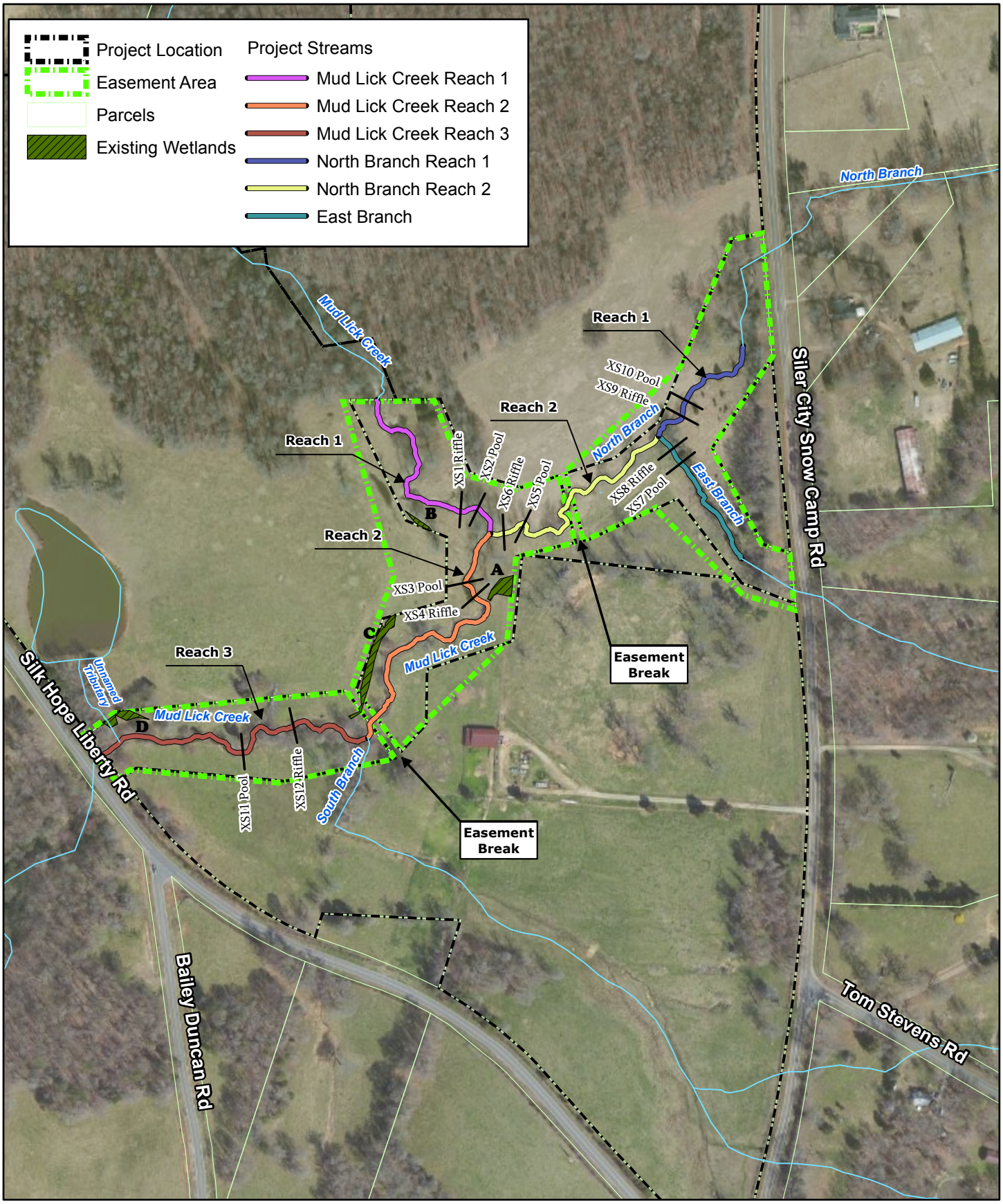
Figure 5 Site Soil Survey Map
Mud Lick Creek Mitigation Site
Mitigation Plan
DMS #93482

Chatham County, NC



WILDLANDS ENGINEERING

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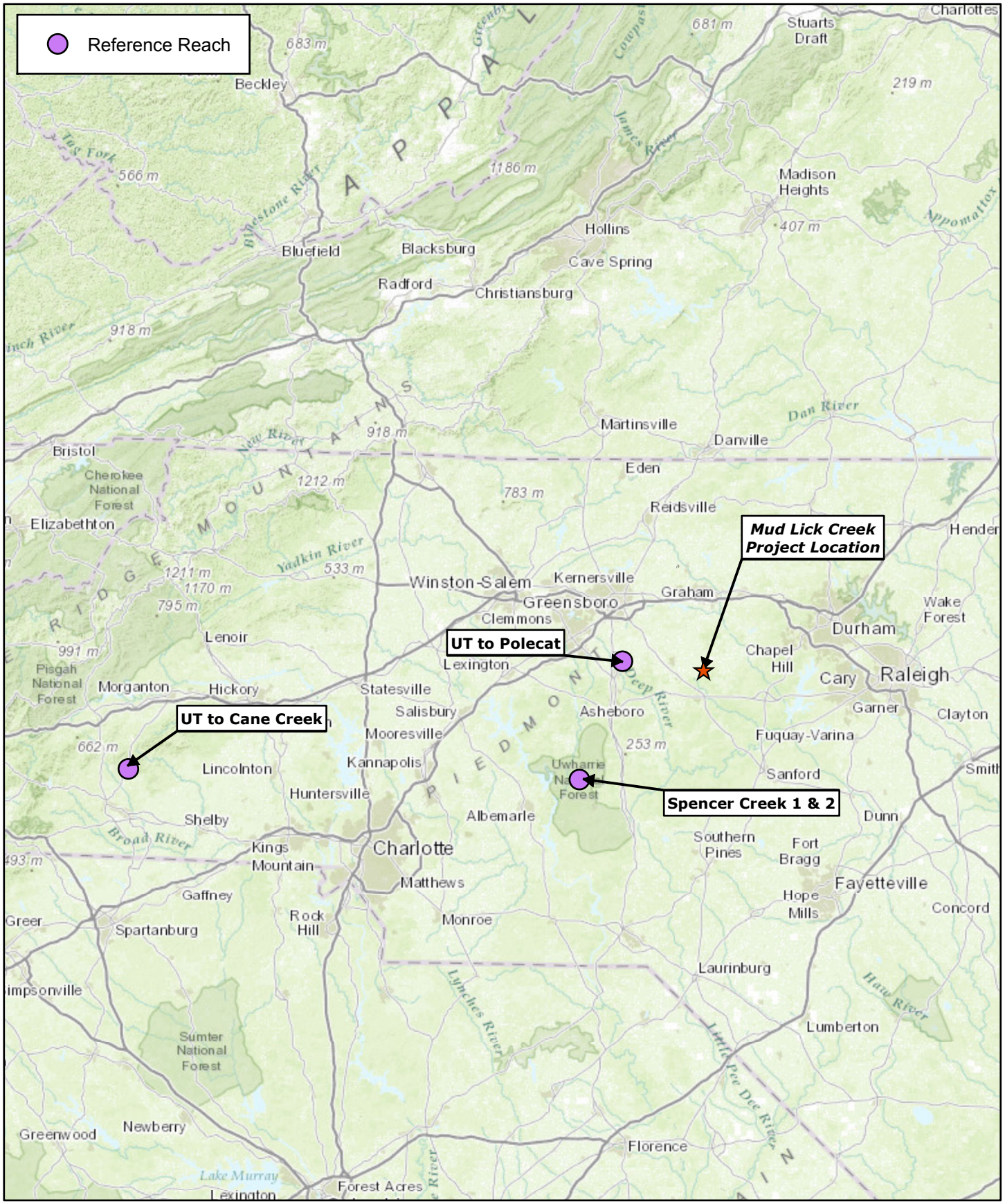
Figure 6 Hydrologic Features Map
Mud Lick Creek Mitigation Site
Mitigation Plan
DMS #93482

Chatham County, NC



WILDLANDS ENGINEERING

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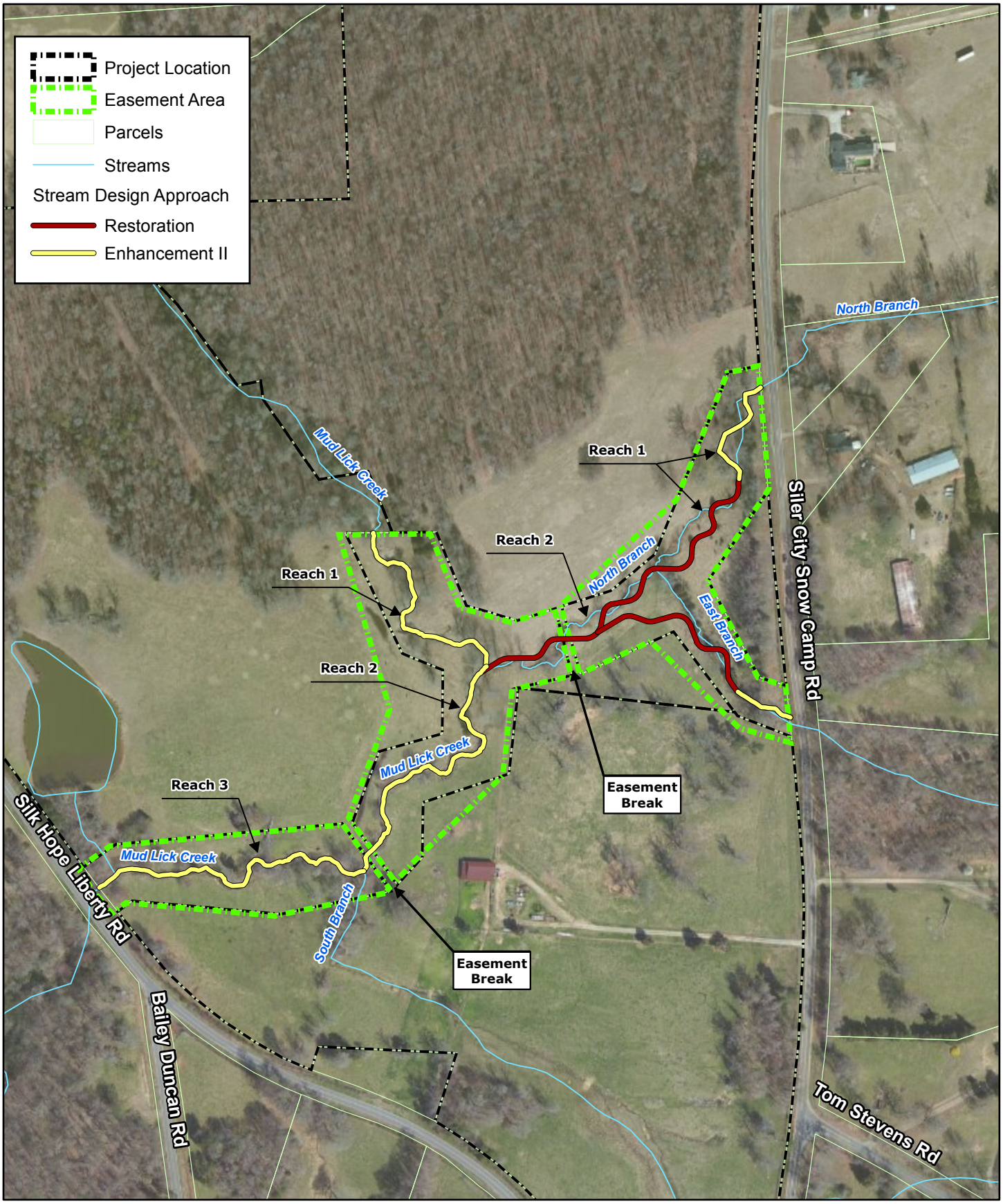
Figure 7 Reference Reach Vicinity Map
Mud Lick Creek Mitigation Site
Mitigation Plan
DMS #93482

Chatham County, NC



WILDLANDS ENGINEERING

0 200 400 Feet

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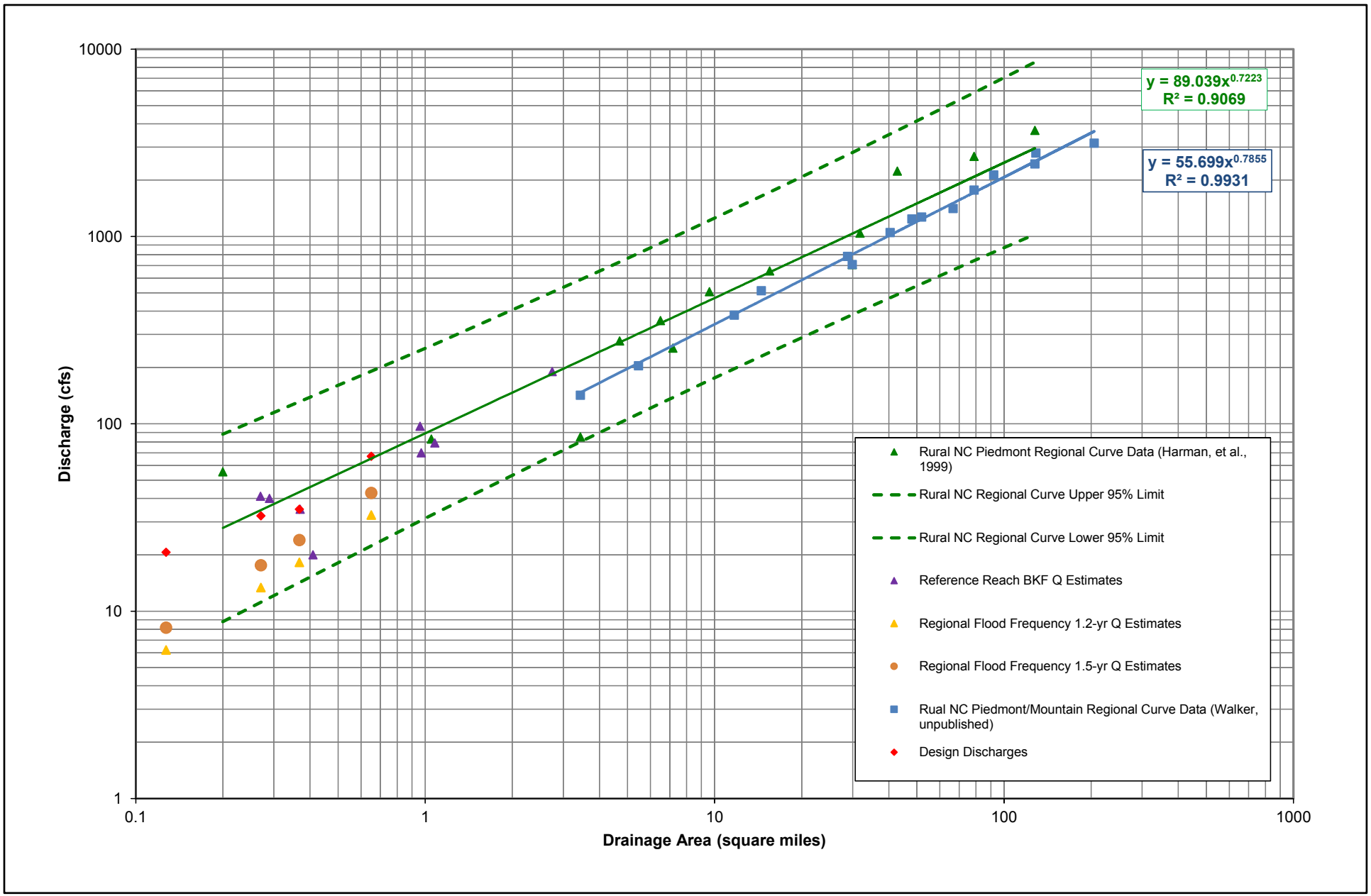
Figure 8 Design Overview Map
Mud Lick Creek Mitigation Site
Mitigation Plan
DMS #93482

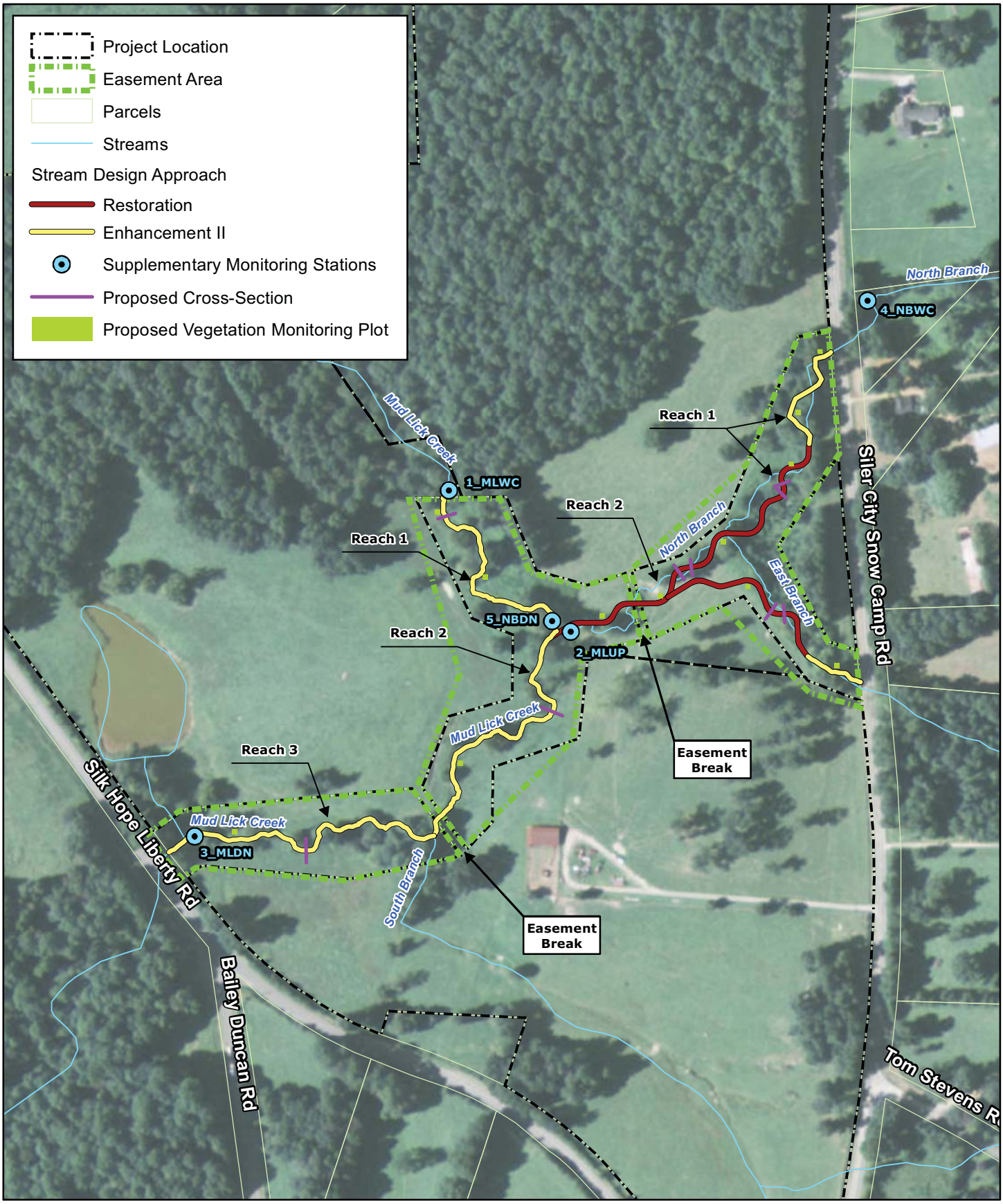
Chatham County, NC



WILDLANDS ENGINEERING

Figure 9 Regional Curves and Discharge Estimate Data
Mud Lick Creek Mitigation Site
Mitigation Plan
DMS #93482

Chatham County, NC



WILDLANDS ENGINEERING

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Figure 10 Supplementary Monitoring Stations
Mud Lick Creek Mitigation Site
Mitigation Plan
DMS #93482

Chatham County, NC

APPENDIX 1: Project Site Photographs

Photo 1. Mud Lick Creek – Reach 1

Photo 2. Mud Lick Creek – Reach 2

Photo 3. Mud Lick Creek – Reach 3

Photo 4. Double box culvert at downstream end of project

Photo 5. Existing wetland feature adjacent to Mud Lick Creek

Photo 6. North Branch – Reach 1 (Enhancement II)

Photo 7. North Branch – Reach 1 (Restoration)

Photo 8. North Branch – Reach 2

Photo 9. East Branch (Enhancement II)

Photo 10. East Branch (Restoration)

APPENDIX 2: Historic Aerial Photographs


INQUIRY #: 3673576.5
YEAR: 1973
= 500'
N


INQUIRY #: 3673576.5
YEAR: 1983
= 500'
N


INQUIRY #: 3673576.5
YEAR: 1993
= 500'
N


INQUIRY #: 3673576.5
YEAR: 1999
= 750'
N


INQUIRY #: 3673576.5
YEAR: 2005
= 500'
N


INQUIRY #: 3673576.5
YEAR: 2006
= 500'
N


INQUIRY #: 3673576.5
YEAR: 2008
= 500'
N

APPENDIX 3: NCDWQ Stream Forms

NC DWQ Stream Identification Form Version 4.11

Date: 8/22/13	**Project/Site:** Mud Lick Creek	**Latitude:** 35.813692°N
Evaluator: IJE/AKT	**County:** Chatham	**Longitude:** -79.435173°W
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 42	**Stream Determination (circle one)** Ephemeral Intermittent (Perennial)	**Other** SCP1 - Mud *e.g. Quad Name:* Lick Creek

A. Geomorphology (Subtotal = 21.5)	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 = 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: Pickerelweed (OBL) wetland plant in streambed.

Sketch:

NC DWQ Stream Identification Form Version 4.11

Date: 8/22/13	**Project/Site:** Mud Lick Creek	**Latitude:** 35.814268°N
Evaluator: IJE/AKT	**County:** Chatham	**Longitude:** -79.432665°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 - North Branch *e.g. Quad Name:*

A. Geomorphology (Subtotal = 15.5)	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 = 8.5)				
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:

Sketch:

S3

NC DWQ Stream Identification Form Version 4.11

Date: 8/22/13	Project/Site: Mud Lick Creek	Latitude: 35.812984°N
Evaluator: IJE/AKT	County: Chatham	Longitude: -79.432573°W
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 34	Stream Determination (circle one) Ephemeral Intermittent (Perennial)	Other SCP3 - East e.g. Quad Name: Branch

A. Geomorphology (Subtotal = 16.5)	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 = 8)				
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:

Sketch:

Macros present: dragonfly, midges, waterboatmen, caddisfly (hydropsychid nets)

NC DWQ Stream Identification Form Version 4.11

Date: 8/22/13	**Project/Site:** Mud Lick Creek	**Latitude:** 35.811648°N
Evaluator: IJE/AKT	**County:** Chatham	**Longitude:** -79.435654°W
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 28.5	**Stream Determination (circle one)** Ephemeral Intermittent (Perennial) *	**Other** SCP4-South *e.g. Quad Name:* Branch

A. Geomorphology (Subtotal = 8.5)	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)				
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 =)				
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:

- Depicted as second order stream on Crutchfield Crossroads USGS Quad. map but first order based on field review.

*Channel scores out as high intermittent (28.5) but strong presence of fish indicates perennial status.

S5

NC DWQ Stream Identification Form Version 4.11

Date: 8/22/13	**Project/Site:** Mud Lick Creek	**Latitude:** 35.811895°N
Evaluator: IJE/AKT	**County:** Chatham	**Longitude:** -79.437667°W
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 25.5	**Stream Determination (circle one)** Ephemeral Intermittent (Perennial) *	**Other** SCP5 *e.g. Quad Name:* UT from Pond

A. Geomorphology (Subtotal = 8)	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)				
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.

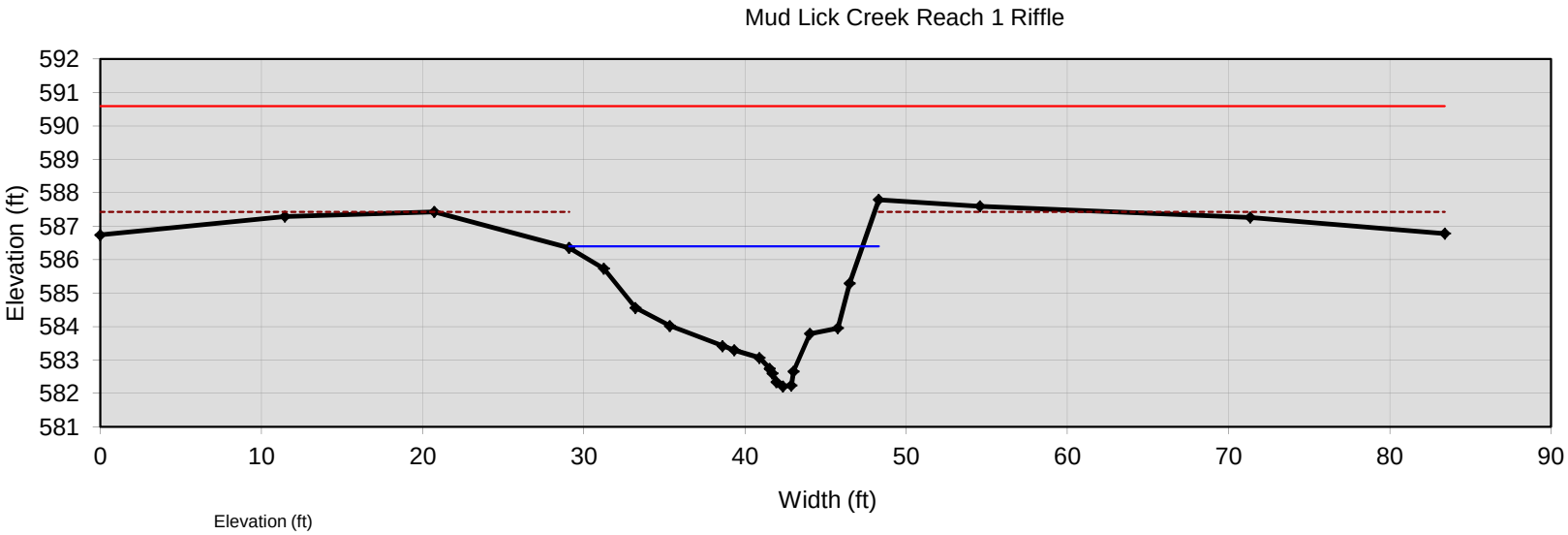
Notes:

Sketch:

* Channel scores out at 25.5 (intermittent) but strong presence of fish indicates perennial status.

APPENDIX 4: Existing Conditions Geomorphic Data

Cross Section 1 Reach 1



Elevation (ft)

Bankfull Dimensions

41.3	x-section area (ft.sq.)
18.2	width (ft)
2.3	mean depth (ft)
4.2	max depth (ft)
21.2	wetted parimeter (ft)
1.9	hyd radi (ft)
8.0	width-depth ratio

Flood Dimensions

250.0	W flood prone area (ft)
13.7	entrenchment ratio
5.2	low bank height (ft)
1.2	low bank height ratio

Materials

1.6	D50 Riffle (mm)
7.6	D84 Riffle (mm)
12	threshold grain size (mm):

Rosgen Stream Type

C5/E5

Bankfull Flow

3.0	velocity (ft/s)
122.6	discharge rate (cfs)
0.37	Froude number

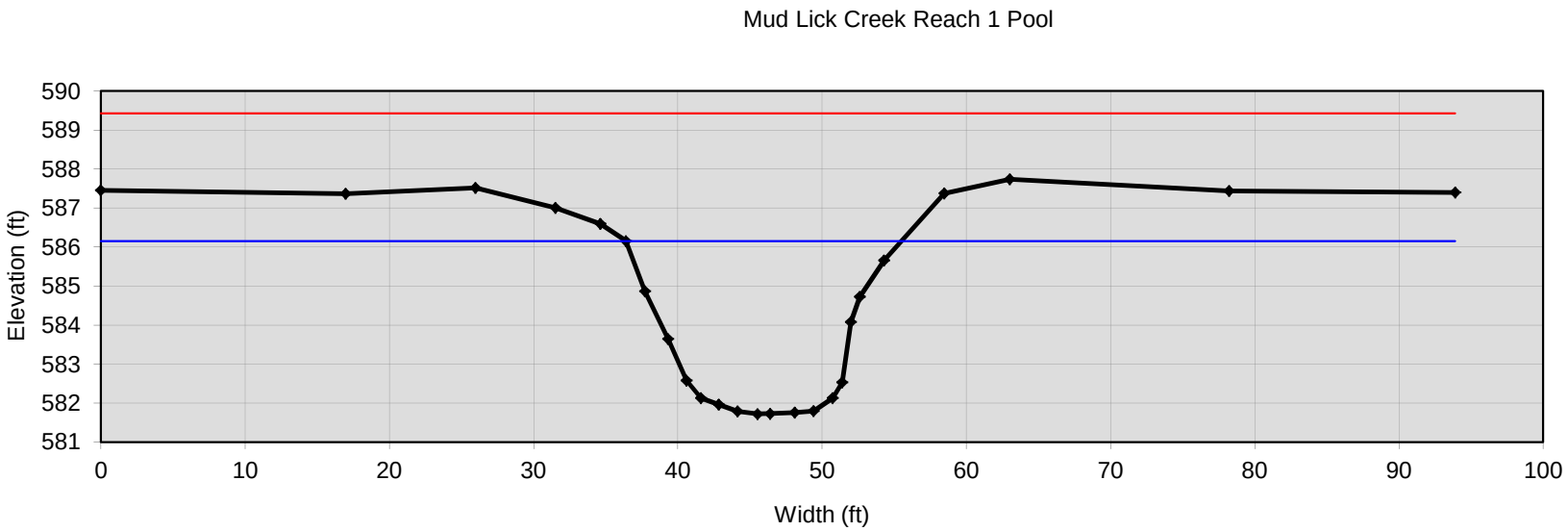
Flow Resistance

0.035	Manning's roughness
0.11	D'Arcy-Weisbach fric.
14.4	resistance factor u/u*
90.9	relative roughness

Forces & Power

0.2	channel slope (%)
0.24	shear stress (lb/sq.ft.)
0.35	shear velocity (ft/s)
0.84	unit strm power (lb/ft/s)

Cross Section 2 Reach 1



Bankfull Dimensions	
58.1	x-section area (ft.sq.)
19.1	width (ft)
3.0	mean depth (ft)
4.4	max depth (ft)
22.4	wetted parimeter (ft)
2.6	hyd radi (ft)
6.3	width-depth ratio

Flood Dimensions	
---	W flood prone area (ft)
---	entrenchment ratio
---	low bank height (ft)
---	low bank height ratio

Materials	
1.6	D50 Riffle (mm)
7.6	D84 Riffle (mm)
16	threshold grain size (mm):

Rosgen Stream Type

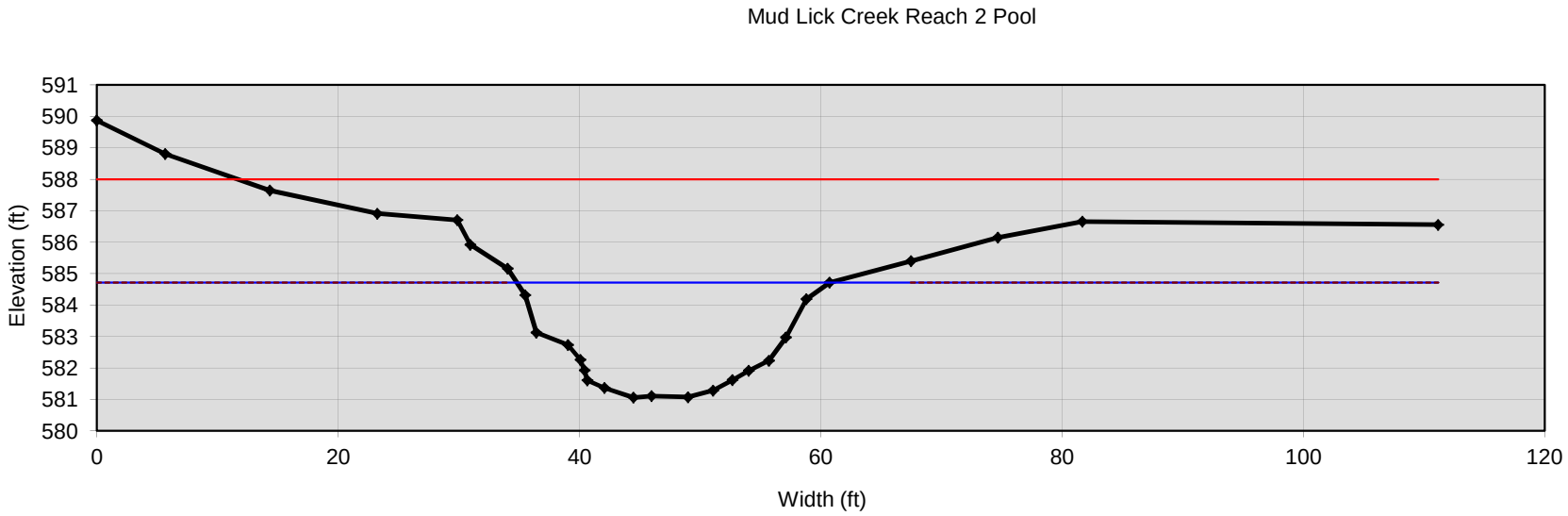
/

Bankfull Flow	
3.6	velocity (ft/s)
209.0	discharge rate (cfs)
0.39	Froude number

Flow Resistance	
0.035	Manning's roughness
0.04	D'Arcy-Weisbach fric.
14.9	resistance factor u/u*
122.1	relative roughness

Forces & Power	
0.2	channel slope (%)
0.32	shear stress (lb/sq.ft.)
0.41	shear velocity (ft/s)
1.37	unit strm power (lb/ft/s)

Cross Section 3 Reach 2



Bankfull Dimensions

65.5	x-section area (ft.sq.)
25.9	width (ft)
2.5	mean depth (ft)
3.7	max depth (ft)
27.9	wetted parimeter (ft)
2.4	hyd radi (ft)
10.3	width-depth ratio

Flood Dimensions

---	W flood prone area (ft)
---	entrenchment ratio
3.7	low bank height (ft)
1.0	low bank height ratio

Materials

1.6	D50 Riffle (mm)
7.6	D84 Riffle (mm)
14	threshold grain size (mm):

Rosgen Stream Type

/

Bankfull Flow

3.4	velocity (ft/s)
220.4	discharge rate (cfs)
0.39	Froude number

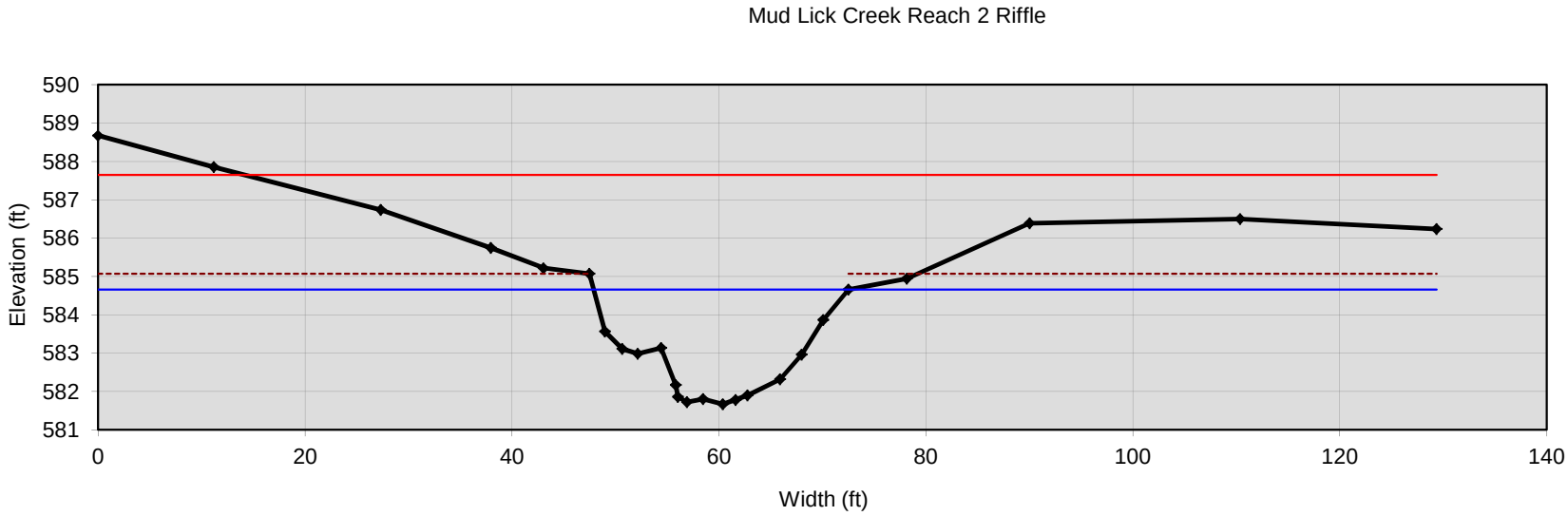
Flow Resistance

0.035	Manning's roughness
0.10	D'Arcy-Weisbach fric.
14.6	resistance factor u/u*
101.3	relative roughness

Forces & Power

0.2	channel slope (%)
0.29	shear stress (lb/sq.ft.)
0.39	shear velocity (ft/s)
1.06	unit strm power (lb/ft/s)

Cross Section 4 Reach 2



Bankfull Dimensions

47.5	x-section area (ft.sq.)
24.6	width (ft)
1.9	mean depth (ft)
3.0	max depth (ft)
26.1	wetted parimeter (ft)
1.8	hyd radi (ft)
12.8	width-depth ratio

Flood Dimensions

371.0	W flood prone area (ft)
15.1	entrenchment ratio
3.4	low bank height (ft)
1.1	low bank height ratio

Materials

1.6	D50 Riffle (mm)
7.6	D84 Riffle (mm)
11	threshold grain size (mm):

Rosgen Stream Type

C4

Bankfull Flow

3.0	velocity (ft/s)
142.7	discharge rate (cfs)
0.39	Froude number

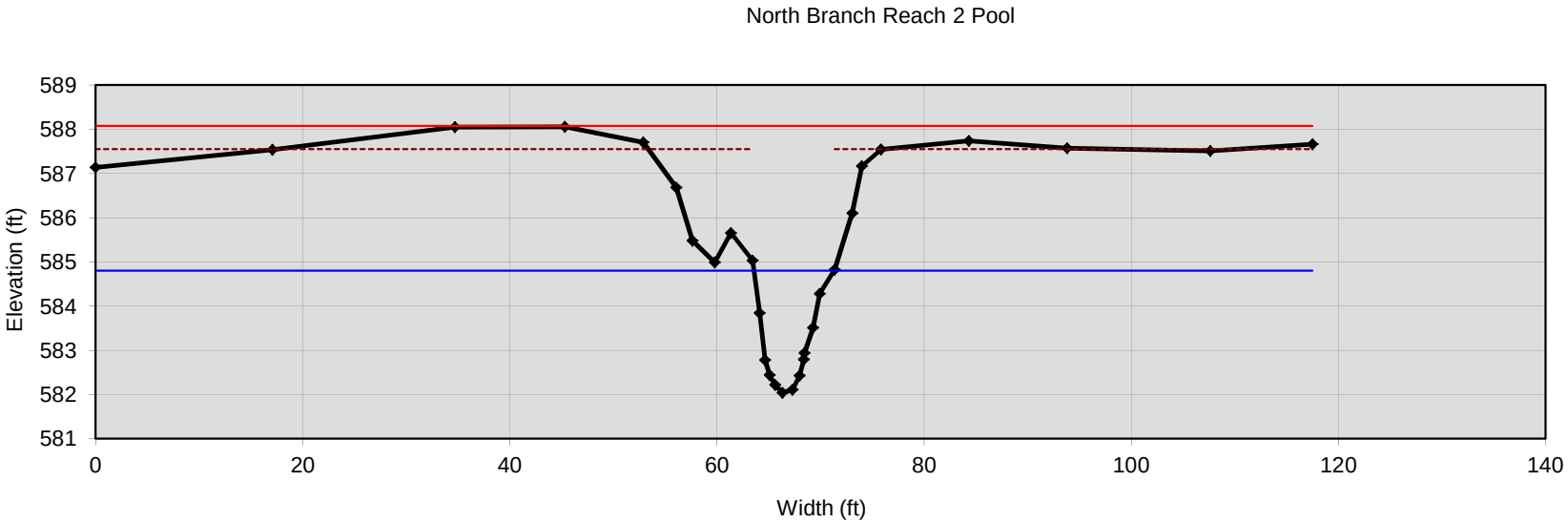
Flow Resistance

0.033	Manning's roughness
0.10	D'Arcy-Weisbach fric.
14.0	resistance factor u/u*
77.3	relative roughness

Forces & Power

0.2	channel slope (%)
0.23	shear stress (lb/sq.ft.)
0.34	shear velocity (ft/s)
0.72	unit strm power (lb/ft/s)

Cross Section 5 North Branch Reach 2



Bankfull Dimensions

12.8	x-section area (ft.sq.)
7.7	width (ft)
1.7	mean depth (ft)
2.8	max depth (ft)
10.1	wetted parimeter (ft)
1.3	hyd radi (ft)
4.7	width-depth ratio

Flood Dimensions

80.0	W flood prone area (ft)
10.3	entrenchment ratio
5.5	low bank height (ft)
1.997	low bank height ratio

Materials

1.6	D50 Riffle (mm)
7.6	D84 Riffle (mm)
20	threshold grain size (mm):

Rosgen Stream Type

/

Bankfull Flow

3.5	velocity (ft/s)
45.3	discharge rate (cfs)
0.55	Froude number

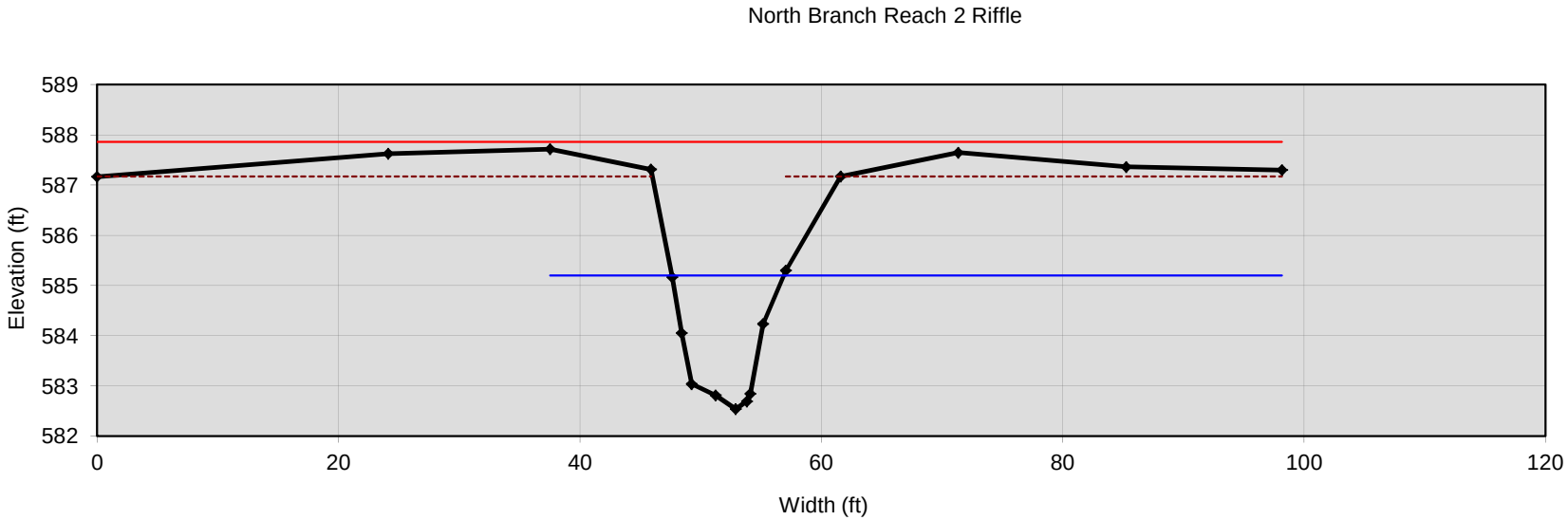
Flow Resistance

0.035	Manning's roughness
0.13	D'Arcy-Weisbach fric.
13.3	resistance factor u/u*
66.5	relative roughness

Forces & Power

0.5	channel slope (%)
0.40	shear stress (lb/sq.ft.)
0.45	shear velocity (ft/s)
1.83	unit strm power (lb/ft/s)

Cross Section 6 North Branch Reach 2



Bankfull Dimensions

16.2	x-section area (ft.sq.)
9.3	width (ft)
1.7	mean depth (ft)
2.7	max depth (ft)
11.4	wetted parimeter (ft)
1.4	hyd radi (ft)
5.3	width-depth ratio

Flood Dimensions

15.2	W flood prone area (ft)
1.6	entrenchment ratio
4.6	low bank height (ft)
1.7	low bank height ratio

Materials

1.6	D50 Riffle (mm)
7.6	D84 Riffle (mm)
22	threshold grain size (mm):

Rosgen Stream Type

B5c

Bankfull Flow

3.8	velocity (ft/s)
61.9	discharge rate (cfs)
0.56	Froude number

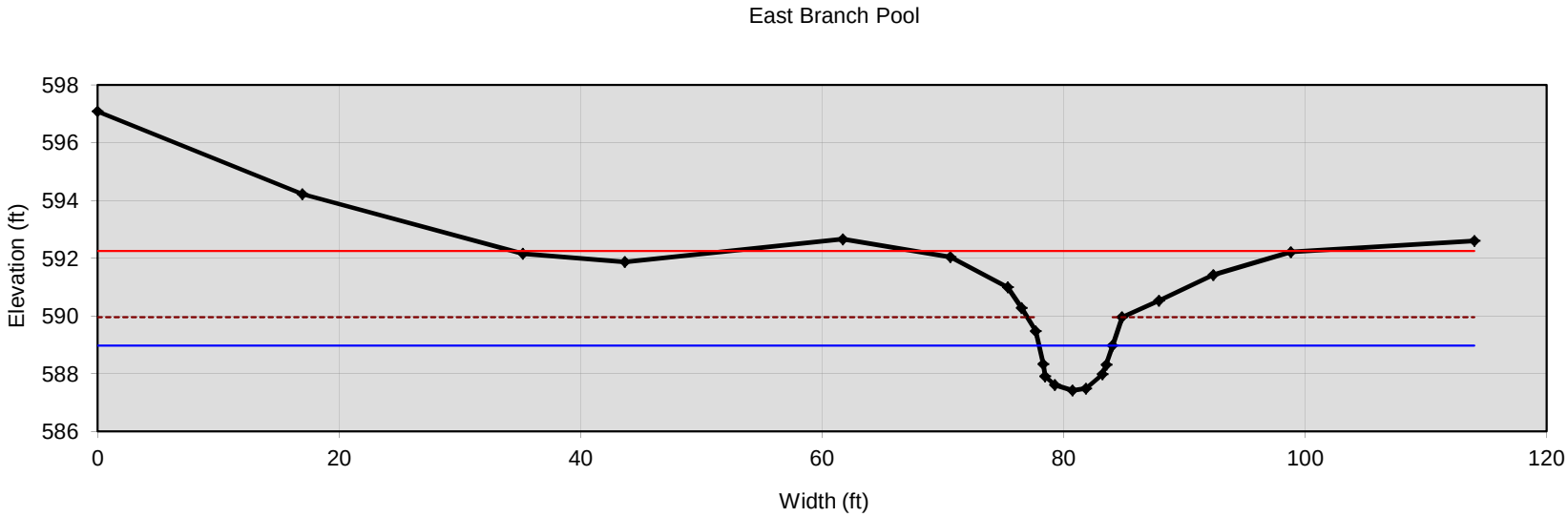
Flow Resistance

0.035	Manning's roughness
0.13	D'Arcy-Weisbach fric.
13.5	resistance factor u/u*
70.2	relative roughness

Forces & Power

0.5	channel slope (%)
0.45	shear stress (lb/sq.ft.)
0.48	shear velocity (ft/s)
2.1	unit strm power (lb/ft/s)

Cross Section 7 East Branch



Bankfull Dimensions	
7.2	x-section area (ft.sq.)
6.1	width (ft)
1.2	mean depth (ft)
1.6	max depth (ft)
7.4	wetted parimeter (ft)
1.0	hyd radi (ft)
5.2	width-depth ratio

Flood Dimensions	
23.0	W flood prone area (ft)
3.8	entrenchment ratio
2.5	low bank height (ft)
1.6	low bank height ratio

Materials	
1.6	D50 Riffle (mm)
7.6	D84 Riffle (mm)
39	threshold grain size (mm):

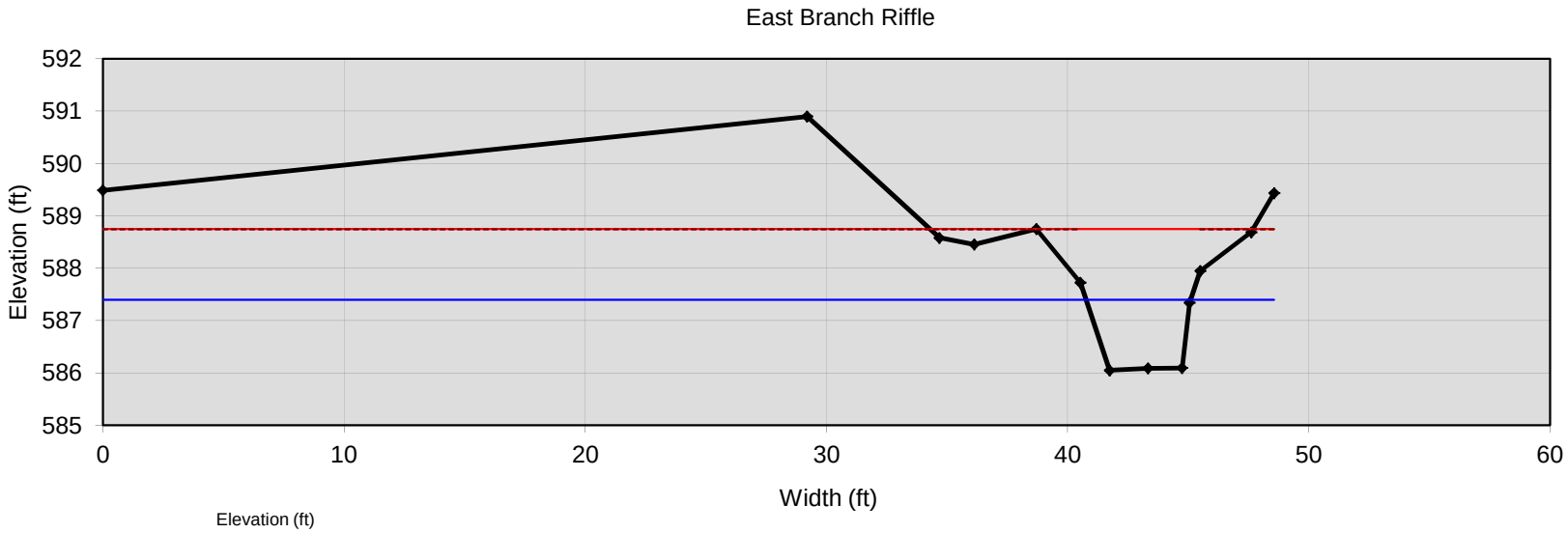
Rosgen Stream Type

Bankfull Flow	
4.8	velocity (ft/s)
34.1	discharge rate (cfs)
0.85	Froude number

Flow Resistance	
0.035	Manning's roughness
0.14	D'Arcy-Weisbach fric.
12.4	resistance factor u/u*
47.1	relative roughness

Forces & Power	
1.3	channel slope (%)
0.79	shear stress (lb/sq.ft.)
0.64	shear velocity (ft/s)
4.5	unit strm power (lb/ft/s)

Cross Section 8 East Branch



Elevation (ft)

Bankfull Dimensions

4.8	x-section area (ft.sq.)
4.3	width (ft)
1.1	mean depth (ft)
1.4	max depth (ft)
6.0	wetted parimeter (ft)
0.8	hyd radi (ft)
3.9	width-depth ratio

Flood Dimensions

8.9	W flood prone area (ft)
2.1	entrenchment ratio
2.7	low bank height (ft)
2.0	low bank height ratio

Materials

1.6	D50 Riffle (mm)
7.6	D84 Riffle (mm)
32	threshold grain size (mm):

Rosgen Stream Type

E4

Bankfull Flow

4.2	velocity (ft/s)
20.3	discharge rate (cfs)
0.82	Froude number

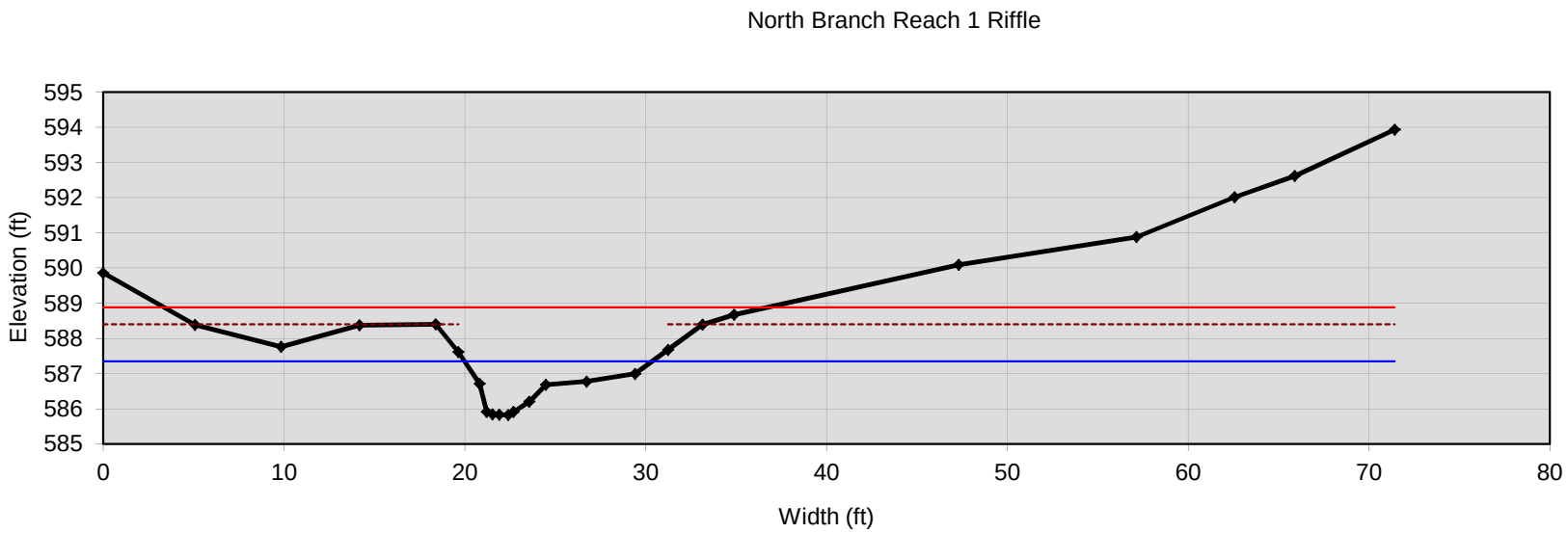
Flow Resistance

0.035	Manning's roughness
0.14	D'Arcy-Weisbach fric.
12.0	resistance factor u/u*
44.8	relative roughness

Forces & Power

1.3	channel slope (%)
0.65	shear stress (lb/sq.ft.)
0.58	shear velocity (ft/s)
3.8	unit strm power (lb/ft/s)

Cross Section 9 North Branch Reach 1



Bankfull Dimensions	
7.7	x-section area (ft.sq.)
10.4	width (ft)
0.7	mean depth (ft)
1.5	max depth (ft)
11.4	wetted parimeter (ft)
0.7	hyd radi (ft)
14.0	width-depth ratio

Flood Dimensions	
33.3	W flood prone area (ft)
3.2	entrenchment ratio
2.6	low bank height (ft)
1.7	low bank height ratio

Materials	
1.6	D50 Riffle (mm)
7.6	D84 Riffle (mm)
21	threshold grain size (mm):

Rosgen Stream Type

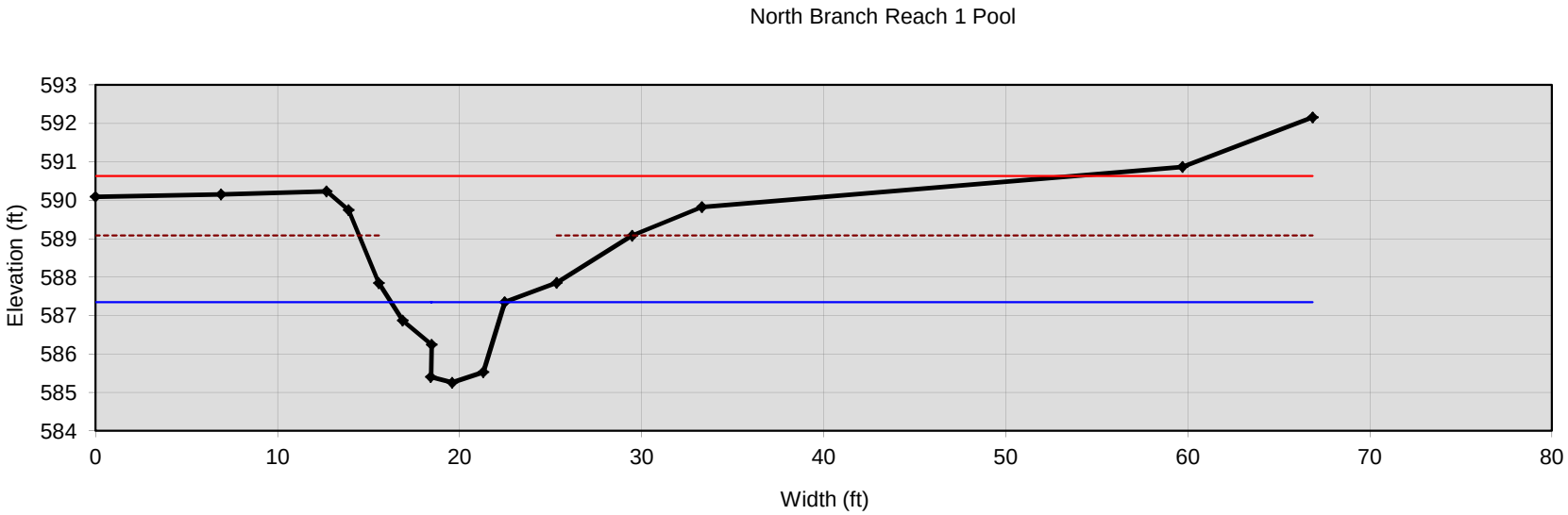
C5

Bankfull Flow	
3.3	velocity (ft/s)
25.2	discharge rate (cfs)
0.70	Froude number

Flow Resistance	
0.035	Manning's roughness
0.14	D'Arcy-Weisbach fric.
11.8	resistance factor u/u*
29.7	relative roughness

Forces & Power	
1	channel slope (%)
0.42	shear stress (lb/sq.ft.)
0.47	shear velocity (ft/s)
1.52	unit strm power (lb/ft/s)

Cross Section 10 North Branch Reach 1



Bankfull Dimensions	
8.2	x-section area (ft.sq.)
6.3	width (ft)
1.3	mean depth (ft)
2.1	max depth (ft)
8.5	wetted parimeter (ft)
1.0	hyd radi (ft)
4.8	width-depth ratio

Flood Dimensions	
28.0	W flood prone area (ft)
4.5	entrenchment ratio
3.8	low bank height (ft)
1.8	low bank height ratio

Materials	
1.6	D50 Riffle (mm)
7.6	D84 Riffle (mm)
30	threshold grain size (mm):

Rosgen Stream Type

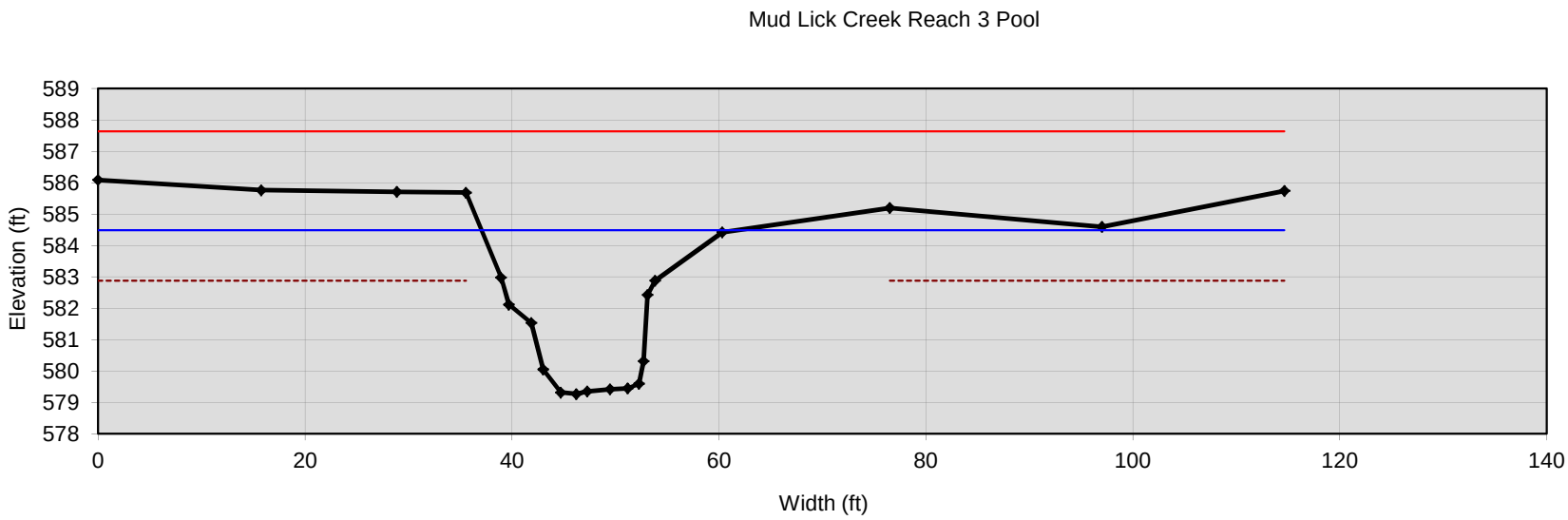
/

Bankfull Flow	
4.2	velocity (ft/s)
33.9	discharge rate (cfs)
0.75	Froude number

Flow Resistance	
0.035	Manning's roughness
0.14	D'Arcy-Weisbach fric.
12.6	resistance factor u/u*
52.1	relative roughness

Forces & Power	
1	channel slope (%)
0.60	shear stress (lb/sq.ft.)
0.56	shear velocity (ft/s)
3.4	unit strm power (lb/ft/s)

Cross Section 11 Reach 3



Bankfull Dimensions	
69.7	x-section area (ft.sq.)
24.7	width (ft)
2.8	mean depth (ft)
5.2	max depth (ft)
29.1	wetted parimeter (ft)
2.4	hyd radi (ft)
8.8	width-depth ratio

Flood Dimensions	
---	W flood prone area (ft)
---	entrenchment ratio
3.6	low bank height (ft)
0.7	low bank height ratio

Materials	
1.6	D50 Riffle (mm)
7.6	D84 Riffle (mm)
---	threshold grain size (mm):

Rosgen Stream Type

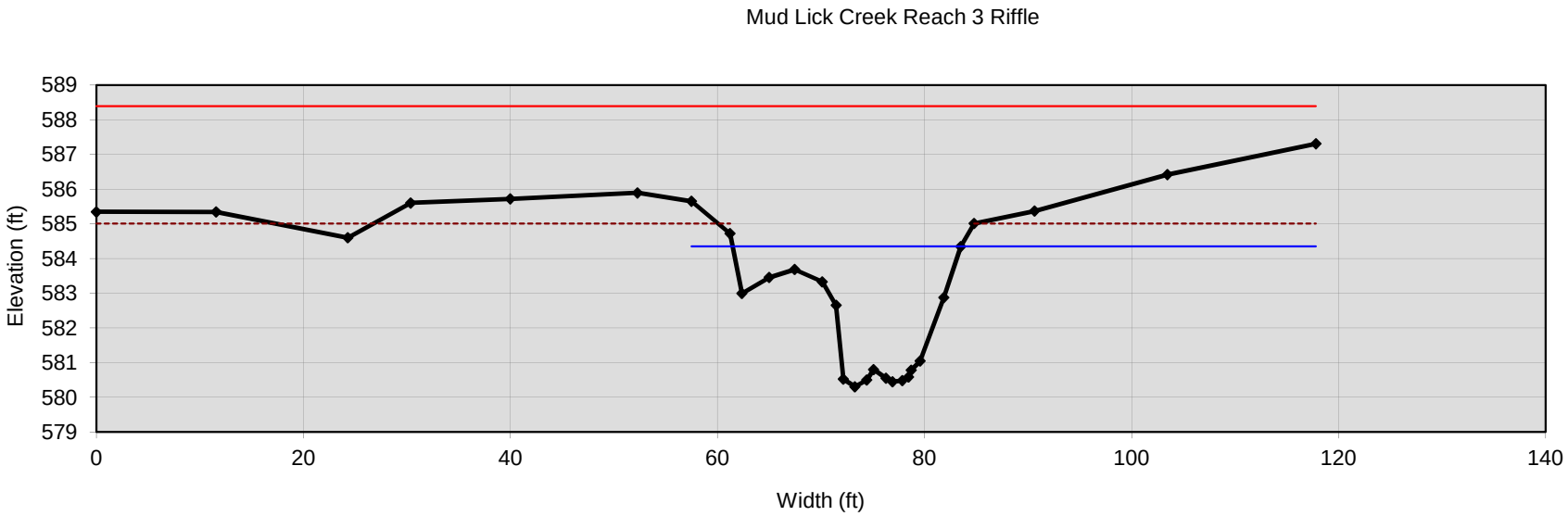
/

Bankfull Flow	
---	velocity (ft/s)
---	discharge rate (cfs)
---	Froude number

Flow Resistance	
0.020	Manning's roughness
0.04	D'Arcy-Weisbach fric.
14.9	resistance factor u/u*
113.1	relative roughness

Forces & Power	
---	channel slope (%)
---	shear stress (lb/sq.ft.)
---	shear velocity (ft/s)
---	unit strm power (lb/ft/s)

Cross Section 12 Reach 3



Bankfull Dimensions	
46.3	x-section area (ft.sq.)
22.0	width (ft)
2.1	mean depth (ft)
4.0	max depth (ft)
26.0	wetted parimeter (ft)
1.8	hyd radi (ft)
10.5	width-depth ratio

Flood Dimensions	
336.0	W flood prone area (ft)
15.2	entrenchment ratio
4.7	low bank height (ft)
1.2	low bank height ratio

Materials	
1.6	D50 Riffle (mm)
7.6	D84 Riffle (mm)
16	threshold grain size (mm):

Rosgen Stream Type

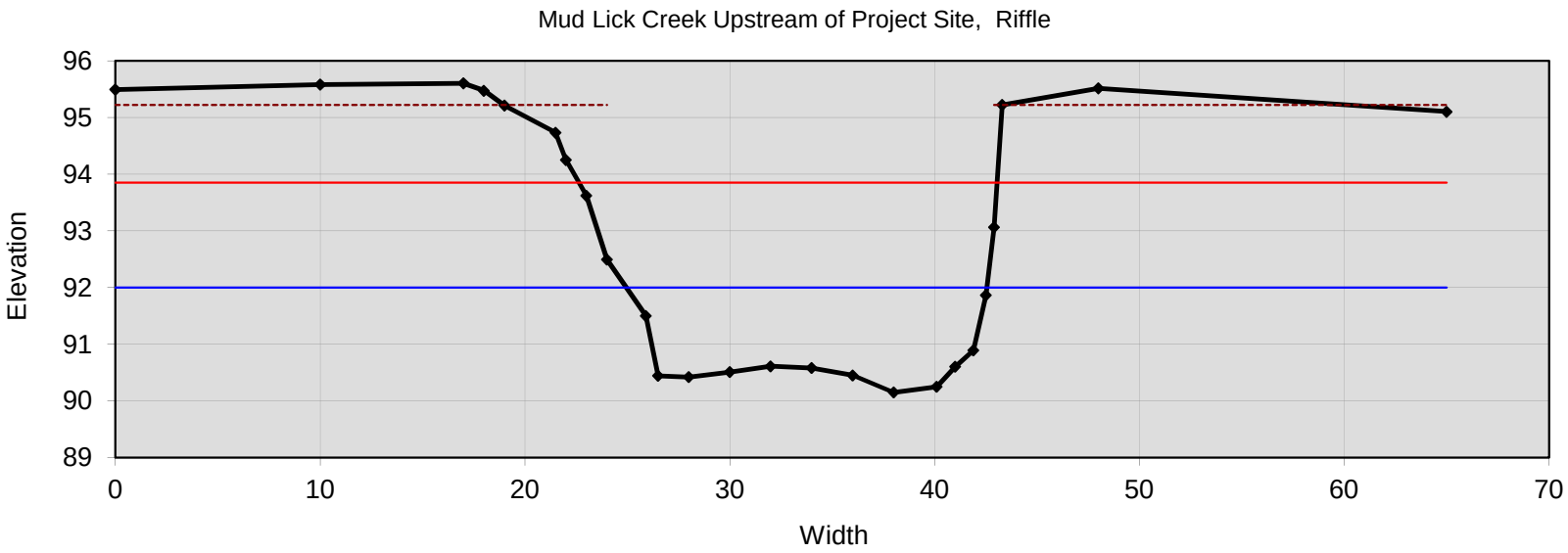
C4/E4

Bankfull Flow	
3.4	velocity (ft/s)
158.3	discharge rate (cfs)
0.45	Froude number

Flow Resistance	
0.035	Manning's roughness
0.12	D'Arcy-Weisbach fric.
14.2	resistance factor u/u*
84.1	relative roughness

Forces & Power	
0.3	channel slope (%)
0.33	shear stress (lb/sq.ft.)
0.41	shear velocity (ft/s)
1.34	unit strm power (lb/ft/s)

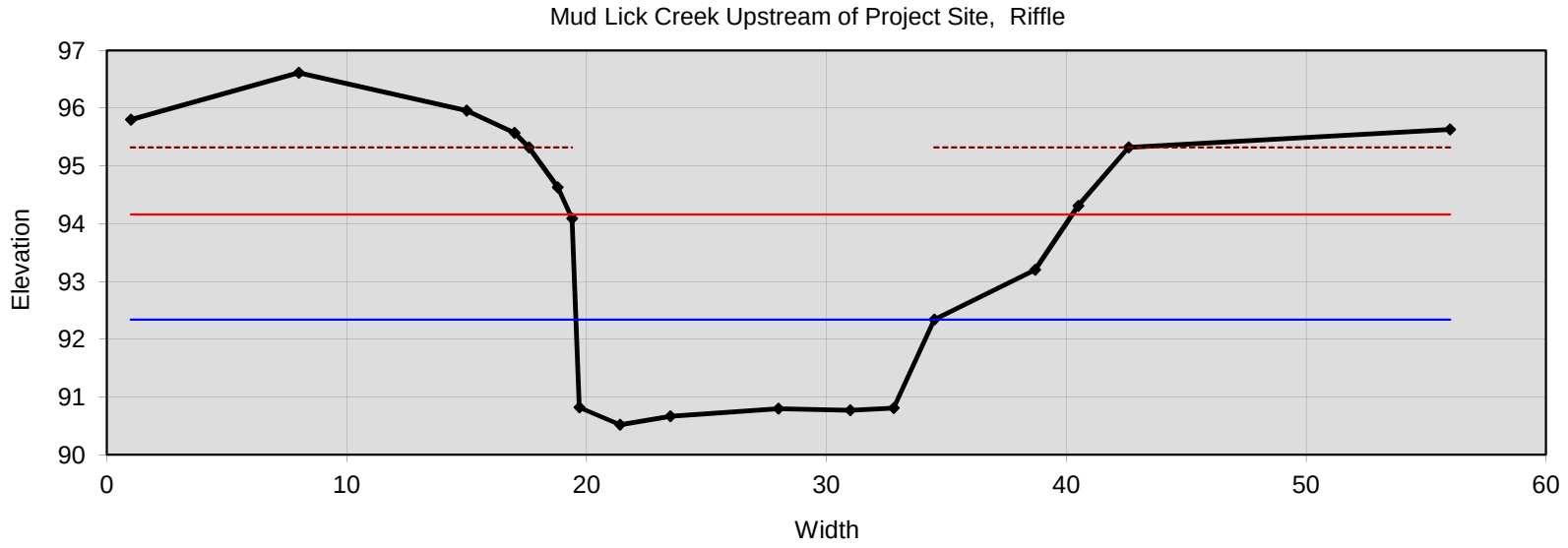
Cross Section 13



Bankfull Dimensions		Flood Dimensions		Materials	
25.0	x-section area (ft.sq.)	22.0	W flood prone area (ft)	---	D50 (mm)
17.6	width (ft)	1.2	entrenchment ratio	---	D84 (mm)
1.4	mean depth (ft)	5.1	low bank height (ft)	8	threshold grain size (mm):
1.8	max depth (ft)	2.7	low bank height ratio		
19.1	wetted parimeter (ft)				
1.3	hyd radi (ft)				
12.4	width-depth ratio				

Bankfull Flow		Flow Resistance		Forces & Power	
2.1	velocity (ft/s)	0.038	Manning's roughness	0.2	channel slope (%)
52.6	discharge rate (cfs)	0.15	D'Arcy-Weisbach fric.	0.16	shear stress (lb/sq.ft.)
0.32	Froude number	---	resistance factor u/u*	0.29	shear velocity (ft/s)
		---	relative roughness	0.37	unit strm power (lb/ft/s)

Cross Section 14



Bankfull Dimensions	
22.6	x-section area (ft.sq.)
14.9	width (ft)
1.5	mean depth (ft)
1.8	max depth (ft)
16.9	wetted parimeter (ft)
1.3	hyd radi (ft)
9.9	width-depth ratio

Flood Dimensions	
41.3	W flood prone area (ft)
2.8	entrenchment ratio
4.8	low bank height (ft)
2.6	low bank height ratio

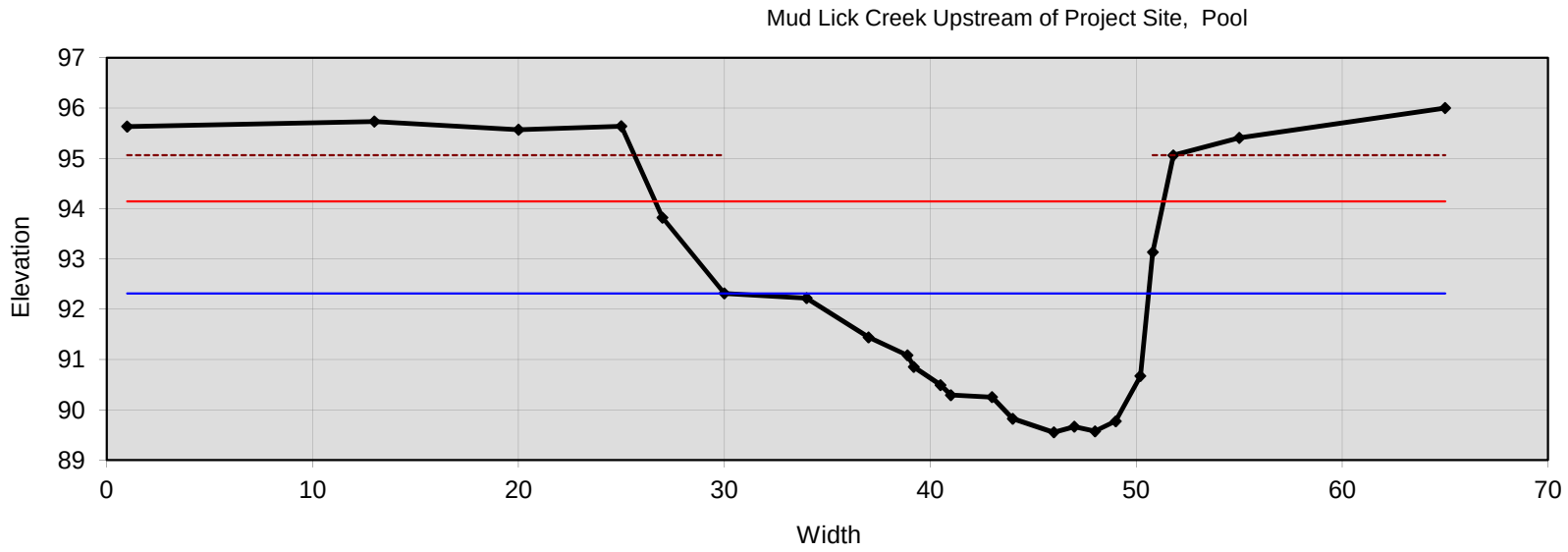
Materials	
---	D50 (mm)
---	D84 (mm)
8	threshold grain size (mm):

Bankfull Flow	
2.2	velocity (ft/s)
49.3	discharge rate (cfs)
0.33	Froude number

Flow Resistance	
0.037	Manning's roughness
0.14	D'Arcy-Weisbach fric.
---	resistance factor u/u*
---	relative roughness

Forces & Power	
0.2	channel slope (%)
0.17	shear stress (lb/sq.ft.)
0.29	shear velocity (ft/s)
0.41	unit strm power (lb/ft/s)

Cross Section 15

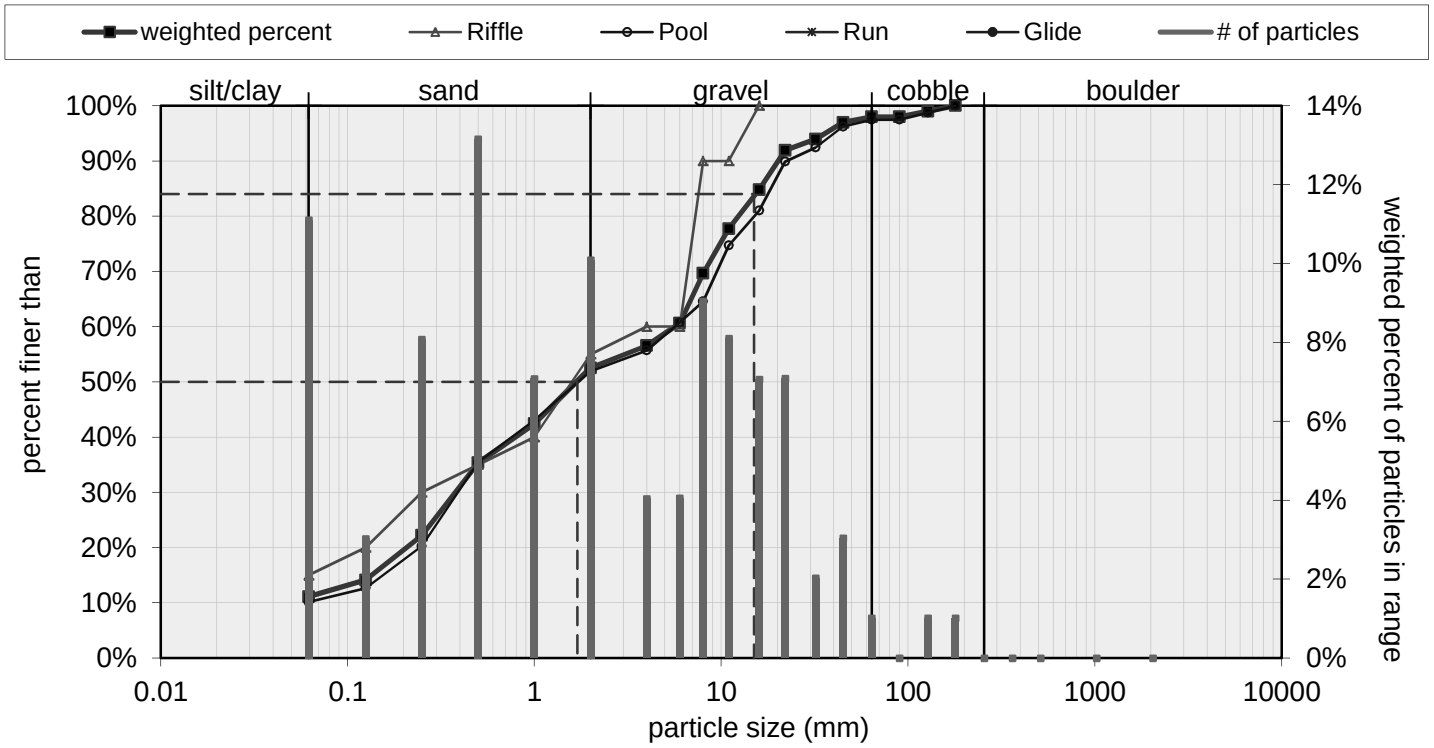


Bankfull Dimensions		Flood Dimensions		Materials	
29.6	x-section area (ft.sq.)	25.8	W flood prone area (ft)	---	D50 (mm)
20.6	width (ft)	1.3	entrenchment ratio	---	D84 (mm)
1.4	mean depth (ft)	5.5	low bank height (ft)	8	threshold grain size (mm):
2.8	max depth (ft)	2.0	low bank height ratio		
22.6	wetted parimeter (ft)				
1.3	hyd radi (ft)				
14.3	width-depth ratio				

Bankfull Flow		Flow Resistance		Forces & Power	
2.2	velocity (ft/s)	0.037	Manning's roughness	0.2	channel slope (%)
63.7	discharge rate (cfs)	0.15	D'Arcy-Weisbach fric.	0.16	shear stress (lb/sq.ft.)
0.33	Froude number	---	resistance factor u/u*	0.29	shear velocity (ft/s)
		---	relative roughness	0.39	unit strm power (lb/ft/s)

Weighted pebble count by bed features Mud Lick Creek R1

20% riffle 80% pool



0%

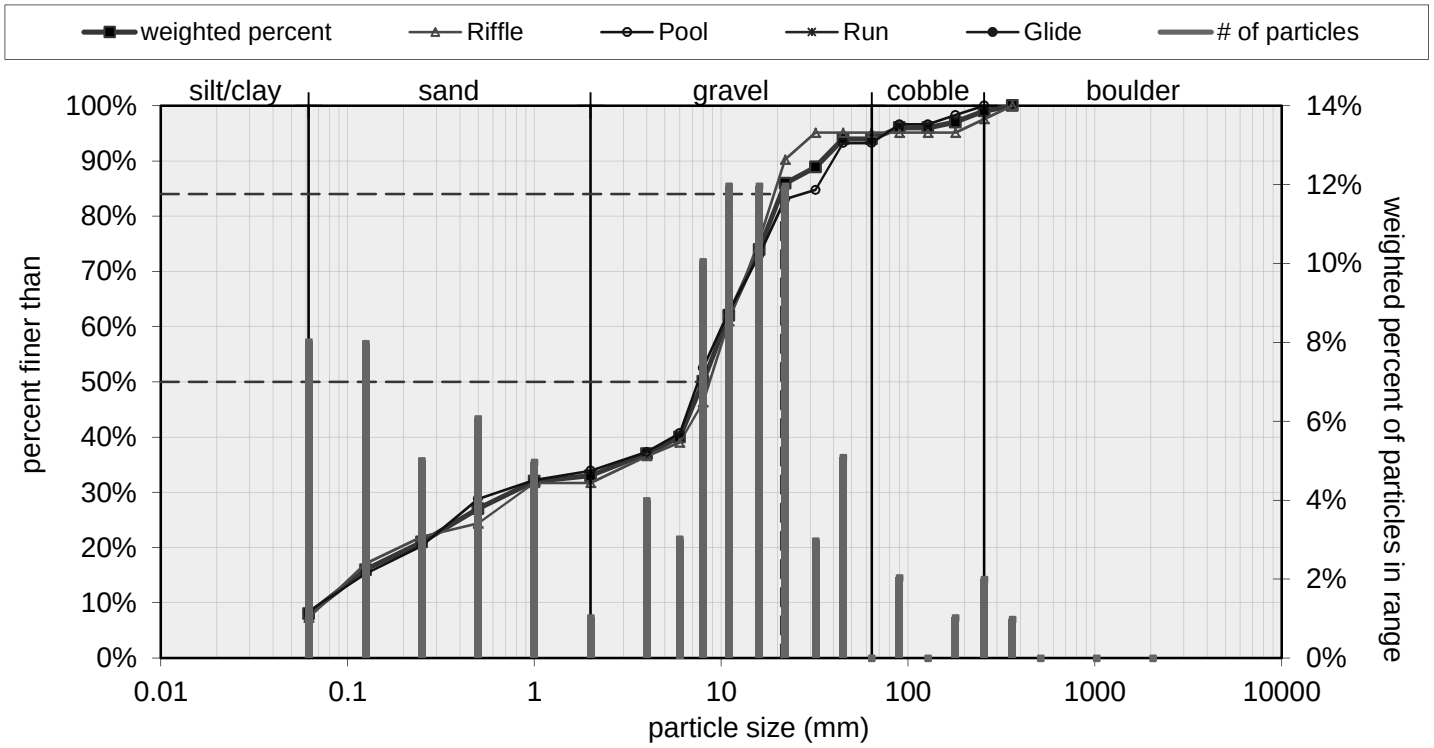
Size (mm)	
D16	0.15
D35	0.49
D50	1.7
D65	6.9
D84	15
D95	36

Size Distribution	
mean	1.5
dispersion	10.1
skewness	-0.04

Type			
silt/clay	11%	bedrock	1%
sand	41%		
gravel	45%		
cobble	2%		
boulder	0%		

Weighted pebble count by bed features Mud Lick Creek R2

40% riffle 60% pool



0%

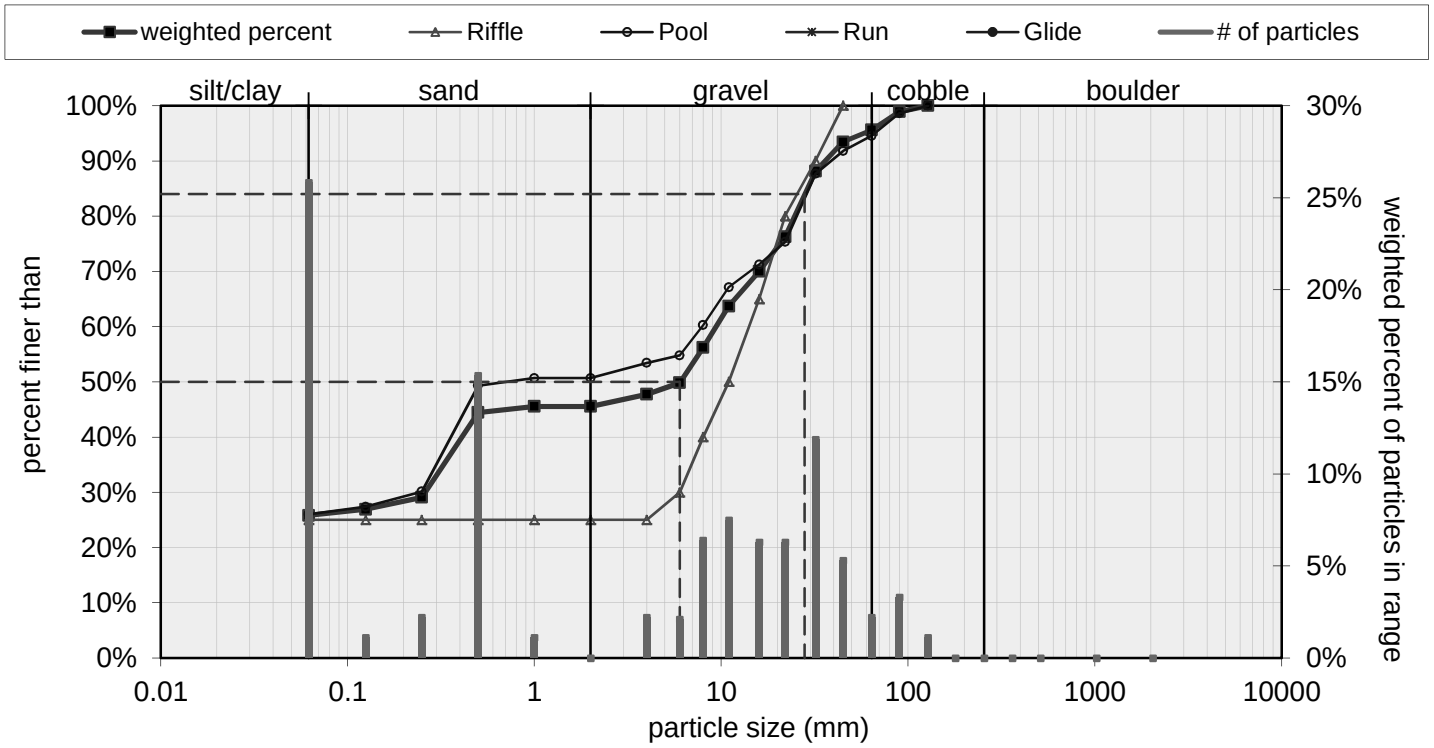
Size (mm)	
D16	0.13
D35	2.8
D50	8
D65	12
D84	21
D95	76

Size Distribution	
mean	1.7
dispersion	32.1
skewness	-0.46

Type	
silt/clay	8%
sand	25%
gravel	61%
cobble	5%
boulder	1%

Weighted pebble count by bed features Mud Lick Creek R3

20% riffle 80% pool



0%

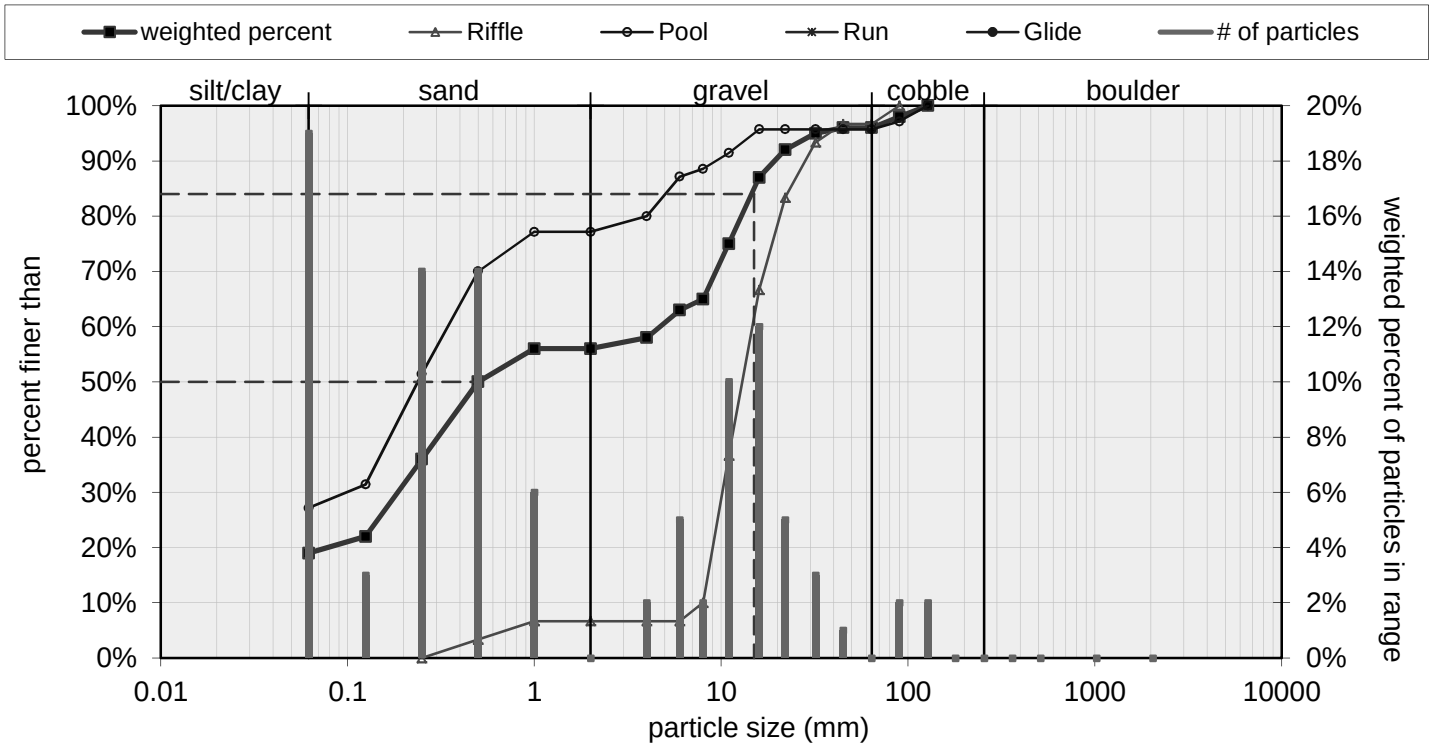
Size (mm)	
D16	0.062
D35	0.33
D50	6
D65	12
D84	28
D95	58

Size Distribution	
mean	1.3
dispersion	50.7
skewness	-0.40

Type			
silt/clay	24%	bedrock	8%
sand	18%		
gravel	46%		
cobble	4%		
boulder	0%		

Weighted pebble count by bed features North Branch

30% riffle 70% pool



0%

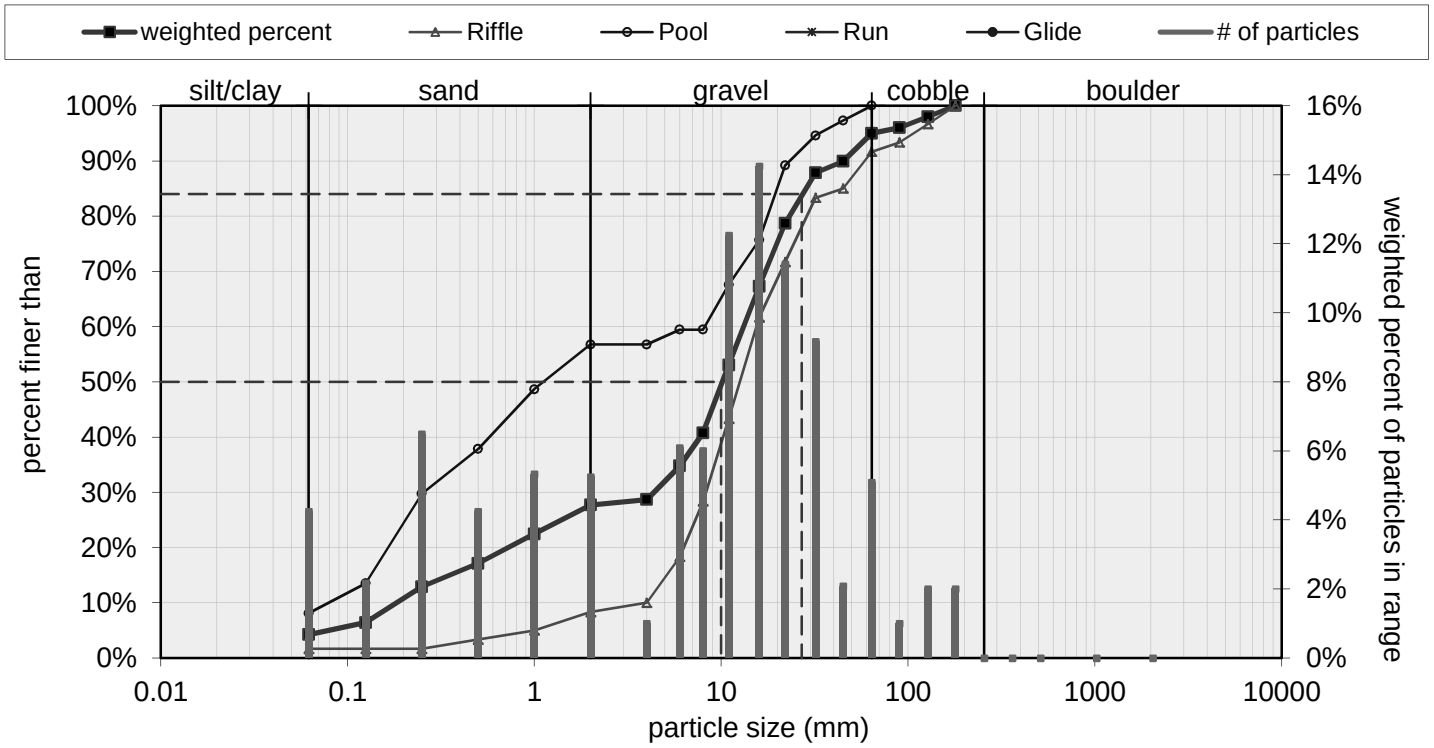
Size (mm)	
D16	0.062
D35	0.24
D50	0.5
D65	8
D84	15
D95	32

Size Distribution	
mean	1.0
dispersion	19.0
skewness	0.18

Type			
silt/clay	19%	bedrock	1%
sand	37%		
gravel	40%		
cobble	4%		
boulder	0%		

Weighted pebble count by bed features East Branch

60% riffle 40% pool



0%

Size (mm)	
D16	0.42
D35	6.1
D50	10
D65	15
D84	27
D95	64

Size Distribution	
mean	3.4
dispersion	13.3
skewness	-0.35

Type			
silt/clay	4%	bedrock	3%
sand	23%		
gravel	65%		
cobble	5%		
boulder	0%		

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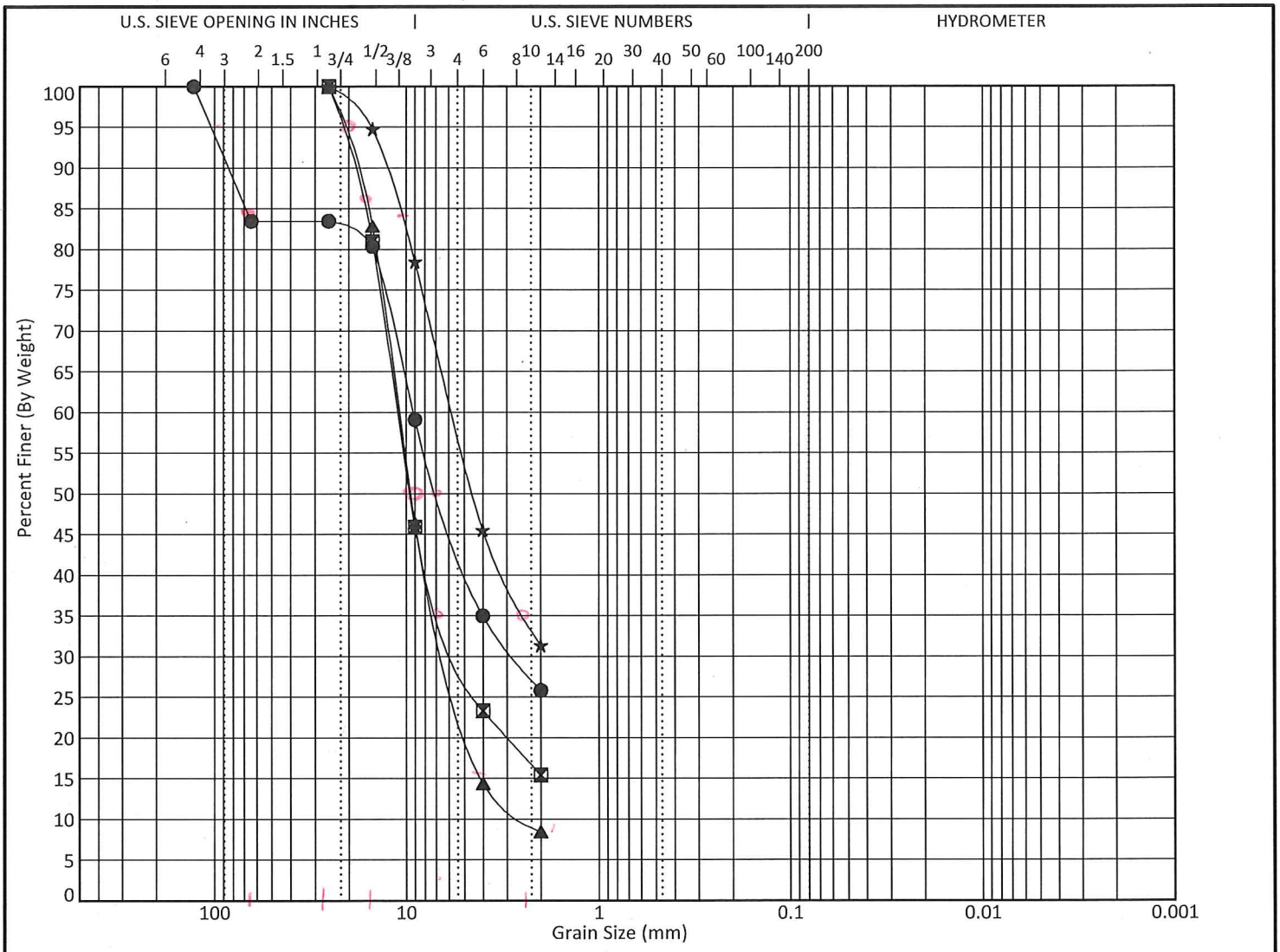
GRAIN SIZE DISTRIBUTION

Project No: 66S-0148
Client: Wildlands Engineering
Project: Mud Lick Creek
City/State: Chatam Co. NC



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Sample No.		Depth	Location	LL	PL	PI	Cc	Cu
●	01	at	0.0	Mud Lick Creek Reach 1 Pavement	NP	NP	NP		
⊠	02	at	0.0	Mud Lick Creek Reach 1 Subpavement	NP	NP	NP		
▲	03	at	0.0	Mud Lick Creek Reach 2 Pavement	NP	NP	NP	1.35	4.54
★	04	at	0.0	Mud Lick Creek Reach 2 Subpavement	NP	NP	NP		

	Sample No.		Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	01	at	0.0	128	9.193	2.739		47.2			
⊠	02	at	0.0	25.4	11.049	5.08		71.9			
▲	03	at	0.0	25.4	10.888	5.937	2.396	78.8			
★	04	at	0.0	25.4	5.707			47.5			

US_GRAIN_SIZE 66S-0148.GPJ F&R.GDT 7/29/14

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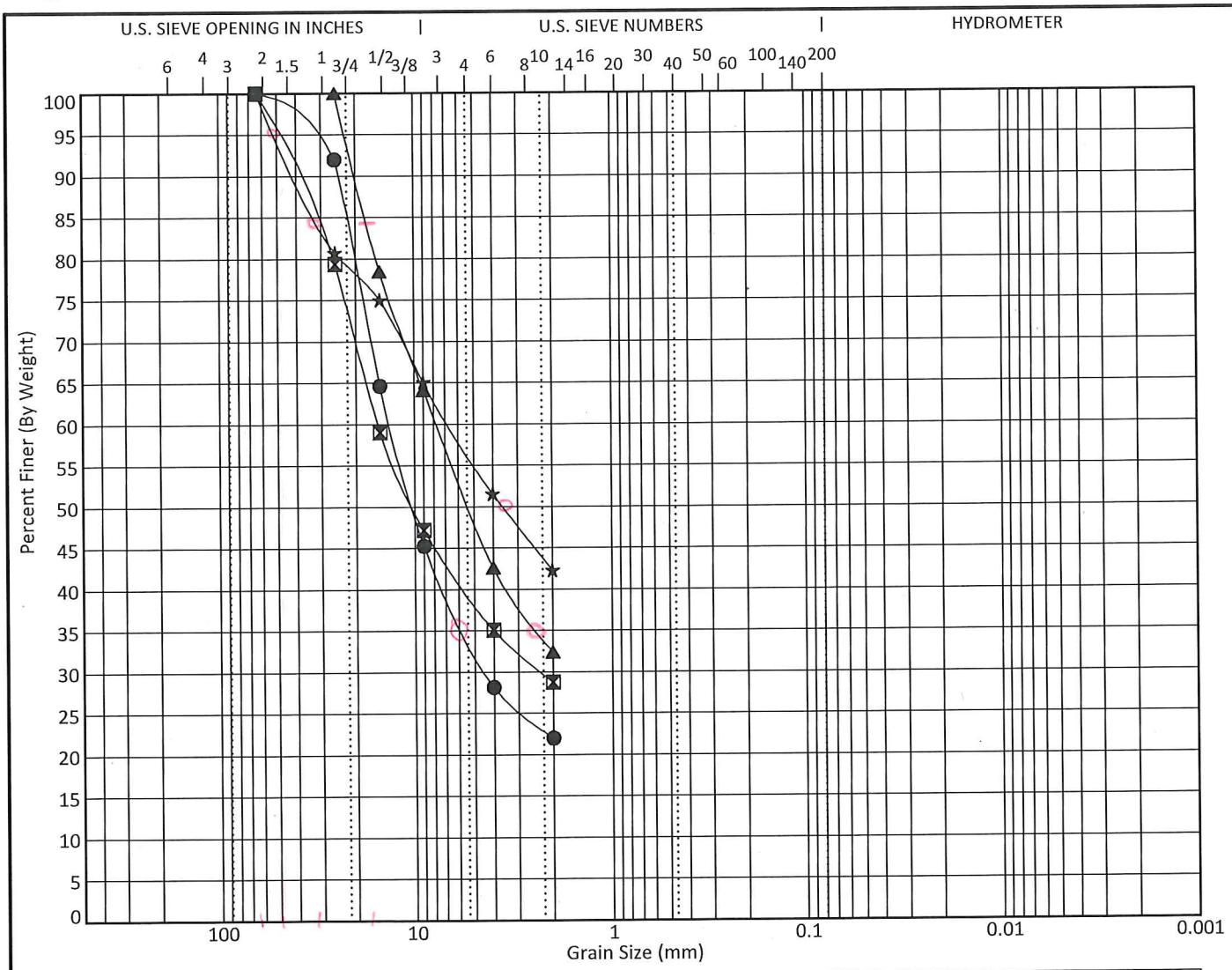
Client: Wildlands Engineering
Project: Mud Lick Creek
City/State: Chatam Co. NC



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Sample No.		Depth	Location	LL	PL	PI	Cc	Cu
●	05 at	0.0	Mud Lick Creek Reach 3 Pavement	NP	NP	NP		
⊠	06 at	0.0	Mud Lick Creek Reach 3 Subpavement	NP	NP	NP		
▲	07 at	0.0	North Branch Reach 1 Pavement	NP	NP	NP		
★	08 at	0.0	North Branch 1 Subpavement	NP	NP	NP		

Sample No.		Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	05 at	0.0	64	13.265	4.362		68.2			
⊠	06 at	0.0	64	15.371	2.293		62.4			
▲	07 at	0.0	25.4	7.704			52.8			
★	08 at	0.0	64	6.629			45.6			

US_GRAIN_SIZE 66S-0148.GPJ F&R.GDT 7/29/14

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GRAIN SIZE DISTRIBUTION

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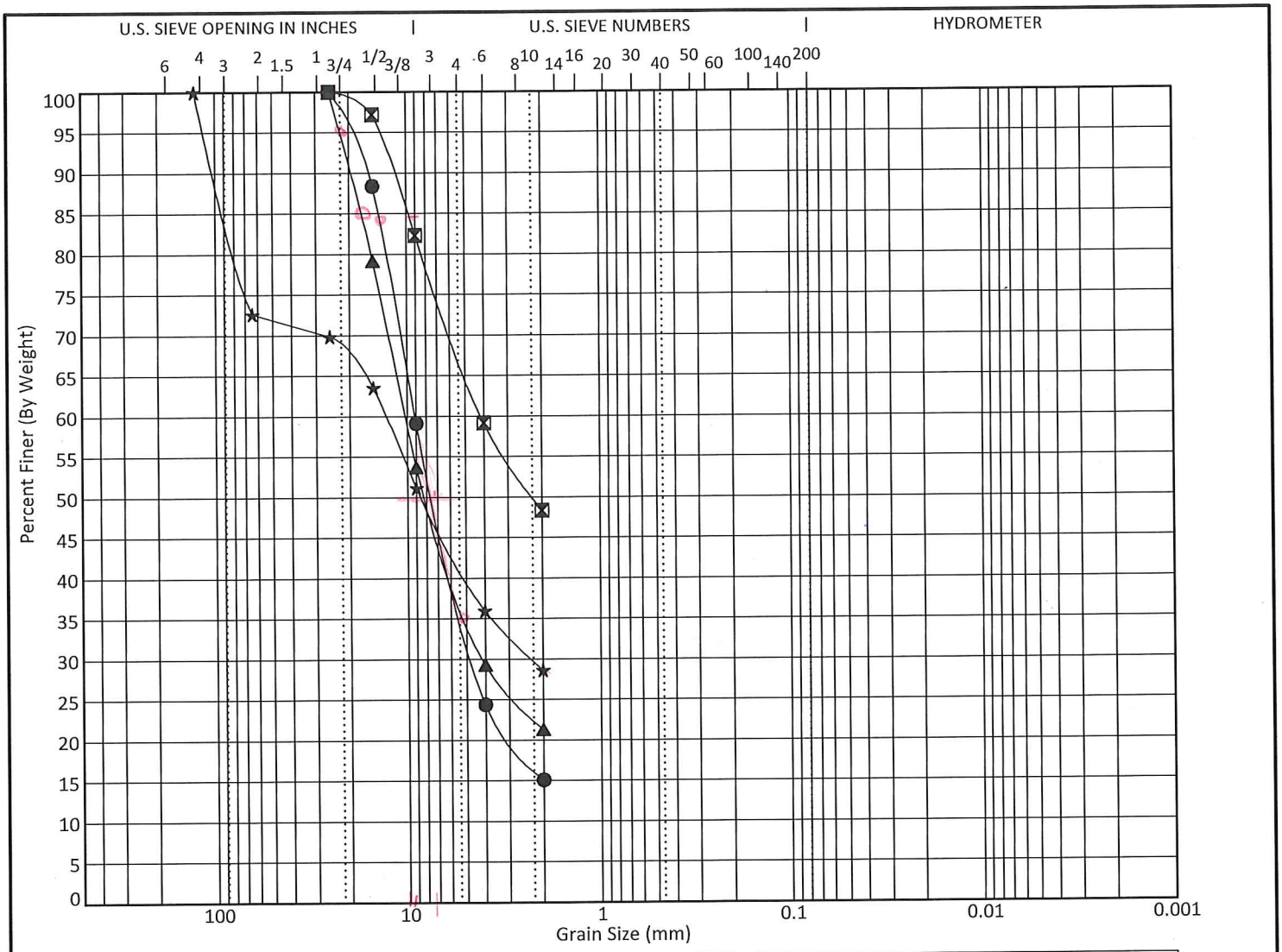
Client: Wildlands Engineering
Project: Mud Lick Creek
City/State: Chatam Co. NC



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Sample No.		Depth	Location	LL	PL	PI	Cc	Cu
● 09	at	0.0	North Branch Reach 2 Pavement	NP	NP	NP		
⊠ 10	at	0.0	North Branch Reach 2 Subpavement					
▲ 11	at	0.0	East Branch Reach 1 Pavement	NP	NP	NP		
★ 12	at	0.0	East Branch Reach 1 Subpavement	NP	NP	NP		

Sample No.		Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● 09	at	0.0	25.4	9.136	4.558		68.2			
⊠ 10	at	0.0	25.4	4.12			35.9			
▲ 11	at	0.0	25.4	10.209	4.095		65.5			
★ 12	at	0.0	128	12.954	2.273		39.7			

US_GRAIN_SIZE 66S-0148.GPJ F&R.GDT 7/29/14

APPENDIX 5: USACE Wetland Data Forms

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont

Project/Site: Mud Lick Creek Mitigation Site City/County: Chatham Sampling Date: 8/22/13

Applicant/Owner: Wildlands Engineering State: NC Sampling Point: Wetland A - DP1

Investigator(s): Ian Eckardt Section, Township, Range:

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

Subregion (LRR or MLRA): MLRA 136 Lat: N 35.812806 Long: W 79.434493 Datum:

Soil Map Unit Name: Nanford-Badin complex (NaC) NWI classification:

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 located in the left floodplain of Mud Lick Creek. The vegetation has been routinely managed at the sampling location.

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)
- ___ True Aquatic Plants (B14)
- ___ 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)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ✓	No ____	Depth (inches): 2
Water Table Present?	Yes ____	No ____	Depth (inches): -
Saturation Present? (includes capillary fringe)	Yes ✓	No ____	Depth (inches): <12

Wetland Hydrology Present? **Yes ✓** **No ____**

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

Remarks:

VEGETATION (Four Strata) – Use scientific names of plants.

Sampling Point: Wetland A - DP1

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: 15')			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
	= Total Cover		
Herb Stratum (Plot size: 5')			
1. Polygonum pensylvanicum	50	Yes	FACW
2. Eleocharis spp.	20	Yes	FACW-OBL
3. Ludwigia spp.	20	Yes	FACW-OBL
4. Fescue spp.	10	No	FAC
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	100 = Total Cover		
Woody Vine Stratum (Plot size: 30')			
1.			
2.			
3.			
4.			
5.			
6.			
	= 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:

✓ 1 - Rapid Test for Hydrophytic Vegetation

___ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vine – All woody vines greater than 3.28 ft in height.

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

Remarks: (Include photo numbers here or on a separate sheet.)

Feature is located in a maintained farm field. Routine maintenance has removed tree strata.

SOIL

Sampling Point: Wetland A - 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
0-8	10YR 4/2	85	7.5YR 4/6	15	C	PL	clay loam	
8-12	2.5Y 6/3	90	7.5YR 4/6	10	C	PL	clay loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked 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)
- ___ 2 cm Muck (A10) **(LRR N)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1) **(LRR N, MLRA 147, 148)**
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
- ___ Thin Dark Surface (S9) **(MLRA 147, 148)**
- ___ Loamy Gleyed Matrix (F2)
- ✓ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
- ___ Umbric Surface (F13) **(MLRA 136, 122)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 148)**

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) **(MLRA 147)**
- ___ Coast Prairie Redox (A16) **(MLRA 147, 148)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** ✓ **No** ___

Remarks:

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont

Project/Site: Mud Lick Creek Mitigation Site City/County: Chatham Sampling Date: 8/22/13

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

Investigator(s): Ian Eckardt Section, Township, Range:

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

Subregion (LRR or MLRA): MLRA 136 Lat: N 35.812971 Long: W 79.434552 Datum:

Soil Map Unit Name: Nanford-Badin complex (NaC) NWI classification:

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 located in the left floodplain of Mud Lick Creek. The vegetation has been routinely managed at the sampling location.

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)
- ___ True Aquatic Plants (B14)
- ___ 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)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ 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 (Four Strata) – Use scientific names of plants.

Sampling Point: Upland - DP2

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: 15')			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
	= Total Cover		
Herb Stratum (Plot size: 5')			
1. Eulalia viminea	79	Yes	FAC
2. Festuca spp.	20	Yes	FAC
3. Solanum carolinense	1	No	FACU
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	100 = Total Cover		
Woody Vine Stratum (Plot size: 30')			
1.			
2.			
3.			
4.			
5.			
6.			
	= Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (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:

- ___ 1 - Rapid Test for Hydrophytic Vegetation
- ✓ 2 - Dominance Test is >50%
- ___ 3 - Prevalence Index is ≤3.0[1]
- ___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vine – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** ✓ **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)

Feature is located in a maintained farm field. Routine maintenance has removed tree strata.

SOIL

Sampling Point: Upland - 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
0-5	10YR 5/3	95	7YR 4/6	5	C	PL	clay loam	
5-12	10YR 5/4	100					loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked 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)
- ___ 2 cm Muck (A10) **(LRR N)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1) **(LRR N, MLRA 147, 148)**
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
- ___ Thin Dark Surface (S9) **(MLRA 147, 148)**
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
- ___ Umbric Surface (F13) **(MLRA 136, 122)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 148)**

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) **(MLRA 147)**
- ___ Coast Prairie Redox (A16) **(MLRA 147, 148)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

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

Remarks:

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont

Project/Site: Mud Lick Creek Mitigation Site City/County: Chatham Sampling Date: 8/22/13

Applicant/Owner: Wildlands Engineering State: NC Sampling Point: Upland - DP3

Investigator(s): Ian Eckardt Section, Township, Range: _____

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

Subregion (LRR or MLRA): MLRA 136 Lat: N 35.813487 Long: W 79.435312 Datum: _____

Soil Map Unit Name: Nanford-Badin complex (NaC) NWI classification: _____

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 located in the right floodplain of Mud Lick Creek. The vegetation has been routinely managed at the sampling location.

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)
- ___ True Aquatic Plants (B14)
- ___ 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)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ 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 (Four Strata) – Use scientific names of plants.

Sampling Point: Upland - DP3

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: 15')			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
	= Total Cover		
Herb Stratum (Plot size: 5')			
1. Festuca spp.	100	Yes	FAC
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	100 = Total Cover		
Woody Vine Stratum (Plot size: 30')			
1.			
2.			
3.			
4.			
5.			
6.			
	= Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (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:

___ 1 - Rapid Test for Hydrophytic Vegetation

✓ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vine – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** ✓ **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)

Feature is located in a maintained farm field. Routine maintenance has removed tree strata.

SOIL

Sampling Point: Upland - DP3

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
0-7	7.5YR 5/3	100					loam	
7-12	10YR 6/4	100					loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked 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)
- ___ 2 cm Muck (A10) **(LRR N)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1) **(LRR N, MLRA 147, 148)**
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
- ___ Thin Dark Surface (S9) **(MLRA 147, 148)**
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
- ___ Umbric Surface (F13) **(MLRA 136, 122)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 148)**

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) **(MLRA 147)**
- ___ Coast Prairie Redox (A16) **(MLRA 147, 148)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

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

Remarks:

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont

Project/Site: Mud Lick Creek Mitigation Site City/County: Chatham Sampling Date: 8/22/13

Applicant/Owner: Wildlands Engineering State: NC Sampling Point: Wetland B - DP4

Investigator(s): Ian Eckardt Section, Township, Range:

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

Subregion (LRR or MLRA): MLRA 136 Lat: N 35.813199 Long: W 79.435076 Datum:

Soil Map Unit Name: Nanford-Badin complex (NaC) NWI classification:

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 located in the right floodplain of Mud Lick Creek. The feature is a linear concave depression that has standing water over a foot deep. Hydrophytic vegetation is present along the edge of the feature but doesn't account for more than 10% of the total cover.

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)
- ___ True Aquatic Plants (B14)
- ___ 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)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ✓	No _____	Depth (inches): 12
Water Table Present?	Yes _____	No ✓	Depth (inches): -
Saturation Present? (includes capillary fringe)	Yes ✓	No _____	Depth (inches): <12

Wetland Hydrology Present? Yes ✓ No _____

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

Remarks:

VEGETATION (Four Strata) – Use scientific names of plants.

Sampling Point: Wetland B - DP4

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: 15')			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
	= Total Cover		
Herb Stratum (Plot size: 5')			
1. Juncus effusus	5	Yes	FACW
2. Ludwigia spp.	5	Yes	FACW-OBL
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	10 = Total Cover		
Woody Vine Stratum (Plot size: 30')			
1.			
2.			
3.			
4.			
5.			
6.			
	= 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:

✓ 1 - Rapid Test for Hydrophytic Vegetation

___ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vine – All woody vines greater than 3.28 ft in height.

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

Remarks: (Include photo numbers here or on a separate sheet.)

The feature is located in a linear concave depression that was inundated with over a foot of water. Hydrophytic vegetation is present along the water's edge but doesn't account for more than 10% of the total cover.

SOIL

Sampling Point: Wetland B - DP4

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	2.5Y 5/2	95	7.5YR 4/6	5	C	PL	clay silt	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked 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)
- ___ 2 cm Muck (A10) **(LRR N)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1) **(LRR N, MLRA 147, 148)**
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
- ___ Thin Dark Surface (S9) **(MLRA 147, 148)**
- ___ Loamy Gleyed Matrix (F2)
- ✓ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
- ___ Umbric Surface (F13) **(MLRA 136, 122)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 148)**

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) **(MLRA 147)**
- ___ Coast Prairie Redox (A16) **(MLRA 147, 148)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

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

Remarks:

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont

Project/Site: Foust Creek Mitigation Site City/County: Chatham Sampling Date: 8/22/13

Applicant/Owner: Wildlands Engineering State: NC Sampling Point: Upland - DP5

Investigator(s): Ian Eckardt Section, Township, Range: _____

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

Subregion (LRR or MLRA): MLRA 136 Lat: N 35.812575 Long: W 79.435253 Datum: _____

Soil Map Unit Name: Cid-Lignum complex (CmB) NWI classification: _____

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 located in the right floodplain of Mud Lick Creek. The vegetation has been routinely managed at the sampling location.

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)
- ___ True Aquatic Plants (B14)
- ___ 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)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ 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 (Four Strata) – Use scientific names of plants.

Sampling Point: Upland - DP5

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: 15')			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
	= Total Cover		
Herb Stratum (Plot size: 5')			
1. Festuca spp.	100	Yes	FAC
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	100 = Total Cover		
Woody Vine Stratum (Plot size: 30')			
1.			
2.			
3.			
4.			
5.			
6.			
	= Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (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:

- ___ 1 - Rapid Test for Hydrophytic Vegetation
- ✓ 2 - Dominance Test is >50%
- ___ 3 - Prevalence Index is ≤3.0[1]
- ___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vine – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** ✓ **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)

Feature is located in a maintained farm field. Routine maintenance has removed tree strata.

SOIL

Sampling Point: Upland - DP5

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
0-5	10YR 5/2	85	7.5YR 4/6	15	C	PL	loam	
5-12	10YR 6/6	100					loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked 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)
- ___ 2 cm Muck (A10) **(LRR N)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1) **(LRR N, MLRA 147, 148)**
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
- ___ Thin Dark Surface (S9) **(MLRA 147, 148)**
- ___ Loamy Gleyed Matrix (F2)
- ✓ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
- ___ Umbric Surface (F13) **(MLRA 136, 122)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 148)**

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) **(MLRA 147)**
- ___ Coast Prairie Redox (A16) **(MLRA 147, 148)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

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

Remarks:

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont

Project/Site: Mud Lick Creek Mitigation Site City/County: Chatham Sampling Date: 8/22/13

Applicant/Owner: Wildlands Engineering State: NC Sampling Point: Wetland C - DP6

Investigator(s): Ian Eckardt Section, Township, Range:

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

Subregion (LRR or MLRA): MLRA 136 Lat: N 35.812417 Long: W 79.435465 Datum:

Soil Map Unit Name: Cid-Lignum complex (CmB) NWI classification:

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 located in the right floodplain of Mud Lick Creek. The feature is a linear concave depression that has standing water over a foot deep. Hydrophytic vegetation is present along the edge of the feature but doesn't account for more than 15% of the total cover.

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)
- ___ True Aquatic Plants (B14)
- ___ 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)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ✓ No _____ Depth (inches): 12

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

Saturation Present? (includes capillary fringe) Yes ✓ No _____ Depth (inches): <12

Wetland Hydrology Present? Yes ✓ No _____

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

Remarks:

VEGETATION (Four Strata) – Use scientific names of plants.

Sampling Point: Wetland C - DP6

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum (Plot size: 30')			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: 15')			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
	= Total Cover		
Herb Stratum (Plot size: 5')			
1. Juncus effusus	5	Yes	FACW
2. Ludwigia spp.	5	Yes	FACW-OBL
3. Polygonum pensylvanicum	5	Yes	FACW
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	15 = Total Cover		
Woody Vine Stratum (Plot size: 30')			
1.			
2.			
3.			
4.			
5.			
6.			
	= 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:

✓ 1 - Rapid Test for Hydrophytic Vegetation

___ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vine – All woody vines greater than 3.28 ft in height.

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

Remarks: (Include photo numbers here or on a separate sheet.)

The feature is located in a linear concave depression that was inundated with over a foot of water. Hydrophytic vegetation is present along the water's edge but doesn't account for more than 15% of the total cover.

SOIL

Sampling Point: Wetland C - DP6

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 5/1	100						

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked 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)
- ___ 2 cm Muck (A10) **(LRR N)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1) **(LRR N, MLRA 147, 148)**
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
- ___ Thin Dark Surface (S9) **(MLRA 147, 148)**
- ___ Loamy Gleyed Matrix (F2)
- ✓ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
- ___ Umbric Surface (F13) **(MLRA 136, 122)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 148)**

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) **(MLRA 147)**
- ___ Coast Prairie Redox (A16) **(MLRA 147, 148)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

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

Remarks:

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont

Project/Site: Foust Creek Mitigation Site City/County: Chatham Sampling Date: 8/22/13

Applicant/Owner: Wildlands Engineering State: NC Sampling Point: Upland - DP7

Investigator(s): Ian Eckardt Section, Township, Range: _____

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

Subregion (LRR or MLRA): MLRA 136 Lat: N 35.811936 Long: W 79.437361 Datum: _____

Soil Map Unit Name: Chewacla and Wehadkee soils (ChA) NWI classification: _____

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 located in the right floodplain of Mud Lick Creek. The vegetation has been routinely managed at the sampling location.

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)
- ___ True Aquatic Plants (B14)
- ___ 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)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ 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 (Four Strata) – Use scientific names of plants.

Sampling Point: Upland - DP7

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: 15')			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
	= Total Cover		
Herb Stratum (Plot size: 5')			
1. Festuca spp.	100	Yes	FAC
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	100 = Total Cover		
Woody Vine Stratum (Plot size: 30')			
1.			
2.			
3.			
4.			
5.			
6.			
	= Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (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:

___ 1 - Rapid Test for Hydrophytic Vegetation

✓ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vine – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** ✓ **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)

Feature is located in a maintained farm field. Routine maintenance has removed tree strata.

SOIL

Sampling Point: Upland - DP7

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
0-5	10YR 4/3	95	7.5YR 4/6	5	C	PL	loam	
5-12	10YR 5/4	80	7.5YR 4/6	20	C	PL	loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked 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)
- ___ 2 cm Muck (A10) **(LRR N)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1) **(LRR N, MLRA 147, 148)**
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
- ___ Thin Dark Surface (S9) **(MLRA 147, 148)**
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
- ___ Umbric Surface (F13) **(MLRA 136, 122)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 148)**

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) **(MLRA 147)**
- ___ Coast Prairie Redox (A16) **(MLRA 147, 148)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

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

Remarks:

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont

Project/Site: Mud Lick Creek Mitigation Site City/County: Chatham Sampling Date: 8/22/13

Applicant/Owner: Wildlands Engineering State: NC Sampling Point: Wetland D - DP8

Investigator(s): Ian Eckardt Section, Township, Range:

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

Subregion (LRR or MLRA): MLRA 136 Lat: N 35.811983 Long: W 79.437510 Datum:

Soil Map Unit Name: Chewacla and Wehadkee soils (ChA) NWI classification:

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 located in the right floodplain of Mud Lick Creek. The feature is located on the edge of a maintained cattle pasture and wooded area. Half of the vegetation has been routinely maintained and the tree strata has been removed in that portion of the feature.

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)
- ___ True Aquatic Plants (B14)
- ___ 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)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ✓ No ____ Depth (inches): 2

Water Table Present? Yes ____ No ✓ Depth (inches): -

Saturation Present? (includes capillary fringe) Yes ✓ No ____ Depth (inches): <12

Wetland Hydrology Present? Yes ✓ No ____

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

Remarks:

VEGETATION (Four Strata) – Use scientific names of plants.

Sampling Point: Wetland D - DP8

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1. Acer rubrum	10	Yes	FAC
2. Carpinus caroliniana	10	Yes	FACW
3. Fraxinus pennsylvanica	1	No	FACW
4.			
5.			
6.			
7.			
8.			
	21	= Total Cover	

Sapling/Shrub Stratum (Plot size: 15')			
1. Ilex opaca	5	Yes	FAC
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
	5	= Total Cover	

Herb Stratum (Plot size: 5')			
1. Eulalia viminea	30	Yes	FAC
2. Pontederia cordata	5	No	OBL
3. Saggitaria spp.	5	No	OBL
4. Lobelia cardinalis	1	No	FACW
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	41	= Total Cover	

Woody Vine Stratum (Plot size: 30')			
1. Smilax rotundifolia	10	Yes	FAC
2.			
3.			
4.			
5.			
6.			
	10	= Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 4 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (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:

___ 1 - Rapid Test for Hydrophytic Vegetation

✓ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vine – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** ✓ **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: Wetland D - DP8

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
0-7	2.5Y 6/1	85	7.5YR 4/6	15	C	PL	Clay loam	
7-12	2.5Y 6/1	80	7.5YR 4/6	20	C	PL	Clay loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked 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)
- ___ 2 cm Muck (A10) **(LRR N)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1) **(LRR N, MLRA 147, 148)**
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
- ___ Thin Dark Surface (S9) **(MLRA 147, 148)**
- ___ Loamy Gleyed Matrix (F2)
- ✓ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
- ___ Umbric Surface (F13) **(MLRA 136, 122)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 148)**

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) **(MLRA 147)**
- ___ Coast Prairie Redox (A16) **(MLRA 147, 148)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

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

Remarks:

APPENDIX 6: Categorical Exclusion

Categorical Exclusion Form for Ecosystem Enhancement Program Projects
Version 1.4

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

Part 1: General Project Information	
Project Name:	Mud Lick Creek Mitigation Site
County Name:	Chatham County
EEP Number:	# 93482
Project Sponsor:	Wildlands Engineering, Inc.
Project Contact Name:	Andrea S. Eckardt
Project Contact Address:	1430 S. Mint Street, Suite 104 Charlotte, NC 28203
Project Contact E-mail:	aeckardt@wildlandsinc.com
EEP Project Manager:	Perry Sugg

Project Description

The Mud Lick Mitigation site is a stream mitigation project located in northwest Chatham County, NC. The project is located on Mud Lick Creek and two unnamed tributaries. The project will provide stream mitigation units to NCEEP in the Cape Fear River Basin (03030003). The mitigation project involves a combination of stream restoration and enhancement.

For Official Use Only

Reviewed By:

9-11-2013
Date

EEP Project Manager

Conditional Approved By:

Date

For Division Administrator
FHWA

☐ **Check this box if there are outstanding issues**

Final Approval By:

10-9-13
Date

For Division Administrator
FHWA

Categorical Exclusion Form for Ecosystem Enhancement Program Projects
Version 1.4

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

Part 1: General Project Information	
Project Name:	Mud Lick Creek Mitigation Site
County Name:	Chatham County
EEP Number:	# 93482
Project Sponsor:	Wildlands Engineering, Inc.
Project Contact Name:	Andrea S. Eckardt
Project Contact Address:	1430 S. Mint Street, Suite 104 Charlotte, NC 28203
Project Contact E-mail:	aeckardt@wildlandsinc.com
EEP Project Manager:	Perry Sugg

Project Description

The Mud Lick Mitigation site is a stream mitigation project located in northwest Chatham County, NC. The project is located on Mud Lick Creek and two unnamed tributaries. The project will provide stream mitigation units to NCEEP in the Cape Fear River Basin (03030003). The mitigation project involves a combination of stream restoration and enhancement.

For Official Use Only

Reviewed By:

Date | **EEP Project Manager**

Conditional Approved By:

Date | **For Division Administrator FHWA**

☐ **Check this box if there are outstanding issues**

Final Approval By:

Date | **For Division Administrator FHWA**

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

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

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

National Historic Preservation Act (Section 106)

The National Historic Preservation Act declares a national policy of historic preservation to protect, rehabilitate, restore, and reuse districts, sites, buildings, structures, and objects significant in American architecture, history, archaeology and culture, and Section 106 mandates that federal agencies take into account the effect of an undertaking on a property which is included in, or eligible for inclusion in, the National Register of Historic Places.

Wildlands Engineering, Inc. (Wildlands) requested review and comment from the State Historic Preservation Office (SHPO) with respect to any archeological and architectural resources related to the Mud Lick Creek Mitigation Site on July 24, 2013. SHPO responded on September 3, 2013, and stated they were aware of no historic resources that would be affected by the project. All correspondence related to Section 106 is included in the Appendix.

Endangered Species Act (ESA)

Section 7 of the ESA requires federal agencies, in consultation with and with the assistance of the Secretary of the Interior or of Commerce, as appropriate, to ensure that actions they authorize, fund or carry out are not likely to jeopardize the continued existence of threatened or endangered species or result in the destruction or adverse modification of critical habitat for these species.

Wildlands requested review and comments from the United States Fish and Wildlife Service (USFWS) on July 24, 2013, in respect to the Mud Lick Creek Mitigation Site and its potential impacts on threatened or endangered species. USFWS responded on August 29, 2013 and stated that the proposed project is "not likely to adversely affect any federally-listed endangered or threatened species, their formally designated critical habitat, or species currently proposed for listing" and that the requirements of section 7(a)(2) of the Act "have been satisfied" for the project.

Based on a pedestrian survey performed August 22, 2013 of the project area, no individual species, critical habitat, nor suitable habitat was found to exist on the site. It is Wildlands' position that for the Chatham County listed endangered species (the bald eagle *Haliaeetus leucocephalus* (BGPA), Cape Fear shiner *Notropis mekistocholas*, red-cockaded woodpecker *Picoides borealis*, and harperella *Ptilimnium nodosum*) the Mud Lick Creek Mitigation Site's biological conclusion is "no effect". All correspondence with USFWS is included in the Appendix.

Fish and Wildlife Coordination Act (FWCA)

The FWCA requires consultation with the USFWS and the appropriate state wildlife agency on projects that alter or modify a water body. Reports and recommendations prepared by these agencies document project effects on wildlife and identify measures that may be adopted to prevent loss or damage to wildlife resources.

The Mud Lick Creek Mitigation Site includes stream restoration and enhancement; Wildlands requested comment on the project from both the USFWS and the North Carolina Wildlife Resources Commission (NCWRC) on July 24, 2013. NCWRC responded on August 2, 2013, and stated they "do not anticipate the project to result in significant adverse impacts to aquatic and terrestrial wildlife resources." USFWS responded on August 29, 2013 and recommended adequate sedimentation and erosion control measures be implemented. All correspondence with the two agencies is included in the Appendix.

Migratory Bird Treaty Act (MBTA)

The MBTA makes it unlawful for anyone to kill, capture, collect, possess, buy, sell, trade, ship, import, or export any migratory bird. The indirect killing of birds by destroying their nests and eggs is covered by this act, so construction in nesting areas during nesting seasons can constitute a taking.

Wildlands requested comment on the Mud Lick Creek Mitigation Site from the USFWS in regards to migratory birds on July 24, 2013. USFWS had no comments regarding migratory birds in their response dated August 29, 2013. All correspondence with USFWS is included in the Appendix.

Mud Lick Creek Mitigation Site
Categorical Exclusion

Appendix

WILDLANDS
ENGINEERING

July 24, 2013

Renee Gledhill-Earley
State Historic Preservation Office
4617 Mail Service Center
Raleigh, NC 27699-4617

Subject: EEP Stream Mitigation Project in Chatham County.
Mud Lick Creek 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 restoration project on the attached site (USGS site map with approximate areas of potential ground disturbance is enclosed).

The Mud Lick Creek site has been identified for the purpose of providing in-kind mitigation for unavoidable stream channel impacts. Several sections of channel have been identified as significantly degraded. No architectural structures or archeological artifacts have been observed or noted during preliminary surveys of the site for restoration purposes. The majority of the site has historically been disturbed due to agricultural purposes.

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

North Carolina Department of Cultural Resources

State Historic Preservation Office

Ramona M. Bartos, Administrator

Governor Pat McCrory
Secretary Susan Kluttz

Office of Archives and History
Deputy Secretary Kevin Cherry

September 3, 2013

Andrea Eckardt
Wildlands Engineering
1430 South Mint Street, 104
Charlotte, NC 28203

Re: Mud Lick Creek Mitigation, Chatham County, ER 13-1556

Dear Ms. Eckardt:

Thank you for your letter of July 24, 2013, 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, contact Renee Gledhill-Earley, environmental review coordinator, at 919-807-6579 or renee.gledhill-earley@ncdcr.gov. In all future communication concerning this project, please cite the above referenced tracking number.

Sincerely,

Renee Gledhill-Earley

for Ramona M. Bartos

WILDLANDS
ENGINEERING

July 24, 2013

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

Subject: Mud Lick Creek Mitigation Site, Chatham County, North Carolina

Dear Mr. Suiter,

The Mud Lick Creek Mitigation Site has been identified for the purpose of providing in-kind mitigation for unavoidable stream channel impacts. Several sections of channel throughout the site have been identified as significantly degraded as a result of past agricultural activities.

We have already obtained an updated species list for Chatham County from your web site (http://www.fws.gov/raleigh/species/cntylist/nc_counties.html). The threatened or endangered species for this county are: the bald eagle (*Haliaeetus leucocephalus*) (BGPA), Cape Fear shiner (*Notropis mekistocholas*), red-cockaded woodpecker (*Picoides borealis*), and harperella (*Ptilimnium nodosum*). 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 areas of potential ground disturbance is enclosed. Figure 1 was prepared from the Crutchfield Crossroads, NC 7.5-Minute Topographic Quadrangle.

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.

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

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Raleigh Field Office
Post Office Box 33726
Raleigh, North Carolina 27636-3726

August 29, 2013

Andrea Eckardt
Wildlands Engineering, Inc.
1430 S. Mint Street
Charlotte, NC 28203

Re: Mud Lick Creek Mitigation Site- Chatham County, NC

Dear Ms. Eckardt:

This letter is to inform you that a list of all federally-protected endangered and threatened species with known occurrences in North Carolina is now available on the U.S. Fish and Wildlife Service's (Service) web page at http://www.fws.gov/raleigh. Therefore, if you have projects that occur within the Raleigh Field Office's area of responsibility (see attached county list), you no longer need to contact the Raleigh Field Office for a list of federally-protected species.

Our web page contains a complete and frequently updated list of all endangered and threatened species protected by the provisions of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.)(Act), and a list of federal species of concern[1] that are known to occur in each county in North Carolina.

Section 7 of the Act requires that all federal agencies (or their designated non-federal representative), in consultation with the Service, insure that any action federally authorized, funded, or carried out by such agencies is not likely to jeopardize the continued existence of any federally-listed endangered or threatened species. A biological assessment or evaluation may be prepared to fulfill that requirement and in determining whether additional consultation with the Service is necessary. In addition to the federally-protected species list, information on the species' life histories and habitats and information on completing a biological assessment or evaluation and can be found on our web page at http://www.fws.gov/raleigh. Please check the web site often for updated information or changes.

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[1] The term "federal species of concern" refers to those species which the Service believes might be in need of concentrated conservation actions. Federal species of concern receive no legal protection and their designation does not necessarily imply that the species will eventually be proposed for listing as a federally endangered or threatened species. However, we recommend that all practicable measures be taken to avoid or minimize adverse impacts to federal species of concern.

If your project contains suitable habitat for any of the federally-listed species known to be present within the county where your project occurs, the proposed action has the potential to adversely affect those species. As such, we recommend that surveys be conducted to determine the species' presence or absence within the project area. The use of North Carolina Natural Heritage program data should not be substituted for actual field surveys.

If you determine that the proposed action may affect (i.e., likely to adversely affect or not likely to adversely affect) a federally-protected species, you should notify this office with your determination, the results of your surveys, survey methodologies, and an analysis of the effects of the action on listed species, including consideration of direct, indirect, and cumulative effects, before conducting any activities that might affect the species. If you determine that the proposed action will have no effect (i.e., no beneficial or adverse, direct or indirect effect) on federally listed species, then you are not required to contact our office for concurrence (unless an Environmental Impact Statement is prepared). However, you should maintain a complete record of the assessment, including steps leading to your determination of effect, the qualified personnel conducting the assessment, habitat conditions, site photographs, and any other related articles.

With regard to the above-referenced project, we offer the following remarks. Our comments are submitted pursuant to, and in accordance with, provisions of the Endangered Species Act.

Based on the information provided and other information available, it appears that the proposed action is not likely to adversely affect any federally-listed endangered or threatened species, their formally designated critical habitat, or species currently proposed for listing under the Act at these sites. We believe that the requirements of section 7(a)(2) of the Act have been satisfied for your project. Please remember that obligations under section 7 consultation must be reconsidered if: (1) new information reveals impacts of this identified action that may affect listed species or critical habitat in a manner not previously considered; (2) this action is subsequently modified in a manner that was not considered in this review; or, (3) a new species is listed or critical habitat determined that may be affected by the identified action.

However, the Service is concerned about the potential impacts the proposed action might have on aquatic species. Aquatic resources are highly susceptible to sedimentation. Therefore, we recommend that all practicable measures be taken to avoid adverse impacts to aquatic species, including implementing directional boring methods and stringent sediment and erosion control measures. An erosion and sedimentation control plan should be submitted to and approved by the North Carolina Division of Land Resources, Land Quality Section prior to construction. Erosion and sedimentation controls should be installed and maintained between the construction site and any nearby down-gradient surface waters. In addition, we recommend maintaining natural, vegetated buffers on all streams and creeks adjacent to the project site.

The North Carolina Wildlife Resources Commission has developed a Guidance Memorandum (a copy can be found on our website at (http://www.fws.gov/raleigh) to address and mitigate secondary and cumulative impacts to aquatic and terrestrial wildlife resources and water quality. We recommend that you consider this document in the development of your projects and in completing an initiation package for consultation (if necessary).

We hope you find our web page useful and informative and that following the process described above will reduce the time required, and eliminate the need, for general correspondence for species' lists. If you have any questions or comments, please contact John Ellis of this office at (919) 856-4520 ext. 26.

Sincerely,

Pete Benjamin
Field Supervisor

List of Counties in the Service's Raleigh Field Office Area of Responsibility

Alamance
Beaufort
Bertie
Bladen
Brunswick
Camden
Carteret
Caswell
Chatham
Chowan
Columbus
Craven
Cumberland
Currituck
Dare
Duplin
Durham
Edgecombe
Franklin
Gates
Granville
Greene
Guilford
Halifax
Harnett
Hertford
Hoke
Hyde
Johnston
Jones
Lee
Lenoir
Martin
Montgomery
Moore
Nash
New Hanover
Northampton
Onslow
Orange
Pamlico
Pasquotank
Pender
Perquimans
Person
Pitt
Randolph
Richmond
Robeson
Rockingham
Sampson
Scotland
Tyrrell
Vance
Wake
Warren
Washington
Wayne
Wilson

WILDLANDS
ENGINEERING

July 24, 2013

Shannon Deaton
North Carolina Wildlife Resource Commission
Division of Inland Fisheries
1721 Mail Service Center
Raleigh, NC 27699

Subject: **Mud Lick Creek Mitigation Site**
Chatham County, North Carolina

Dear Ms. Deaton,

The purpose of this letter is to request review and comment on any possible issues that might emerge with respect to fish and wildlife issues associated with a potential stream restoration project on the attached site. A USGS map (Figure 1) showing the approximate area of potential ground disturbance is enclosed. Figure 1 was prepared from the Crutchfield Crossroads, NC 7.5-Minute Topographic Quadrangle.

The Mud Lick Creek Mitigation Site has been identified for the purpose of providing in-kind mitigation for unavoidable stream channel impacts. Several sections of channel throughout the site have been identified as significantly degraded as a result of past agricultural activities.

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

Attachment:
Figure 1. USGS Topographic Map

North Carolina Wildlife Resources Commission

Gordon Myers, Executive Director

2 August 2013

Andrea S. Eckardt, Senior Environmental Planner
Wildlands Engineering
1430 South Mint Street, Suite 104
Charlotte, NC 28203

Subject: Mud Lick Creek Mitigation Site, Chatham County, North Carolina.

Dear Ms. Eckardt:

Biologists with the North Carolina Wildlife Resources Commission have reviewed the subject information. Our comments are provided in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661-667e) and North Carolina General Statutes (G.S. 113-131 et seq.).

The proposed project would provide in-kind mitigation for unavoidable stream channel impacts. Several sections of channel throughout the site have been identified as significantly degraded from past agricultural activities. The project site includes Mud Lick Creek and tributaries to Mud Lick Creek. Mud Lick Creek is a tributary to Rocky River in the Cape Fear River basin. There are records for the federal species of concern and state endangered Carolina creekshell (*Villosa vaughaniana*), the state special concern notched rainbow (*Villosa constricta*), and the state significantly rare Eastern creekshell (*Villosa delumbis*) in Rocky River.

Stream restoration projects often improve water quality and aquatic habitat. Establishing native, forested buffers in riparian areas will help protect water quality, improve aquatic and terrestrial habitats, and provide a travel corridor for wildlife species. Provided measures are taken to minimize erosion and sedimentation from construction/restoration activities, we do not anticipate the project to result in significant adverse impacts to aquatic and terrestrial wildlife resources.

Thank you for the opportunity to review this proposed project. If we can provide further assistance, please contact our office at (336) 449-7625 or shari.bryant@ncwildlife.org.

Sincerely,

Shari L. Bryant

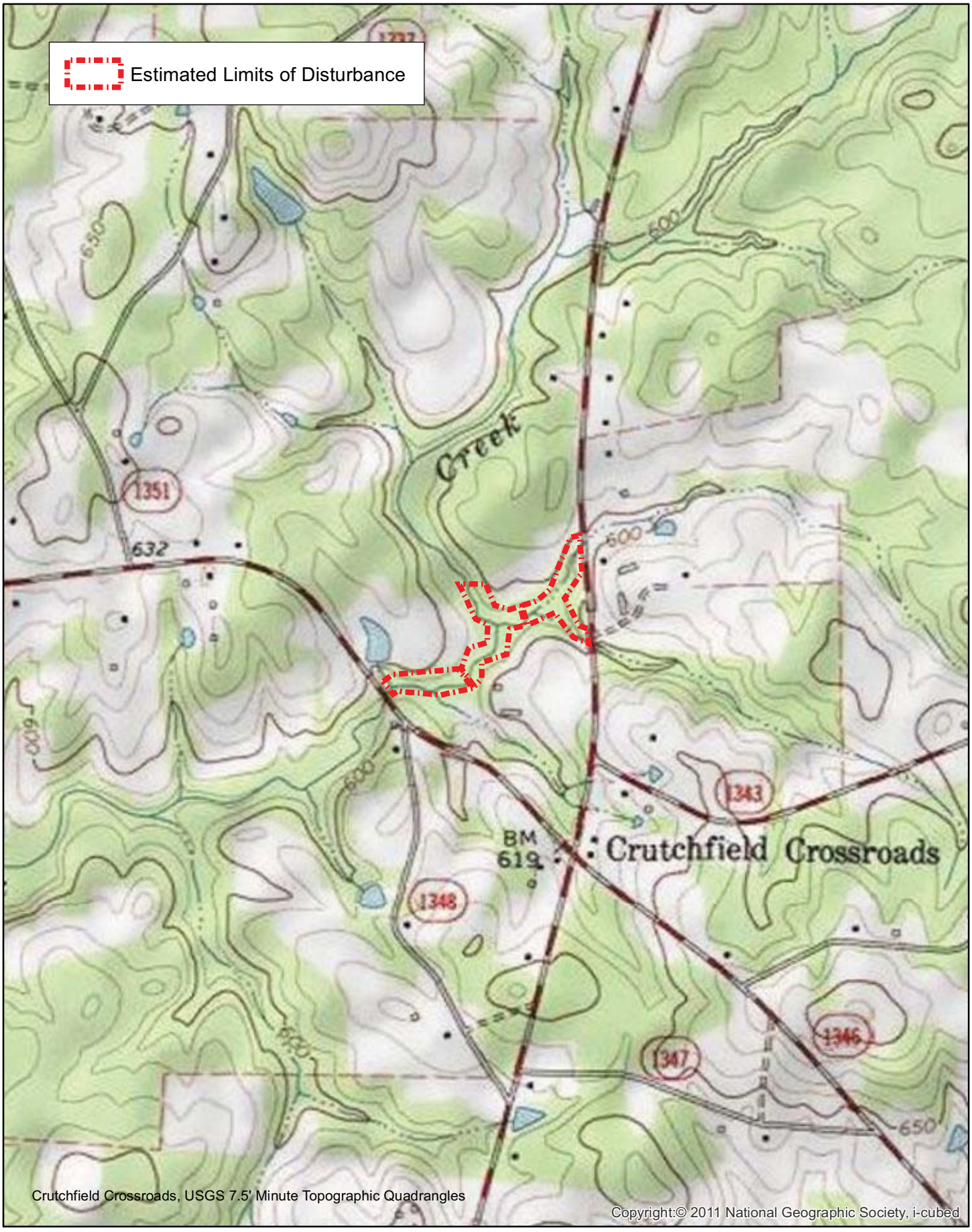
Shari L. Bryant
Piedmont Region Coordinator
Habitat Conservation Program

ec: Ryan Heise, NCWRC

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

Mud Lick Creek Mitigation Site
Categorical Exclusion

Figures



WILDLANDS ENGINEERING

0 1,000 Feet

N

Figure 1 Site Map
Mud Lick Creek
Chatham County, NC

APPENDIX 7: Resource Agency Correspondence

WILDLANDS
ENGINEERING

July 24, 2013

Renee Gledhill-Earley
State Historic Preservation Office
4617 Mail Service Center
Raleigh, NC 27699-4617

Subject: EEP Stream Mitigation Project in Chatham County.
Mud Lick Creek 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 restoration project on the attached site (USGS site map with approximate areas of potential ground disturbance is enclosed).

The Mud Lick Creek site has been identified for the purpose of providing in-kind mitigation for unavoidable stream channel impacts. Several sections of channel have been identified as significantly degraded. No architectural structures or archeological artifacts have been observed or noted during preliminary surveys of the site for restoration purposes. The majority of the site has historically been disturbed due to agricultural purposes.

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

North Carolina Department of Cultural Resources

State Historic Preservation Office

Ramona M. Bartos, Administrator

Governor Pat McCrory
Secretary Susan Kluttz

Office of Archives and History
Deputy Secretary Kevin Cherry

September 3, 2013

Andrea Eckardt
Wildlands Engineering
1430 South Mint Street, 104
Charlotte, NC 28203

Re: Mud Lick Creek Mitigation, Chatham County, ER 13-1556

Dear Ms. Eckardt:

Thank you for your letter of July 24, 2013, 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, contact Renee Gledhill-Earley, environmental review coordinator, at 919-807-6579 or renee.gledhill-earley@ncdcr.gov. In all future communication concerning this project, please cite the above referenced tracking number.

Sincerely,

Renee Gledhill-Earley

for Ramona M. Bartos

WILDLANDS
ENGINEERING

July 24, 2013

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

Subject: Mud Lick Creek Mitigation Site, Chatham County, North Carolina

Dear Mr. Suiter,

The Mud Lick Creek Mitigation Site has been identified for the purpose of providing in-kind mitigation for unavoidable stream channel impacts. Several sections of channel throughout the site have been identified as significantly degraded as a result of past agricultural activities.

We have already obtained an updated species list for Chatham County from your web site (http://www.fws.gov/raleigh/species/cntylist/nc_counties.html). The threatened or endangered species for this county are: the bald eagle (*Haliaeetus leucocephalus*) (BGPA), Cape Fear shiner (*Notropis mekistocholas*), red-cockaded woodpecker (*Picoides borealis*), and harperella (*Ptilimnium nodosum*). 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 areas of potential ground disturbance is enclosed. Figure 1 was prepared from the Crutchfield Crossroads, NC 7.5-Minute Topographic Quadrangle.

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.

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

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Raleigh Field Office
Post Office Box 33726
Raleigh, North Carolina 27636-3726

August 29, 2013

Andrea Eckardt
Wildlands Engineering, Inc.
1430 S. Mint Street
Charlotte, NC 28203

Re: Mud Lick Creek Mitigation Site- Chatham County, NC

Dear Ms. Eckardt:

This letter is to inform you that a list of all federally-protected endangered and threatened species with known occurrences in North Carolina is now available on the U.S. Fish and Wildlife Service's (Service) web page at http://www.fws.gov/raleigh. Therefore, if you have projects that occur within the Raleigh Field Office's area of responsibility (see attached county list), you no longer need to contact the Raleigh Field Office for a list of federally-protected species.

Our web page contains a complete and frequently updated list of all endangered and threatened species protected by the provisions of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.)(Act), and a list of federal species of concern[1] that are known to occur in each county in North Carolina.

Section 7 of the Act requires that all federal agencies (or their designated non-federal representative), in consultation with the Service, insure that any action federally authorized, funded, or carried out by such agencies is not likely to jeopardize the continued existence of any federally-listed endangered or threatened species. A biological assessment or evaluation may be prepared to fulfill that requirement and in determining whether additional consultation with the Service is necessary. In addition to the federally-protected species list, information on the species' life histories and habitats and information on completing a biological assessment or evaluation and can be found on our web page at http://www.fws.gov/raleigh. Please check the web site often for updated information or changes.

---

[1] The term "federal species of concern" refers to those species which the Service believes might be in need of concentrated conservation actions. Federal species of concern receive no legal protection and their designation does not necessarily imply that the species will eventually be proposed for listing as a federally endangered or threatened species. However, we recommend that all practicable measures be taken to avoid or minimize adverse impacts to federal species of concern.

If your project contains suitable habitat for any of the federally-listed species known to be present within the county where your project occurs, the proposed action has the potential to adversely affect those species. As such, we recommend that surveys be conducted to determine the species' presence or absence within the project area. The use of North Carolina Natural Heritage program data should not be substituted for actual field surveys.

If you determine that the proposed action may affect (i.e., likely to adversely affect or not likely to adversely affect) a federally-protected species, you should notify this office with your determination, the results of your surveys, survey methodologies, and an analysis of the effects of the action on listed species, including consideration of direct, indirect, and cumulative effects, before conducting any activities that might affect the species. If you determine that the proposed action will have no effect (i.e., no beneficial or adverse, direct or indirect effect) on federally listed species, then you are not required to contact our office for concurrence (unless an Environmental Impact Statement is prepared). However, you should maintain a complete record of the assessment, including steps leading to your determination of effect, the qualified personnel conducting the assessment, habitat conditions, site photographs, and any other related articles.

With regard to the above-referenced project, we offer the following remarks. Our comments are submitted pursuant to, and in accordance with, provisions of the Endangered Species Act.

Based on the information provided and other information available, it appears that the proposed action is not likely to adversely affect any federally-listed endangered or threatened species, their formally designated critical habitat, or species currently proposed for listing under the Act at these sites. We believe that the requirements of section 7(a)(2) of the Act have been satisfied for your project. Please remember that obligations under section 7 consultation must be reconsidered if: (1) new information reveals impacts of this identified action that may affect listed species or critical habitat in a manner not previously considered; (2) this action is subsequently modified in a manner that was not considered in this review; or, (3) a new species is listed or critical habitat determined that may be affected by the identified action.

However, the Service is concerned about the potential impacts the proposed action might have on aquatic species. Aquatic resources are highly susceptible to sedimentation. Therefore, we recommend that all practicable measures be taken to avoid adverse impacts to aquatic species, including implementing directional boring methods and stringent sediment and erosion control measures. An erosion and sedimentation control plan should be submitted to and approved by the North Carolina Division of Land Resources, Land Quality Section prior to construction. Erosion and sedimentation controls should be installed and maintained between the construction site and any nearby down-gradient surface waters. In addition, we recommend maintaining natural, vegetated buffers on all streams and creeks adjacent to the project site.

The North Carolina Wildlife Resources Commission has developed a Guidance Memorandum (a copy can be found on our website at (http://www.fws.gov/raleigh) to address and mitigate secondary and cumulative impacts to aquatic and terrestrial wildlife resources and water quality. We recommend that you consider this document in the development of your projects and in completing an initiation package for consultation (if necessary).

We hope you find our web page useful and informative and that following the process described above will reduce the time required, and eliminate the need, for general correspondence for species' lists. If you have any questions or comments, please contact John Ellis of this office at (919) 856-4520 ext. 26.

Sincerely,

Pete Benjamin
Field Supervisor

List of Counties in the Service's Raleigh Field Office Area of Responsibility

Alamance
Beaufort
Bertie
Bladen
Brunswick
Camden
Carteret
Caswell
Chatham
Chowan
Columbus
Craven
Cumberland
Currituck
Dare
Duplin
Durham
Edgecombe
Franklin
Gates
Granville
Greene
Guilford
Halifax
Harnett
Hertford
Hoke
Hyde
Johnston
Jones
Lee
Lenoir
Martin
Montgomery
Moore
Nash
New Hanover
Northampton
Onslow
Orange
Pamlico
Pasquotank
Pender
Perquimans
Person
Pitt
Randolph
Richmond
Robeson
Rockingham
Sampson
Scotland
Tyrrell
Vance
Wake
Warren
Washington
Wayne
Wilson

WILDLANDS
ENGINEERING

July 24, 2013

Shannon Deaton
North Carolina Wildlife Resource Commission
Division of Inland Fisheries
1721 Mail Service Center
Raleigh, NC 27699

Subject: **Mud Lick Creek Mitigation Site**
Chatham County, North Carolina

Dear Ms. Deaton,

The purpose of this letter is to request review and comment on any possible issues that might emerge with respect to fish and wildlife issues associated with a potential stream restoration project on the attached site. A USGS map (Figure 1) showing the approximate area of potential ground disturbance is enclosed. Figure 1 was prepared from the Crutchfield Crossroads, NC 7.5-Minute Topographic Quadrangle.

The Mud Lick Creek Mitigation Site has been identified for the purpose of providing in-kind mitigation for unavoidable stream channel impacts. Several sections of channel throughout the site have been identified as significantly degraded as a result of past agricultural activities.

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

Attachment:
Figure 1. USGS Topographic Map

North Carolina Wildlife Resources Commission

Gordon Myers, Executive Director

2 August 2013

Andrea S. Eckardt, Senior Environmental Planner
Wildlands Engineering
1430 South Mint Street, Suite 104
Charlotte, NC 28203

Subject: Mud Lick Creek Mitigation Site, Chatham County, North Carolina.

Dear Ms. Eckardt:

Biologists with the North Carolina Wildlife Resources Commission have reviewed the subject information. Our comments are provided in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661-667e) and North Carolina General Statutes (G.S. 113-131 et seq.).

The proposed project would provide in-kind mitigation for unavoidable stream channel impacts. Several sections of channel throughout the site have been identified as significantly degraded from past agricultural activities. The project site includes Mud Lick Creek and tributaries to Mud Lick Creek. Mud Lick Creek is a tributary to Rocky River in the Cape Fear River basin. There are records for the federal species of concern and state endangered Carolina creekshell (*Villosa vaughaniana*), the state special concern notched rainbow (*Villosa constricta*), and the state significantly rare Eastern creekshell (*Villosa delumbis*) in Rocky River.

Stream restoration projects often improve water quality and aquatic habitat. Establishing native, forested buffers in riparian areas will help protect water quality, improve aquatic and terrestrial habitats, and provide a travel corridor for wildlife species. Provided measures are taken to minimize erosion and sedimentation from construction/restoration activities, we do not anticipate the project to result in significant adverse impacts to aquatic and terrestrial wildlife resources.

Thank you for the opportunity to review this proposed project. If we can provide further assistance, please contact our office at (336) 449-7625 or shari.bryant@ncwildlife.org.

Sincerely,

Shari L. Bryant

Shari L. Bryant
Piedmont Region Coordinator
Habitat Conservation Program

ec: Ryan Heise, NCWRC

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

APPENDIX 8: 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. State NFIP Engineer), NC Floodplain Mapping Unit (attn. State NFIP Coordinator) and NC Ecosystem Enhancement Program.

Project Location

Name of project:	Mud Lick Creek Mitigation Site
Name if stream or feature:	Mud Lick Creek
County:	Chatham
Name of river basin:	Cape Fear
Is project urban or rural?	Rural
Name of Jurisdictional municipality/county:	Chatham County
DFIRM panel number for entire site:	8764
Consultant name:	Wildlands Engineering, Inc.
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, Inc. (Wildlands) is completing a stream restoration and enhancement project at the Mud Lick Creek Mitigation Site (Site) for the North Carolina Ecosystem Enhancement Program (EEP) to restore and enhance a total of 3,750 linear feet (LF) of perennial stream in Chatham County, NC. The Site is proposed to generate 2,806 Stream Mitigation Units (SMUs). This site is located in the Upper Rocky River Watershed within Cape Fear River Basin Hydrologic Unit Code (HUC) 03030003 (Cape Fear 03). Restoration and enhancement activities will be performed on Mud Lick Creek and two unnamed tributaries hereafter referred to as North Branch and East Branch.

Summarize stream reaches or wetland areas according to their restoration priority.

Reach	Length	Priority
North Branch R1	*327*	*Enhancement II*
North Branch R2	*520*	*Priority 1/2*
North Branch R2	*303*	*Priority 1/2*
East Branch	*168*	*Enhancement II*
East Branch	*409*	*Priority 1/2*
Mud Lick Creek R1	*623*	*Enhancement II*
Mud Lick Creek R2	*693*	*Enhancement II*
Mud Lick Creek R3	*748*	*Enhancement II*

Floodplain Information

Is project located in a Special Flood Hazard Area (SFHA)?

(•) Yes ( ) No

If project is located in a SFHA, check how it was determined:

- [ ] Redelineation
- [ ] Detailed Study
- [x] Limited Detail Study
- [ ] Approximate Study
- [ ] Don't know

List flood zone designation:

Check if applies:

☑ AE Zone

- ○ Floodway
- ◉ Non-Encroachment
- ○ None

☐ A Zone

- ○ Local Setbacks Required
- ○ No Local Setbacks Required

If local setbacks are required, list how many feet: N/A

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: State NFIP Engineer, (919) 715-8000)

Name of Local Floodplain Administrator: Dan LaMontagne
Phone Number: 919-542-5516

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: Chatham County Floodplain Administrator required that a Floodplain Development permit be applied for and issued. The permit has been submitted and written approval is expected August 2014

Comments: Activities in the floodplain of Mud Lick Creek will include only planting, fencing, bank stabilization, and very minor cut.

Name: Angela Allen, PE Signature: [signature]

Title: Water Resources Engineer Date: 8/1/14

Environmental Quality Department
Post Office Box 54
80-A East Street – Dunlap Building
Pittsboro, NC 27312-0054

CHATHAM COUNTY
NORTH CAROLINA

Phone: 919-545-8394
Fax: 919-542-2698

Dan LaMontagne, P.E., Environmental Quality Director

Application for Permit to Develop in a Floodplain Area

The undersigned hereby makes application for a permit to develop in a designated floodplain area. The work to be performed is described below and in attachments hereto. The undersigned agrees that all such work shall be done in accordance with the requirements of Chatham of County Flood Damage Prevention Ordinance and with all other applicable local, State, and Federal regulations. This application does not create liability on the part of Chatham County or any officer or employee thereof for any flood damage that results from reliance on this application or any administrative decision made lawfully thereunder.

Owner: Billie Lassiter	Builder: TBD by NCEEP (Will update County when Builder is selected)
Address: C/O Billie Lassiter	Address:
319 Augusta Drive	
Statesville, NC 28625	
Telephone:704-873-4948	Telephone:
Address of Property: Northwestern portion of intersection at Siler City Snow Camp Road	
and Silk Hope Liberty Road	

1) Description of Work (Complete for ENTIRE Project)

A) Proposed Development Description (circle one):

- ☐ New Building
- ☐ Manufactured Home
- ☐ Improvement to Existing Building
- ☐ Filling
- ☒ Other Grading and enhancement

B) Size and location of proposed development (attach site plan):

Limits of disturbance of grading activities within FEMA Zone AE is approximately 4.3 acres.

C) Is the proposed development in a Special Flood Hazard Area (Zones A, AE, A1-A30, AH, or AO)?

- Yes ☒
- No ☐

Environmental Quality Department
Post Office Box 54
80-A East Street – Dunlap Building
Pittsboro, NC 27312-0054

CHATHAM COUNTY
NORTH CAROLINA

Phone: 919-545-8394
Fax: 919-542-2698

Dan LaMontagne, P.E., Environmental Quality Director

D) Per the floodplain map, what is the zone and panel number of the area in the proposed development:

Zone: AE Panel Number: 8764J Effective Date February 2, 2007

E) Have other Federal, State, or local permits been obtained?

Yes ☒
No ☐

Type(s):

Categorical Exclusion (NCDENR), 401, 404. Erosion Control Permit to be obtained prior to commencement of construction activities.

F) Is the proposed development in an identified floodway?

Yes ☐
No ☒

G) If 'Yes', is a "No Rise Certification: with supporting data attached?

Yes ☐
No ☐

2) Complete for New Structures and Building Sites:

Base Flood Elevation at the site: _____feet NGVD

Required lowest flood elevation (include basement): _____feet NGVD

Elevation to which all attendant utilities, including all heating and electrical equipment will be protected from flood damage: _____feet NGVD

3) Complete for Alterations, Additions, or Improvements to Existing Structures:

What is the estimated market value of the existing structure: $ N/A

What is the cost of the proposed construction: $ N/A

* If the cost of the proposed construction equals or exceeds 50 percent of the market value of the structure, then the substantial improvements provisions shall apply.

Environmental Quality Department
Post Office Box 54
80-A East Street -- Dunlap Building
Pittsboro, NC 27312-0054

CHATHAM COUNTY
NORTH CAROLINA

Phone: 919-545-8394
Fax: 919-542-2698

Dan LaMontagne, P.E., Environmental Quality Director

4) Complete for Subdivisions and Planned Unit Developments:

Will the subdivision or other development contain 50 lots or 5 acres?

Yes ☐
No ☐

If 'Yes', does the plat or proposal clearly identify base flood elevations?

Yes ☒
No ☐

Are the 100 Year Floodplain and Floodway delineated on the site plan?

Yes ☒
No ☐

ADMINISTRATIVE

Permit: Approved ☒ Denied ☐ (Statement attached)

Elevation Certificate Attached: Yes (No)

As-built lowest floor elevation: N/A feet NGVD

Work inspected by: _____

Local Administrator Signature: _____ Date: _____

Applicant Signature: G T Miller Date: 4/29/14

Conditions: _____

Chatham County, NC

FLOODPLAIN DEVELOPMENT PERMIT

(*Internal use only* (Permit Number 14-001 Issuance Date 08/4/2014 AKPAR 83307)

In accordance with the Chatham County Flood Damage Prevention Ordinance, a Floodplain Development Permit is hereby granted to:

Wildlands Engineering and Ecosystem Enhancement Program (EEP)

to conduct development activities within the area of special flood hazard on property located at:

Northwest portion of intersection at Siler City Snow Camp Rd. and Silk Hope Liberty Rd.

recorded in Book 1233, Page 0849, Registry of Chatham County.

This Permit is issued to the aforementioned individual, firm, partnership, etc. for the purpose noted below and in accordance with the Chatham County Flood Damage Prevention Ordinance, Floodplain Development Permit No. 14-001 and attachments thereto; and is subject to the following modifications and/or performance reservations:

1. Permit issued for the following development only:

   Excavation: X Fill: __ Grading: X Utility Construction: _____
   Road Construction: _____ Residential Construction: _____ Nonresidential
   Construction: ____ Addition: _____ Renovation: _____ Other/notes (specify): __
   Stream Restoration and Enhancement project

2. The lowest floor and all attendant utilities shall be at or above N/A feet Mean Sea Level (MSL).

3. Pursuant to Section B (3) (a) or (b) of the Chatham County Flood Damage Prevention Ordinance, it shall be the duty of the permit holder to submit to the Floodplain Administrator the Elevation or Floodproofing Certification, if applicable.

4. Fill material shall not encroach into the floodway of Mud Lick Creek.

5. Proper Erosion and Sediment control measures shall be installed and maintained in accordance with Chatham County Soil Erosion and Sedimentation Control Ordinance, revised December 2, 2008.

6. All provisions applicable to this permit apply pursuant to the Chatham County Flood Damage Prevention Ordinance.

7. Upon completion of any foundation construction, contact Building Inspection Division for foundation inspection.

Failure to comply with the Chatham County Flood Damage Prevention Ordinance including any modifications and/or performance reservations could result in a misdemeanor conviction and shall be punished at the discretion of the court.

Issued this 4th day of August, 2014.

Dan J. LaMontagne, P.E.
Floodplain Administrator for Chatham County, NC